INDUSTRIAL AND COMMERCIAL GEOGRAPHY

BY

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PREFACE TO THE NEW EDITION

Since this book was first written we have had that great earthquake, the World War, which shook down so many man-made boundaries. The war gave Europe 10,000 miles of new national boundaries. It hatched out a brood of eager young states and thus in no way added to the peace of mind of the older states which claim for a little longer time their particular bits of the earth's surface.

The maps of Asia and Africa have also been changed. Tens of millions of thoughtful persons have had their complacency shaken and have come to question the permanence of this Western civilization which has spread its power, its ships, its railroads, its cables, and its trade so riotously over the surface of the earth.

The boundaries have changed but no wheat field or beet field or peat field has been moved or made, no rivers or mountains have been moved or created or destroyed. The same old earth is here. Boundaries may dance back and forth upon it as cloud shadows race across the summer landscape. Our civilization may (probably will) collapse as so many have done before it, to be followed by others which may easily be better or worse.

The nations may rise and fall, the boundaries may flicker, the leagues may wax and wane, civilizations may glitter or smash, but man will still be tilling for breadstuff, tending flocks, catching fish, hewing wood, drawing water, weaving fabric, fashioning implements and carrying freight to and fro to meet his primeval and unchangeable needs.

Man is a tough animal but his handiwork is most fragile and most intimately dependent upon the resources of the particular parts of the earth upon which he depends. Hence the perennial importance of a study of the great fundamental economic resources and economic activities of man which this book tries to present.

A study of this subject has become a part of the required course in almost or quite all of the collegiate and secondary schools of commerce, finance, or business administration in the United States.

In many places it is a part of the foundation utilized for the study of theoretical economics and is gaining recognition by many of the representatives of history, civics and sociology.

This marked increase in the educational importance of the subject since this book was first written has added to the pleasure of rewriting it in the attempt to bring it up to date both in fact and philosophy. This heavy task has been immeasurably lightened by the discriminating and diligent aid of Professor Howard H. Martin of the University of Cincinnati who has worked with me for many months as research assistant.

I have also received valuable aid from Mr. Everett Rodebaugh who has given especial attention to the illustrations.

J. RUSSELL SMITH.

Honolulu, T. H.
July 24, 1925.

PREFACE TO THE FIRST EDITION

This book aims to interpret the earth in terms of its usefulness to humanity. Since the primary interest is humanity rather than parts of the earth's surface, the book deals with human activities as affected by the earth, rather than with parts of the earth as they affect human activities.

The mass of facts pressing upon geographers is so great that space for discussion, as distinguished from description, is always too short, and this space is still further reduced by the repetitions involved in the usual regional arrangement of matter. That is one reason why I have employed, in the first part of this book, the alternative arrangement by industries. The wheat industry, for example, proceeds from certain environmental conditions and exists in every continent. Its treatment as a unit brings causes and results together in their explanatory relation and makes the facts not only appeal to the reason but also grip the memory. Such a conspectus of the world industries, when properly illustrated by charts and diagrams, should give a sound knowledge of the trade activities of each country, without sacrificing the no less valuable knowledge of the industries themselves.

In the second part of the book there is an attempt to increase and reinforce this regional knowledge by a description of the commerce of the world. Here the great ports of traffic are considered and the geographic and economic reasons for their greatness indicated. The description of the principal trade routes and the commerce that passes over them is still another means of making the various countries of the world stand out in the mind of the reader in their commercial individuality. I believe this method permits results that cannot be attained in the same space by the more usual method of presenting one country after another.

In the preparation of this book, I am greatly indebted to Professor Walter S. Tower, of Chicago. It is impossible for me to estimate the influence that he has had upon it through years of friendly conference and cogent criticism. He has also rendered me the very great service of carefully reading the manuscript and suggesting innumerable changes. My associates, Messrs. George B. Roorbach and Joseph H. Willits, have also critically read the manuscript. All three of these gentlemen are, however, absolved from any responsibility for the final errrors of fact and of style, for after their work was done, I spent months in working the book over and in adding illustrative data. Mr. Willits and Mr. Alfred G. White assisted me in the preparation of the statistical diagrams.

I also wish to express my appreciation of the counsel given me by Professors Wesley N. Clifford and Calvin O. Althouse, of Philadelphia. The unending willingness of the numerous scientific writers of the U. S. Dept. of Agriculture places me under great obligation. It is a pleasure also to recall the cheerful aid given me by the Philadelphia Museum.

J. RUSSELL SMITH.

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GENERAL REFERENCES

The world of industry which this book aims in part to explain and interpret is constantly undergoing changes. Some users of this book may wish to enlarge or bring down to the moment their knowledge of particular subjects treated here. For their aid, brief bibliographic direction is given, partly at the ends of the various chapters and partly in the immediately following paragraphs:

GENERAL REFERENCE FOR PART I

A. AGRICULTURE.—The United States Department of Agriculture, Washington, publishes much valuable information about the agricultural industries of the United States and other countries. See its "Yearbook" and "List of Publications," both of which are to be had without cost. Persons wishing to make use of current agricultural statistics should by all means have a copy of this "Yearbook," which has a very complete collection. "Crops and Markets," published weekly by the Department, also has many valuable presentations and comparisons.

The Encyclopedia of American Agriculture, by Bailey, is a valuable reference work. "The Country Gentleman," Philadelphia, may be mentioned as a journal aiming to cover the whole field of agriculture. Numerous agricultural journals discuss the various phases of agriculture, thus:

"Hoards Dairyman"—Dairying, Fort Atkinson, Wis.
"Breeders Gazette"—All animal industries, Chicago.
"The Fruit Grower and Farmer"—St. Joseph, Mo.
"Better Fruit"—Portland, Ore.

Many are devoted to certain regions, thus:

"Rural New Yorker"—New York.
"California Cultivator"—Los Angeles.
"Louisiana Planter"—New Orleans.
"The Iowa Homestead"—Des Moines.

The International Institute of Agriculture, Rome, has valuable publications. Anyone who reads "Commerce Reports," the weekly survey of foreign trade published by the Bureau of Foreign and Domestic Commerce, will tap a source of information covering the whole field of this book, and valuable in supplementary work.

B. MANUFACTURING.—Persons desiring detailed or current information on particular industries are especially recommended to consult the more serious trade journals, of which the following are suggested as a partial list.

Subject	*Name of Journal*	*Where Published*
Canning	American Grocer	New York
Sugar	International Sugar Journal	London
	American Sugar Bulletin	New York
Spices	Tea and Coffee Journal	New York
Coffee	Tea and Coffee Journal	New York
Tea	Tea and Coffee Journal	New York
Cocoa	Tea and Coffee Journal	New York
Fisheries	Fishing Gazette	New York
Iron	Iron Age	New York
Coal	Black Diamond	Chicago
	Coal Age	New York
Petroleum	National Petroleum News	New York
Lumber	American Lumberman	Chicago
General Textile	Textile World	New York
	Dry Goods Economist	New York
Cotton Trade and Manufacture	American Wool and Cotton Reporter	Boston
Wool Trade and Manufacture	American Wool and Cotton Reporter	Boston
Leather	Shoe and Leather Report	Boston
	Shoe and Leather Facts	Philadelphia
Tanning	Hides and Leather	Chicago
Rubber Manufacturing	India Rubber World	New York
Rubber Growing	India Rubber World	New York
Automobile	Automotive Industries	New York
Machinery Trade and Manufacture	American Machinist	New York
Jewelry	American Jeweler	New York
Chemical Industries	Chemical Trade Review	Philadelphia
Fertilizer Industry	American Fertilizer	Philadelphia
Coal Tar and Dyes	Oil, Paint and Drug Reporter	New York
Vegetable Oils and Extracts	Oil, Paint and Drug Reporter	New York
Soaps	Soap Gazette and Perfumer	New York
Mining and Mineral Industries	Engineering and Mining Journal	New York
	Mines and Minerals	Scranton
Cement	Cement	New York
Pottery and Porcelain	Glass and Pottery World	Chicago
Glass	The Glass Worker	Pittsburg

The Commercial Museum of Philadelphia publishes "Commercial America," a monthly journal containing many valuable presentations of statistics, usually of manufactures and commerce, but occasionally of agriculture.

C. General.—Of especial value in the field of this book are "The American Review of Reviews," "The Worlds Work," and numerous other magazines treating world affairs and current events. It should be noted that geographic, industrial and economic questions are gaining a rapidly increasing share of space in many periodic publications. The contents of nearly 400 leading periodicals are indexed in The Readers Guide to Periodical Literature, and in the International Index to Periodicals. Search through these indexes will give a wealth of titles on the topics covered by this book.

PART I

INDUSTRIAL GEOGRAPHY

CHAPTER I

OUR CHANGING ENVIRONMENT

1. THE CHANGING ATTITUDE TOWARD GEOGRAPHY

The chief object of education in America is to prepare people for jobs. The job value of a study profoundly influences the number of those who take it. For example, geology has been well organized in many American universities for several decades because a hundred geological surveys and a thousand mining companies seek and pay for the services of trained geologists.

Geography, meanwhile, has remained unorganized through most of this period in most American universities because there were few jobs for trained geographers, as such. Yet it has long been known that geography was fundamental to the understanding of history, of economics, of sociology, of civics. But these subjects, alas, have little call in education save the call of culture and the fact that their understanding is vital to civilization, the care of which is nobody's job in particular and is not a source of personal revenue.

The World War caused a deeper and more widespread realization of the fact that an understanding of geography was vital to the understanding of history, of international relations, of foreign investment, of foreign trade. There is also a steadily increasing appreciation of the fact that the successful business man in any country needs to know his economic geography.

The recent great increase in the number of people studying geography is a hopeful sign, both for the increase of fundamental understanding in education, for culture, for citizenship, and also for increasing the effectiveness of education for business.

2. THE VALUE OF LANDS TO MAN

A group of people can only prosper, increase and grow powerful when their environment furnishes them an abundance of food and of materials for making appliances to supply the other necessities of existence.

Examine them as we may, we find that every want of man, whether Eskimo or banker, is a desire for one of these six classes of goods: food, clothes, house or shelter, fuel, luxuries, and tools and materials of industry which enable him to produce and handle the others. So nearly universal are these wants that practically all men have all six classes of goods. Even those whom we in our arrogance call savages have luxuries in the form of toys, ornaments, and musical instruments.

All these materials for a living come directly or indirectly out of the soil or crust of the earth. The man in a ship at sea or in a steel skyscraper in a modern city gets his sustenance from the soil just as surely as does the farmer who takes potatoes from the furrow. Each particular method by which a man gets some useful commodity leads to an industry often of world-wide distribution. To understand the way the human race turns the earth into its home, we have but to study closely the various industries by which groups of men achieve their living.

While ultimately depending upon the contents of the earth's crust, most of our living comes indirectly through the intermediate stages of plant and animal life, the crust itself supplying directly but a small part of our wants. In and upon the earth is the indispensable water without which we would promptly perish. While the more solid substances of the earth's crust are also directly available and of great value, as salt, building stones, and metals, we depend chiefly upon vegetation for our support. The plants grow from the soil. We eat them in myriad ways or clothe ourselves with their fibers, cut them into pieces, shape them into tools to build our houses and barns, extract their juices and dig their roots for drugs and medicines. We burn them for fuel, shape them into articles of luxury, and thus make them help in the supply of some of the wants of each of the six classes. The animals in turn eat the plants and each other, and furnish us their meat and milk as nourishment; their wool and furs become our clothing; their tougher hides make our shoe leather, the tents of the nomad, and the belts of the engine wheel, while the cultural services are hinted by the soft leather bindings of our choicest books.

The environment upon which we depend, then, and which supplies our six wants is, in a broad sense, land. From our human standpoint, a country is good or bad in accordance with the good or bad manner in which it supplies these six wants. The most important exception to this is the influence upon man of the climate, which sometimes turns into an empty Eden what would otherwise be an economic paradise.

To an extent little appreciated, the environment of land, location and climate makes the race. It is a common mistake of the historian to give the idea that peoples have certain qualities inherently. It is much more correct to say that primitive or savage peoples are primitive or savage because of the niggardliness or peculiarities of nature's gifts to the land in which they happen to live, rather than because of bad qualities which they may inherently possess. The environment, in making the race, has developed the qualities out of the fundamental and universal human nature. The Eskimo upon the bleak, windy, treeless, bitter-cold shore of the Arctic Sea, in a climate where he constantly faces the danger of freezing and starving and where he, therefore, needs much protection from the cold in the form of fuel, clothes, house or food, has almost nothing with which to build houses, make clothes, or prepare food. Accordingly, the population is exceedingly sparse and has supported itself only along the seacoast where the few advantages of the land may be combined with the more numerous advantages of the sea with its fish and seals. Shall the Eskimo be dismissed as a barbarian or praised as a master of a ferocious environment? In winning a living from such meager and almost exclusively animal sources the Eskimo has shown great ingenuity. Even the kyak or canoe, the most complex of his implements of industry, is made of bones and tough skins bound together with sinews and rawhide thongs, unless perchance the ocean currents bring a little drift wood from afar. For fuel, with which they cook their food but rarely heat their houses, they use the fat of seal and walrus, or blubber of whale. The Eskimo himself is not a bad, weak, or stupid fellow. His many fine qualities are highly praised by explorers. Upon being put to school he has shown that he can learn with the rest of us. The severity and poverty of his environment have made any large economic progress impossible.

Peoples dependent on one resource. Other peoples have succeeded in living in countries with almost as few natural aids as are possessed by the Eskimo, and there also culture has been held in check. The South Sea Islander has lived on coral islands a few feet above the waves, where his resources were limited to the cocoanut-palm upon the strand and fish that came from the sea. Yet with these limited resources he has managed to keep strong and healthy and fill in some manner all his needs. When he wanted a saw, he got it by fastening shark's teeth into a piece of wood. His other equipment was made by equally ingenious devices.

Upon the plains of central Asia people have for ages lived in a land where the one resource was grass. Flocks of sheep, cows, horses, goats and camels fed upon the grass. The herdsmen upon their horses followed the flocks as they roamed the flat plains in search of grass. These people were nomads because they had to go wherever they could find grass. Their diet was milk, cheese, and meat, and grain obtained by barter at some oasis; their clothing, wool and skins; their shelter, a felt or leather tent stretched over a few precious poles which they had carried with them for hundreds of miles from the banks of some mountain stream. Burning cow dung made the fire. A little metal was bought from trading caravans.

3. INFLUENCE OF CLIMATE IN THE ORIGIN OF CIVILIZATION

Civilization is a product of moderate adversity. For races as for men it seems debilitating to be born with a silver spoon in the mouth. The great civilizations of all time seem to have arisen where nature made production possible only a part of the year, and thus made it necessary for man to work and save up for the time when he could not produce. Man does not naturally like to work steadily, and if nature enables him to avoid it he usually seems content to loaf rather than labor and progress. Accordingly, there have been no great civilizations in the warm, moist parts of the torrid zone, where nature does the most to make easy the support of life. Man's wants there are so easily met and the climate is so enervating that he does not get the habit of work or become ambitious. The climate is continually warm, and the rainfall is sufficiently regular over vast areas to keep vegetation always green and growing. The native of Jamaica, or Cuba, or central Africa, or the East Indies, or any other part of the humid tropics can build himself a little shelter of palm leaves to keep off the rain; the warm climate removes the need of further shelter or many clothes. A few banana plants by the hut, and a little patch of sweet potatoes will live and yield for years, for there is no frost to kill the plants. Cassava, beans, peanuts and other vegetables grow easily. The forest is full of nuts and wild fruit and game; the streams are alive with fish, a variety common in southern Asia burying themselves in the mud, where they can be caught with the bare hand. Wood in abundance supplies the little fuel he needs for cooking, and if he would make himself a drum or any other simple luxury, the raw materials of the forest lie at his hand in great abundance. Accordingly, the native of these regions may sit and doze most of the time, as, for untold generations, his ancestors have done before him—enervated by plenty and organizing only the small village community.

Fig. 1.—The Jamaica negro finds life in the tropics to be easy. (Hamburg American S. S. Co.)

The influence of tropic abundance. This abundance without effort does not require or induce the work habit. For this reason lands of perennial plenty have never been lands of power. The lands of perennial plenty therefore fall prey to the more ambitious peoples from the lands of alternating scarcity and plenty in the temperate zone. Thus nearly all of Africa and that part of Asia within the tropics have been taken as colonies by the peoples of Europe. The only absolutely independent territory in all Africa is Abyssinia, where the cool climate of a high plateau stimulates the people into a vigor and activity that has enabled them to protect themselves from annexation and even to subjugate several less energetic races.

Faced by starvation, man will work long, hard and continuously. Civilizations have arisen where this annual threat of nature was followed by conditions permitting fruitful harvests. If fruitful harvest is followed by the stimulus of frost we have the best conditions for the development of energetic races.

After our summer, the growing season, our winter's frost and snow bring death or hibernation to the whole vegetable kingdom, and drive man to the protection of house and warm clothing. In such climates we must either starve, eat wild animals, or eat what

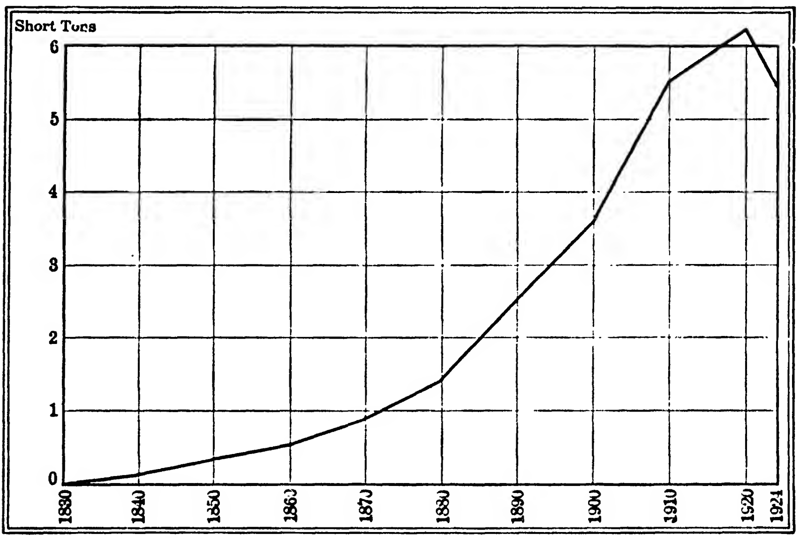


FIG. 2.—Per capita production of coal in United States, 1830–1924.

we have saved by our work during the summer. Therefore we have worked. A similar but less severe climatic goad to man's activity is furnished by climates that are alternately productive and nonproductive through variations in the rainfall. The first great nations (probably) in the world's history had their empires in the valleys of the Euphrates and the Nile, where a fertile soil and a good moisture supply produced by an annual overflow made great crops followed by blistering drought, a kind of warm winter so far as food production was concerned. Thus Babylon, Nineveh and Thebes were rich and cultured cities at a time when all Europe lay in barbarism, and the pyramids were built before the drought-driven Joseph went down to Egypt. These valleys got their early start because their advantages as the home of man were almost unrivaled. They had a warm climate, fertile soil, and a protected location. Each year the rivers overflowed, fertilizing the soil with the muddy waters and promoting the growth of a crop by irrigation. The surplus of food to last through the dry season naturally produced the habit of working and saving, and resulted in a sufficient surplus of goods to support life while attention was given to learning and the things we call civilization.

THE INFLUENCE OF COAL AND IRON. When man could resist cold and keep himself fed, civilization could go north. This depended

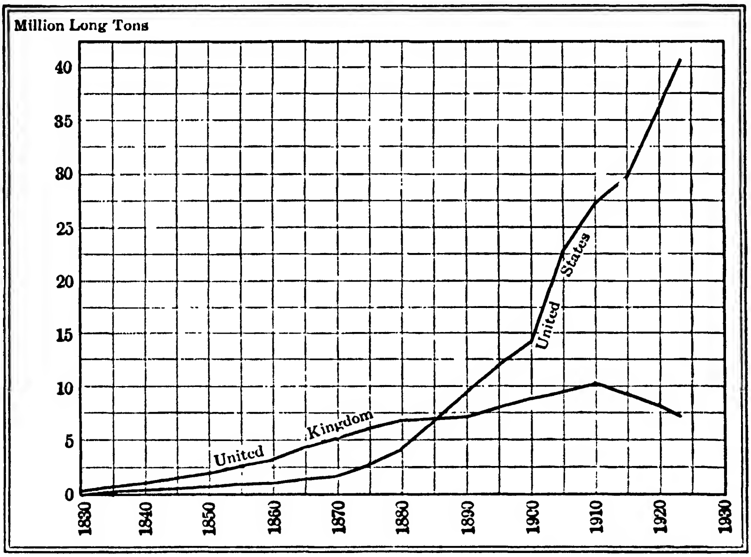


FIG. 3.—Production of pig iron, 1830–1930.

upon the improvement of agriculture and the building and heating of houses. For ages this fight with the cold environment was slow. In recent times it has been most swift. The railroad with its accompanying car of coal has emancipated man from the dependence upon the local fuel supply furnished by forests, or annual crops as in China or dried dung as in all dry pasture plains; and has permitted a great rush of civilized humanity into cold interior regions such as the Mississippi Valley and the plains of Canada, Russia, and Siberia.

The human race is thus being much more exposed to frost than formerly, probably to its benefit. Cold is a great stimulus to activity. Men and animals alike want to move more rapidly on a brisk, cold day of winter than on a sultry summer afternoon. This is as true of nations as of persons. The most energetic and powerful nations therefore are those living in a climate where frost forces them to activity and where the warm summer enables them to produce vast supplies of food.

The great cities of the world's so-called Great Powers are surprisingly close to the middle latitude between the extremes of heat and cold. The cities that make the policy of world politics are New

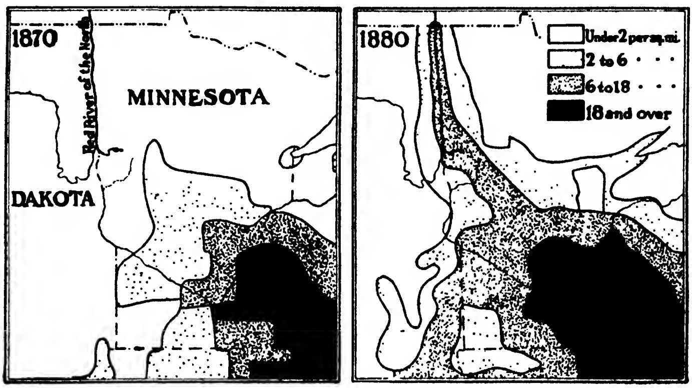


FIG. 4.—(*a*) Map showing distribution of population in region of Red River of the North in 1870. (*b*) Population map of region of Red River of the North in 1888. The level, treeless, fertile plain of the Red River Valley was settled almost entirely by wheat growers, and the population of Dakota increased from 14,000 to 135,000 between 1870 and 1880. (From Salisbury, Barrows, and Tower.)

York, Boston, Philadelphia, Washington, Chicago, St. Louis, San Francisco, Seattle, London, Liverpool, Edinburgh, Paris, Berlin, Hamburg, Leipzig, Vienna, Rome, Milan, Prague, Warsaw, Moscow, Pekin, and Tokyo. Every one of them has a cool or cold winter and a hot summer. They all lie in the middle third of latitude, none being above 60° or below 30° N. North of this line of centers of world leadership, the population and power decline because there is too much frost to allow production and many people, and south of it power and national energy decline because there is too much heat and disease to permit activity, although the tropics teem with unmatched possibilities.[1]

[1] Since these pages were first written this philosophy has been worked out with much richness of detail in Huntington, E., *Climate and Civilization*, with which no student of Geography should remain unacquainted.

THE INFLUENCE OF NATURAL PROTECTION AND BEASTS OF BURDEN. The origin of civilization cannot be explained solely on this basis. These factors are present but others also enter. Shaler, with his keen appreciation of man's relation to his environment, has pointed out the influence of easy defense. The community that has become agricultural is, with its stores of food, the natural prey to hungry nomads. One of the essences of war is transportation—speed, mobility. This is the daily practice of the nomad. From the times of the shepherd kings of Egypt to the raiding Apaches of Arizona, and doubtless back to the very dawn of agriculture, one of the commonest cycles of human history has been the conquest of the shore or valley farmer by the nomad—Mede, Persian, Goth, Vandal, Hun, Angle, Northman, Arab, Tartar, Turk, Apache.

The American Indian suffered greatly from this cause as well as from the poverty that lack of beasts of burden imposed upon him. In the open country of eastern America any locality was open to easy attack; not so the cliff dwellings of New Mexico and Arizona where in an arid region the greatest Indian progress was made by people who lived in fastnesses easy of defense and laboriously tilled fertile patches of irrigated land in the valleys below.

For similar reasons civilizations arose in such naturally protected nooks as Athens, Sparta, Crete, and Etruria, while the great open plains of Russia and North America have remained half barbarous until the nineteenth century railroads brought governments strong enough to keep order and give the same protection that was afforded by a sheltered valley in Greece.[2]

[2] "What is an Arab to do when his camels, his sheep, his wife, his children, and himself are all suffering the pangs of hunger? The only resource under such circumstances is plunder. The man who is starving has little thought of right or wrong. To have such thoughts would seem to him fatal. If considerations of humanity or any other moral idea prevent him from engaging in raids upon the tribes around him the doom of his family is sealed, for his children die of hunger. Thus through the thousands of years since Semitic nomads first lived in Arabia, the hard conditions of climate have steadily weeded out all who withheld their hands from violence.

"The man who would succeed and who would keep his children in health must not only be ready to commit depredations and be utterly dishonest according to our standards, but he must also be strong in the endurance of heat, thirst, and the weariness of long rides; unfortunately, however, he has little need of steady industry or of strength to endure long physical labor. In a word 'laziness,' according to our definition of the word, is no great disadvantage provided a man is able to summon up his powers in a crisis when the camels have strayed far away, when they have been driven off by raiders, or when the man himself goes on a foray. Hence the Arab is

4. THE NECESSITY FOR COMMERCE

COMMERCE EVENS UP THE INEQUALITIES OF LANDS. The limitations of support for a people living by one resource serve to emphasize the necessity for commerce. The early South Sea Islander's saw of shark's teeth set in wood was much more expensive in labor than that which his descendants get by trading copra over the schooner's side for the product of Sheffield. Few localities are capable of supplying, even in a poor fashion, all the many goods desired by civilized man. Hence the location of pre-19th century civilizations in places with varied resources. Hence the imperative necessity of commerce to get the products of other lands. Commerce has been essential to the spread of modern civilization, and civilization has very naturally lingered in those localities that afforded food, order, and opportunity for commerce. Without commerce, the means of selling as well as buying, a locality with a great surplus of natural wealth could make no use of it and therefore could have no large production, for large production requires wide markets. Production itself, the industries of any region, and the way it supports its population, can only be understood by noting the influence of commerce in stimulating the industries and making possible the support of large or small numbers of people.

Commerce is first of all dependent upon transportation. Men can trade without money and by signs without even understanding each other's speech. The important thing in all commerce is the fact that the goods can be moved. Accordingly, commerce is great only where transportation is good. Since the boat moves more cheaply than the pack animal, the wagon, or the railroad train, we find that waterways, the sea, the river, and the canals are the routes of greatest commerce. The greatest cities are seaports, and so great is our dependence upon water transportation that one might name a hundred of the world's largest cities before coming to one where boats did not discharge their cargoes.

TRANSPORTATION THAT DEPENDS UPON ANIMAL OR MAN POWER. Without the boat or the railroad, commerce is a minor thing. The

lazy as well as utterly disregardful of the commonest principles of honesty. Just as he thinks of raids as a part of the ordinary routine of life, so he thinks of steady work as something scarcely to be demanded even of women and fit only for slaves."—From *The Arabian Desert and Human Character*, by Ellsworth Huntington, *Journal of Geog.*, Jan., 1912. The career of the Arabs in Spain under another environment is an interesting contrast.

horse-drawn wagon enters into commerce that is modern only by taking goods to and from the railway or boat. Where commerce depends entirely upon animal muscle, as the horse-drawn wagon or the caravan, we have the commercial conditions which made the Middle Ages. These means still serve a surprisingly large portion of the earth's surface, but a very small proportion of its population. The first great commercial enterprises of which we know were carried on by means of caravans. Such caravans as set out from Egypt in the days of Pharaoh, and from Babylon in the days of Nebuchadnezzar are to-day the chief commercial dependence of a vast region reaching from the shores of the Atlantic in northwest

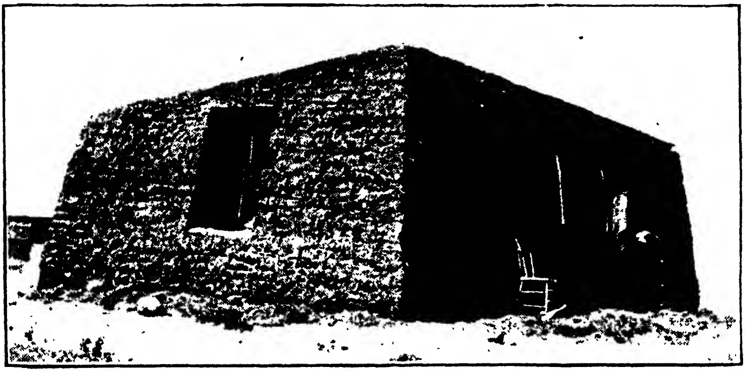


Fig. 5.—Sod house of the new settler on the treeless prairie of North Dakota. No wooden house is so warm, and commerce has made the minimum contribution to it.

Africa eastward to Pekin. Here and there in this vast stretch are a few lines of railroad, but the main dependence is still the caravan, chiefly of camels, sometimes of horses, mules or donkeys, and occasionally of wagons.[3] By such means and over such great distances, only the most valuable goods can be carried, and accordingly only the most costly goods are worth caravan freights. Nearly everything that man uses here must be produced by his immediate locality. The high cost of transportation almost drives man back upon his own resources in vast areas of Alaska, northern British America, north Europe, and northern Asia, where commerce depends upon the sledge commonly drawn by dogs in the New World and by the reindeer in the Old.

[3] Recently the automobile has begun to do surprising things in this roadless desert such as the lines that connect Damascus and Bagdad, Pekin and Urga.

RELATION OF TRANSPORTATION TO CIVILIZED COMMUNITIES. Large parts of temperate Siberia are still remote from railways; good roads are absent and nearly all their commercial products are sent out in the winter-time when the snow makes sledging so much easier than summer hauling by wagons over bad roads. But summer isolation makes conditions that no large community can stand. Consequently the large modern community can only arise where commerce is also modern. This condition commonly exists where the boat and the railway transport our goods with regularity. The new means of conducting commerce have greatly widened the area over which our civilization can spread. Before the coming of steam only the localities favored with many resources or easy access to the sea could furnish the many commodities necessary to support a civilized community. But now the railway, the steamboat, and the motor truck make it possible for a backwoods district having but one product in abundance to supply its inhabitants with all the varieties of goods in the metropolis, because it can sell its one product and buy in return a thousand different things that the people need. When crops are good, the farmers of Saskatchewan, who sell only wheat, buy American books and magazines, French gloves, English traveling bags, Chinese tea, New England clocks, Michigan automobiles, and goods from a thousand distant factories.

The great and still nearly empty plains of western Canada give us a chance to see how civilized communities take possession of the earth and how dependent they are upon their present freight carriers, the coal-driven locomotives. Land is still being given away by the Government to new settlers. Every new railroad means new settlers along its lines. The new settler often finds, however, that the land near the railroad has been bought up by speculators, and is being held at a price which he may not be able to pay. Farther back from the railroad there is free land, but the wheat grower cannot afford to haul wheat in wagons or trucks more than 40 or 45 miles, even though he can then get good land for nothing. As a result the land 50 miles from the railroad is a wilderness, or a pasturage, though it may be a smooth, level, fertile prairie ready for the plow, rich in the possibilities of wheat and ready for any farmer to come and take possession. He can take possession only when a railroad, the most controlling of all factors of commerce by land, comes near enough to make possible the marketing of his products and the supplying of his wants. Such has been the history of the settlement of all that vast farm-land plain lying beyond the Mississippi River and reaching from the Gulf of Mexico northward beyond Winnipeg to a place where, thus far, the bitter elements of the north have stopped the advance of the farmer. The heart of Russia and Siberia where the largest of plains reaches eastward, was developed by new lines of railway at the same time as Canada, making possible the immigration of the Russian peasants into untilled Asia, as the Americans and Canadians went westward into empty Canada. In both of these central regions the development was rapid in the decade before the World War. Both stagnated after the World War because trade was bad, in Siberia due to po-

FIG. 6.—The frame house, barn, outbuildings, silos, water tank, and fences of a modern American dairy farm require much wood, often brought long distances. (United States Dept. Agr.)

litical disturbance, in Canada due to the poor purchasing power of impoverished Europe.

There can be some sparse settlements in western civilization more than 50 miles from the railway or boat but they are few and small, with export products limited to articles of high value such as wool or precious metals, and to flocks and herds which can walk to the railroad. This has been the case in Australia, Argentina, and the Great Plains of the United States; but the coming of the railroad almost invariably produces in an arable district a severalfold increase in population.

The railway, that profound changer of man's environment, is still spreading into new territories. There has been a tremendous increase in the use of the motor truck, with its transport miracles.

The farm tractor is doing the work of dozens of horses and doing it better. The year 1925 saw the airplane pressed into regular service as a freight carrier. Man's inventiveness is causing man's environment to undergo the greatest and most sudden revolution that it has ever experienced. It is the change from the local environment in which the local conditions dominated, to the world environment to which one export commodity admits us and which tends to make us all alike. As evidences of response to this unifying world environment, we see the white man in all lands, the American Indian, the Maori, and the Japanese putting on the clothes of Europe, regardless of adaptation to local needs, and the Chinese cutting off his queue and sending his sons to the universities of the western world.

This world environment creates a world commerce and a world market which we must understand before we fully comprehend man's relation to any community.

5. WORLD COMMERCE AND THE WORLD MARKET

THE NEW COMMERCIAL WORLD. We sometimes speak of the Old World—Europe, Asia, and Africa—and of the New World which Columbus discovered more than 400 years ago. In this sense the word "new" is used with regard to mere geographic discovery, a date. If we look at things from the standpoint of the way man is being supported, it is plain that we have a newer world, the world of modern commerce which depends upon the steamboat and the railway. As real servants of mankind the steamboat is only a little more than a century old and the railway much less than a century, yet they now support practically all the large cities of the world and have created the most of them. During this short period, we have come to depend on transportation that makes great commerce, and man's relation to his immediate environment is entirely changed. One of the greatest of geographers, Penck, has pointed out that under any condition it takes a certain space on the earth's surface to support a man, but that, since we have acquired the new means of transportation, a man's home space or the place where he lives may be far removed from his sustenance space or the place which produces the necessaries upon which he lives. This possible wide separation of the sustenance space from the home space has come almost entirely within the past hundred years, chiefly through the assistance of coal and iron working together in the form of the steam engine. For example, our first census in 1790 showed only three percent of our people liv- in cities.

This separation of the home space and the sustenance space has made possible the great and rapid expansion of large cities, as New York, London, and Chicago. In all three of these cities people may and do eat bread that is made from wheat grown in Minnesota, meat from cattle raised in Texas, wear clothes from wool produced in Australia, and in a hundred ways depend upon the coal and iron and products brought from remote parts of the earth.

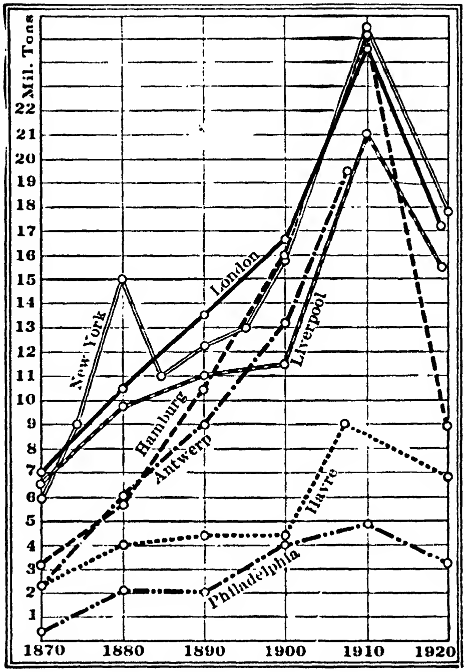


Fig. 7.—The growth of world commerce. (After J. Paul Goode.)

The world market. We have as a result what may be called a world market. Such a market exists for any commodity that is either produced or consumed over a large part of the world, and is sufficiently portable and durable to permit people in widely separated regions to be interested in the buying or the selling of the same consignments. In the days of the sailing vessel, the world market was unimportant, because, with the unsatisfactory, slow, and costly means of communication, only a few valuable and unperishable commodities could be transported long distances. The staple commodities of the world trade and the world market of that day were spices, silks, tea, coffee, furs, and curios made by the peoples of the different races.

The staples of a century ago are no longer the great staples of the world market. They are handled in greater quantities than ever, but cheap and bulky goods have become the staples since all continents have their railroads and all oceans their steamships.

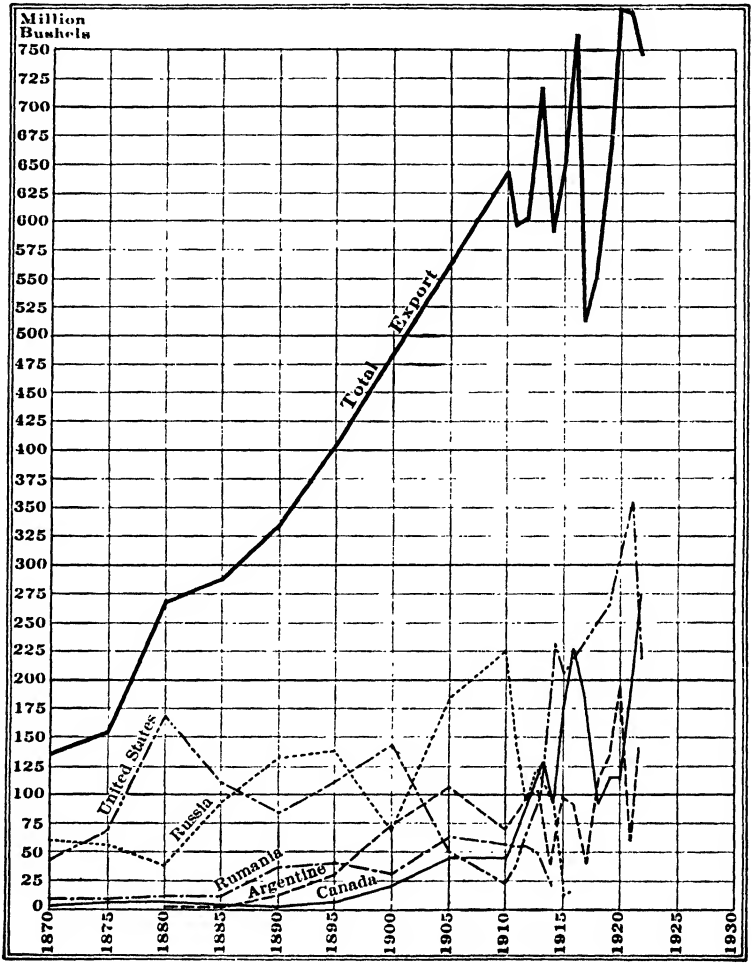


FIG. 8.—World export of wheat and flour in millions of bushels.

Spices, for which India was once so important, are now twenty-second in her list of exports.

A century ago, tea, coffee, and spices were the chief foodstuffs in world trade. To-day the important food staples are wheat, corn, oats, rice, sugar, beef, pork, mutton, butter, potatoes, apples, oranges, and bananas. These are the great staple foods of the white race, and, in part, of the other races also.

The fact that staple foods can be produced in the heart of one continent one year and sold in the heart of another continent the next year at a cheap price, means to most of us a comfort and security usually unrecognized, because we have nothing with which to contrast it, save the beleaguered city, and beleagured cities are as far away as famine. We know nothing of famine in America or western Europe, yet two centuries ago it was a nightmare that haunted all peoples. If a season happened to be too dry or too wet, or some sudden blight or disease broke out and made a local crop a failure, the people of the locality had to go hungry because there was no means of carrying bulky foods any great distance. In England the months of April and May were called the starving time, because the new spring crops were not sufficiently ripe to be eaten and the supply from the crops of the year before often ran low. Now the Englishman's breadstuffs come from Winnipeg, Minneapolis, Odessa, Buenos Aires, or Bombay, and his meat from even greater distances. The starving time has dropped from his calendar because there is a world market for wheat, rice and meat, sugar, coffee, and even potatoes, and the Englishman has something with which to buy them. The world market staples of clothing a hundred years ago were silk and furs—luxuries for the rich. To-day they are cotton, wool, hides, skins, cotton-cloth, shoes, hats and ready-made clothes—the clothes of the masses. In almost every school-room in the United States is clothing of wool, cotton or leather from two or three continents.

A century ago world commerce brought for the equipment of man in his activities little but lumber, wax, trinkets, and curios. To-day there is a world market for iron, steel, cement, coal, ores, locomotives, machinery, rubber, jute, hemp, and other fibers, so that the school building and the dwelling house usually have in them many articles made of materials that have been carried thousands of miles.

CHINA AND THE WORLD MARKET. China is the last great country to begin to patronize the world market. There the domestic system still continues to a great extent, and railroad building has just begun. Most interior localities there are still self-supporting; each farmer saves his own garden seeds and raises his own food; his wife spins and weaves cloth and makes the family clothes; but the railroad, commerce and the world market are beginning to make the economic conditions of China like those of Europe and the United States—a part of the world of standardized consumption, complicated industry, strikes, lockouts and necessarily increased government control. But China will continue to have her periodic

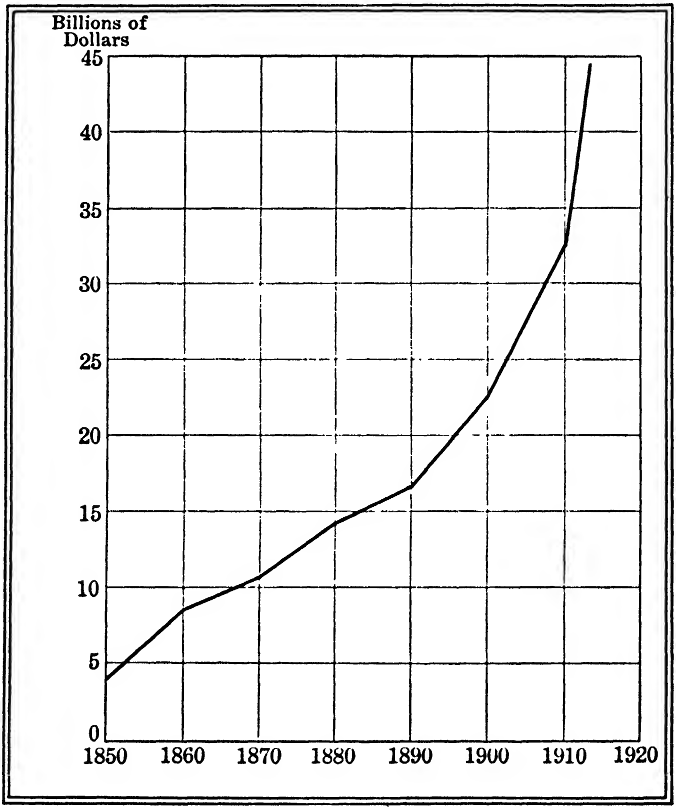


FIG. 9.—Combined imports and exports of foreign commerce of leading countries. A tenfold increase in over seventy years.

famines until the railway net spreads all over that country. In many parts of China to-day as in ages past, the transport limitations (see other parts of this book) are so great that crop failures and famine may not be many miles away from good harvest and surplus.

Any idea that the growth of cities and of great commerce is essentially American is not founded on fact. England leads the world in percentage of city population and the ports of Europe kept pace with those of America before the temporary paralysis produced by the World War. On the other side of the world the trade of Australia is much like that of Kansas and our own central west, the trade of India and the East Indies grows apace, and that of Japan has sprung up like a mushroom. But it is on a firm basis and resembles that of England.

No one should think of this world trade as having reached its greatest magnitude. It is rather at its beginning if only we can develop enough good sense and good will to organize the world and keep the nations out of war, and then grow enough people of brains to run the vast enterprises which our new machines make possible. We have only made a beginning on the regional division of labor. There will be an almost unbelievable trade when the various parts of the tropic world are as fully used at producing the things for which they are best fitted as are the forested Swiss hills and the well-tilled fields of Holland and Illinois. The great test facing man now is not the conquest of nature. Nature is in hand. We have but to drive her. The great task is to organize society and complete the civilization of man—beginning with those groups which are pleased to consider themselves the most highly civilized. From this process yet greater changes in our environment may come.

As yet the prevalent world system is international anarchy. Under this Germany felt free to try to destroy France in 1914 and in 1923 France felt compelled to try to destroy Germany. (See Simonds, "Germany Under Siege," *Review of Reveiws*, March, 1923.) If this is to last, man must continue to grovel along in the lowest dregs of his economic possibilities. The League of Nations is the first organized attempt to end such anarchy.

This world market business is really a great gamble. All those who live by it have indeed given hostages to fortune. Their financial ruin, even their starvation, may be encompassed by the acts of those whom they have never seen, those of whom they have never even heard.

The World War threw millions of American farmers into feverish prosperity. Then the price slump of 1921–25 threw tens of thousands of them into bankruptcy. An invention anywhere may annihilate an industry anywhere—for example, synthetic indigo exterminated agricultural indigo.

We are building up a world-reaching, regional interdependence which must keep up indefinitely or we perish. When transport stops working the Dakota farmer will be almost as helpless as the denizens of New York and London. We will all be much like the animals in an abandoned zoo. People fell famished in the streets of ranch settlements in Chubut, Southern Argentina, when the World War stopped the one steamer that connected them with the world of many things.

THE DEATH OF ARTS AND CULTURES. This world-reaching transport, carrying goods to the end of the earth, carrying exports and imports and money to places where there had been only barter and local supply, is doing much to reduce human labor and increase human comfort. It is also one of the most wide-sweeping destructions that ever fell upon the arts of man. A hundred years ago there were a thousand little peoples, each a going concern, possessed of many skilled crafts, producing every necessity of primitive existence. Enter the steamboat, the railroad, the trader with his bale of goods. They buy. They sell. The local crafts are discontinued. The younger generation acquires not the art—it dies with the elders. If you think the primitives had no arts go make an Indian arrow head. Use every facility within your reach to make one Indian arrow head. After you have worked a few days with this thing you will realize that the Indian was an artist.

Within the last hundred years a thousand arts have become lost arts. In another hundred years there will be nothing left but the factory arts. And if our civilization should slump as other civilizations have and the factory produce become unavailable, see what our civilization will have done to humankind.

Just at present our civilization of science, transport, the world market and division of labor seems to be rushing rapidly toward a collapse. The reasoning is as follows: The world market civilization depends on highly educated people. At present, education is a kind of disease highly fatal to families as evidenced by the fact that at present birth and death rates a thousand holders of the bachelor's degree would have fifty descendents in six generations.[4]

[4] Wiggam, A. E., *The New Decalogue of Science.*

CHAPTER II

THE PLACE AND NATURE OF AGRICULTURE

Sometimes the egotism that inheres in all races causes us to look down pityingly upon those peoples who still have a mythology. Yet I might well say we have mythology even in geography. For example, in the spring of 1925, 28 mature students in geography out of 29 in a class at Columbia University told me that their geography instruction, like my own, had said that the natives of the African forest made their living by hunting, fishing, and the gathering of wild produce. The only person in the class who knew better had had personal acquaintance with a returned missionary.

Now the fact is[1] that the African forest peoples have been farmers for unknown centuries. They were not farmers in the European sense but they were practitioners of the primitive agriculture. A clearing was made, small trees being cut and burned and the larger trees deadened, and in this partial clearing bananas, cassava, upland rice or millet or sorghum, beans, tomatoes, pumpkins and other vegetables were grown. When this garden became full of weeds and undergrowth another was cleared.

The native of the more humid grasslands of Africa had a similar garden. Only on the desert's edge were there small numbers of true hunting peoples, living by wild produce. This is true throughout the world. No one knows when primitive agriculture started. It is age-old and world-wide. The American Indian practiced it. Yet there was scarcely a breath of it in the American education of twenty years ago or even ten years ago. In many cases it has not yet entered American education.

It is historically correct that agriculture comes first in any general study of the industries that arise from man's attempt to win support from his environment. Industrially, agriculture precedes manufactures in all nations. Among the moderns it is the first and

[1] Brunhes, J., *Human Geography*, p. 453, article on the Fang; Smith, J. R., *North America*, pp. 666-668.

fundamental group of industries. 2 No nation has risen into importance in manufacture and commerce until after it had developed and lived by agriculture. It has not yet been proved that a people can long survive without an agriculture, despite the comforts of the world market. 3 Agriculture furnishes raw material for the factory and food for the worker, and the number of people engaged in farm-

FIG. 10.—Panama farmer's family, home, and all the tools of agriculture —a machete to cut the bushes and weeds and a sharp stick to make holes for seeds. These people of the tropic world have not developed through the pastoral or animal-tending stage. That is the Aryan method. Tropic people seem never to have used animals to any extent but developed at once a hand agriculture depending largely on starchy roots, sweet potato, yam, manioc, taro, caladium and others which have been tilled so long that they have lost the power of producing seed. The banana, corn and sugar cane are important additions to this untilled soil-preserving agriculture. (Photo H. H. Bennett, United States Bureau of Soils.)

ing tends to increase as countries grow in manufactures and commerce, although the proportion engaged in agriculture may decline, as it has in Great Britain and Belgium, because of heavy importation of agricultural products. 4 Another important aspect of agriculture is its permanency. The mine must be exhausted, the forest usually is, and the importing of raw materials from abroad is at best uncertain and at times temporary. Thus England will probably be unable to secure breadstuffs and meats from the United States for many decades because of our own increasing consumption and declining export. In the long run the only sure dependence of a nation is its soil resource, upon which depends agriculture, the fundamental group of industries, and the soundest basis of national strength. Granted good agriculture, a nation may develop and maintain manufactures and commerce; without it, a nation is at best in unstable equilibrium and dependent upon other nations. Witness the millions of unemployed in the United Kingdom for years after the World War. They were dependent on conditions quite beyond their control in foreign lands.

In the study of economic geography one must look closely at the factors that make for the support of human life—the fitness of land to man. Fortunately this fitness of lands to support us is rapidly increasing in spite of the present destruction—often reckless and useless destruction—of resources. Our inventions, discoveries and new abilities to do new things in both manufacture and agriculture enable us to create new products and get our living more easily, so that the various kinds of lands that make up our world will support more people than at any previous time. At the same time that old lands have the possibility of greater productivity, new lands have been coming rapidly into use during the century of steam.

Relation of transportation and the world market to agriculture. Since the rise of the world market and world commerce, one important product will support more people in greater comfort to-day than could have been done in a locality with several products in the older periods. Before the coming of railroads, level treeless plains in the continental interiors were almost useless to man and he clung to the waterway no matter how fertile and productive the treeless plains were. The first settlers of Illinois shunned the rich level treeless prairies and fought stumps and hills on the forested areas near the streams. The problems of shelter and fuel were perplexing without trees or coal. About the only way this difficulty could be met was to follow the methods practiced by the people of northern China, who have succeeded in living in the old fashioned way on such plains by building mud or unburned brick houses covered with thatch, and using, for fuel, the coarse stalks of a kind of millet which they grew as an annual crop for this purpose. Owing to the scarcity of this fuel supply they must economize severely, and therefore make no attempt to heat their rooms. They wear quilted cotton or thick sheepskin clothing instead, and sit by day and sleep by night upon a low, hollow brick platform continually kept warm by a small fire of millet stalks smoldering beneath it.

FIG. 11 —World rainfall, annual. (After Mark S. W. Jefferson.)

Very heavy—an annual rainfall, including melted snow, of over 80 inches.
Heavy—an annual fall of from 40 to 80 inches.
Light—an annual fall of from 20 to 40 inches.
Scant—Less than 20 inches in the year.

World commerce enables western peoples to live very differently on such plains. The vast treeless plains from Texas to Manitoba, and westward to the Rocky Mountains have become the home of millions of comfortable farmers and townsmen, who bring their wood and their coal hundreds of miles and pay for it with their wheat and corn and cattle, their sheep, their horses, and their hay, while they ride in automobiles and live in houses supplied with bath-rooms and electric lights.

This fact, that a community can arise wherever one salable product can be produced, has multiplied the world, and makes it necessary to examine a region very closely to see its possibilities.

Because of the fundamental character and enduring nature of agriculture, one of the first things to note in the examination of any region is its fitness for this group of industries.

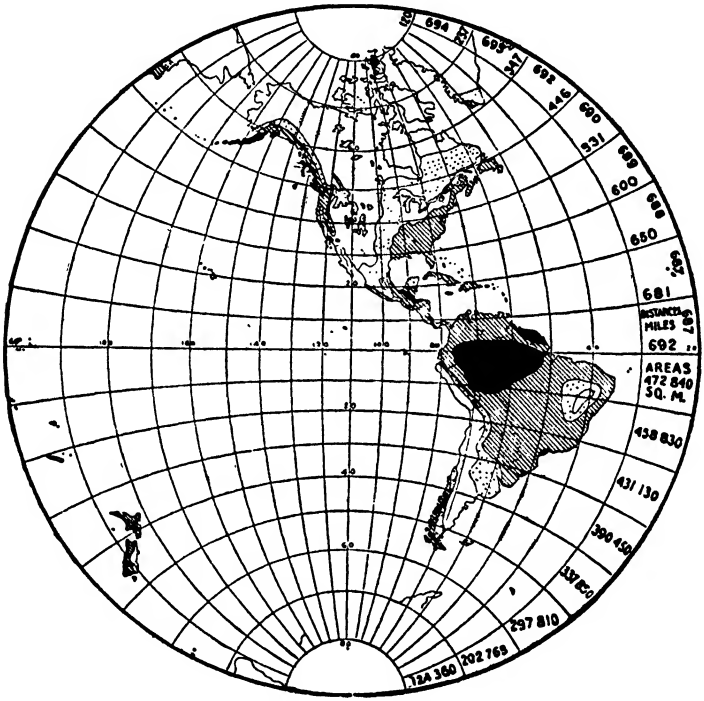


FIG. 11.—(Continued.)

AGRICULTURE MORE DIFFICULT TO UNDERSTAND THAN MANUFACTURE. Agriculture is affected by the forces of nature more than is manufacture. It consists primarily in the growing of plants, which are more affected by the weather, especially temperature and moisture, than they are by the soil in which their roots are fixed, although the soil, too, has great influences. The weather is notoriously changeable and uncertain, and each crop and animal has its own nice adjustment to the environment. This dependence of agriculture upon the uncertainties of nature is in strong contrast to manufacturing, which goes on in factories almost independent of the weather, and dependent upon a comparatively small number of factors, all within the control of man.

Agriculture is really a group of industries. It is a mistake to contrast farming with any single branch of manufacture, merely

FIG. 12.—World rainfall, June, July, and August.
(After Mark S. W. Jefferson.)

Heavy—more than 10 inches of rain and melted snow in the three months.
Light—from 6 to 10 inches in the three months.
Scant—less than 6 inches in the three months.

because there are so many kinds of manufacture. There are also many kinds of farming. There are 10.9 million farm workers and 12.8 million factory workers in the United States; but throughout the world at large a much greater proportion of the human race is employed in fields than in factories. Even industrial Belgium with its many small farms has a larger proportion of farmers than the United States. Through the materials and food it produces, the farm supports alike the factory and the factory worker, and enables them to render their great service to mankind.

FARMING IN THE DOMESTIC EPOCH. Farming, like manufacture, has been revolutionized by world commerce. In 1786 a Massachusetts farmer wrote a book telling just how he supported his family.[2] With the wheat and corn and buckwheat that grew in his fields he furnished the family bread. The chickens, pigs, sheep,

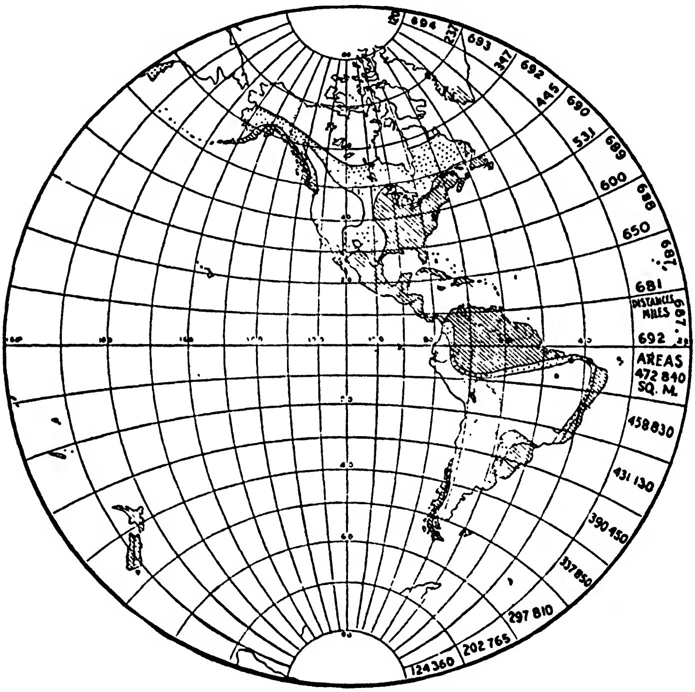


FIG. 12.—(Continued.)

and an occasional beef animal that he slaughtered furnished the meat. His garden furnished all the vegetables and his orchard all the fruits, many of which were dried for winter use. The farm produced the family food. For clothing, his wife spun the wool which he sheared from the sheep; and the flax that grew in the corner of a field was made into linen. The skin of the meat animals was tanned and made the family's shoes, and thus were they clothed. The trees from his wood lot furnished the boards to build

[2] See MacMaster, J. B., *History of the People of the United States*, Vol. I.

his house and the logs for his fire and the rails for such fences as were not of stone. He himself, as most farmers of that time, was a fairly good worker in wood, and he had a little blacksmith's shop so that he made practically all of his own tools on rainy days and in snowy winter weather. Only a few things were needed from the outside world, such as salt, pepper, and iron for his little forge. These

FIG. 13.—World rainfall in December, January, and February. (After Mark S. W. Jefferson.)

Heavy—more than 10 inches of rain and melted snow in the three months.
Light—from 6 to 10 inches in the three months.
Scant—less than 6 inches in the three months.

outside products cost him $10 a year, permitting him to save $150 out of the $160 received for the wheat and cattle that he sold. This glorified primitive agriculture, this completeness of support was obtained by an amount of hard work and discomfort that would not be tolerated in this age of commerce and division of labor.

FARMING IN THE COMMERCIAL EPOCH. Since the coming of the epoch of coal, steam, and machinery, the farmer, especially the

American farmer, sells much more and buys much more, and his family usually does less work. His shoes and clothes are factory-made, the lumber for his new barn often comes from afar, as does the coal for his stove and the stove itself, as well as the tools, the wagon, and often the horse that draws the wagon as well as the gasoline that runs various engines. A much greater farm product is required to support a family by the commercial than the domestic

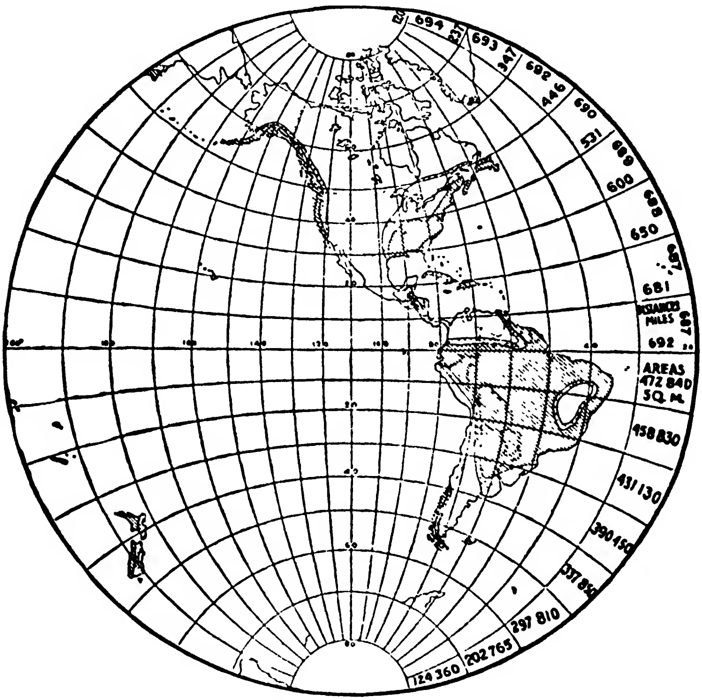


FIG. 13.—(Continued.)

system. The increased product goes to pay for things not done on the farm. To see this clearly take the matter of clothing. A flock of fifteen sheep yielding 75 pounds of fleece would abundantly clothe a family with homespun. If the same 75 pounds of unwashed wool were sold at forty cents a pound the resulting $30.00 would scarcely buy one-tenth as much ready-made woolen clothing. Thousands of American farms that supported large families in the domestic epoch will not do so in the commercial epoch, and hence have been abandoned. These farms are to be found in every state.

One·authority (Guy Huston) said in 1924 that we should abandon a million farms in the United States.

Money crops and supply crops. In the commercial system, the most important consideration in connection with farming is the

Fig. 14.—World distribution of population.
(After Mark S. W. Jefferson.)

Grade of peopling.		People to 1 square mile.
Very dense		......250 or more
Dense		......125 to 250
Moderate		...... 26 to 125
Thin		...... 2½ to 26
Scanty		......less than 2½

money crop. Every farm or every farming community has one or more crops which are usually sold and converted into cash, and hence usually called money crops. Among the world's great money crops are grain, sugar, animals, fruits and vegetables, cotton, wool, coffee, tea, and tobacco. The money crops do not occupy half the land in American farms, for most of the land is devoted to what may be called supply crops, that is, crops which are used entirely upon the farm and are sold, if at all, in some indirect form. For example, nearly half of the American farm lands are in grass. Some of it the animals eat in summer, the rest is made into hay for winter forage, so that, while important, the pasture and hay are not sold directly, but supply the means for producing something else. On many farms there may be fields of corn, oats, hay, grass, and rye,

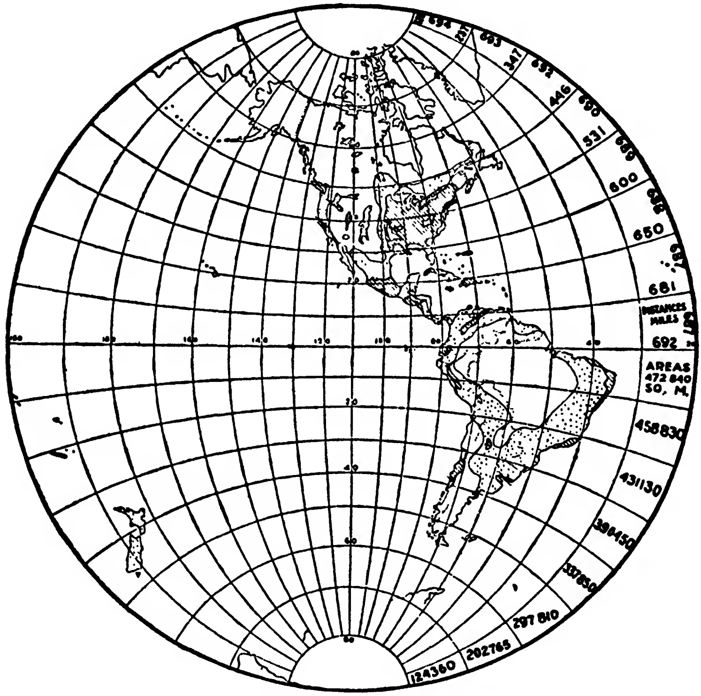


FIG. 14.—(Continued.)

yet these are all supply crops contributing to the one money crop of milk, butter, lambs, cattle, swine, or horses.

THE RURAL DOLLAR AND THE CITY DOLLAR. The complete self-support and the well-nigh money-free life of which the Massachusetts farmer wrote 140 years ago, is gone; but a strong trace of it remains in the fact that a dollar for the farmer is often as valuable as two dollars to the city man because he buys many things cheaply where they are grown, and he also produces many things for home use. Nearly every farm has a garden, from which a complete supply of vegetables is drawn to last the family through winter and spring as well as for summer use. It also has an orchard in which peaches, apples, pears, plums, and grapes may be grown, so that no fruit need be bought, for the home supply can be stored, canned, preserved, or dried for winter use. One or two cows furnish milk and butter. A few chickens about the farmyard supply the farm with eggs and poultry, and usually leave some to sell for cash. Millions of farmers raise a few hogs or sheep or cattle which they slaughter for their own meat supply. Even the dwelling house, usually considered part of the value of the farm, is used rent-free by every rural family.[3]

In contrast to all these benefits of the farm, which are had without direct cash cost, the entire food supplies of the city consumer must be bought, and at prices that are often several times higher than they were in the country, because of the great amount of work and expense necessary to get the products from the place where they are grown to the consumer's house. When the city housekeeper, for example, buys a basket of beans she pays for the beans and in addition pays for the following: one basket, the cost of packing the basket ready for shipping, cost of hauling it to the station, transportation charges from the farmer's station to the city, cartage from the railroad station to the commission house, commission to the merchant for selling it, cartage from the commission house to the grocery store, and profit to the groceryman. This profit to the grocer must be based on all the costs that have accrued before the goods came to him. This profit must also be large enough to include rent, clerk hire, delivery-wagon costs, and the value of the damaged goods that cannot be sold. All these costs and charges reach a total that amounts to about sixty-five cents out of every dollar expended by the housekeeper in a great American city for farm products. Only the remaining thirty-five cents of the dollar are spent for the food itself, with the result that living in the city is much more expensive than living in the country—a frightful waste of effort and resource for an object that might often be otherwise obtained.

[3] "The farmer's cost of living in actual cash expenditures is very materially reduced by what the farm furnishes in food products, fuel, and house rent; in fact, the income from this source adds as much to the real wealth of many farmers as does the net income from the sale of farm products."—"What the Farm Contributes Directly to the Farmer's Living," *Farmers' Bulletin No.* 635, United States Department of Agriculture.

In many small towns and country districts of the United States, a family can live with as great comfort and independence on $1,000 per year as one can live in a great city for $2,000; or, again, in the same rural regions referred to, $1,500 a year would make one relatively wealthy, while $3,000 per year in a large city leaves one relatively poor. These statements are made with reference to the real country and not the suburbs, in which the cost of living is often

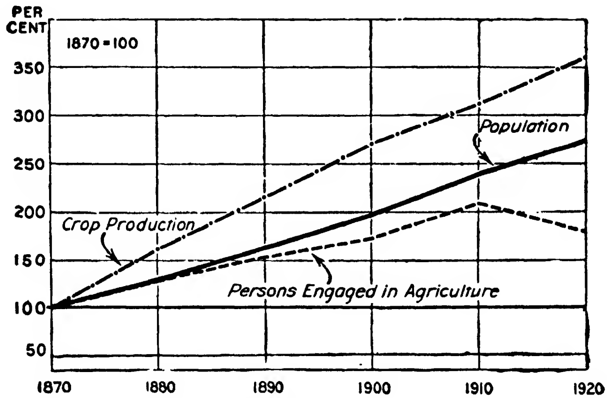


FIG. 15.—A chart of profound significance, showing how machinery helps fewer people to feed us. (United States Dept. Agr.)

higher than in the great cities, because it involves one more movement of supplies—from the city center to the suburban town.

Farming in the United States has been through a period of depression, between 1880 and 1900, when prices were low and dollars hard to get. Prices have recently risen. Cities have grown up so suddenly that these differences between city and country conditions have not been fully appreciated. Now, however, there is coming a rapid increase of understanding of the conditions of living in the country, where one pays for the things he gets, as contrasted with the great city, where he must pay, also, for a host of services that add no value to the goods and often detract from their value.

Agriculture has also suffered from the disadvantage of isolation of the rural dweller, which has partly caused the great rush to the city to get the social opportunity that comes of being near large numbers of one's fellows. The telephone, the trolley, the motor car, the rural delivery of mail, and the radio are greatly improving the social possibilities of American country life.

THE APPLICATION OF SCIENCE TO AGRICULTURE. Farming is one of the most scientific branches of production. The factory has a few operations involving a science or two, but the farmer must deal with soil chemistry, plant nutrition, animal nutrition, and the diseases and enemies of both plants and animals. He must also be his own purchaser, salesman, and mechanic. Much experiment is required in all this wide field, but in no occupation is experiment so difficult. Experiment consists in altering *one* factor, the others remaining as before. This, the vagaries of temperature, humidity, rainfall, sunshine, and accident, so rarely permit, that experiment in agriculture is difficult and superstition has lingered longest in the most scientific of industries. When one succeeds with experiments it often takes years, and then the cycle of production is so slow that there may not be much of his life left in which to profit by the experiments. In a factory an experiment may easily affect more cycles of production in a year than farm experiments will in a lifetime. Further than this, many experiments of great value to agriculture are too difficult and costly for farmers to perform, but, at the same time, they may be of great profit to a community or state. Hence agricultural experiment has been largely taken up by the state. Nearly all progressive governments are working systematically to promote agricultural production. In the United States we have in every state a college of agriculture and the mechanic arts, with practically free tuition. Every state has one or more agricultural experiment stations where men are supposed to be constantly making scientific discoveries and testing the usefulness of other discoveries for their particular localities. These results are published and distributed free, so that the individual farmer may be able to use the latest results of science. In addition, we have at Washington, under the national government, the Department of Agriculture, which is one of the greatest scientific institutions in the world, although conservatism is gradually sapping its vitality. Perhaps it is too much to hope that it alone should escape this weakness of age. Along with many other lines of work, it sends its explorers into the Desert of Sahara, into subarctic Russia, into tropic Africa, into Turkestan, Mongolia, and the ends of the earth where perchance may be found some plant,[4] or practice, of value

[4] It must also be added that terrible destructions are also being introduced in the form of weeds, diseases and insects—for example, the cotton boll weevil, which is only one of many. Most of these enemies come in through commercial efforts.

to some part of the United States. This plant introduction work alone promises to increase the productivity of the United States more than would the addition of a new state.

Germany, with eighty-seven experiment stations in 1904, formerly led the world in the promotion of scientific agriculture.[5] England, France, Holland, Belgium, and all progressive countries of Europe are also in the same work. Uruguay and Argentina are going at it in earnest. Cyprus (British) is well equipped, while Japan is, in some respects, more advanced than any other nation. This world-wide distribution of scientific research for agriculture gives to Massachusetts or California the possibility of hearing at once of discoveries that may be made in Germany, Japan, or Sweden. The result is that it is now becoming possible for agriculture to be actually one of the most scientific of all industries, since the experiment station and the Department of Agriculture bring experimental science within the farmer's reach. As a result, agriculture is becoming more and more an occupation for the educated man. The last phase of the promotion of agriculture in America has been the creation of a thousand county agents. These men are teachers with a county for their field and any who will listen, for their school.[6]

The greatest work for the promotion of agriculture now is the popularizing of science; [7] not more discoveries, but the practice of

[5] BUSHELS PER ACRE (1913)

	Wheat	Rye	Barley	Oats	Potatoes
Germany	35.0	30.4	40.9	61.0	235.4
United States ...	15.1	16.2	23.7	29.5	90.2

[6] The county agent has resulted partly from the innate conservatism of the farmer and partly from the inability of bulletin writers to reach him with their message.

[7] As an example of results of such endeavor, note the following astonishing increases in average yield resulting from twenty-five years of teaching in Belgium.

	1880–85, bushels per acre	1907–10, bushels per acre	Increases, bushels per acre
Wheat	24.54	38.55	14.01
Rye	23.86	36.69	12.73
Oats	49.79	81.48	31.69
Winter barley ..	38.25	57.57	19.32

what is now known, so that we may have an agriculture that is adjusted to resources. This adjustment is a very complex thing; for the crop selection is influenced by character of soil, land values, labor supplies, transport facilities, climatic conditions, and the likes, dislikes and abilities of men.

CROP ROTATION AND THE INTENSIFICATION OF AGRICULTURE. The start of agriculture is almost always the plantation system—the planting of one profitable, easily grown, money crop year after year, until its yield becomes low and unprofitable. This practice is limited to no one crop, climate, race or continent. Then variation of crops follows (usually with the increase of population and

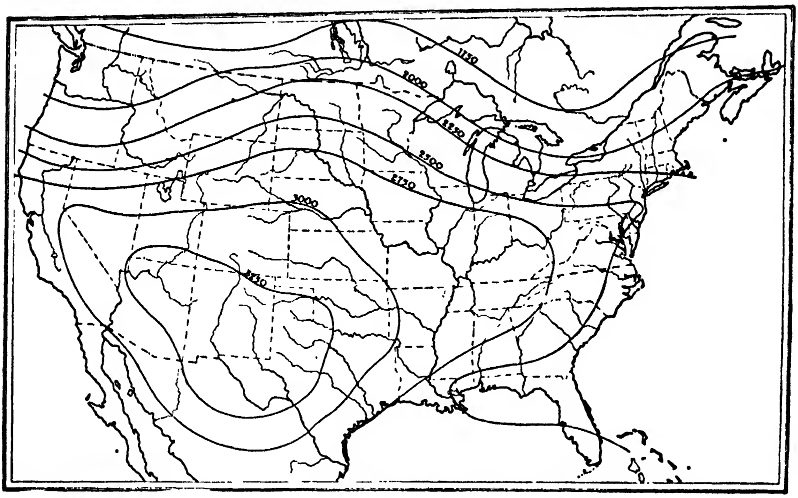


FIG. 16.—Map showing mean annual number of hours of sunshine in the United States. (After Salisbury, Barrows, and Tower.) Sunshine has great influence on plant growth, and aids greatly in giving color to fruit.

workers) and, if this variation is systematic, it is called rotation of crops. This rotation causes variation in the demands upon the soil and gives it time to recuperate from the strain of any one crop. If sufficient humus is provided, by the plowing in of plant roots, leaves, manure, etc., and the soil is not allowed to wash away, agriculture may, with crop rotation, continue on the same fields for indefinite periods, as in parts of Europe and Asia. The violation of these simple rules of soil preservation has in a few decades already brought irreparable ruin to many American fields, especially in the southeastern states. The keeping of live stock is the type of agriculture which best preserves the soil, because it permits the return of the manure to the land and thus tends to maintain fertility.

During the past half century there has been throughout the western world a steady decline in the proportion of the people engaged in agriculture. The invention of agricultural machinery has

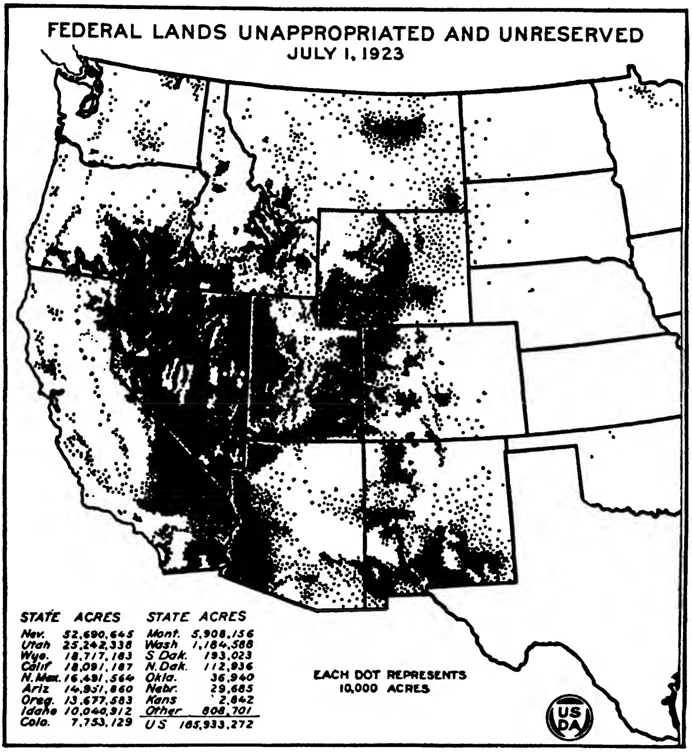


FIG. 17.—If we rule out the National Forests of the states west of Texas we have here a map of the land on which agriculture is not now possible.

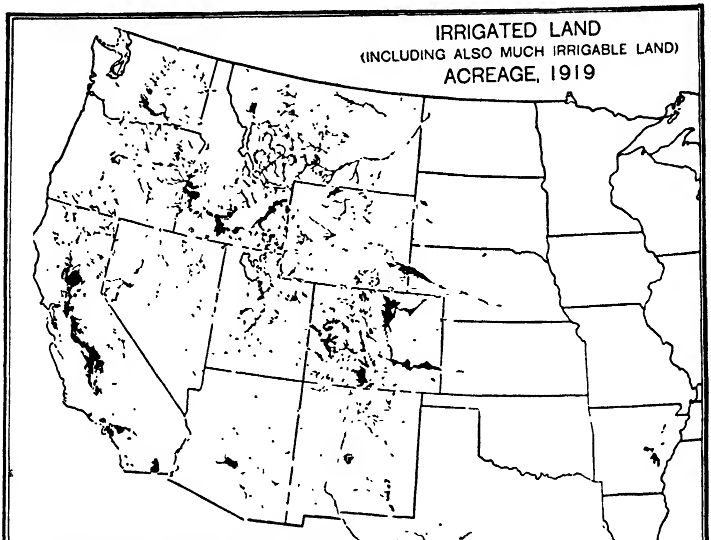
permitted a given number of farmers to produce a greater output, releasing a portion of the population for other occupations and for leisure, which has increased greatly in these later days. Between 1856 and 1915 our crops per capita increased 30 percent. The percentage of males in agriculture decreased from 50 to 35 percent of those employed in the United States.[8]

Another factor tending to reduce the proportion of farmers is

[8] *Quarterly Publications of the American Statistical Association,* March, 1916.

the carrying over to the factory of so many operations that were once done on the farm.

Diminishing returns, that accompany the increase of population, are a factor tending to increase the proportion of agriculturists. Crop rotation, the intensification of agriculture, can increase the output per acre, but rarely the output per man. When four families support themselves respectively on a 2,000-acre ranch, as in the



IRRIGATED AND IRRIGABLE LAND, 1919 AND 1920

State	Area irrigated acres 1919	Area in enterprises were capable of irrigating	Area in enterprises acres 1920	Estimated irrigable area including irrigated	State	Area irrigated acres 1919	Area in enterprises were capable of irrigating	Area in enterprises acres 1920	Estimated irrigable area including irrigated
Calif	4,219 048	5,894 466	7 805 707	10 000 000	Wash	529 899	637 151	836 795	3 000 000
Colo.	3,348,385	3,855,348	5 220 [illegible]65	5 000 000	Ariz	467 565	627 303	813 153	1,000 000
Idaho.	2 488,806	3 092,810	3 760 048	5 600 000	La	454 862	728 742	851,211	
Mont	1,681 729	2,753 498	4 329 148	6 000 000	Nebr	442 690	562 488	766 768	1,000 000
Utah.	1 371 651	1 700 550	2 359,244	2 500 000	Ark	143 946	179 013	245 480	
Wyo	1,207 982	1,831 039	2 564,665	4 000 000	S Dak	100 682	150,914	188,382	1 000 000
Oreg	986 162	1 344,046	1,925,987	3 000,000	Kans	47 312	67,853	102,562	500 000
Tex	586 120	1 150,542	1,687 447	3 000 000	N Dak	12 072	34 235	57,476	1,500 000
Nev	561 447	704 708	1,382 036	1 500 000	Okla	2 969	9 872	11 742	500 000
N Mex	538 377	696,119	961 879	2 000 000	U S	19 191 716	28 020,477	35,890,821	51 000,000

FIG. 18.—Irrigation can turn a desert waste into a green oasis where alfalfa and other forage crops fatten our live stock. (United States Dept. Agr.)

American West, or on a 160-acre farm, as in the Corn Belt, or on a 20-acre farm, as in France, or on a 2-acre garden farm, as in Japan, there is no questioning the fact that a Japanese *acre* is the most productive acre and the American *family* the most productive family. During the last half century the discovery of new lands and the increase of machinery have been influences that much more than offset the more fundamental influence of diminishing returns from increase of population.

REFERENCES

See General References

STEDMAN, J. M. *The Results of Agricultural Extension in Belgium.* U. S. Dept. of Agriculture, office of Experimental Stations.

SMITH, C. B., and FARREL, G. E. "Boys' and Girls' Clubs Enrich Country Life." *Yearbook,* U. S. Dept. of Agriculture, 1920.

ROWNTREE, B. S. *Land and Labor: Lessons from Belgium.* New York, Macmillan, 1910.

EAST, E. M. "The Agricultural Limits of our Population." *Scientific Monthly,* vol. XII, No. 6, 1921.

McCRORY, S. H. "The Drainage Movement in the United States." *Yearbook,* U. S. Dept. of Agriculture, 1918.

BAKER, O. E., and STRONG, H. M. "Arable Land in the United States." *Yearbook,* U. S. Dept. of Agriculture, 1918.

SHOWALTER, W. G. "How the World is Fed." *National Geographic Magazine,* January, 1916.

BAKER, O. E. "A Graphic Summary of American Agriculture." *Yearbook,* U. S. Dept. of Agriculture, 1920.

SPIELMAN, W. J. "Distribution of Types of Farming in the United States." U. S. Dept. of Agriculture, *Farmers' Bulletin No.* 1289 (1923).

DANA, SAMUEL T. "Farms, Forests and Erosion." *Yearbook,* U. S. Dept. of Agriculture, 1916.

CHAPTER III

THE CEREALS

Bread was long ago called the staff of life, a fact which shows that the Bible was not written in the humid tropics or subtropics where bananas, cassava, yams or rice were and are the staffs of life. Some cereal food is used among practically all peoples in the temperate zone, and also among the more commercial peoples of the tropics. As population increases in density, meat declines and cereals increase in importance as an element in man's nutrition. All the cereals are furnished by the grass family. These plants pack starch, gluten, oils, and other elements of nutrition into their seeds to provide for the nourishment of the young plant before it gets its roots well into the earth. This food is equally acceptable to man and to many beasts, and it is furnished to man in various lands by a much larger number of plants than we as a wheat-eating nation would at first expect.

I. WHEAT

THE PLANT AND ITS CLIMATIC REQUIREMENTS. Wheat is a grass, and in the first part of its growth the plant consists of a tuft of green blades much like any other grass. Later it sends up stalks of straw that support the grain-bearing heads. The number of stalks and heads depends on the size and vigor of the plant, and these are greatly dependent upon the duration of cool, moist weather. If the cool, moist season of formative growth is long, the grass-like development is good and the heads many. Early sunshine that shortens the damp period shortens the grain yield. The formative period is therefore important. In milder climates it usually includes the winter; where the winters are too severe it falls wholly in the spring and summer. Winter wheat, therefore, the wheat of warmer latitudes, is sown in autumn and harvested early the next summer. Spring wheat, the wheat of the lands of cold winter, is sown in spring and harvested at the end of summer. Although wheat grows in many and widely scattered lands and different climates, it must have for the period of its early growth moderate rainfall[1] with rather cool, moist weather, long continued if possible. This must then be followed by warm, bright, and preferably dry weather. Abundance of summer rain is fatal to extensive wheat growth. It causes the plant to make straw rather than grain, and also induces rust and other fungous diseases to attack the plant. If excessive, it causes the grain to shrivel before harvest, and often causes it to mold or decay after harvest; witness the northern part of the cotton belt in the United States. Consequently, warm regions of heavy summer rainfall cannot grow wheat with assurance of good harvest.

This double requirement of a cool, moist formative period and a warm, sunny period of ripening explains the importance of wheat in regions of rainy winter and dry summer, like California and Italy; and its absence from lands of heavy summer rainfall, like the coasts of the Gulf of Mexico. The rainfall of eastern and southern United States promotes heavy vegetation, permits a rich and luxuriant agriculture, but is quite unsuitable for wheat. A seven-year average for Georgia shows 10.5 bushels per acre, while Wisconsin made in the same seven years 19.2 bushels per acre. Even the corn belt of the Ohio and Mississippi valleys has sufficient moisture at times to injure the wheat crop to some extent, although it is grown in every county and almost every township in the whole region. In the cotton belt with its still greater summer rainfall, so favorable for cotton, wheat becomes less and less possible, and the little that is grown in the northern margins of the east Gulf States and in the Carolinas and Georgia has the lowest yield per acre found anywhere among English speaking peoples except in the Union of South Africa. The whole torrid zone with its tendency toward summer rain is, therefore, practically barred from wheat growing, except here and there where some climatic exception holds sway, as in Egypt, arid, but having enough river water for irrigation, or again, where high elevation, as in Mexico, Colombia and Abyssinia, gives the temperate conditions to plateaus and mountain regions. The most important of these tropic exceptions is India, where the summer rains, brought by a monsoon, arrive after the

[1] The moisture left from a period of seasonal rainfall is sufficient in some parts of the Pacific slope to mature a crop of wheat upon which no rain falls.

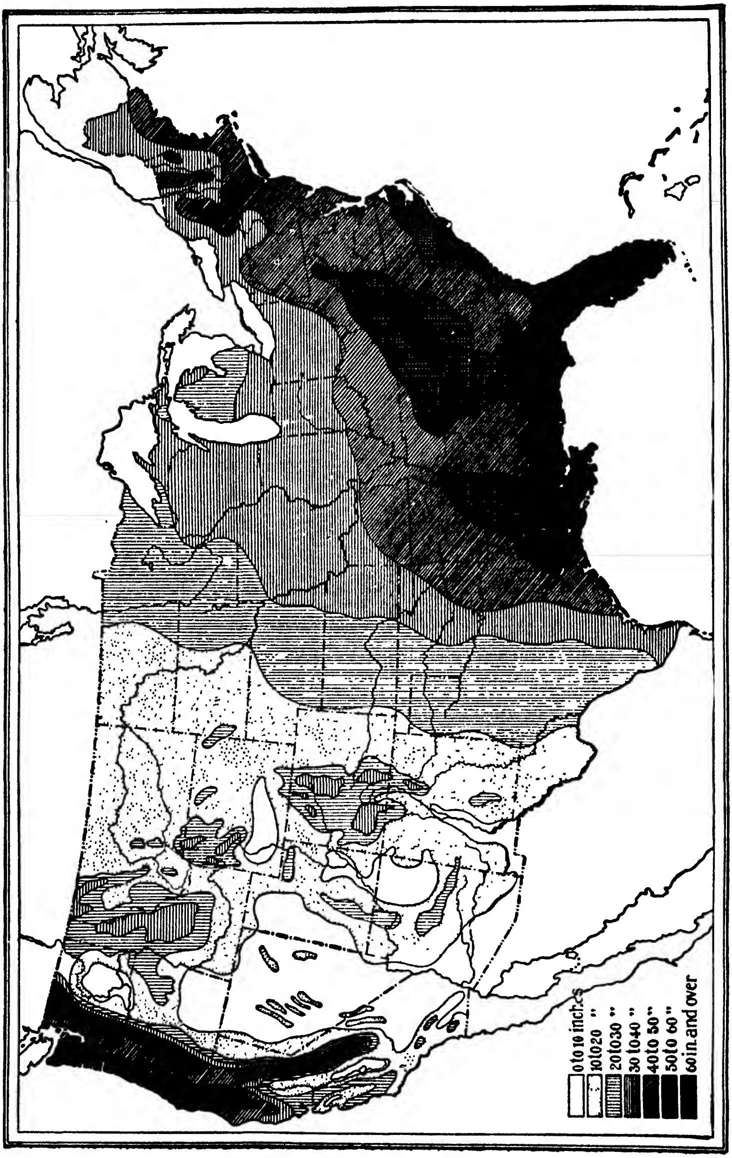


FIG. 19.—Mean annual rainfall in the United States. (After Gannett, from data of U. S. Weather Bureau.) (From Salisbury, Barrows, and Tower.)

wheat has been ripened by the heat and droughts of early summer, thus permitting India to be one of the world's important wheat countries.

FREEZING AND THAWING OF AN OPEN WINTER. In addition to the handicap of summer rain, parts of the corn belt of the United States have another difficulty in the alternate freezing and thawing of the early spring and late winter. This is much worse than a heavy mantle of snow or even solid and continuous freezing. The expansion and resultant lifting of the top soil by freezing, and the contraction of the thaw, gradually pull the wheat plant out of the ground. As a result, wheat is much less important in many corn belt localities than it was forty or fifty years ago.[2] The wheat regions have been shifted beyond the Mississippi Valley southwestward, into a less frosty climate for winter wheat, and also into the colder Red River Valley of the North and to the plains of Canada, where the rigors of the winter climate have no direct effect upon the wheat because it is spring-sown. Between these two wheat areas is an interesting gap where it is too hot for spring wheat and too cold for winter wheat.

REGIONS WITH GOOD WHEAT CLIMATE. The ideal wheat climate, with a rainy winter and a dry summer, is sometimes called the Mediterranean type of climate because it is characteristic of most countries facing that body of water. This wheat climate exists in all continents in a climatic zone with a western ocean frontage corresponding to the Mediterranean region and produced by the same elements in the world-wind system. This Mediterranean wheat climate is to be found upon the margins of the six arid or desert regions that afflict each of the six continents in the latitude of transition between the zones of trade wind and the prevailing westerly.

This transition land with rainfall varying from the abundant to the scanty, and having a winter maximum, prevails along the northern edge of the Old World desert from Gibraltar through South Europe and North Africa, to Persia. We find it again in South America where the desert extends diagonally from Peru through northern Chile into western Argentina and is bordered by a wheat region on the west in central Chile and on the east in eastern Argentina. Wheat lands border on the cooler edges of the

[2] Iowa, which averaged about 30 million bushels annually from 1870 to 1880, is now producing from 10 to 15 million bushels each year.

deserts of Central Asia. The same is true of South Africa and Australia, but the desert encroaches upon the wheat lands so much

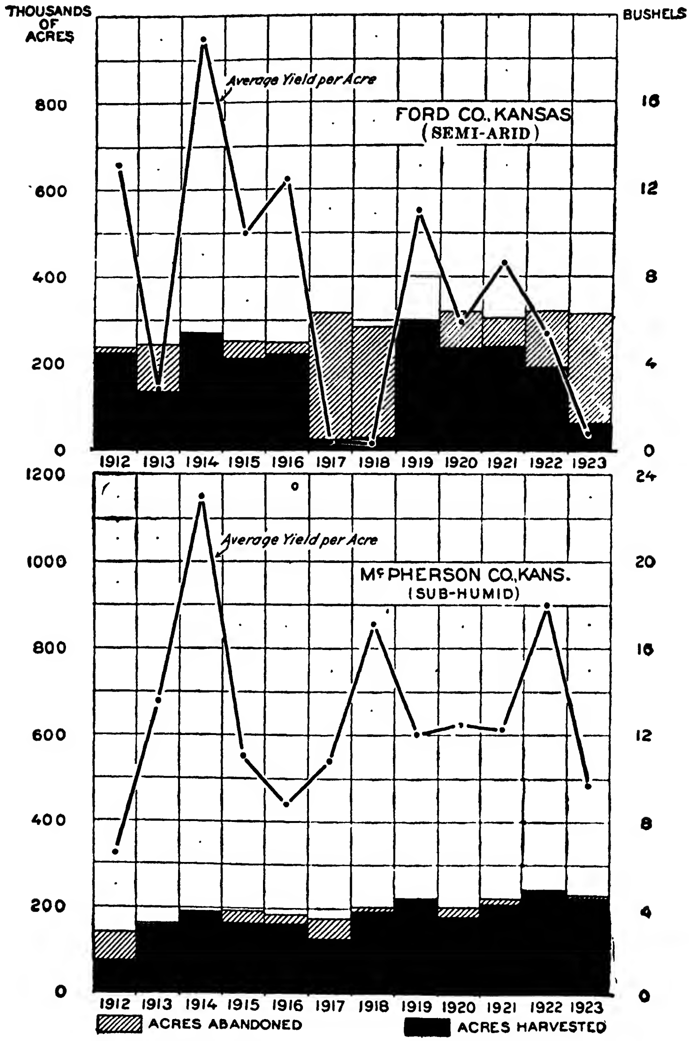


Fig. 20.—The semi-arid West produces much wheat but at a greater risk. During the 12 year period 1912-23 the acreage abandoned in semi-arid Ford County was 37.1 percent of the planting, while in sub-humid McPherson County it was only 9.4 percent. (United States Dept. Agr.)

that these areas are unimportant in the world's supply. South Africa even now imports wheat, and in Australia the moisture suffices only on the eastern, southern, and extreme southwestern sections, and her crop varies greatly with the fluctuating rainfall on this desert margin. New Zealand is a regular wheat exporter because its location, a little nearer the south pole than Australia, permits it to miss the belt of scanty rainfall which roughly follows the tropics of Cancer and Capricorn. New Zealand gets instead the regular rains of the west wind. Australia gets the rain of Southern California, and New Zealand that of Washington state. Like England, in a similar latitude and climate, New Zealand has a

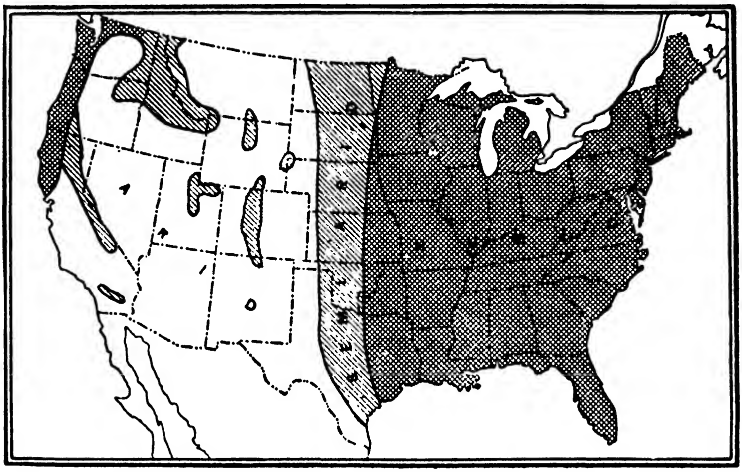


FIG. 21.—Map showing arid, semi-arid and humid regions of the United States. (After Newell.) (From Salisbury, Barrows, and Tower.) It is interesting to note the small number of people in the arid territory.

splendid wheat yield per acre, about 30 bushels, in contrast to 10 or 12 bushels in southern Australia.

In the United States, also, we see the wheat regions distributed according to the same conditions. The western part of our country (about 40 to 45 percent of the whole) is mostly too arid for cultivation, except when irrigated. The district of greatest aridity is in the Great Basin. Going from the east toward the arid region we find close to the line of 20 inches of rainfall the most important wheat belt in America, reaching from Texas north through Oklahoma, Kansas, Nebraska, the Dakotas, and Minnesota into Canada. A second belt is found as we go north and northwest from the deserts of the Great Basin, into an area of increased rainfall, which gives the wheat areas of eastern Oregon and Washington. To the west of the Great Basin, across the Sierras in California, is the great valley of that state, long one of the important wheat regions of the country. Its essentially Mediterranean conditions give it a better wheat climate for quality of product than any east of the Rockies. The painful fact of inadequate rainfall keeps down the yield.

In that part of the Mississippi Valley north of Nebraska and its continuation in the plains of west Canada, the winter is too cold for fall-sown (winter) wheat, but a fortunate rainfall distribution permits the planting of wheat in spring. The rather light rainfall (15 to 20 inches) has a maximum in early summer or midsummer which promotes the grassy growth of wheat. A *hot* June injures this wheat and sets the southern limit of the region. The wheat usually ripens well in the drier late summer. This makes the plains in the center of North America one of the most promising granaries of the twentieth century. But the promise of great production in the next decades is due more to great area than to any perfection of climate.

This is really a marginal land with a "small margin of safety."[3] Its small margin of safety arises from the painful frequence of drought, hot Junes, frost, hail and pests of grasshoppers. Further uncertainties of income arise from fluctuating price depending on production of competing regions in every continent.

This region, however, has a fertile soil, the black prairie soil of continental interiors.[4] It is really the advance of agriculture into

[3] Phrase borrowed from Isaiah Bowman.

[4] The geologists long claimed that soil, unless transported to its present position, was dependent upon bed rock. The Russians (see the works of C. F. Marbut, U. S. Department of Agriculture) have shown us quite otherwise. In forested areas of heavy rain soils are light colored. In grassland areas of moderate rain such as Illinois, Iowa, Manitoba, Argentina, South Russia, the myriad roots of grass mix themselves so intimately with the earth as to make it black and rich. On westward into the lands of less rain in our Great Plains territory the soil becomes lighter brown and there is a nearer approach to the surface of a layer of calcareous matter which collects at the point where the down-sinking rain turns and goes back to the surface to be evaporated. As desert conditions are approached (as in western Texas) this calcareous layer comes close to the surface. These phenomena are characteristic of the transition from black soil to desert interior in Argentina, Russia, Siberia, Australia, South Africa, and would doubtless occur in a new continent in those latitudes if we could make one.

these black soil plains of continental interiors that has done so much to permit the easy feeding of city populations with wheat bread and their rapid increase during the half century following 1870.

INTRODUCTION AND BREEDING OF NEW WHEATS. Still further extensions of the world's wheat areas may be expected through our knowledge of plant breeding and production of new varieties. Since we have come into possession of Mendel's Law, the usable working law of heredity,[5] we are able to change wheat and most of the other crops grown by man. Progress in plant breeding has been rapid since 1910. An example of recent occurrence in the Northwest is

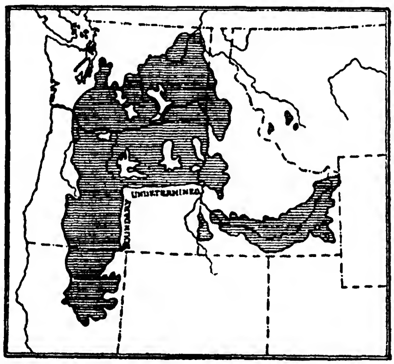


FIG. 22.—Lava flows of the Northwest. (From Salisbury, Barrows, and Tower.) Basis of a very fertile soil, and a large wheat production.

illustrative of the new-found ability that is destined to enrich every land in the world. On the lava plains of eastern Washington the practically rainless summer permits the farmers to let the wheat stand for a month after it is ripe. The harvesting can accordingly be extended over a period of several weeks, and comparatively few hands can thus take care of vast farms. It so happened, however, that the best yielding variety permitted many of the grains to scatter out of each head and fall to the ground before it was cut. The rival variety that held its grains tightly was so tender as to be injured one year in three by the frosts, which follow periods of warmth and growth, in this land of open winter where wheat is usually sown in the fall. An experimenter at the agricultural experiment station in the State of Washington crossed these two varieties,

[5] Jones, D. F., *Genetics in Plant and Animal Improvement.*

and produced a third variety which has the frost-resisting qualities of one and the grain-holding qualities of the other, thus permitting large extension of wheat growing on the wide fertile lava plain of the Columbia basin, which now averages 21 bushels per acre, while the average of the whole United States is but 13.4 per acre.

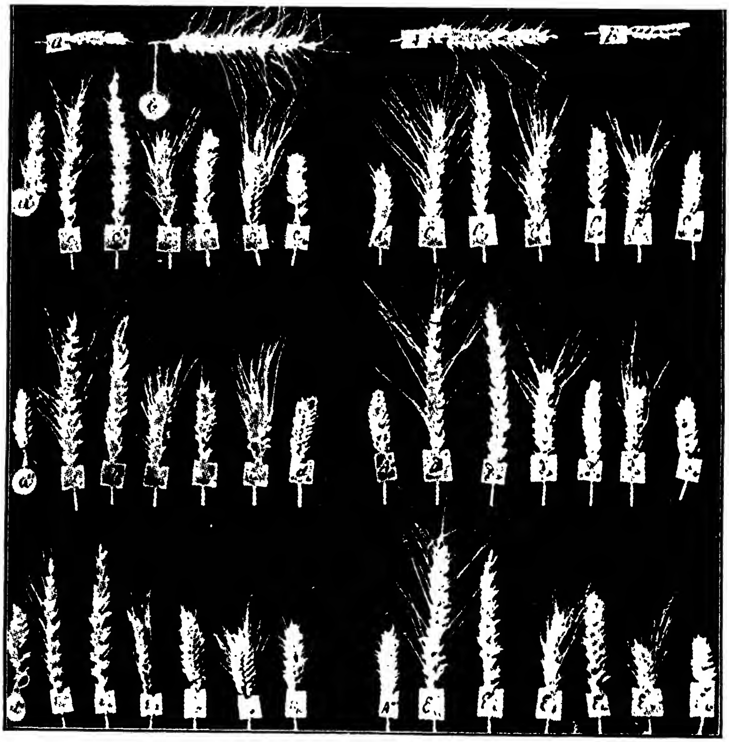


FIG. 23.—An experiment in plant breeding, cross-bred wheat showing great variation in offspring of hybrids.

ab, = parents.
$a' \; a'' \; a'''$ = offspring of ab cross.
c_1c_2 etc., d_1d_2 etc., e_1e_2 etc. = offspring of $a' \; a'' \; a'''$.

BA = parents same variety as ab but crossed the other way.
$A'A''A'''$ = hybrid offspring of BA cross.
C_1C_2, D_1D_2, E_1E_2 etc. = offspring of hybrids $A'A''A'''$

The introduction of foreign varieties has already been very effective in increasing our harvest. The large production of the spring-wheat belt of the United States and Canada did not take place until after the introduction of the Red Fyfe, a variety well suited to that climate. The recent introduction to the United States and

Canada of a drought-resisting variety of wheat known as durum, from the arid lands of Uralsk territory in Asiatic Russia, has caused the further extension of the wheat area into the drier lands. This variety of wheat contains much gluten and is thus very valuable for the manufacture of macaroni, the principal use of durum flour. From 50 to 100 million bushels per year are now grown in the United States.

Several varieties of Australian wheat have been introduced into the Pacific coast states. Although grown as spring wheats in Australia (also in Washington and Oregon) they have been successful as winter wheats in California. Some of the transplanted Australian strains have produced higher yields than the old varieties

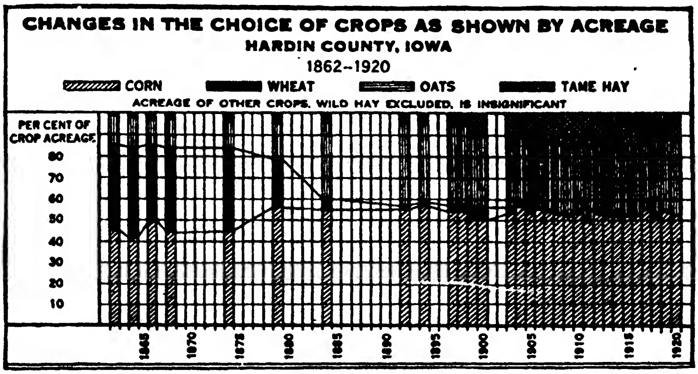


FIG. 24.—Wheat is a frontier crop. It tends to diminish in importance as a region becomes thickly settled. (United States Dept. Agr.)

and have proved superior for milling and bread-making purposes.

The introduction of new varieties gives new *materials* for the plant breeders to use. Plant explorers are now scouring all possible corners of the world (but not as much as they should) in search of plants adapted to particular purposes and environments. These plants, specialized in one quality to the point of genius, can be used as parent plants by the plant breeders. Kubanka, the most widely adapted variety of durum wheat grown in the United States, is being constantly improved by pure-line selection, and over 150 strains have been developed at the experiment stations. Thus, Kubanka No. 98 is considered one of the most promising, as it combines high yielding ability with rust resistance and a good quality for the making of macaroni. It is known by the name of

Nodak and has been distributed throughout North Dakota for commercial growing.

Effect of the gradual reduction process of milling upon wheat growing. The northern extension of the wheat fields of central North America is largely due to the comparatively recent perfection of the process of milling spring-sown wheat. The Old World wheat crops and the wheat crops of Eastern United States had always been sown in the fall and harvested at the beginning of summer. The spring-sown wheat of central North America is so hard and so brittle that for many years it could not be satisfactorily ground. The bran broke up and mixed with the flour. It made a wholesome bread but not one pleasing to the eye and unfortunately for health we eat too largely with our eyes. Therefore the new hard wheat made "poor" flour, it brought poor prices, and the lands upon which it was grown were in low esteem. The discovery of the gradual reduction process of milling made of this despised grain the best flour, and gave to the northern country a great wheat boom which in the last quarter of the nineteenth century caused the movement of wheat-growing population, caused the shifting of wheat growing and the rapid growth of the states in the northern Mississippi Valley and, in the first two decades of the twentieth century, caused large gains in western Canada. This northwestern movement of population for wheat growing will doubtless continue for decades to come if the demand for the product resumes its pre-war force. After a century of westward movement, wheat growing, like the centers of human power, has shifted northward.

Effect of machinery in wheat production. The methods of producing wheat have been made much cheaper and easier by mechanical inventions. Eighteenth-century wheat was cut in the Scriptural way, by sickle held in one hand of the laborer, while he grasped a few heads of wheat in the other. Then came the cradle invented in New England in 1806. It was a kind of scythe (scythe invented at Lynn, Mass., 1655) provided with fingers above the blade to catch and throw into an even row the straw it cut. The cradle was the main dependence of the United States through the first half of the nineteenth century. In 1851 Cyrus McCormick of Virginia made a reaper, which cut and dropped the grain in bundles to be bound by hand. Then came the reapers which also tie the bundles, and finally the reapers that carry the bundles and drop them in piles where the shocks are to be made. One of these machines with three or four horses and a driver has no difficulty in performing with comparative ease as much work as was done sixty years ago by from five to seven men working arduously with cradles and rakes. As wheat cutting is now merely the driving of horses and the adjusting of levers on the reaper the work is occasionally done by women.[6] Where wheat is grown in hundreds of acres, still more specialized machines are used, the most complicated of which is the combined harvester and thrasher. This machine can be used most successfully where very dry summers, such as occur in the Columbia River basin and the great valley of California, permit the grain to dry out on the stalk so that shocking it up to cure it is not necessary. Here the combined harvester and thrasher, driven by steam or drawn by twenty-five or thirty horses, sweeps over the great fields and daily puts into sacks the thoroughly dry grain of thirty acres of waving wheat fields.

Similar improvements have been made in thrashing, which is equally a part of wheat production. Men are still living in the United States who in their youth helped thrash by driving horses around and around upon the sheaves that their feet might shatter out the grains upon the thrashing floor in true Scriptural fashion. A method similar to this, in which the horses drag a rolling stone around the thrashing floor, is still in use in Russia, Turkey, and other countries adjacent to the Black and Mediterranean Seas.[7] In more progressive regions, under the influence of high wages, the engine-driven thrasher does nearly all the work. In the United States, it is common for one of these machines to thrash a thousand bushels of wheat per day and be taken at evening to the next farm by its own traction engine. These revolutionary improvements in wheat production cheapened its labor cost from 133 minutes of human labor per bushel in 1830 to 10 minutes in 1904.

[6] The glamor of wheat harvest is gone from many an Eastern American countryside. The reaper has made a commonplace occurrence of an event that was talked about for months, prepared for for weeks, and which furnished the great athletic event of the year, where strong men sent each other to the shade in contests more grueling than the Marathon of the Olympiad. The man who could cut 5 acres of wheat per day with a cradle for six consecutive days was a *man*.

[7] These floors are often unroofed, and for many years prior to the World War by Turkish law the grain could not be moved from them until the tax gatherer came. Meanwhile birds, beasts, and weather injured. Bribe, if sufficiently large, might induce the tax gatherer to hurry. This is typical of the many ways that the Turkish government has limited industry.

The machinery for planting, harvesting, and thrashing wheat has also been adapted, with minor changes, to do the same work for the other small grains—rye, oats, barley, and buckwheat. The cheapening that results from the easier production permits wheat to become more universally used as food. It is now eaten by many people in the southern United States who previously made a larger use of corn. Before the World War it was replacing the standard rye loaf in central Europe. Even the Chinese and Japanese are increasing their use of it as a luxury to replace partially their cheaper foods of barley, rye, millet, corn and the more expensive rice.

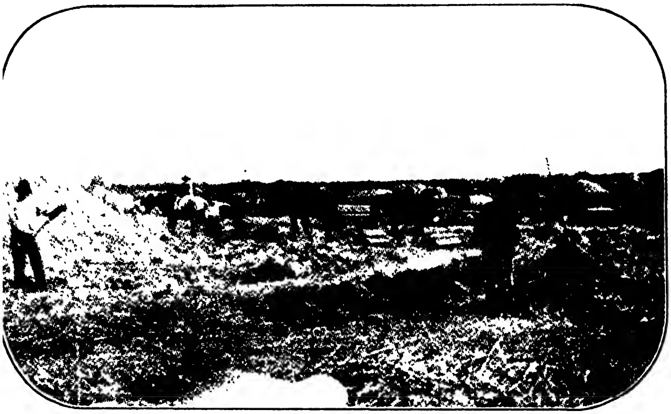


FIG. 25.—Russian thrashing floor of type common in eastern Mediterranean countries.

YIELD AND PRODUCTION OF WHEAT IN NEW COUNTRIES. It is a peculiar fact that the world's greatest wheat exports are produced in regions of comparatively low yield per acre, and in regions that do not have the ideal wheat climate. (See Table of Wheat Trade and Production, p. 58.) This is because wheat where it can be grown in treeless countries is a good frontiersman's crop. With the aid of modern agricultural and transportation facilities, wheat is a money crop easily grown. A single farmer can in some cases raise 400 or 500 acres of wheat, whereas 60 acres of corn might be his limit and no man can milk or care for more than a very limited number of dairy cows. Wheat has good keeping qualities, is easily shipped, is in universal demand. It is of more value in proportion to its bulk than hay or any temperate zone grain. It grows well in a greater number of places than either corn or oats. Once it is safely sheltered near a railroad, it can be marketed many months later, thousands of miles away. These advantages of wheat as a money crop often make it the first and most profitable thing that can be grown by the new settler upon an open plain after the railroad is within reach, even though the average yield per acre be low.[8] The world's chief wheat exports are grown upon such newly accessible plains in the Mississippi, Missouri, and Red River valleys of the United States, in western Canada, Argentina, Russia, Siberia, and Australia. Owing to the fact that there is no rival cultivated crop, the settler on a new plain, if not a tender of flocks, usually grows wheat year after year as long as the yield

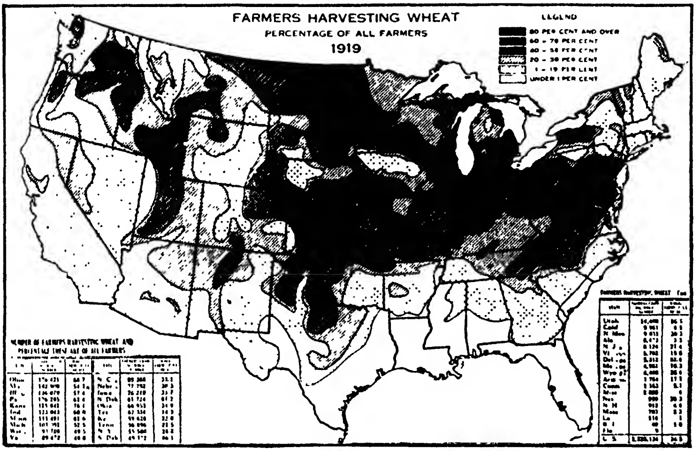


FIG. 25A.—No other one crop is grown as widely throughout the United States as is wheat. (United States Dept. Agr.)

will be at all profitable. Illinois and Iowa have passed through this exploitation or continuous cropping stage which prevails at the present time in the more newly settled lands of central Kansas, Nebraska, Oklahoma, and Texas. The Red River Valley of the North, comprising the major part of the wheat districts of Minnesota, North Dakota, and Manitoba, has experienced a decline in yield and is now abandoning continuous wheat production in favor of crop rotation and live stock (especially dairy) farming. With the possible exception of the Russian black earth belt there never

[8] The distribution of the world's wheat crop is a fine illustration of the fact that products are often grown in places that are not best suited to them. This does not prevent the crop from being the best thing to grow on these lands.

was in the whole world an easier place than the Red River country for the growth of wheat. This fertile plain, the bed of a glacial lake, often for miles literally as flat as a floor, without a stone or tree, lends itself perfectly to the use of the most complicated machinery and large scale production. Year after year wheat has been grown until the declining yield has made the farmers turn to other crops—the raising of horses, the keeping of cattle, the making of butter. The tall white silo of dairy farming is gradually displacing the big red grain elevator.

At the present time in western Canada, where new railroads

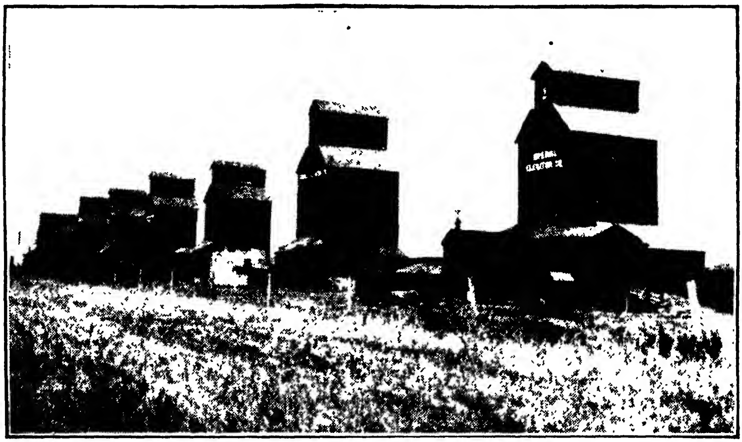


FIG. 26.—Grain elevators at West Hope, N. D., a railroad station on the agricultural frontier near the Manitoba boundary, longitude 101 ° W. The first stage in the journey of grain from the farmer's wagon to the distant user.

have been built across open, empty, treeless plains, the new settlers are still trying to get along with continuous wheat growing which will last them one, two, or three decades before they too must take to other crops and cattle keeping. In the meantime these wheat crops on the virgin prairie soil of the harvest frontier are larger than those of the Red River Valley. It is possible that the Canadian region suitable for the extension of wheat growing reaches 60° north, and extends from Lake Winnipeg to the Rockies. Even Alaska reports good wheat crops on the Tanana River.[9] If experi-

[9] The Tanana Valley in 1921 produced 3,500 bushels of wheat (20 bushels to the acre) and a flour mill was erected which almost supplied the local demand. The variety grown was Siberian No. 1, brought from Irkutsk,

ence proves these northern regions dependable, the wheat-growing possibilities are enormous, and the continuous cropping method will have land to support it for several decades.

The Italian farmers, who sometimes go to Argentina at the rate of 100,000 per year, are having an identical experience upon the magnificent black soil plains that lie along the western banks of the Parana River. The Russian peasant also exploits in the same way when he emigrates to central Siberia and settles on those endless plains called steppes where the trans-Siberian railroad made possible the export of grain and settlements of trading men in the decade before 1914. After a time these Siberians also must rotate crops, keep cattle, and export butter and eggs to London, as do their brethren in the older and more developed lands of Russia and West Siberia.

While important for the frontiersman, wheat is also important in established crop rotations and mixed farming for two reasons. It affords an easy way to start pasture and hay fields because the young grass can grow up as the wheat grows, the wheat serving as a nurse crop. Among keepers of livestock the straw is valuable for bedding for the animals. Wheat thus becomes essential in the semi-garden agriculture of Belgium but not so vital as it is on the new plains of Canada and Siberia. The greater care and labor hold the total production of wheat in densely peopled lands at a high figure.

EFFECT OF CHEAP WHEAT ON FARM VALUE IN OLD COUNTRIES. These new lands upon the plains of North America and other continents were opened up by railroads, and often actually given away. This made the production of wheat a much cheaper process in these lands than in Europe, where rent and interest on high land value are large factors in crop cost. With wheat production made easy by the new machinery, it became so cheap that, especially during the later years of the 19th century, it was no longer profitable to grow it on much of the land in the eastern United States and western Europe, particularly Great Britain, where it had long been the mainstay as a money crop. Animal products were cheapened by the same forces. Accordingly land values fell in both regions. Many farms

Siberia, and developed at Rampart Station, 65 miles south of the Arctic Circle. An abnormally early freeze in 1922 ruined the wheat crop, but in 1923 Fairbanks and Matanuska counties grew 1,656 bushels. The experiment station at Fairbanks has produced 92 bushels of wheat on 4 acres, or 23 bushels to the acre (1923).

have been abandoned in New England and New York, while many thousands more throughout the North Atlantic slope would sell for less than before there was a mile of railroad in America. New York state produced 12 million bushels of wheat in 1839 and 8 million in 1923.

WHEAT TRADE AND PRODUCTION (1910–1923)

Importing Countries

	Million bushels				Yield in bu. per acre	
	Crop		Import			
	1910	1923	1910	1923	1910	1923
Belgium	14.6	12.5	49	41.0	40.0 [10]	36.9
Denmark	4.5	9.6	5	6.2	37.8 [10]	39.0
France	315.4	290.4	22	44.0	15.9	21.3
Germany	194.4	103.6	67	42.7	29.6	28.4
Italy	192 4	224.8	42	112.0	13.0	19.5
Japan	24.8	26.4	3	14.1	21.0	22.1
Netherlands	5.6	6.6	21	25.9	32.0	43.6
Switzerland	3.5	3.5	14	16.0	34.2 [10]	34.2
United Kingdom	66.4	57.1	247	209.3	31.4	35.8
Average of importing countries					28.3	31.2
New York State	8.4	8.1			23.7	26.0

COMPARISON OF CROP AND YIELD IN EUROPE AND AMERICA

America is such a heavy exporter of wheat that it is something of a surprise when we first learn that normal, peace-time Europe produces much more wheat to the acre and more wheat altogether than America or even the rest of the world. In 1909-13 the figures for Europe were 1,800 (in 1923, 1,270) million bushels, for North America 900 (in 1923, 1,256) million, and 3,600 million for the entire world.[11] Europe and the United States do not differ greatly

[10] 1909.

[11] The World War caused an expansion of about one-third in North American wheat growing. The United States and Canada increased their exports to make up for the 164 million bushels formerly supplied by Russia

in size, but one has 110 million people and the other 490 million. In order to get enough to eat the Europeans must till their land thoroughly. While the wheat farmers on the cheap lands of Kansas, the Argentine, or the Prairie Provinces of western Canada are by their careless but inexpensive methods averaging 12 to 18 bushels[1]

Exporting Countries

	Million bushels				Yield in bu. per acre	
	Crop		Export			
	1910	1923	1910	1923	1910	1923
Argentina	146.0	248.7	75	248.7	9.1	14.4
Australia	98.1	120.0	64	49.6	14.2	12.0
British India	359.6	369.2	42	28.8	12.8	12.0
Bulgaria	48.0	38.7	11	4.5 [12]	15.7	17.2
Canada	215.8	469.7	60	274.8	16.1	20.7
Rumania	90.9	102.5	32	1.5	23.0	15.5
Russia	676.6	158.4 [12]	23	....	11.2	....
United States	621.3	785.7	61	221.9	13.9	13.5
Average of exporting countries					14.5	15.0
Kansas	63.2	83.8			14.1	10.1

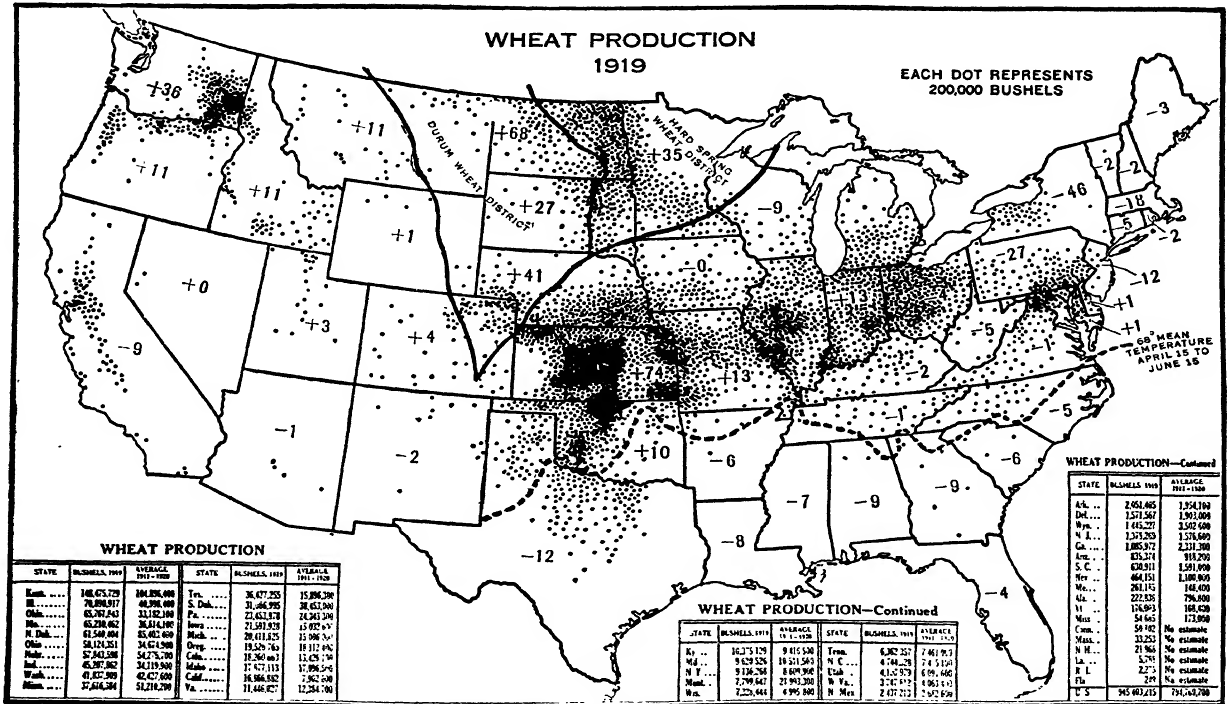
per acre, from land worth from $10 to $50 per acre, the careful English farmer, with a systematic crop rotation, is averaging 30 or even more per acre on land worth over $200. The English tenant farmer does not make proportionately large profits because he has to pay high rent and his higher yield requires much expense for labor and fertilizer.

EUROPEAN WHEAT GROWING. The hills and the rain of northern and western England and Scotland and Wales, and the rains of Ireland cause wheat growing to be of small importance in those parts of the United Kingdom.

Eastern and southern England are the chief British wheat dis-

to the world trade in wheat. If Russia resumes her former position as the world's largest wheat exporter, it remains to be seen whether or not the United States and Canada will still find it profitable to grow as large crops. The rapid shrinkage in American wheat area after the price slump of 1921 is suggestive.

[12] 1922.



WHEAT PRODUCTION

STATE	BUSHELS, 1919	AVERAGE 1911-1920	STATE	BUSHELS, 1919	AVERAGE 1911-1920
Kans.	148,475,729	104,856,400	Tex.	36,477,255	15,896,300
Ill.	70,890,917	40,996,000	S. Dak. ...	31,466,995	38,653,900
Okla.	65,767,443	33,182,100	Pa.	23,653,978	24,343,300
Mo.	65,210,062	36,614,100	Iowa	21,591,928	15,032,[illegible]
N. Dak. ...	61,540,404	85,402,600	Mich.	20,411,625	15,096,[illegible]
Ohio	58,124,351	34,674,900	Oreg.	19,529,765	18,112,[illegible]
Nebr.	57,843,598	54,275,700	Colo.	18,360,[illegible]	13,425,[illegible]
Ind.	45,287,862	34,119,900	Idaho	17,957,113	17,096,5[illegible]
Wash.	41,837,909	42,427,600	Calif.	16,966,932	7,962,600
Minn.	37,616,384	51,210,200	Va.	11,446,027	12,354,700

WHEAT PRODUCTION—Continued

STATE	BUSHELS, 1919	AVERAGE 1911-1920	STATE	BUSHELS, 1919	AVERAGE 1911-1920
Ky. ..	16,375,129	9,815,500	Tenn.	6,302,357	7,461,9[illegible]
Md. ..	9,629,526	10,531,543	N. C. ...	4,744,[illegible]	[illegible]
N. Y. ...	9,136,268	8,609,900	Utah .	4,156,979	[illegible]
Mont. .	7,799,647	21,993,300	W. Va.	3,707,[illegible]	4,063,[illegible]
Wis.	7,220,444	4,995,800	N. Mex.	2,437,213	[illegible]

WHEAT PRODUCTION—Continued

STATE	BUSHELS, 1919	AVERAGE 1911-1920
Ark. ..	2,451,465	1,954,100
Del. ...	1,571,567	1,903,000
Wyo. .	1,445,227	3,502,600
N. J. ..	1,373,269	1,576,600
Ga.	1,085,972	2,231,300
Ariz. ..	835,378	918,200
S. C. .	630,911	1,591,000
Nev. ..	464,151	1,100,900
Me. ...	261,155	148,400
Ala. .	222,835	796,800
Vt. ..	176,993	168,430
Miss. .	54,665	173,050
Conn. .	54,102	No estimate
Mass. .	33,253	No estimate
N. H. ..	21,966	No estimate
La. ..	5,755	No estimate
R. I.	2,275	No estimate
Fla.	209	No estimate
U. S.	945,403,215	754,763,700

FIG. 27.—The plus and minus figures on this map show the amount of wheat which the state had to import per year on the average before the Great War. It is surprising how many of our states are like England in being dependent on imported breadstuff.

Compare with the cotton map and we see how cotton's climate is wheat's enemy. (Adapted from the United States Dept. Agr.)

tricts. With their suitable climate, level plains, and fertile soil these districts are about equal in output to any corresponding area of the United States. England with 55 million bushels in 1923 exceeded as a wheat grower any state east of Illinois and had twice as much as South Dakota, a state of slightly greater area. France, with only one-sixth as much tillable land, has a wheat crop nearly one-half as great as that of the United States. French farms average 20 acres each and those of the United States average 150 acres. Stimulated by a high tariff the French farmers make their country more nearly independent in wheat than any other country of west Europe. There has been great increase in the wheat yields of Europe since 1840. Belgium, with great manufactures and the densest population in Europe, has an accompanying agriculture so productive that her wheat crop of 12.6 million bushels was greater in proportion to her area than that of the leading American wheat states of Kansas, Washington, or North Dakota. Holland and western and southern Germany are also important wheat growers in proportion to their area, and the crop is carefully tilled; yet the great manufacturing population of these northwestern countries of Europe consumes much more wheat than the fertile and well-tilled fields produce.

The European wheat grower, who gets twice the American crop on his high-priced home lands with their high rental, usually adopts frontier methods if he emigrates to the plains of the United States or Argentina where land is cheap. The same process is repeated within the United States. Old states like Maine (with an average yield of 25 bushels for 1922 and 26 bushels for 1923) have, through good care, a higher wheat yield than the rich plains states where North Dakota, a leading state, had a yield of 14.1 bushels per acre in 1922 and 7.1 bushels in 1923. The *production* of wheat in Maine is insignificant.

In the Mediterranean countries of Spain, Portugal, Italy, and Greece, where the climate is ideal for wheat (if enough rain falls), it is the chief grain. But the percentage of tillable land is small owing to the rough nature of the country, the yield is lower than in north Europe largely because of inferior methods, and the amount produced is not sufficient for the very dense population. Yet Italy, with about 200 million bushels of wheat per year on 118,000 square miles of area, produces double the amount of wheat per 1,000 square miles grown by the leading American states.

European wheat exporters. Southeastern Europe is the only part of that continent having in normal times a wheat surplus for export. The grain-growing plains in Hungary and Rumania, in the Danube Valley and the Black Sea Basin of Russia, are normally given over to the growing of wheat as the chief money crop. During the five years 1909–13 European Russia averaged 522 million of bushels of wheat while the United States had 690, but the Russian export averaged 161 million bushels, while that of the United States was only 100 million bushels. During that period Rumania (only half its present size) exported one-half as much wheat as the United States. Steamers by the hundred loaded at the ports of Galatz, Braila, and Sulina on the lower Danube and at Odessa on the Black Sea and discharged their wheat cargoes at Palermo and Naples, at Genoa to feed the people of northern Italy and Switzerland, at Marseilles for the people of France (in years of short crop in that country), at Barcelona for the Spaniards, or at Hamburg and Rotterdam for the factory workers of the lower Rhine Valley and Berlin. Britain also drew much wheat from Russia prior to the World War. This trade may be expected to revive in time.

Asiatic wheat growing. While wheat is grown from Smyrna at the west of Asia to Vladivostock at the east, the small population clustered thickly upon the oases of western Asia, Arabia, Persia, Turkestan and other arid interior countries grow only limited quantities for their own use. In the north of China, also, great quantities are grown and consumed by the natives, but there are no crop statistics. An American Consul, after observing the crops by the wayside during a long journey through central and western China, reports that wheat is extensively grown there. He saw fine wheat fields in the Hwang basin that would yield over 40 bushels to the acre. He thinks the region north of the Yangtze and west of the rice-growing plains near the coast, contains more wheat eaters than the United States. He estimated the crop of the two provinces of Shansi and Shensi at 50 million bushels. New modern flour mills (owned by Chinese) are rapidly making the city of Shanghai a center of flour export to the Chinese coasts and less American flour is imported.

India in bad years eats her crop and in good years has a small export. With her uncertain climate and large population she does not promise much wheat to feed other lands. The Indian wheat is chiefly grown in the dry Indus Valley and on the plateau near

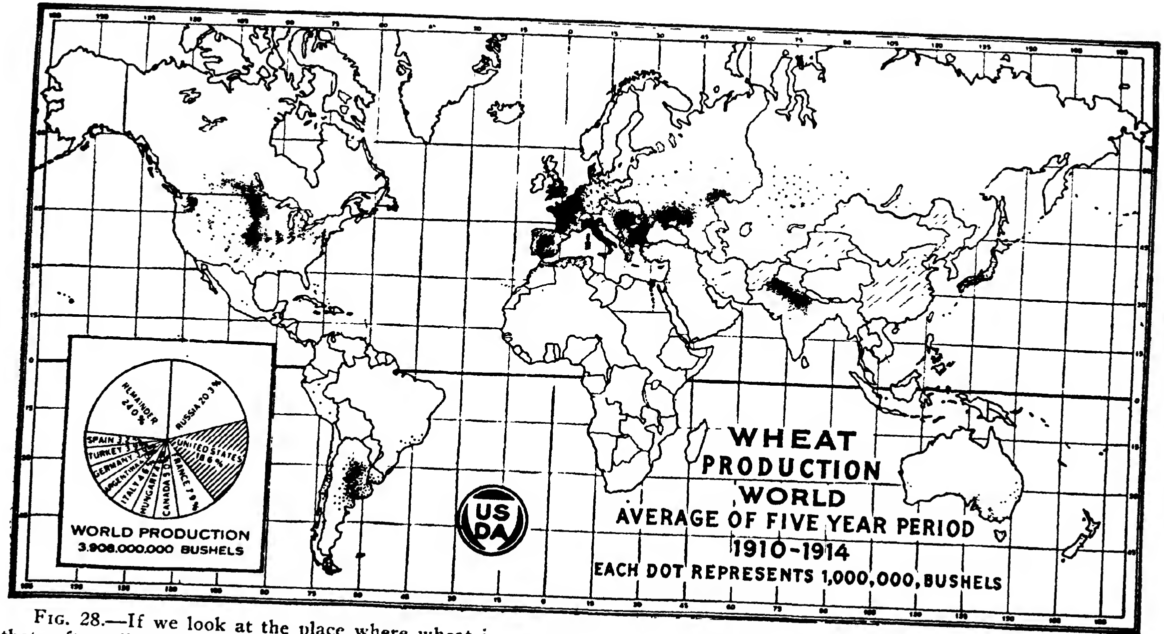


Fig. 28.—If we look at the place where wheat is grown and the places where it is not grown, we can easily see that, after all, a large part of the human race has easily got along without it. Its importance to us is a matter of habit, but habits in diet, once they are formed, are hard to change. Compare wheat areas of United States and Europe to see how good Europe is.

Bombay. Practically none is grown in the Ganges Delta or on the coasts of the Peninsula.

The Japanese wheat crop is equal to about one-fifteenth of her rice-crop or to the wheat crop of Idaho. There is much interest over the discovery that there is room for the extension of wheat growing in the sparsely peopled north end of the Japanese Empire. Sakhalin, for example, long considered hopeless, is now thought to have winter wheat possibilities.

There is little doubt that the great Siberian plain reaching nearly all the way from the Urals to Lake Baikal, and closely resembling in climate and in its rich black flatness much of the Canadian wheat country, is the most promising future wheat region of Asia. The recent railroads enabled it to become a wheat exporter before the War, but its crop combined with that of the adjacent

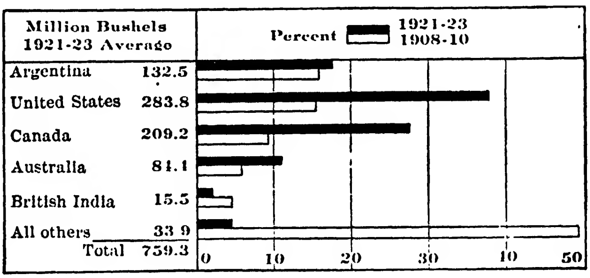


FIG. 29.—Wheat and wheat flour exports, three-year average.

Russian provinces of Central Asia amounted to but 84 million bushels (1909-13), which is less than the present average production of North Dakota alone. But Siberia has resources of great area and fertile soil, and her empty lands can be utilized to feed the world after Russia recovers from her present bankruptcy and chaos.

East of Lake Baikal, Manchuria has the best grain-growing possibilities. She resembles the Red River Valley of the North and has suitable soil and climate for the growing of wheat. An American agricultural expert in the employ of the Chinese Government estimates that the utilization of the now relatively empty wheat lands of Manchuria and eastern Mongolia should produce by native methods alone 300 or 400 million bushels. There is no reason for Europe to expect to consume much or any of the prospective Manchurian wheat, as the large and increasing population of eastern Asia, now importing some wheat, will probably take it all.

WHEAT IMPORTING COUNTRIES. An examination of the table on wheat trade and production will show that the chief wheat importers are the manufacturing peoples of west Europe, and that their chief supplies come from central North America, Argentina, Australia, India, and before the war from southeast Europe. International statistics do not reveal what is likewise a fact, that the entire region east of the Appalachian Mountains in the United States is also, like the manufacturing countries on the other side of the Atlantic, drawing large supplies of wheat from the agricultural hinterland. It happens that a shipload of wheat from Duluth to Buffalo is domestic (naturally uncounted) trade, and a shipload from the Danube to the Rhine or to Barcelona is foreign trade. Europe and the United

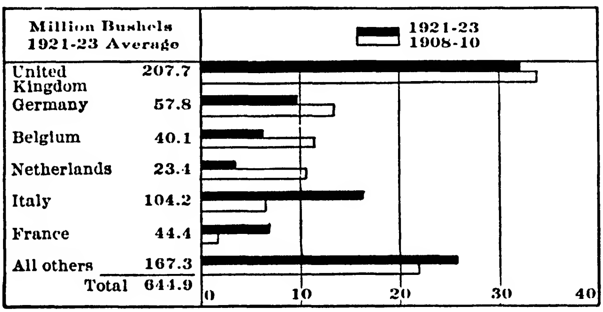


FIG. 30.—Wheat and wheat flour imports, three-year average.

States are much alike in area and kinds of production, but differences in statistical methods tend to hide it.

SITUATION OF WHEAT EXPORTING REGIONS COMPARED. The wheat exporters of southern Europe, on the Black Sea, share with the exporters of Argentina and Australia the advantage of cheap ocean transportation. The wheat exporters of the United States and Canada grow their surplus for export in the heart of a continent a thousand miles or more from seaports. That this last region nevertheless takes a leading place among export regions is due solely to the excellence of the transportation conditions which have made possible the bringing of wheat to ocean harbors where it could be exported. In 1825 the Erie Canal connected the Hudson River with the Great Lakes and made possible boat transportation from the shores of the Great Lakes to New York at a fraction of the previous cost. This made possible the extensive growing of wheat in western New York, northern Ohio, Michigan and other lake shore districts. Ohio ranked first among the wheat-growing states in 1839. Twenty-five years after the canal opened the lake shores to the world market railroads began to reach from these inland waterways out across the plains, and from that time to this wheat has gone eastward to the sea in millions of bushels, being gathered together in the great markets, first at Chicago, and later at St. Louis, Kansas City, Milwaukee, Duluth, Port Arthur, and Winnipeg. At the present time the movement of wheat east of the Rocky Mountains is largely to the Atlantic ports, most of it passing down the basin of the Great Lakes, whence, as a result of railroad agreements, it scatters to reach the sea at all ports between Montreal and Norfolk. From Kansas and southward, the Gulf is nearer than the Atlantic and much wheat reaches the ocean steamer at New Orleans and Galveston. Since 1920 there has been a rapid increase in the shipment of Alberta wheat westward to the port of Vancouver and from there to Europe by way of the Panama Canal.

A new railroad is being built from the Canadian wheat country to Port Nelson on Hudson Bay, where, for a short time after wheat harvest, steamers can get out with their cargoes before the ice closes this great and at present unused arm of the sea. Shipping Canadian wheat to Europe by way of Hudson Bay will shorten the combined rail and water haul several thousand miles and it is estimated that it will save the West Canada grain grower six or seven cents per bushel.

The wheat of the Columbia River basin is exported from Portland and the Puget Sound ports. Some Pacific Coast wheat goes to the Orient but most of it still goes to Europe by cheap water transportation, which has always been less expensive than an overland journey to an eastern port.

The Siberian wheat plains, drained to the frozen Arctic and shut off by mountains from the southern sea, have the worst situation of all wheat exporters with regard to the sea. The Siberian crop must make the long rail journey to the Baltic unaided by any such gift of nature as the American Great Lakes or the Danube River. For this reason the Siberian plain has been the last of the world's great plains to be settled.

Manufacture of wheat products. The manufacture of wheat products has sprung up either near the wheat fields or along the line of wheat shipment. The waterfalls at Rochester and Niagara Falls, both being close to the Erie Canal, led to the early development of milling. Then the flour mills followed the wheat fields westward and Minneapolis became the greatest flour manufacturing city in the world. Here the falls of St. Anthony on the Mississippi River give power for driving the machinery in a location very convenient for the assembling of the wheat from the northwestern fields of the United States and Canada. From these Minneapolis mills flour is sent to all the cities of the northern and eastern United States and western Europe. Wichita, Kansas, in the midst of waving wheat fields, is another prosperous milling center.

Buffalo, with the power of Niagara Falls close at hand, has recently become the second milling center of North America. On the natural trade route between the western grain fields and the Atlantic seaboard, wheat was elevated from the holds of grain vessels and poured into freight cars at Buffalo. From a trans-shipper of wheat, Buffalo has become a grinder of it, and is now disputing the flour-milling supremacy with Minneapolis. Rochester and Niagara Falls also have ample power and natural trade route locations for their growing milling industries.

In various towns along the route of wheat shipment from the Mississippi Valley to the sea there have sprung up manufactures of prepared breakfast foods, an increasing form of cereal consumption. These, however, use other grains by themselves or in combination with wheat.

The chief by-product of the American flour mills, bran, the outer covering of wheat, is used as stock food, especially for dairy cattle, in the same populous regions that buy the flour. It is interesting to note that China has so few domestic animals that the flour mills of Shanghai are handicapped in the disposition of their by-products.

WHEAT IN AMERICAN FOREIGN TRADE. Wheat has been important in the foreign trade of the United States for two centuries and a half. As early as 1656 the traders of New York rejoiced over their shipments of flour and bread to the West Indies, where wheat could not be grown. A century ago, during the Napoleonic wars, American wheat helped to feed the European armies and wheat export was a most important part of our foreign trade. Land values of American farms and the location of the population depended greatly upon the ability to get wheat to the sea by wagon or flatboat. (See population map of 1800 and 1810, U. S. statistical atlas.) Throughout the whole of the nineteenth century wheat was the leading agricultural export of the north. The recent

World War, with its attendant dislocation of normal agricultural processes, created an abnormal demand for American wheat in Europe; our export of 100 million bushels (5-year average, 1909-13) increased to 240 million bushels (7-year average, 1914-20). There is to-day, in addition to our heavy trade with Europe, a widely scattered trade in flour with the West Indies and other tropical countries, where some flour is used and little or no wheat is grown.

The future promises to see a steady decline in the export of both wheat and flour, as our increasing population leaves a smaller and smaller surplus for other lands. A growing population also creates

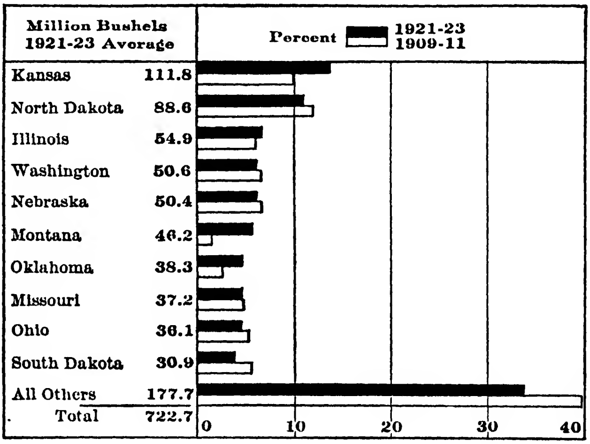


FIG. 31.—Wheat production of United States, three-year average.

a need for a more intensive type of agriculture which tends to displace wheat. California furnishes an interesting example of this change. That state, once a great wheat exporter, reached her maximum wheat acreage in 1893. Since that time alfalfa fields, poultry ranches and fruit orchards have cut in on the wheat area until the state no longer supplies herself.

THE FUTURE WHEAT SUPPLY. As our export declines, we are likely to see, during the second third of the twentieth century, the exports from Argentina and Canada (especially Canada) increase because of the large area of level plains of these countries, new to the plow, fertile, and sparsely populated—just the kind of place for wheat-growing by the one-crop method which produces large yields for a short time. Already the Argentine wheat exports of about 150 million a year are nearly three-fourths of our combined wheat and flour exports. The proportion of the crop exported is even more significant.

In 1922-23 the United States exported 25 percent of the crop, Argentina 75, and Canada 70. Canada's rise is indicated by the yield of Saskatchewan—4 million bushels in 1900, 34 million in 1908, 252 million in 1923. There is as yet little reason to modify Dr. Saunders' reasonable prophecy of 1904—that wheat grown on one-fourth of the land suitable to it in the Canadian Northwest, with the acre yield of Manitoba for the previous decade, would bring a crop of more than 800 million bushels, which, as he shows, would feed 30,000,000 people in Canada and three times supply

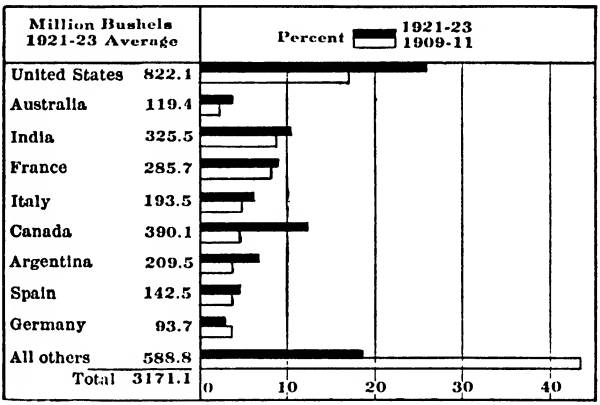


FIG. 32.—World wheat production, three-year average.

the import need of Great Britain. The remaining three-fourths of the land would provide room for a vast animal industry with soil-enriching crop rotations.

2. RYE

RYE COMPARED WITH WHEAT. Botanically, rye is closely allied to wheat which it resembles, but the grain is smaller and darker, less nutritious, and hence less valuable. That the pre-war production of rye was nearly one-half that of wheat for the whole world is due to the fact that under certain conditions it will produce more food per acre than wheat. It is hardier, as shown by the fact that the rye belt of North America runs 300 miles farther north than winter wheat. In the spring wheat region rye enlarges farm activity

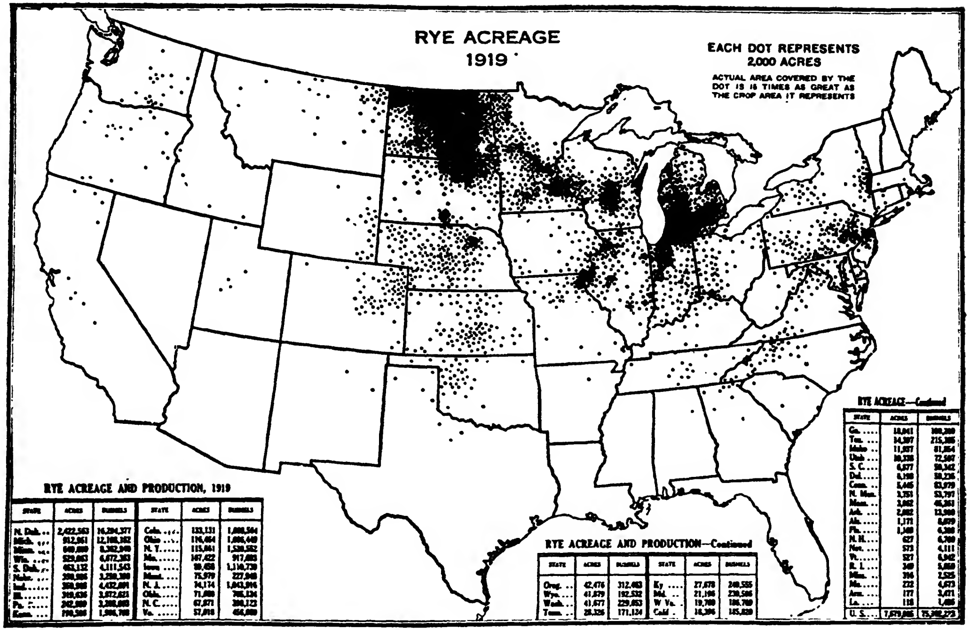


FIG. 33.—Europe is ahead of America in rye growing partly because she has such a large area of cold, sandy plain to the north of her wheat belt. When America has as many people as Europe, our rye area will be much larger than it is now. We will be growing rye on many sandy stretches and now unused, or little used, upland fields between Carolina and the plateaus north of the St. Lawrence, between Canada and Nova Scotia. (United States Dept. Agr.)

by providing a fall-sown crop which can be harvested before wheat is ready. Rye also grows more successfully on thin, sandy or sour soils, and is less affected by rust and insect pests.

Uses. The chief use of rye is as a breadstuff, primarily for people with a low purchasing power and consequent less expensive standard of life. For example, in central, north, and northeastern Europe rye is the chief breadstuff of the poor, as Indian corn, the cheap grain of the warm land, is in parts of south Europe, the Danube Valley, and Mexico.

Regions of production. The region of the world's greatest rye production is in the low plain of north Europe reaching from the English Channel through Holland, Belgium, Germany, Poland, Denmark, the Baltic States, and Russia to the Ural Mountains. Owing to the work of glaciers, which once covered this part of Europe, the soil is in many places sandy and poor. Here rye grows better than wheat. Russia normally grows more rye than wheat, which explains her large export of wheat, as the people eat the rye. Before the War Russia alone produced nearly half of the world's rye crop, Germany more than a fourth, and the United States, with its 36 million bushels, about one-fiftieth. Austria and Czechoslovakia are also rye growers. Germany grows nearly three times as much rye as wheat. The peasants and factory workers of rye-growing countries eat the most of it in the form of black bread, which, after all, is nearly as nourishing as wheat bread, and more nourishing than much of the white bread eaten in America. But these people frequently substitute the esteemed wheat bread for rye bread, when they become able to buy wheat.

As it grows with little care and on rough ground, rye was an important crop to the early settlers in the northeastern United States, but after the opening up of the fertile level West, it was neglected in favor of wheat. During the last decade rye growing has increased greatly. In 1903-13 we had 36 million bushels, or one-twentieth of the wheat crop; in 1921-23 it averaged 76 million bushels, or one-tenth of the wheat crop. While it has held its old place in the poorer lands of the East, southern Michigan and Ontario, the significant increase has been in the northern spring-wheat belt. Canada, with conditions resembling those of the United States, has also had a recent increase in rye production. This is a natural response to the demand for more grain.

From the standpoint of crop rotations, and farm practice, rye, oats, and barley are similar to wheat, but call for harvesting at slightly different times.

3. OATS

Regions of production. Among cereal crops in the United States oats stand third in importance. The soil requirements of the oat plant are not unlike those for wheat. In its climatic requirements it can stand nearly as much heat, but being nearly always spring sown it has a later growing season and requires more

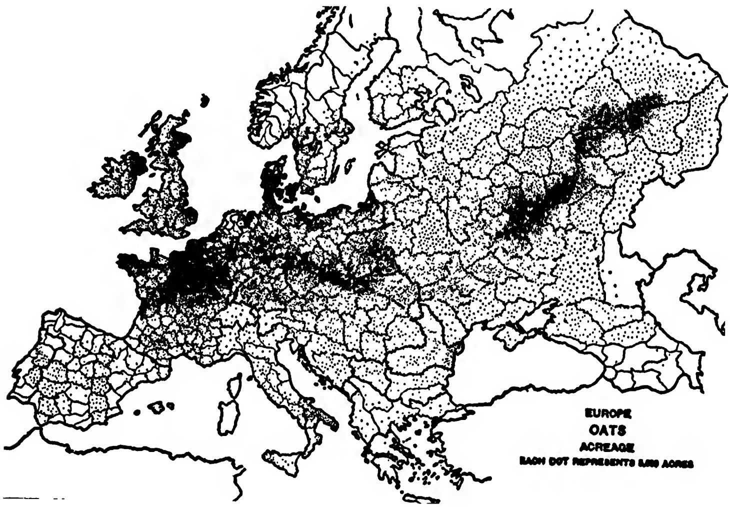


Fig. 34.—Europe is rich in her oat area. (Finch and Baker.)

rain. It will also grow in a colder climate than wheat. Its moisture requirement bars it from the Mediterranean climates with their hot dry summers. Because of these qualities, it is grown to some extent in very nearly all the important northern wheat regions and also in rye and northern barley regions. It is of the greatest relative importance in such cold, damp countries as Ireland, Scotland, Sweden, and Norway, and is grown to a great extent also by the people of the central and eastern European rye belt. It is also important throughout Canada, where the climate is too cold for corn. In the colder northern parts of Korea and Japan where rice does not thrive and wheat is not at its best, the farmer resorts to oats and barley. In the last 10 years Japan doubled her oat crop, while barley remained static.

Uses of oats. The Scotch, probably because of their moist climate, have most largely utilized the oat as human food. Dr. Johnson's famous English dictionary is said to have defined oats as "food for men in Scotland, horses in England," to which the unbeatable Scotch replied, "And England is noted for the excellence of her horses, Scotland for the excellence of her men." The people of other countries are now, since the coming of the breakfast food habit, learnng to eat more oatmeal. A little oaten bread is used in parts of north Europe, but the main use is as horse food. Oats are seldom raised as a cash crop and are usually fed on the farm where grown.

Grown on same farm as Indian corn. The fact that oats are better adapted to corn farming crop-rotation than any other small grain makes them very important in the corn belt of the United States. In much of this territory the summer is not fully suited to spring-sown wheat, and the alternate freezing and thawing of the open winter often injure winter wheat. Oats, not being hurt by a little frost, fit nicely into these climatic and agricultural conditions by being sown very early in the spring before corn can be planted. Since it is not necessary to plow the seed bed, where oats follow corn, this crop permits great economy of labor. After seeding they require no attention until harvest time, which does not occur until after the corn has been planted and has received its cultivation. Then while the corn is maturing, after the hay harvest or possibly before it, the oats are harvested. The excellent way in which these crops dovetail together makes the field of oats as well as the field of corn and the field of hay a part of the great corn belt farm system, and here is grown the greater part of the United States crop, which amounts to nearly a billion and a quarter bushels.

The oats crop of the United States is now equal to the production of all Europe. The pre-war Russian crop was about three-fourths that of the United States and the German crop about one-half.

Effect of light weight on export. The oat grain has a thick, light, close-fitting husk which is not removed by ordinary thrashing. It is left upon the grain if used for animals and only removed by special machinery when the grain is prepared for human food. This husk contributes to cause a great variation in the weight of oats, ranging from 25 to 50 pounds per bushel, in great contrast to the small variation commonly found in wheat and corn. The usual legal weight of oats is 32 pounds per bushel. The large bulk per unit of value is one of the reasons for the small export, which in the United States amounts to less than a twentieth part of the crop. Another and greater reason for the small export from America is the great importance of oats in the agriculture of the grain-importing countries of western and northern Europe.

Oatmeal makes up an important part of the American export of oats, the centers of manufacture being in a number of small towns in Iowa and other corn belt states, from which the familiar little pasteboard boxes go out in millions, while the more economical sacks and barrels also take their share.

4. BARLEY

CHARACTER, RANGE, AND HARDINESS OF BARLEY. This is the hardiest of the important cereals. The wheat limit in Russia is near Leningrad, but barley goes on to the Arctic. It is neighbor alike to the sledge-drawing reindeer and the desert-crossing camel. In the appearance of the growing plant and of the seed it bears close resemblance to wheat. Under similar cultural conditions the yield per acre is much greater than wheat, with the advantage of wider climatic range. Barley is important in northern Norway and Sweden, and in the adjacent Lapland, growing beneath the midnight sun, and ripening 150 miles beyond the Arctic Circle in 70° north latitude. It is regularly grown in Finland and north Russia to the shores of the Arctic Ocean, and its ability to resist droughts and heat causes it to be grown as far south as the Nile Valley, parts of the Sudan, Abyssinia, and the east point of Africa near the equator.

USES. An essential element of breadstuff for general use is gluten, which permits the making of the sticky dough necessary to impound particles of gas and make light bread. But for its shortage of gluten barley would probably replace wheat as our dominant breadstuff and with the new knowledge of plant-breeding such a change may yet be possible. The large yield of barley in combination with its ability to resist drought made it the chief grain food of the ancient Hebrews, Greeks, and Romans, who had rather dense population in lands with a very dry summer (Mediterranean climate). At the present time it is somewhat used as breadstuff in Scandinavia, Russia, Germany, and southeastern Europe. Its use in countries with high standards of living is chiefly confined to stock food and the making of malt for beer, for which it is extensively used in Europe.

The large yield makes barley a substitute for corn as a food for hogs, horses and cattle in countries that cannot grow corn, such as Canada, where its acreage doubled between 1913 and 1924, and Europe north of the Alps and the Pacific slope of the United States. In England and Germany it occupies about as much of the farm land as wheat, and to a considerable extent takes the same place in

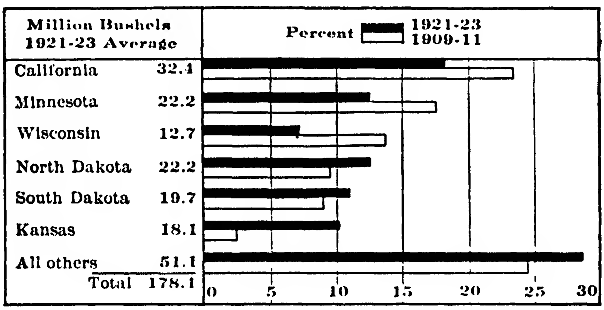


FIG. 35.—United States barley production, three-year average.

farm economy that corn does in the American corn belt. Its close approach to corn in yield makes it a real rival.

IMPORTANCE IN ARID LANDS. The drought-resisting quality makes barley important in arid lands, such as those around the Mediterranean Sea, Asia Minor, central Asia, Australia, and California, where it will grow nearer to the desert than wheat. In countries having a winter rain and summer drought kind of climate, such as Australia and California, the barley is often made into hay by being cut before the grain is mature. At this time the entire plant makes good forage. In California, the barley crop (33 million bushels in 1923) is double that of wheat, which it is rapidly replacing as a market grain, probably because of superior drought-resisting quality—a factor of great importance in a state with so much arid land. In the Great Valley barley produces a larger average return per acre than either wheat or oats. Most of this

California barley is used as corn is in Iowa—for horse, cattle or hog feed. As in summer-dry California, so it is important in Spain and Algeria.

The most important barley region in America reaches from Chicago northwestward through Minneapolis up into Canada, and corresponds roughly with the spring wheat belt, but it also includes Wisconsin, and part of northern Iowa.

The fact that barley ripens earlier than wheat is a factor of very great importance because the two crops, one food for man, the other food for beast, do not compete for the growers' time at harvest, so that he can grow more acres of the two grains than he could of either alone. The superiority of corn as a forage plant in the United States has limited the total growth of barley in this country (in 1923 198 million bushels, about one-fourth as large as the wheat crop), but the almost cornless pre-war Europe grew a billion bushels, nearly the half being grown in Russia. Russia was the chief pre-war barley exporter. In 1924 she again exported barley, while she imported flour from Canada. Little Denmark with her many cattle grows over three times as much barley as wheat. Its recent growth in Kansas and for hog feed suggests its substitution for corn on the arid edge of the corn belt, but it must compete with kafir corn south of Nebraska.

Its heavy yield causes the Japanese to use it on lands not suited to rice and the crop is about one-fifth as great as the rice crop, and three times as great as the wheat crop.

5. BUCKWHEAT

Place of growth and use. Buckwheat, an unimportant cereal, is among grains as the goat is among animals—conspicuous for its ability to nourish itself where the supply of nourishment is meager. This feeding habit of the plant, enabling it to live on the poorer and rougher lands, in combination with its very short period of growth, makes it the cereal best fitted for growth under the worst conditions of cold countries. These characteristics also make it a soil exhauster. It grows so quickly that it can be sown in midsummer in eastern United States after other crops have failed, or have been harvested, and yet ripen before frost. Its qualities combine to make it a crop for farms of rough and mountainous localities, such as the upper part of the Appalachian Plateau in New York and

Pennsylvania, parts of New England and Canada, the mountainous districts of France, the Alps, and Russia. The excellence of the buckwheat flour for making batter cakes makes it a favorite article of diet where buckwheat is known. Persons who keep bees for the large-scale production of honey sometimes grow buckwheat because of the large amount of honey in the flowers, thus getting a double harvest. New York and Pennsylvania produce two-thirds of the total crop of the United States, which amounts to about 2 percent of the wheat crop.

6. RICE

RICE CHARACTERISTICS AND RICE CLIMATE. Without rice the human race would be greatly handicapped for locally grown cereal food in the tropics and in some parts of the warm temperate zone where there is a heavy summer rain, as along the Gulf coast in the United States. In such a climate all the European grains—wheat, barley, rye, oats, and buckwheat—fail miserably, and corn is far from its best, owing to the bad effects of the moisture. Commerce would find difficulty in filling the gap because it is so difficult to keep these northern grains in a hot moist climate. Trouble is often experienced in shipping corn down the Mississippi River and through the Gulf of Mexico to Europe, because the humidity causes the corn to heat and mold. It is indeed fortunate that these climates have rice, Asia's great gift to the world, which thrives under wet summer conditions and which, owing to the dryness of the kernels and a protecting husk, can also be kept without deterioration.

This grain is to the regions with moist summers what wheat is to the regions with a dry summer. The two plants do not thrive in the same region unless, as is the case in a few districts of China and Japan, a crop of winter wheat can be harvested before the beginning of summer rains, which furnish the proper conditions for rice.

RICE REGION AND THE MONSOON. In the summer season the Asiatic monsoon, a seasonal wind, a gigantic sea breeze, blows inland from the warm, moist Indian and Pacific oceans across all coast lands between the lower Indus Valley and latitude 51° north in Japan. It gives to southern and eastern India, Ceylon, Burma, Siam, and Cochin China, the Philippines, China, southern Korea, Japan, and the windward side of many East Indian islands a heavy, warm midsummer rain.

The Asiatic summer rain produced by the monsoon is one of the greatest factors in the relation of man to the earth. Southeastern Asia and adjoining islands, the region of monsoon climate with rice the leading cereal, is the home of more than half the human race. One of the important reasons why this small corner of the world holds so many of its people is because the monsoon

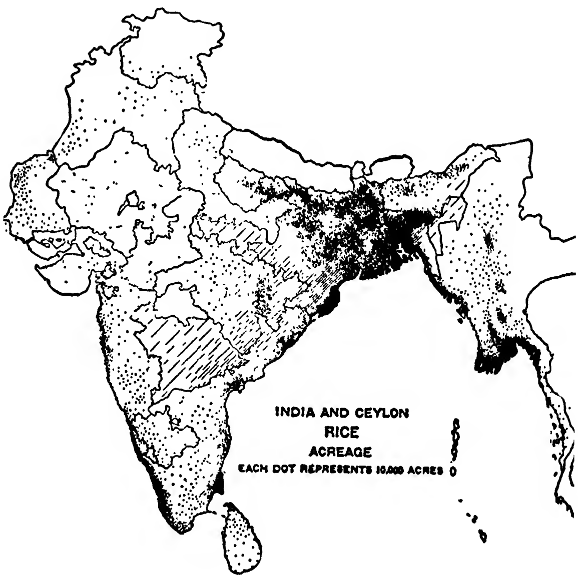


Fig. 36.—Rice is the greatest crop of India, having four times the area of wheat. Compare this with a rainfall map. (Finch and Baker.)

climate has rain at the season of greatest heat and growth rather than in the cooler period of least growth such as results from the winter rainfalls of California, Spain, Italy, Australia, and Chile. The climate possesses first the intermittency to compel people to work for the non-productive season of drought and then rainfall enough to permit great production and thus great numbers. The rainfall is regular over large areas,—a factor of inestimable importance.

Rice flourishes in the wet summer due to the monsoon, and in these parts of southeastern Asia, where the moisture is sufficient to its satisfactory growth, rice is the mainstay of the population. It is said to be the main food supply of one-third of the human race, but the extent of its use has been somewhat exaggerated through our major contact with Oriental people at sea coast and lowland points and the resultant generalizations from those observations coupled with our ignorance of inland districts, especially in China. The rice is the grain of the moist low plain, and contrary to the general opinion it is a luxury to millions of Chinese and Japanese who live on the cheaper and less desirable millet, European small grains, corn, sweet potatoes, and other cereals not known in America.

These European and other grains are raised where rice is impossible of cultivation. Thus, in northwest India the valley of the Indus does not have much rain and is an important wheat grower, as are the central plateaus of India around Bombay and upper Bengal. In north central and northern China, also, rice does not thrive, and wheat is extensively grown. In colder or more arid localities comes barley, and in the region of Pekin and southern Manchuria, corn, while many districts of central and north China have millet as their chief cereal. Southern Korea depends much upon rice, while in the rougher and colder north they grow barley, rye and oats, millet, and some wheat, and the same practices prevail in Japan.

Wheat and barley are often grown on rice land in winter, and the two grain crops per year measure the intensity of production. To get the two crops in one year requires the laborious time-saving device of transplanting the rice *by hand* from seed bed to field.

THE ANTIQUITY AND USES OF RICE. The use of rice in these old lands of the East goes back into the unknown past.[13] Centuries ago rice spread from China and India to Egypt and north Africa, then in 1468 to Pisa in Europe, and in 1694 the governor of South Carolina succeeded in cultivating it in his garden and thus started the industry in this country. A little rice is grown throughout nearly

[13] "In some parts of the Orient, where it is grown in large quantities, rice was and still is the medium of exchange. Debts, taxes, charities, various feudal obligations, pensions, even wages, were paid in rice. In China and Japan for example, one of the earliest and most common institutions was the public-charity granary, where rice was received, sometimes as taxes, sometimes merely as gifts from the well-to-do or from the feudal lords, and stored as a community provision against times of famine."—"Rice as a Food." U. S. Department of Agriculture. *Farmers' Bulletin No.* 1195 (1921).

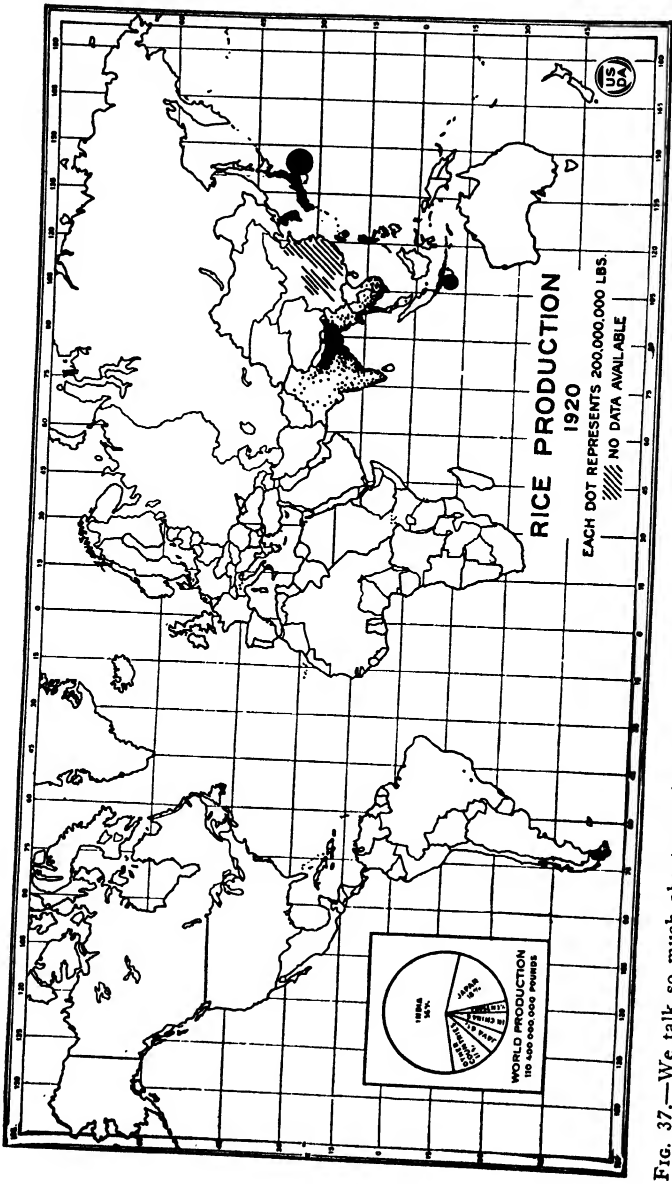


FIG. 37.—We talk so much about our American rice industry that we need this map to give us correct proportion.

all tropical America, on both coasts of equatorial Africa and in the Congo forests, but no people depends upon it so fully as do those of southern and eastern Asia, with whom its use often replaces that of wheat, potatoes, and, to some extent, meat also. The people of Europe and America use rice as an ordinary vegetable, as well as for pudding, and in place of the potato when that crop fails. Among these western peoples, rice is more of a substitute food than a regular staple of diet. Rice is widely used as a staple article of diet in the tropics, especially tropic America. Along with beans it is the great mainstay of Porto Rico, although almost none of it is grown there. It is much easier to boil rice than it is to bake bread. This, in combination with its good keeping qualities, may explain its predominance. Its great keeping quality and convenience in transport enable it to be used anywhere and it is consumed throughout the western world from Iceland and Greenland to Patagonia and New Zealand. This fact in combination with its use in the Orient and the tropics undoubtedly makes it the most widely used of human foods.

Rice does not make light bread because it lacks the gluten.[14] The Oriental boils rice, eats it in that form, or flavors it with a bit of meat or fish if he can afford it; or uses curry, a hot seasoning preparation made in endless varieties. With peas and beans rice furnishes almost the entire nourishment for hundreds of millions of people. Peas and beans are widely grown by almost all Eastern peoples who raise rice, and they are the substitute for meat, milk, and cheese of the West, while the starch of rice is the substitute for bread, potatoes, and many puddings as well. The unpolished rice eaten by the Oriental is much more wholesome than the shiny, white grain which we of the West insist upon eating. The process of polishing it takes off the most nourishing part, as well as the life-giving vitamins.[15]

[14] With the purpose of making rice more attractive to the American palate and so increase its consumption, the United States Rice Experiment Station at Crowley, La., has been developing new strains with a superior flavor. One of their new varieties tastes like popcorn.

[15] The discovery of vitamins is attributed to an episode in a Japanese hospital in 1904. A sailor dying of beriberi expressed a dying wish for a bowl of rice soup, such as he had at home. He got it. In four days the dying man walked away, and science was on the trail of a new factor in nutrition—vitamins—things of an unknown nature but very well known functions. They give life where otherwise there is death.

Calories do not tell the complete story of nutrition. They must be made alive with vitamins found in living food such as uncooked greens, most

Polishing rice is one of the numerous cases in which appearance makes the purchaser select the really inferior article. The rice bran is a valuable cattle food and is exported as far as Europe. The straw is used for many purposes, including fodder for animals and for the manufacture of brooms, paper, matting, sandals, hats and many other commercial and household articles used by the Orientals.

RICE GROWING IN SPARSELY PEOPLED EASTERN LANDS. The thousands of varieties of rice due to the age-long cultivation are divided into two classes, known respectively as upland rice and lowland rice. Lowland rice must be grown under water, while the upland rice is grown much like wheat or oats and is grown chiefly where population is sparse and land abundant.

In those parts of the wet tropics such as Sumatra, Borneo, the Malay Peninsula, or some parts of Burma and Indo-China, Equatorial Africa, San Domingo and many other parts of tropic America where the tropical jungle covers with its dense tangle every foot of the land except where man has fought it back, upland rice is grown in a shiftless manner such as commonly prevails wherever a sparse population uses abundant land.

When a new rice field is wanted, the dwellers in the thatch huts will begin the year by cutting down the forest. Among stumps and prostrate logs, often higher than the worker's head, the upland rice is planted in holes made with a sharp stick and filled by the bare foot. As young rice is much prized by wild animals, from the elephant down to the small rodents, the clearing must be watched until the harvest. After two crops are taken, the field is abandoned for a fresh field and the tangled jungle promptly reclaims the land. This is the age-old primitive agriculture.

RICE GROWING IN DENSELY PEOPLED LANDS. Most of the countries with monsoon climates are too densely peopled to grow their rice in this crude way. In such localities the land once cleared is kept in cultivation for centuries. Such dense populations nearly always grow the wet variety of rice, because of its greater and more certain yield. Few crops are surer than the wet rice, and few more uncertain than upland rice, which likes a half inch of rain per day to do its best. Wet rice must be grown by irrigation, and the devices used in fitting and keeping the land for this service are among the

husks, such as bran, the outer coating of rice, milk and its uncooked derivatives, orange juice and all fruits. Hence the practice of giving orange juice to the baby that is fed upon dead (Pasteurized) milk.

greatest monuments of human diligence in the world. They are certainly the most creditable constructions produced by tropical peoples, the only rivals being the slave-built monuments of tyrants. In Ceylon, for example, the railway that goes from the seacoast to the highlands goes through an irrigated plain divided by low banks into ponds of small area,—rice fields, each of which has by great labor been leveled so that the water may be of uniform and proper depth for rice growing. As the railroad climbs the slopes of the hills the rice patches continue, with smaller area and higher banks, turning at last into a giant flight of gentle water steps, one of the most beautiful landscapes that the world possesses. Many mountains in Java are similarly terraced for rice far up their sides; and, in China and Japan, similar stupendous works have been constructed for the support of the populations, which, like those of Java and of Ceylon, are very dense and mainly dependent upon agriculture in which rice is the largest staple. In Japan 60 percent of the arable land (12,000 square miles) is in these irrigated paddy fields. The similar work of the Philippine Igorotes whom we have called savages causes me to wonder what they would call us if they saw the gullied ruins of American corn and cotton fields.

The common treatment of the lowland rice is alternately to flood it and draw off the water during the early periods of its growth. It is kept under water during a larger part of its development, the water being entirely drawn off as it ripens. The water must not become stagnant, and to keep it in motion it is the common practice on the hillsides to lead a stream to the top terrace, and let the water pass from terrace to terrace down the slopes. In many places, especially in China where the water supply is often inadequate, it is necessary to lift the water from the lower terrace to the higher ones by some artificial means. Sometimes where the water is abundant, a high water wheel is used. As it revolves, the bamboo buckets, mere joints of bamboo on its run, empty water in a trough when they reach the top of the wheel. It is an exceptional place where there is sufficient water to use this water-power method. In many parts of China and India two men may be seen straddling a little dyke that separates two terraces. With a bucket they dip the water from the lower to the upper, where they pour it out upon mats so that it may not injure the little rice plants beneath. This is only one of many Oriental methods of lifting water by human muscle.

The utilization of these terraced hillsides with the accompanying menace of an avalanche of mud and water is as great a monument to the diligence and patient care of these peoples as is the construction of the terraces. Only constant vigilance prevents the breaking of the upper terraces, which, should they give way, would promptly discharge the water into the ones below, fill them to overflowing, and so, gathering force as it went down the hillside, the water would, like an avalanche, leave ruin behind it.

Fig. 38.—Reflected light emphasizes some of the many water terraces that surround this Igorote village upon the slope of the tropic mountains. Sagada Bontoc, Philippine Islands. (United States Bureau Insular Affairs.)

Amount and kind of labor in growing and preparing rice. The labor of rice growing often involves the raising of plants in small sprouting beds and transplanting them in little bunches to the rice field itself. This work, as most of the other work in connection with terrace-grown rice, can be done only by hand. The small fields make it impossible to use such machinery as reapers and at times even the ox. But beasts of burden are often unattainable in a densely populated country like China or Japan. There is not land enough to raise food for many animals, so the spade in the hand of a man replaces the plow drawn by a beast, and the garden replaces the field of more sparsely peopled lands. Parts of

China and Japan and India have reached the ultimate stage of agriculture, where man grows by his own labor the food for his support, and there is small possibility for increase of food production. This omission of animals is by no means universally true for there are millions of water buffaloes plowing rice fields in the Philippines and the mainland of southeastern Asia; and India, peopled largely by people who eat no meat, has more cattle than the United States, but their chief purpose is to serve as beasts of burden.[16]

When the Asiatic rice field is finally drained, the ripened grain is usually cut by hand, tied up in bundles, and allowed to dry. To accomplish this in moist places, it is often necessary to put the sheaves upon bamboo frames. It is usually threshed by hand with the aid of some very simple devices. One of these is a board with a slit in it. Drawing the rice through the slit pulls the grains from the heads and allows them to fall into a receptacle. The grain at this stage is called paddy because of a close-fitting husk not unlike that which protects the oat kernel. As with oats, these husks cause the grain to keep much better than when the husk is removed and the final husking of rice for home use is usually deferred until the time of use approaches. Among the Oriental people the husking of the paddy to prepare it for food is a daily occurrence, commonly done by hand. One of the commonest sounds throughout the East from Bombay to Manila and from the equator to Pekin, is the pounding of a heavy mallet or pestle as it falls into a vessel

[16] We have here some of the conditions that enable us to appreciate the great differences in man's relation to the land in the east and the west, in the sparsely and the densely peopled country. The American farmer grows corn and feeds it to cattle and then eats the cattle, but one ox eats as much as five men and requires five times as much land for his support, so the numerous Orientals often omit the animal-feeding stage and grow rice and vegetables and eat them rather than feeding them to animals. Great increase in population could result from the essentially vegetable diet and the omission of animal raising. The ox that consumes as much as five men lives at least two years and will not produce over 750 pounds of meat. It is reported that the excessive amount of 5 pounds of meat per day is allowed the Argentine cowboy. Thus an ox represents 150 days' rations for the Argentinian *vs.* 3,650 days' rations (ten years) for the Oriental—one of the many striking results produced by difference in density of population.

The more closely we study geography and seek the *explanations* of human history, the more we are likely to appreciate the potency of the ratio of population to resources as a causal factor.

full of paddy in the process of pounding the grain, and loosening the husk.

Export of rice. The enormous home consumption of rice in China, Japan, Java, the Philippines and most of India prevents these countries from having a surplus of rice for export. The chief surplus for export to the world's market comes from the less densely peopled section of the Orient, the lower valley of the Ganges in the Province of Bengal near Calcutta, India, the delta of the Irawadi River in Burma, the Menam River in Siam, and the Mekong River in French Indo-China. These stretches of fertile, river-borne soil lie favorably for cultivation by irrigation. In Burma and Siam and Cochin China, these stretches contain the larger part of the population of these countries, but the soil is so productive that large quantities of rice are left as the money crop of the natives

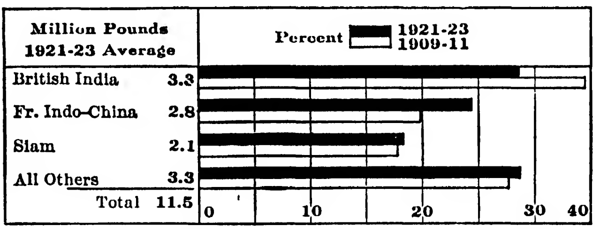


Fig. 39.—World's rice export, three-year average.

who grow it in these unwholesome swamps. This surplus they carry in their native boats down through the winding waterways to Bangkok, Rangoon, and Saigon. Here, in the mills of English, German, French, and Chinese firms, the paddy is cleaned in the wasteful fashion demanded by Caucasian consumers, who eat a part of the grain which is less nutritious than the part consigned to the animals that get the rice bran.

The spread and extent of rice growing. It has come to the West late in history and thus far the development of rice growing outside the Orient has been surprisingly slow and small. The annual overflow of the Nile due to seasonal rains in central Africa, and the easy irrigation, make rice as much at home in Egypt as it is in the garden farms of Japan, the lower valley of the Yangtze, or the terraces of Ceylon and Java. Some rice is grown in Egypt, but not enough for the population, probably because of the European dominance of the Egyptian agriculture. Although rice is a standard article of diet in every country of America and Europe and of nearly every European colony, these many lands are usually importers, with the exception of the United States, Brazil, Italy and Spain.

RICE GROWING BY ASIATIC EMIGRANTS. The spread of East Indian laborers to the Islands of Mauritius, Reunion and Madagascar in the Indian Ocean has introduced rice growing there, while similar people, lately taken to the British colonies of Jamaica, Trinidad, Honduras, and Guiana, have carried with them the methods which their rice-growing ancestors have practiced for a hundred generations. British Guiana is an interesting example of these tropic American rice fields. Here, although the country is mostly uninhabited forest, there are large stretches where the level, alluvial swamp along the seashore has been utilized by the building of dykes, after the manner employed in Holland. The reclaimed land greatly resembles the rice-growing deltas of the rivers of southern Asia, and between 1898 and 1922 the acreage increased from 6,000 to 49,000. The Guiana rice crop is, however, quite small in comparison to that of Brazil, which got a new impetus at rice growing during the ship shortage and high prices of the World War. Brazil is now raising about as much rice as the United States and exporting from 10 to 25 percent of it.

It is easy to let the facts of export cause unsound inferences as to total production. There is no necessary connection between the two. A small population, and a production small in comparison to other countries, permits countries like Argentina and Canada to appear large in wheat export, as French Indo-China and Siam do in rice export, yet they produced about 7 billion pounds of rice each in 1922 in comparison to 19 billion in Japan and 74 billion in India. The rice crop of India covers nearly three times as much ground as the wheat crop. China, almost devoid of statistics including even reliable population figures, is, with rice as with most other articles, incapable of accurate comparisons, but the rice crop is estimated at 52 billion pounds, an amount greater than the average wheat crop of the United States. The total rice export of the world is about 15 billion pounds or 254 million bushels of 60 pounds —an amount smaller than the wheat export of Canada in 1923. The total rice production of the world, including China, seems to be less than the wheat crop of the world exclusive of China.

Rice growing in Europe. Rice is of great value to dense populations because of the high average yield. In Japan in 1922 rice averaged 41.3 bushels to the acre, while wheat yielded 22.5 bushels. In the United States (1921-23) wheat made 13.4 and rice 18.1 bushels per acre. For this reason the cultivation of rice has been taken up in southern Europe in most places where the water supply is sufficient for irrigation. In the Po Valley of Italy a third of a million acres, equal in size to a typical American county, are carefully tilled in rice, and Italy, producing two-thirds as much as the United States, is the only country with Caucasian population growing enough rice for her own use and having a large surplus for export. Spain grows about one-half as much as Italy and Portugal grows a little.

Rice growing and the use of rice machinery in the United States. After the surprising success of the governor of South Carolina in raising a patch of rice in his garden in 1694, rice growing became an industry in that colony and in Georgia, since swamps along the seacoast and rivers could readily be dyked off and cultivated by negro slaves in the Oriental way. This was the chief place in the whole thirteen colonies where negro slaves were profitable in 1787, and it was due to the influence of Georgia and Carolina rice growers that slavery received its recognition in the Constitution of the United States. These two states have grown rice of excellent quality down to the present day, but the quantity is now insignificant.

The newest and most interesting of all the world's large rice fields is upon the plains near the Gulf coast not far from the boundary between Louisiana and Texas. Here are lands of wonderful levelness and with a very satisfactory clay subsoil to keep water from soaking through. By the building of dams, the digging of wells, and the erection of pumping plants, arrangements have been made for the mechanical supply of the irrigation water, after the ground has been plowed and harrowed with teams and cultivators akin to those used in the preparation of large areas of wheat land. This is made possible by having the machine-made dykes of such gentle slope that teams can be driven across them. After the water has been drawn off at ripening time, the ground is firm enough and the area large enough to permit reaping machines to harvest the rice like wheat, and steam thrashers to throw off the chaff and straw into piles, and to fill the rice sacks as quickly as they fill wheat sacks.

This conquest of the primeval Oriental hand-labor garden crop by American farm machinery has enabled one man to take care of eighty acres of rice in a year, and though he is paid twenty times as much as the Chinese laborer, he produces rice more cheaply because the Chinese cares for only one or two acres by his arduous hand labor. In 1923 Texas and Louisiana had a combined rice crop of over 22 million bushels, while Arkansas grew 5 million bushels.

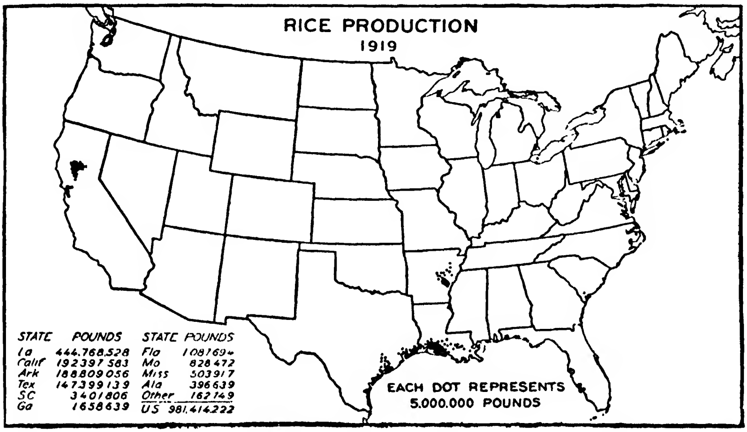


FIG. 40.—America's capture of an old world crop is shown in her rice industry along Gulf coast of Texas and Louisiana, in Arkansas, and in the Sacramento Valley of California. (United States Dept. Agr.)

A rapidly increasing rice industry is one of the most recent steps in California's surprising capture of old world crops. The level, new-made soil of the Sacramento Valley furnishes a fine site, and the melting snows from the forest-clad mountains give plenty of water for irrigation. This is much like the rice industry of the Po Valley in Italy, where an arm of the sea has been similarly filled with water-borne soil, now irrigated by the meltings of mountain snow fields. California began commercial rice growing in 1912, and the crop now averages about 7 million bushels a year, second only to Louisiana. This successful growth of rice in the cool temperate zone of the United States shows that we might have a very large rice industry scattered through many states if we chose to flood all available lowlands.

In spite of our spectacular production methods the fact remains that we grow only about 1 percent of the world's rice while India grows 60 percent and Japan 20. It is still to be proved that white men can maintain health, vigor and culture in the necessarily damp climate which accompanies the irrigation of land upon the warm and moist shores of the Gulf of Mexico.

According to recent estimates there are about 10,000,000 acres of land along the Gulf well suited to rice. Present methods could irrigate 3,000,000 acres of this with surface and artesian waters. The remainder could be irrigated at greater expense. With a two-year rotation one-half of the easily irrigable rice land, 1,500,000 acres, could be in rice each year and should supply 1,620 pounds per acre or approximately 2½ billion pounds. This amount is three times our present consumption. In 1790 we exported about 25 pounds of rice per capita and ate less than half a pound. Now we eat 6 pounds per capita and export 4 or 5 pounds.

7. MILLET AND SORGHUM

Of necessity Americans have much difficulty in appreciating the importance of millet as a cereal. We do not use it as a cereal. It is a plant not unlike corn or sugar cane in general appearance, with its seed in a head somewhat like that of the cat tail. The grain, which is smaller than wheat grains, is boiled and used like rice, or eaten parched or made into meal and porridge. There are many varieties, some a dozen feet in height. Some are grown for forage only, some for the grain to be used as human food, some for both purposes, some varieties furnish fuel in their woody stalks.

Millet is grown to some extent in most parts of the temperate zone and also in the tropics. It is grown occasionally in nearly all parts of the United States for forage only, but the excellence of corn in the east and south and of alfalfa in the west keeps it from having any wide use in this country, save in the Kansas-Oklahoma-Texas part of the eastern Great Plains where it is coming to the front as a forage plant. It has a similar use as forage in Europe, being extensively grown in the Mediterranean region and Russia. It is used as food to a slight extent in Europe and among the natives of Mexico and Africa, but it is in Asia that millet reaches its greatest importance. It is estimated [17] that one-third of the human race use the seed as food. Japan is credited with an annual consumption of 35 million bushels. Millet is the staple food grain of parts of India, where the acreage is estimated to be 35 to 40 million while the wheat

[17] Freeman and Chandler: *The World's Commercial Products,* p. 59.

crop covers but 30 million acres and that of the United States but 58 million (1925). In China also there is very general use of millet as food, and there are records of its use for about 5,000 years. The accounts of the Russo-Japanese War showed that many of the campaigns (Manchuria) were waged in fields of millet and Indian corn, which resemble each other very much as they stand in autumn shocked in the fields.[18] Millet seems to have been very important to the prehistoric lake dwellers of Switzerland.

The sorghum family is another cereal producer little known in the United States but important in many parts of the world. To this family belongs the well-known broom corn from which brooms are made, the Kafir corn of South Africa (where the annual crop is half again as large as maize), the sugar-producing sorghum (discussed on page 313), and many others entirely unknown in this country. They are tall plants with general resemblance to millet in appearance, excepting a difference in the form of seed-bearing head. In uses they are substitutes for both millet and corn. In China, India, and Africa their use as forage is very great and their use as human food is also very common, while some of the many varieties are cultivated for human food in nearly all the warmer countries of the world. A member of this family is durra, the oft-mentioned food grain of many African tribes.[19] Drought-resisting sorghums have recently sprung into prominence [20] as forage plants in the drier parts of the United States where the area planted has gradually risen to 5½ million acres (1923), equal to our rye area. Texas, Kansas and Oklahoma lead in the grain sorghums as in millet. The United States Food Administrator during the World War recommended Kafir corn as a nutritious and palatable foodstuff—but food habits—oh, how they do stick! Our folks have not been sorghum eaters.

[18] E. R. Scidmore in *National Geographic Magazine*, April, 1910, says that a giant millet 10 or 12 feet high, along with a short millet and sorghum, is extensively grown in Manchuria. The giant millet looks like corn shocks in Indiana and "is used for food, fuel, distilled drink, mats for the floor, and for building material, and has thousands of uses and the yield a thousand fold."

[19] A Reuter's dispatch from Wad Menadi, Blue Nile, discusses the effect of rain on "durra, which forms the staple food of the native population." To millions in Africa, who cook it as mush or cake, it is the staff of life.

[20] For excellence in fattening sheep and cattle, see *Texas Agricultural Experiment Station Bulletins*, Nos. 269 and 296.

8. CORN OR MAIZE

THE VALUE OF CORN TO THE SETTLERS OF AMERICA. When the first American settlers landed in Massachusetts and Virginia, the Indians presented them with ears of this valuable grain which the settlers called Indian corn, corn being the English word for grain. The Spanish called it maize. The colonists, to their great benefit, at once began to cultivate it,[21] because it was so much easier for them to grow than the wheat, barley, rye, and oats with which they had been acquainted at home. These small grains, grass-like in their early growth, require for their satisfactory cultivation smooth land free from stumps and stones. This the new settler in the woods did not have. But the Indian showed him how to kill the trees by cutting the bark, so that he could immediately plant corn among the standing trunks and, with a little rough cultivation, have unripe corn ears for roasting as early as August—a much quicker return for his labor than wheat could possibly bestow. By September or October the settler would have ripe grain that would stand a month or two awaiting his convenience to harvest it. In this respect it was superior to the small grains which must be harvested at once, lest storms beat them down. The ripe corn, moreover, yielded twice as much as the small grain, was easily kept, and could be served as food in many forms—as parched corn, the hunter's standby, made by heating the whole grain in a frying pan or over an open fire; as hominy, which is the cracked corn thoroughly boiled; as mush (samp), made by boiling the meal; or, finally, as cornbread. The husk that protected the grain served in the mattress for the colonist's bed; the stalks and leaves fed the horses and cows through the winter, even after they had served for months as a thatch for the temporary shed that shielded the animals from storm.

USEFULNESS OF CORN IN ROUGH COUNTRIES LIKE APPALACHIA. Owing to the ability of corn to grow on very rough land where the

[21] The fact that we spent two centuries in chasing the poor Indian away from his good land has caused us greatly to minimize his achievements. It would be wholesome spiritual exercise for us to really know just what he thinks of us, and why. Mr. Melvin R. Gilmore of the Heye Foundation, New York, says that the Indian had under cultivation when the white man came five different types of corn, each subdivided into many varieties and scattered far beyond what we now regard as Corn Belt. The Indian also cultivated many vegetables. Some of them had apple orchards in New York.

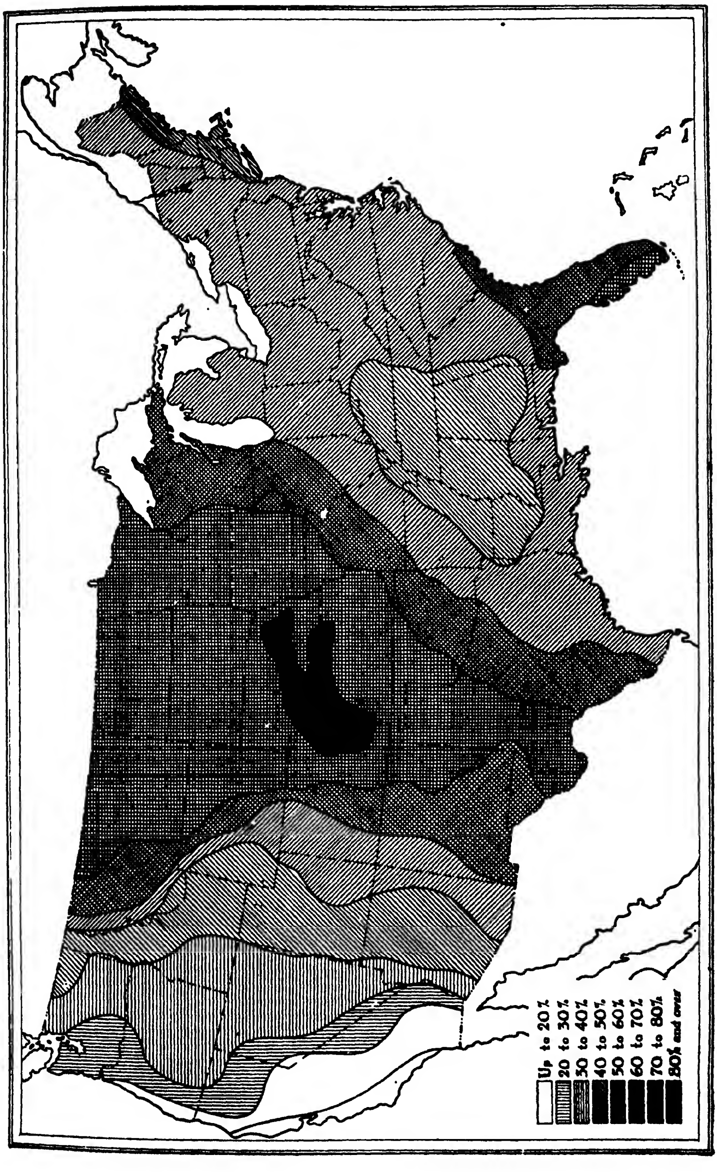


Fig. 41.—Map of United States showing the percentage of annual rainfall received in the six warmer months, April to September. (After Gannett, U. S. Geol. Surv.) (From Salisbury, Barrows and Tower.) Summer rain is a great corn factor.

other grains will not do so well, or yield so much, it has come in many parts of the world to be the mainstay of primitive or isolated hill peoples where the climate permits. In the central Appalachian Plateau of east Kentucky, east Tennessee, and West Virginia, for example, where many counties comprising several thousand square miles are almost devoid of railroads or good wagon roads, the primitive conditions of the Revolutionary period continue and corn, both as food and a staple of commerce, is of greatest importance.[22]

Climatic requirements. Corn will mature if there is a five months' growing season, and a hot midsummer with sufficient rainfall [23] to keep up the growth of the plant, which at times amounts to several inches a day, and in a few weeks to a height of from 6 to 14 feet or even more. Accordingly, regions with a cool summer, such as England, Scotland, Ireland, in fact all north Europe, most of New England north of latitude 44°, and Canada, excepting a part of Ontario, cannot well produce a crop of ripened corn. The heat requirement of the maize plant includes warm nights as well as warm days, so that many arid regions having very hot days and cool nights, such as Nevada, are not suited to the profitable production of corn despite an apparently satisfactory average temperature.

Although a lover of heat, corn does not do its best in the tropics or even in the prolonged summer at the mouth of the Mississippi River. It seems to require a seasonal warning that cold weather is approaching. It must get ahead of cold weather. The rapidly shortening hours of daylight in northern latitudes serve notice to the sensitive plant that winter is on the way, and cause it to turn

[22] This locality with its inferior corn crop furnishes a good example of the influence of environment on history. About the only way in which corn could be exported from these plateaus was by converting it into whisky or live stock. Owing to the fact that the United States Government taxed whisky a dollar a gallon there was a century-long struggle between the collector of revenue and the illicit distiller, the "moonshiner" as he is called, of the Appalachian Mountains. The mountaineer felt that it was a tyranny for the Government to tax the thing he could sell easiest. This feeling took its strongest form in Washington's administration, when the people of western Pennsylvania, objecting to the tax, arose in insurrection against the new Republic in the so-called "Whisky Rebellion." This feud with the government still lives.

[23] The United States Department of Agriculture says that of all causes of damage to the growing corn crop, deficient moisture is by far the greatest. The average loss through deficient moisture over a ten-year period was estimated at 666 million bushels yearly.

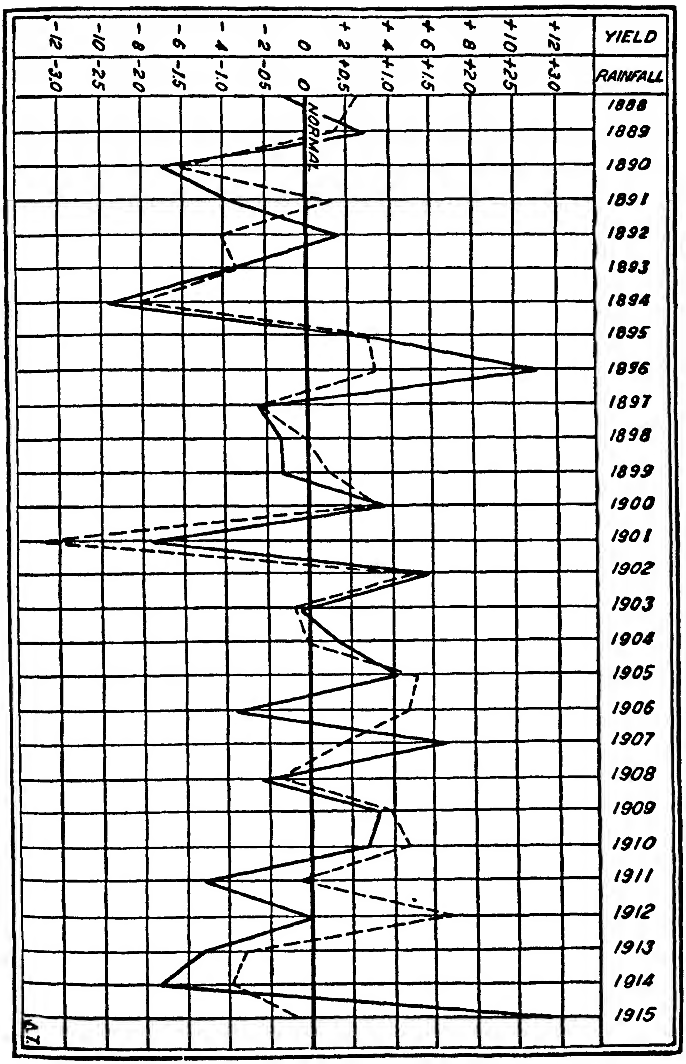


FIG. 42.—This graph of the relationship between corn yield and July rainfall merits study and reflection and shows the relative unfitness of corn in regions of uncertain rain.

its energies from leaf production to seed production. For this cause, apparently, the yield of grain is often larger on the northern margins of the corn belt than in its warmer parts, or in the tropics where length of day varies little from season to season.[24]

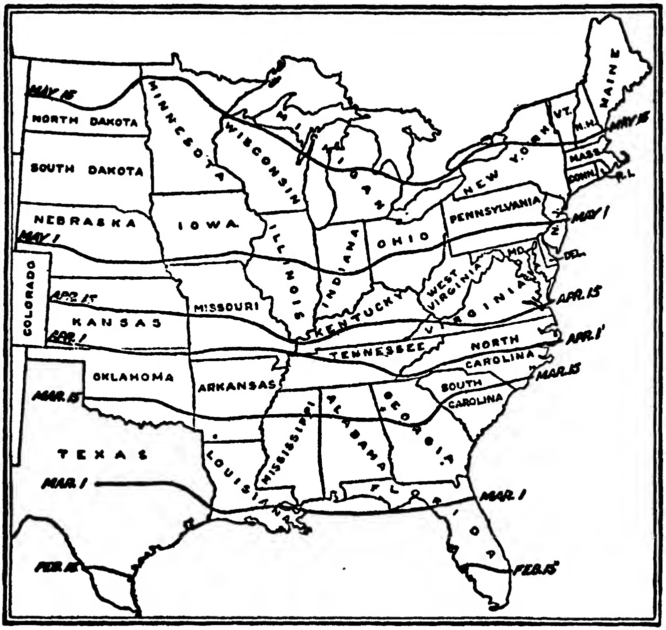


FIG. 43.—Average dates of the beginning of corn planting. Starting about Feb. 1 in southern Texas, it advances northward at an average rate of 13 miles a day until the heart of the corn belt is reached about May 1. Here all the planting is usually completed by June 1. (United States Dept. Agr.)

The cultivation of corn is, however, widely scattered throughout the warmer parts of the world between 45° north latitude and 40° south latitude.

[24] The U. S. Department of Agriculture found by a series of experiments that change in the length of day and night, not change in temperature, caused many plants to cease leaf and stalk growth and start to flower and fruit. Various plants were darkened for a portion of the day. Soy beans which ordinarily flowered in September were forced into blossom in June simply by shortening the daylight period to seven hours. These plants flowered in 26 days while similar plants exposed to regular hours of sunlight flowered in 110 days. The flowering response of numerous other plants to this artificial shortening of the daylight period was prompt and clear cut.—From "Flowering and Fruiting of Plants." *Yearbook*, U. S. Dept. Agr., 1920.

Like influences probably work even greater effects on other plants. Some vegetables of the beet family produce nothing but leafy tops in the con-

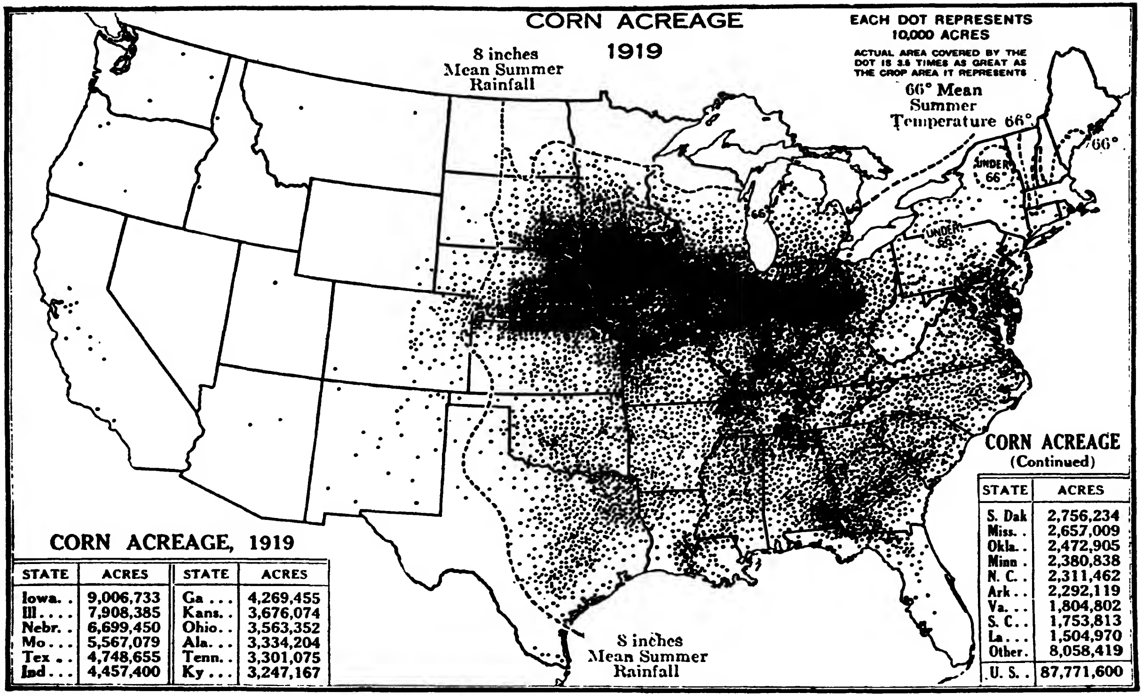
The chief regions of production may be divided into seven zones: the upper Mississippi Valley, the United States cotton belt, tropic America, including Mexico, the Black Sea basin, the Mediterranean countries, southeastern Asia, and the lower Paraná Valley of South America.

THE AMERICAN CORN BELT. Of these the first and most important, indeed more important than all the others combined, is that of the upper Mississippi Valley. Corn is grown from the Gulf of Mexico to the Great Lakes, and from the Atlantic Ocean to western Kansas and in scattered areas beyond, but the region of greatest production, the so-called American corn belt, reaches from central Ohio to central Kansas, and from Kentucky to central Wisconsin and southern Minnesota. It includes all the state of Iowa, nearly all of the states of Missouri, Illinois and Indiana, about half of Ohio, Kansas and Nebraska, and parts of South Dakota, Minnesota and Wisconsin. This region is one of the finest agricultural sections in the entire world. Hundreds of miles of almost level prairie are rarely varied by undulations steep enough to interfere with the laying out of roads on meridians and parallels at regular intervals of one mile. This soil that lies so beautifully for tillage is naturally fertile, and so free from stones that the worker can ride the cultivator with which he tends the corn. Some of these cultivators till both sides of one row of corn, and some of them even take two rows of corn at once. Thus, an unaided farmer can cultivate a large area of corn, sometimes more than forty acres, and produce the grain that was so wonderfully cheap for many years. Serious droughts are infrequent in the corn belt. The abundant rainfall of summer comes in short showers which do not seriously interfere with agricultural operations, and the heat is sufficient to make a most excellent growth of corn.

RELATION OF CORN TO OTHER PRODUCTS OF CORN BELT. Corn is not the only crop in the corn belt. On a single farm there will be, in addition to corn, fields of oats or wheat and hay which require the farmer's labor at different seasons from the corn; also there will be a field of grass upon which cattle can graze.

A surprisingly small portion of the corn belt grain goes directly to the market. While it is estimated that man eats 88 percent of

tinuously warm West Indies, although the nourishment stored in their thick roots for the next year's seed growth makes them an essential part of agriculture in Canada, Sweden, Germany, and other lands of frost and cool summers.



CORN ACREAGE, 1919

STATE	ACRES	STATE	ACRES
Iowa. .	9,006,733	Ga . . .	4,269,455
Ill. . . .	7,908,385	Kans. .	3,676,074
Nebr. .	6,699,450	Ohio. .	3,563,352
Mo . . .	5,567,079	Ala. . .	3,334,204
Tex . .	4,748,655	Tenn. .	3,301,075
Ind . . .	4,457,400	Ky . . .	3,247,167

CORN ACREAGE
(Continued)

STATE	ACRES
S. Dak	2,756,234
Miss. .	2,657,009
Okla. .	2,472,905
Minn .	2,380,838
N. C. .	2,311,462
Ark . .	2,292,119
Va. . .	1,804,802
S. C. .	1,753,813
La . . .	1,504,970
Other.	8,058,419
U. S. .	87,771,600

Fig. 44.—The location of the line of eight-inch mean summer rain in the west and of 66° mean summer temperature in the north shows how definitely the corn region is fenced in by climatic factors. The hilly and rough Ozark and Appalachian plateaus are very clearly shown, also the swamp and sandy lands of the coastal plain. (United States Dept. Agr.)

the wheat grown in the United States, 11 percent is used for seed and 1 percent fed to animals, the reverse is true of corn. About 88 percent of the corn is grown as a supply crop, fed to animals on the farms where raised, and sold in the more condensed forms of beef, pork, mutton, horses and mules. The biggest corn growing states are also the ones which market the major share of the fat hogs and cattle.[25] Near the great markets where the transportation is cheaper, as in Illinois, the proportion of grain sent directly to market is much greater. During the ten-year period 1910–20, 38

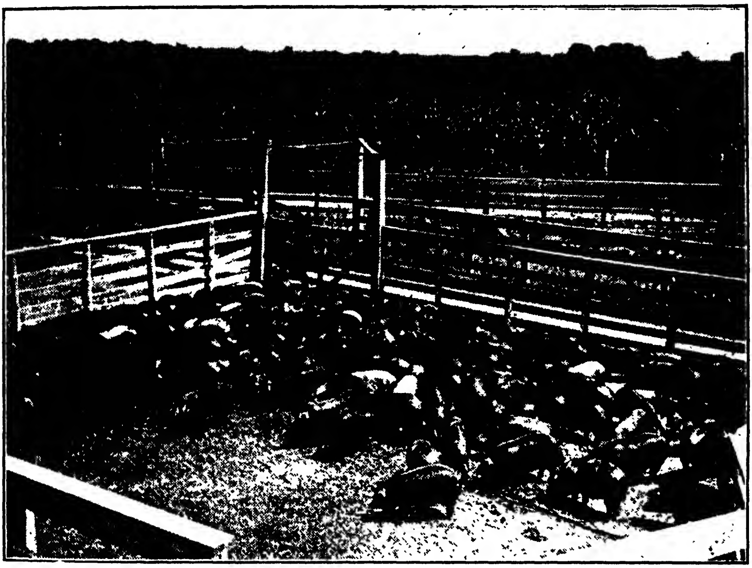


FIG. 45.—Iowa corn field and corn condensers, 140 hogs fed on corn and molasses feed, gained 1 2/3 lb. each per day for 100 days. (Champion Feed Milling Co., Lyons, Ia.)

percent of the corn of Illinois was shipped out of the county where it was produced. In Kansas the corresponding figure was only 15 percent, in Texas, yet farther from markets, it was 6 percent.

THE IMPROVEMENT AND EXTENSION OF CORN GROWING. Great improvement in corn growing takes place from year to year as the scientific agriculturalists breed new and better varieties and select the seed to take advantage of the known laws of heredity. In a

[25] "The six states, Iowa, Illinois, Nebraska, Missouri, Indiana and Ohio, producing 48 percent of the corn in 1921, had within their borders about 45 percent of the swine of the country." *Yearbook*, U. S. Dept. of Agr., 1921.

measured test in Illinois one large field yielded 48 bushels to the acre and a similar adjacent field yielded 77 bushels to the acre, and the only element of difference was in the superior well-selected seed that produced the larger crop. The breeding of earlier ripening kinds is making possible a greater growth of corn in those parts of the northern United States and Canada, where it has not been a dependable crop. For example, a variety of corn known as Minnesota No. 13, which ripens in thirteen weeks after it is up, was perfected in one of the Minnesota experiment stations and with a number of other varieties is steadily permitting corn to grow farther north.[26]

The only significant corn frontiers we have opened since 1895 have been those on the north, and the gradual extension of the corn belt northward has been chiefly due to the use of these earlier maturing varieties. It has only been within the last decade that South Dakota and Minnesota have become large corn-producing states.[27] South Dakota, long known chiefly as a wheat state, now grows 4 bushels of corn to every bushel of wheat. Another way of extending the area and value of corn production, especially in cool climates, is offered by the silo. This device, first introduced from France, is a barrel-like structure, 10 to 20 feet in diameter, made of wood or concrete. Its use is rapidly on the increase be-

[26] Mr. M. R. Gilmore, authority on Indian agriculture, bewails the stupidity of the white man who brought to the West and the Northwest the strains of corn he secured from the first Indians he met, namely, those of the Atlantic Coast. Centuries ago the Indians had adjusted corn to the particular climates and were growing it far beyond our corn belt and well up into the present wheat region of Canada—varieties which have not thus far been made the basis of agriculture.

[27]

	Minnesota		South Dakota	
	Million acres	Million bushels	Million acres	Million bushels
1907...........	1.6	43.6	1.8	47.1
1914...........	2.6	91.0	3.0	78.0
1923...........	4.3	154.7	4.2	145.1

Part of this corn production is made up of the estimated number of bushels used in the making of silage, but according to the United States Department of Agriculture estimates, not more than 15 percent of the crop is cut green for feed or silage.

cause the entire plant, stalk, leaf, ear and husk, when chopped into bits, may be kept moist, warm, and edible for cattle for one or two years. In this form, called silage, corn makes its greatest possible food return to ruminant animals, is much used in the feeding of dairy and beef cattle, and, since it can be put away some weeks before it is fully matured, can be grown much farther north than can the ripened grain, which can be kept only after fully maturing in the field.

In the short summer of New England, the silo helps in a suggestive industrial combination. While corn may not ripen, it easily

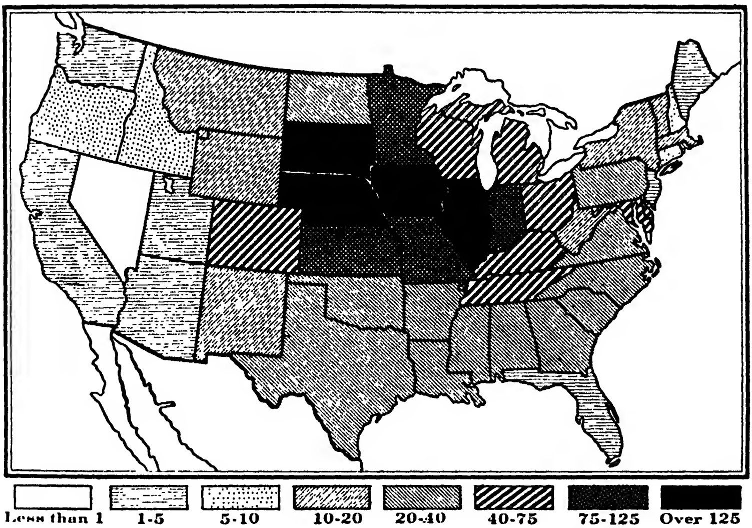


Fig. 46.—United States corn production in bushels per capita of rural population, three-year average, 1921-23. Population, 1920.

and surely gets ready for table use—the so-called roasting-ear stage—so that from a field of sugar corn wagon loads of ears may go to the canning factory or the vegetable market and the stalks are put into the farmer's silo to feed his dairy cattle—an important fact in systematic agriculture. Further than this, the canned corn of the north is in some markets recognized as of superior quality because the cold climate delays ripening, gives a longer period in the edible milky condition, and thus gives better opportunity to harvest it in its best edible form.

Corn in the cotton belt. Corn is the second crop in importance in the cotton lands of the South, but cotton is so overwhelmingly the main crop that the corn crop is often insufficient for local use, and import from the corn belt is necessary. Corn, but little used as human food in the northern half of the United States, is in common use in the southern states and is often the chief breadstuff of white and black alike. Its excellence for the support of human

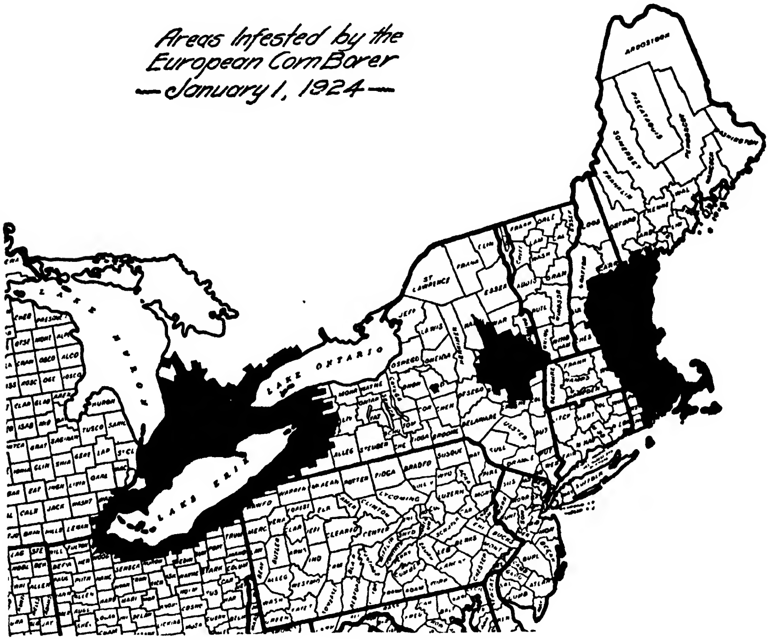


FIG. 47.—This new pest, from southern Europe, appeared in eastern Massachusetts in 1917, and in four years had reached the western end of Lake Erie. Will we Americans, with all our wealth and power, remain essentially inactive and let this little insect eat up billions because we have not the foresight to spend millions and *work* to beat him while he is yet small? The way we sat still and let the cotton boll weevil slowly eat his billion dollar way across the cotton belt is no compliment to our energy or our common sense. (United States Dept. Agr.).

beings is unquestioned by physiologists and it was well shown by the endurance of regiments of soldiers in the Confederate armies during the American Civil War. Nevertheless, corn is generally unappreciated as food outside of the southern states, except in regions where the people are poor, as in Italy, Rumania, Hungary, and Mexico, where it is used because it is cheaper than the other breadstuffs. Two shortcomings suffice to explain its small use: it has no gluten and will not make a dough, or light bread; second, the bread loses much of its palatability, though not of its nutrition, upon getting cold. Cornmeal gruel or mush called "polenta" is a staple article of diet for large numbers of Italians, and millions in southern Europe are poor enough to relish cold corn bread.

AMERICAN CORN EXPORTS. America has often exported a hundred million bushels of corn annually, and sometimes more than that to northwestern Europe where it is fed to farm animals and work horses. It is almost always sent from the region of heaviest production in our corn belt, first being assembled in the markets

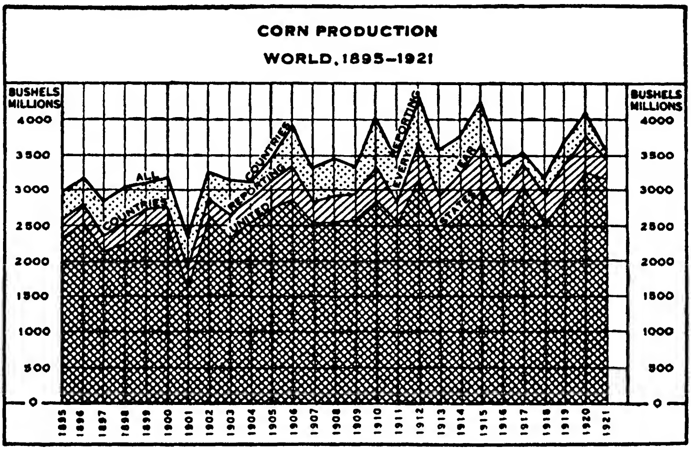


FIG. 48.—The overwhelming importance of the United States in the world's corn production is clearly shown. (United States Dept. Agr.)

of St. Louis, Kansas City, Omaha, or Chicago. From these points it passes by lake steamers and the Erie Canal or by railroads to the Atlantic ports between Norfolk and Montreal for export by the North Atlantic steamships.

At various times exporters of corn from the United States have attempted to spread the habit of corn eating among the peoples of northern Europe, but without success.[28] This is due chiefly to the conservatism of all peoples toward changing their diet, and partly because of the above-mentioned limitations of corn as a breadstuff.

Before the recent war America's corn export had declined from

[28] Even during 1914-18 when there was a great demand for breadstuffs in warring Europe, the attempt to introduce corn as a human food among wheat-eating peoples was a failure.

195 million bushels per year in 1896–99 to 45 million bushels in 1909–13. This was not due to poor crops, for the average production in the first period was 2,040 million bushels, and in the later period it was 2,708 million bushels. The price of corn was 34 cents on the Chicago market in 1899. Ten years later it was 67 cents and the influence upon the European buyer was shown in the drastic decrease of exports. Then came the war and the increased demand for beef and pork drove the price of corn to two dollars a bushel. It is significant that in 1920, when the price of corn still averaged $1.44 per bushel, our exports were only 21 million bushels, and in 1922 when it fell to 56 cents a grain-needy Europe took 166

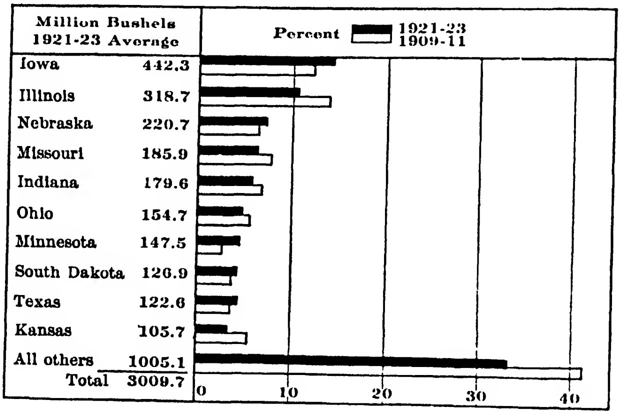


FIG. 49.—United States corn production, three-year average.

million bushels from us. With the war countries returning to normal food production in the near future it is probable that American corn exports will stay down. They were but 23 million bushels in 1924.

The home demand for corn, however, promises to remain large. We have in this country an increasing population, used to a high standard of living, and with a high per capita consumption of corn-fed meats. As we have no new corn lands to turn to and some of the old ones are declining in productivity, we seem to have reached the end of an era of cheap corn. When Kansas corn land was worth $10 to $25 an acre there was plenty of corn to be had; it was at times cheaper than coal and was burned by the farmer as fuel in the family stove.

CORN IN TROPICAL AMERICA AND MEXICO. The Spanish-American highlands, reaching from the boundary of the United States to Argentina, comprise the third corn-growing zone. No corn is exported from these countries and little is raised for stock, since the animals usually graze the year round. In every one of them—Mexico, the five Central American countries, Colombia, Ecuador, Peru and Bolivia—the bulk of the population, native Indians or half-breed peoples, derive their nourishment to a surprising degree from corn and beans. Many of these Indians and half-breeds, known as peons, have a very low standard of living. The simplest shelter suffices and rather than work much, they content themselves with beans, one of the most easily grown of vegetables, and corn, the cereal which they can most easily and cheaply grow, and some leaf greens to furnish bulk, vitamins, mineral salts. In Mexico and other of these countries the commonest form of corn bread is the "tortilla" or hot corn cake which can be baked over an open fire.

In these countries the population is chiefly on the plateaus, where the topography is often broken. The corn fields are usually small, and the production, which is almost always for local consumption, resembles the family garden rather than the broad fields of the American corn belt. Some of these plateau patches are of great fertility. It is said that there are certain fields in Ecuador where the soil, made of dust blown from the volcanos Chimborazo and Cotopaxi, has yielded crops of corn continuously for 200 years. There is no prospect that corn will ever be grown for export from these countries. The development of their resources will follow other lines. All Mexico north of San Luis Potosi imports corn in times of peace when the mineral resources and railroads give employment to workers.

Among the negro population of the West Indian Islands, corn is widely used for food, but not enough is grown for home use, and here, as is sometimes the case in Yucatan, there is a relatively large import of corn and cornmeal from the United States.

THE CORN REGION OF THE DANUBE BASIN. The corn zone second in importance to the United States corn belt is that of the lower Danube Valley and adjacent districts of the Black Sea basin in southeastern Europe. The crop of this region is from 350 to 400 million bushels a year, about one-tenth of the world's supply, and about equal to the crop of Illinois, one of our leading corn states. Although occupied by several different nations, the lower Danube

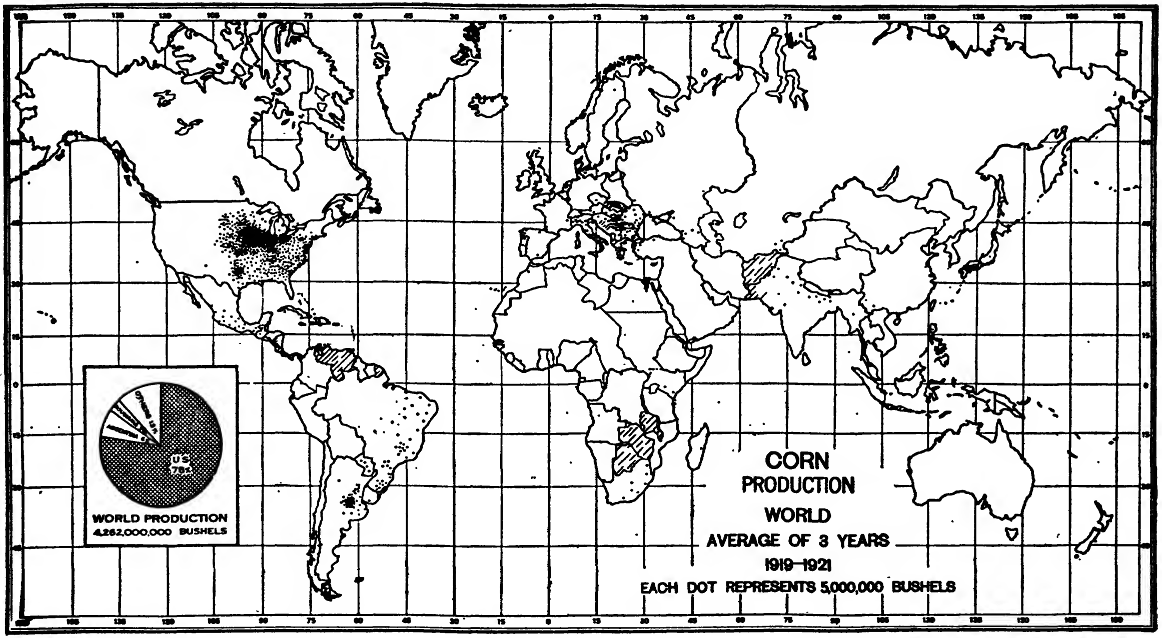


FIG. 50.—The world map shows the leadership of the United States in corn and the smallness of Europe in this great crop. This makes clear the basis of the great export from America to Europe of corn and its derivatives, pork, lard, and beef. European climate is fine for small grains, but forbids any large corn area. (United States Dept. Agr.)

Valley is, like our corn belt, one economic region. Corn is extensively grown on the great fertile plains of Hungary, Rumania, Yugoslavia, Bulgaria, and the near-by territoy of Russia on the Black Sea. Further to the eastward the climate becomes too dry for corn (but not for wheat), and in the Volga basin near the Caspian Sea the aridity is too great for tilled crops.[20] The greater part of Russia and the regions to the north of the Danube Valley and to the west of Hungary are too cold for corn growing. There is also some corn grown in the more hilly part of the Danube drainage basin on the slopes of the Balkan Mountains in Yugoslavia and Bulgaria. Rumania produces about as much corn as Indiana; Yugoslavia about as much as Kentucky, Hungary slightly less than Michigan, and Russia somewhat less than Tennessee. The bulk of the population in this entire region is rather poor, and they depend for breadstuff almost entirely upon corn, and in normal times they export to western Europe the wheat which they also grow.

Of the cultivated land in Rumania one-fourth is in wheat, nearly one-third (or one-eighth of the total area) is in corn, as compared with a little over one-fourth of the total area of Illinois that is annually in corn. The Black Sea basin is a land where droughts come with ever-increasing frequency as one goes eastward. The inferiority of the region as a corn producer is shown by a comparison of annual yield in bushels per acre in Rumania and Illinois.

	Av. 1909–13	1919	1920	1921	1922	1923
Rumania	19.1	20.3	22.4	13.0	13.1	21.6
Illinois	35.0	36.0	34.6	34.0	35.5	37.5

One of the surest spurs to labor is the certainty of reward, and the uncertainty of reward is one of the greatest deterrents to labor. The sure relation between labor and harvest in Illinois and the uncertainty in Rumania, as shown by these figures of fluctuating corn yield, help to explain why one region is filled with progressive and aggressive farmers and townsmen and the other with rather backward peasants using oxen for work animals. The World War enlarged Rumania's corn area from about 5 million acres to 8 million,

[20] The eastward succession of corn, wheat, pasture regions here, is an exact duplicate of the westward zoning of the same in Kansas.

principally by the addition of Bessarabia, which grew much of the corn of pre-war Russia. The Rumanian corn belt is more accessible to water transportation and to market than is that of the United States. Rumania, with 174 million bushels in 1923, grew twice as much corn as Yugoslavia and three times as much as Hungary.

While Rumania and Yugoslavia normally export considerable corn to western Europe, Hungary consumes nearly all of her crop at home, and her exports are small. Prior to the war Russia and Bulgaria were important corn exporters and some Russian corn has appeared on the European market since the war. If production in

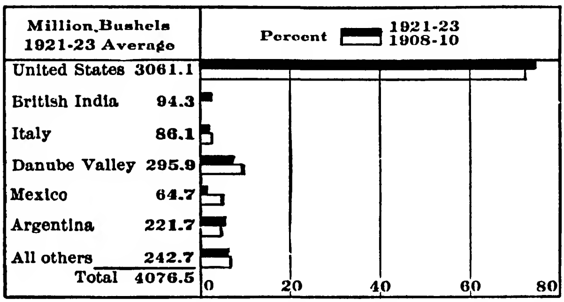


FIG. 51.—World's corn production, three-year average.

the Danube Basin resumes pre-war figures, exports from this source are likely to increase.

CORN PRODUCTION IN MEDITERRANEAN AND ADJACENT REGIONS. Most of the Mediterranean region is too dry in summer for the growth of corn except under conditions of irrigation. The large yield of corn per acre, however, makes it greatly desired as a crop by peoples poor enough to use it as their chief food. Italy with 80 to 100 million bushels a year (about equal to Kentucky) is the leader, producing twice as much as Spain, Portugal and the south of France combined. Wherever corn can be irrigated it is grown for home use, largely as human food, in Turkey, Greece, and Egypt, where it is an important crop; but the dense population consumes all of the 100 million bushels of corn and wheat produced along the lower Nile, and in addition imports some of both grains. Certain plains in Portugal and western Spain near the ocean have rainfall sufficient for mediocre growth of corn without irrigation, and the crop of Portugal about equals that of New Jersey and Delaware.

The desert heart of the Old World and regions adjacent to it, reaching from southern Morocco across north Africa, Arabia, Persia, the deserts of central Asia and Gobi to the great wall of China, can, as in Egypt, produce corn only where irrigation can be practiced. The people of the Barbary states grow some corn, as do those of Palestine and Asia Minor. It is grown to some extent in Persia, and it is relatively important to Bokhara and other oases of Russian central Asia and Turkestan. In all of these regions it is prized as human food.

THE CORN BELT OF SOUTHEASTERN ASIA. The sixth corn zone is to be found in the moist countries of southeastern Asia. In the drier part of the monsoon countries, especially China and India,

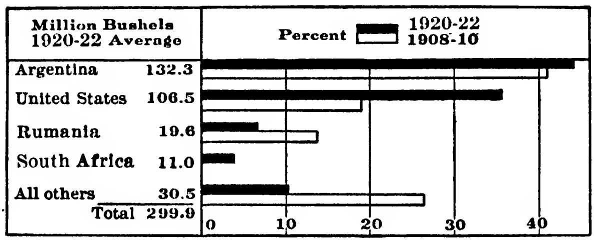


FIG. 52.—World's corn export, three-year average.

there are districts that suit corn much better than they suit rice. For example, Pekin is almost the climatic duplicate of Omaha. British India produces annually about 100 million bushels of the American grain, but not for export. How much is grown in China it is impossible to state, but vast quantities are used by the 440 million inhabitants. It is extensively grown near Pekin and in southern Manchuria. Some of the battles of the Japanese-Russian War were fought in fields of standing corn. Even tropical Java is growing as much corn each year as Virginia, and the Philippines raise two-thirds as much as Louisiana.

THE PARANÁ VALLEY. The seventh and last corn zone is the Paraná Valley of South America. The lower part of this valley resembles Oklahoma and Kansas in latitude and the climate of the growing season. In Paraguay, near the edge of the tropics, considerable corn is grown for local use. Further down the valley in the cooler latitudes are several provinces of Argentina and a small area in Uruguay where corn is of increasing importance. Its growth has recently been taken up, and, while the methods are said to be exceedingly careless, the soil of this land new to the plow is exceptionally fertile, and the crop is receiving more and more attention from the large number of Italian farmers who have settled in that country. Argentina exports at the present time a larger proportion of its corn crop than any other country of the world, because the people, about as numerous as those of New York, do not yet use it largely as food, and for the fattening of live stock alfalfa generally suffices. During the three-year period 1920 to 1922 Argentina exported 132 million bushels per year or over one-half her crop, while the American export of 106 million per year was about one-thirtieth of the total crop. The possibilities for the relative increase of corn production are probably better in the Paraná Valley than in any other corn zone, because of the sparse population and large area, of which only 50,000 square miles is yet in cultivation. As compared with the United States there is, however, a disadvantage in the less regular rainfall and the occasional pest of locusts.[30] The area planted has for some reason remained strangely static from 1909 to 1924.

There are many scattered places where corn is grown to some extent, as in northern New Zealand, and in the eastern margin of Australia, but here it has to battle against droughts and scanty rainfall and is unimportant. The southern part of Australia might grow more corn, but the land is still largely uncleared, being covered with forests or heavy underbrush. Its development is hampered by the newness of the country and the high cost of labor. South Africa, in spite of droughts, hailstorms and locusts is now growing half as much corn as Texas, and exported 11 million bushels in 1922. The grain may be grown almost anywhere through the torrid zone and is grown in many scattered places in Africa.

Corn must have hot nights for a part of its growth and the cool night of arid climates bars it from many irrigated districts in western United States. This fact, in common with the dry summer of the Pacific coast, causes corn to be of almost no importance west of the Rocky Mountains.

The present predominance of the United States in the world's

[30] In January, 1925, Pittsburg steel mills shipped to Argentina 964 carloads of steel sheets valued at more than $5,000,000, to be used to line the sides of ditches in the fields, so that the crawling hordes of locusts could not climb out and might therefore be trapped and burned.

corn production is well shown by the fact that the crop of 1923 (3,054 million bushels) was 73 percent as large as the estimated world crop of that year and 69 percent as large as the largest world crop ever before reported (4,437 million bushels in 1920).

TABLE OF FOOD VALUES

(Figures from U. S. Department of Agriculture)

	Refuse	Water, percent	Protein, percent	Fat, percent	Carbohydrates, percent	Fuel value per pound, calories
White bread		35.3	9.2	1.3	53.1	1,200
Wheat flour patent roller process, high grade and medium.		12.0	11.4	1.0	75.1	1,685
Wheat flour, entire wheat		11.4	13.8	1.9	71.9	1,675
Rye flour		12.9	6.8	0.9	78.7	1,620
Corn meal		12.5	9 2	1.9	75.4	1,635
Rice		12.3	8.0	0.3	79.0	1,620
Beans, dried		12.6	22.5	1.8	59.6	1,520
Beans, baked		68.9	6.9	2.5	19.6	555
Potatoes	20.0	62.6	1.8	0.1	14.7	295
Sweet potatoes	20.0	55.2	1.4	0.6	21.9	440
Bananas	35.0	48.9	0.8	0.4	14.3	260
Apples	25.0	63.3	0.3	0.3	10.8	190
Almonds	45.0	2.7	11.5	30.2	9.5	1,515
Chestnuts, fresh	16.0	37.8	5.2	4.5	35.4	915
Coconuts	48.8	7.2	2.9	25.9	14.3	1,295
Peanuts	24.5	6.9	19.5	29.1	18.5	1,775

TABLE OF FOOD VALUES—*Continued*

	Refuse	Water, percent	Protein, percent	Fat, percent	Carbohydrates, percent	Fuel value per pound, calories
Chocolate		5.9	12.9	48.7	30.3	2,625
Dates	10.0	13.8	1.9	2.5	70.6	1,275
Sirloin steak	12.8	54.0	1.65	16.1		975
Neck of beef	27.6	45.9	14.5	11.9		1,165
Cod, salt	24.9	40.2	16.0	0.4		325
Salmon (canned)		63.5	21.8	12.1		915
Eggs: Hens' eggs	11.2	65.5	13.1	9.3		635
Whole milk		87.0	3.3	4.0	5.0	310
Cheese, full cream		34.2	25.9	33.7	2.4	1,885
Butter		11.00	1.0	85.0		3,410
Oleomargarine		9.5	1.2	83.0		3,525
Unrefined lard		4.8	2.2	94.0		4,010
Pure olive oil, Pure coconut oil, Pure peanut oil, Pure cottonseed oil				100.0		4,040

REFERENCES

See General References

Ball, C. R., and others. "Wheat Production and Marketing." *Yearbook,* United States Department of Agriculture, 1921.

Wallace, H. C. "The Wheat Situation." *Yearbook,* United States Department of Agriculture, 1923.

Clark, J. A. "The Durum Wheats." United States Department of Agriculture, *Farmers' Bulletin,* No. 1304 (1923).

Ball, C. R., and others. "Oats, Barley, Rye, Rice, Grain Sorghums, Seed Flax and Buckwheat." *Yearbook,* United States Department of Agriculture, 1922.

Leighty, C. E. "The Place of Rye in American Agriculture." *Yearbook,* United States Department of Agriculture, 1918.

Harlan, H. V. "Cultivation and Utilization of Barley." United States Department of Agriculture, *Farmers' Bulletin,* No. 968 (1918).

For other topics, see: "Cyclopedia of Farm Crops." Macmillan, 1922.

Chambliss, C. E. "Rice Growing in California." United States Department of Agriculture, *Farmers' Bulletin,* No. 1141 (1920).

——— "Rice as Food." (Prepared by Office of Home Economics.) United States Department of Agriculture, *Farmers' Bulletin,* No. 1195 (1921).

Rothgeb, B. E. "Grain Sorghums—How to Grow Them." United States Department of Agriculture, *Farmers' Bulletin,* No. 1137 (1920).

Leighty, C. E., and others. "The Corn Crop." *Yearbook,* United States Department of Agriculture, 1921.

Brown, E. "How Seed Testing Helps the Farmer." *Yearbook,* U. S. Dept. Agriculture, 1915.

Smith, J. R. *The World's Food Resources.* New York, 1919.

CHAPTER IV

STARCH FOODS

Two chief food elements. Starch, one of the two most universal food elements of all mankind, is classed as a carbohydrate—an energy food. It helps to make fat and heat to keep the body warm and gives energy for work. Starch is really the surplus nutrition which the plants store within themselves for future needs or for their offspring. Sometimes it is packed in the seeds, as in the grains; or the roots, as in sweet potatoes; or in the peculiar underground stem, as in the white potatoes; or even in the trunks of some of the trees, as in the sago palm. The other great food element is proteid, furnished by milk, meat, cheese, eggs, most of the nuts, and the leguminous plants, of which peas and beans are the best and commonest examples. Protein, the tissue or muscle-maker, is contained to some extent in all the grains, from wheat, the richest in protein, to rice, the poorest, so that the grains, by containing both the great food principles, are almost perfect food, save for the needed roughage and vitamins of leaf greens. As rice is the richest in starch, there is less need for the production of other starch-producing plants by rice-using peoples.

I. POTATO

Distribution and use. The potato is probably exceeded only by bread in the number of times per year it is eaten by the average European or American. The plant is a native of America, growing wild on Mexican, Bolivian and Peruvian plateaus, whence it was taken to Spain, to Italy and to Vienna. From Vienna (1598) it spread rapidly through Germany. Introduced into Ireland in 1586 by Sir Walter Raleigh, it soon became important. By 1760 potato growing was general in Scotland, and its growth to some extent is common in all Caucasian lands. It appears occasionally even in Africa, but was not introduced into China till about 1875. In the rice-growing parts of this empire the potato is held in contempt, but in the mountainous and northern parts it is diligently grown and with much pride. Its esteem is increasing. The potato has certainly established itself as a great cool climate starch food. It is probably the plant most commonly grown in the vegetable gardens of Europe and America; but its growth as a money crop is quite restricted, offering in this respect a marked contrast to wheat. The potato and rice are rivals in the supplying of starch upon the tables of Europe and America, but the two plants are rarely rival claimants for the same farmer's attention. The recently redis-

FIG. 53.—Aroostook potatoes as laid out by the digging machine. (Courtesy Coe-Mortimer Co.) (From *North America*, published by Harcourt, Brace and Company.)

covered art of making potato flour has given the otherwise perishable tuber a new means of competing with rice, but thus far the flour has not met with very wide use outside of Germany where it was first manufactured.

QUALIFICATIONS OF A POTATO COUNTRY. The potato is a crop of wide climatic range. Cold Alaska as far north as Fairbanks produces potatoes regularly (23,000 bushels from 250 acres in 1923), and they are cultivated down to the sub-tropic, as in Florida and Egypt. The potato tolerates a variety of soils. It grows well on land that does well in wheat or corn, but tends to become important as a main starch food for people and a money crop for farmers

CROP COMPARISONS FOR 1923

			Potatoes			Wheat		Barley		Rye		Corn		Oats	
	Pop. mil.	Pop. per sq. mi.	Acreage 1,000	Crop mil. bu.	Bu. per capita	Acreage 1,000	Crop mil. bu.	Acreage 1,000	Crop mil. bu.	Acreage 1,000	Crop mil. bu.	Acreage 1,000	Crop mil. bu.	Acreage 1,000	Crop mil. bu.
United States.	110.9	30.6	3,816	412.3	3.7	58,308	785.7	7,905	198.1	5,157	63.0	104,158	3,054.4	40,833	1,707.0
Germany	59.8	328.4	6,735	1,197.1	20.0	3,653	103.6	2,947	99.1	10,785	282.4	....	....	8,262	411.7
Russia	135.9 ‡	68.0 ‡	11,167	1,274.4	9.4	62,066	838.7	30,165	557.6	71,882	972.0	4,210	72.8	42,043	1,105.6
France	39.2	184.3	3,560	350.3	8.9	13,656	290.4	1,799	57.1	2,171	36.9	760	11.9	8,545	377.5
U. Kingdom .	47.3	389.2	604	361.8 †	7.6	1,799	57.1	1,486	48.0	7 *	1.2 *	....	....	2,944	138.8
Belgium	7.4	635.2	374	88.8	12.0	341	12.5	93	4.2	558	19.5	....	....	652	36.4
Sweden	5.9	34.4	392	61.2	10.4	363	11.6	410	11.7	574	25.4	....	....	1,800	66.8
Poland	27.1	185.0	5,632	903.4	33.3	11,380	257.5	2,953	82.0	11,380	257.5	183 †	2.8 †	6,114	259.9
Rumania	17.4	142.2	408	37.7 †	2.1	650	10.2	4,841	69.0	650	10.2	8,411	174.1	3,350	63.7
Italy	38.8	323.7	890	67.4	1.7	3,411	224.8	568	10.5	311	6.4	3,707	84.0	1,223	39.8
World crop ..	......	......	3,949.7			3,691.8		1,460.7		1,431.7		4,201.9		4,142.8	

‡ 1910. * Ireland, 1922. † 1922.

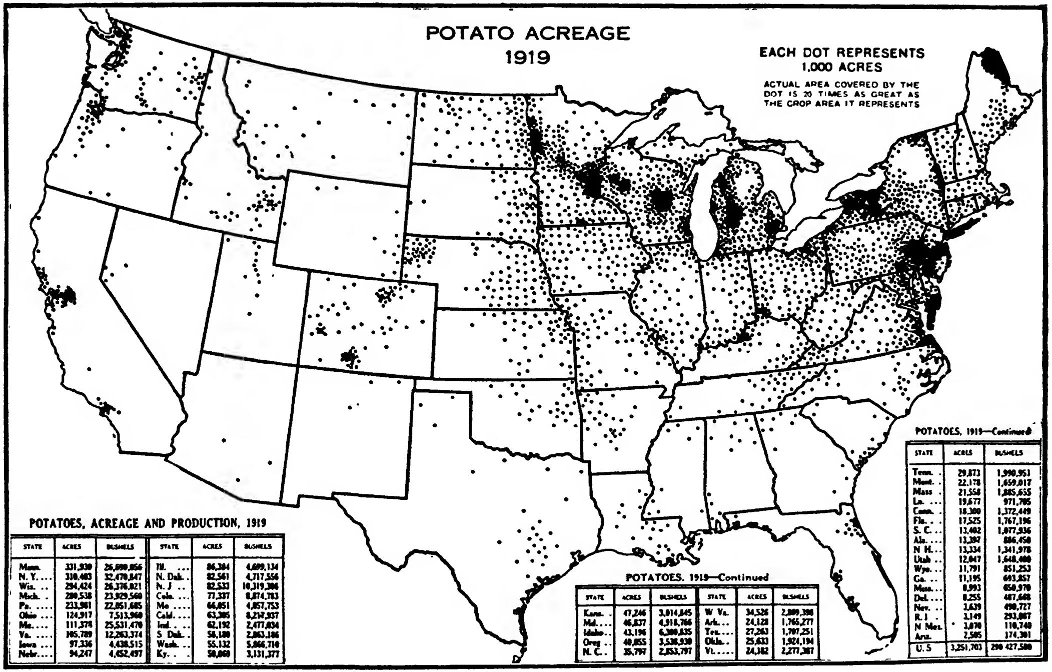
in regions where it is too cool for corn to grow to the best advantage, or where the soil is too sandy and light for the large yields of small grains.[1] It does not do well on heavy clay. The regions that meet the potato conditions are northern and northeastern United States, Canada and north Europe. North of the Alps the potato is exceedingly important, as the region combines coolness with much sandy soil and many people. South of the Alps the dry summer of the Mediterranean climate checks its cultivation. Thus Sweden, with 6 million people, grows as many potatoes as Italy, with 39 million people. In southeastern Europe, as in America, it does not compete much with corn, Hungary with its hot summer being a great corn grower, while Germany, Poland and northern Russia with their cool summer climate are the great potato producers.

The table of crop comparisons for 1923 shows many interesting things about man's relation to the earth which supports him—among them the great per capita growth of potatoes, barley and rye in north Europe where corn is not grown; and the small growth of these three northern crops in southeastern Europe, southern Europe and the United States where corn is more at home. The figures for Poland (in the Baltic basin) and Rumania (in the Black Sea basin) offer strong contrast of northern and southern influences. The maps of United States potato production and corn production show these same facts quite as sharply in the different regions of this country.

The bulky tuber yields five times as many bushels per acre as does wheat, and therefore it is of great value in enabling land to support dense populations, although a bushel of potatoes is not so nutritious as a bushel of grain.[2] (See table of food values, p. 111.) Owing to the laborious method of preparing the seed, the expensive fertilizers necessary, the continuous cultivation, and protection from insects, the potato crop requires more labor than any of the grains. Hence potato fields are smaller than grain fields, and the crop is well fitted to intensive agriculture where a small area must, by

[1] The comparison of the Department of Agriculture map of dairy products with that of potatoes shows in central Wisconsin a dairy vacancy and a potato concentration at the same place that soil maps show a wide stretch of sandy soils.

[2] The United States plants about 4 million acres to potatoes each year, average yield 97 bu. (1913-22); 60 million acres to wheat, average yield 14.4 bu.; and over 100 million acres to corn, average yield 27 bu.



POTATOES, ACREAGE AND PRODUCTION, 1919

STATE	ACRES	BUSHELS	STATE	ACRES	BUSHELS
Minn.	331,930	26,690,856	Ill. ...	86,384	4,699,134
N. Y.	310,403	32,470,847	N. Dak. .	82,561	4,717,556
Wis. ..	294,424	26,376,021	N. J ..	82,533	10,319,306
Mich. .	280,538	23,929,560	Colo. ...	77,337	8,874,783
Pa.	233,981	22,051,685	Mo	66,051	4,857,753
Ohio ...	124,917	7,513,960	Calif. ...	63,305	8,217,937
Me. ...	111,378	25,531,470	Ind. . ..	62,192	2,477,034
Va.	105,789	12,263,374	S. Dak. .	58,100	2,863,186
Iowa ...	97,336	4,438,515	Wash. ..	55,132	5,866,710
Nebr. ...	94,247	4,452,497	Ky. . .	50,060	3,131,377

POTATOES. 1919—Continued

STATE	ACRES	BUSHELS	STATE	ACRES	BUSHELS
Kans. .	47,246	3,014,845	W. Va.	34,526	2,809,398
Md. ...	46,837	4,918,766	Ark. ..	24,128	1,765,277
Idaho. .	43,196	6,300,835	Tex. ...	27,263	1,707,251
Oreg. .	40,855	3,538,930	Okla. .	25,633	1,924,194
N. C. .	35,797	2,853,797	Vt.	24,182	2,277,387

POTATOES, 1919—Continued

STATE	ACRES	BUSHELS
Tenn. .	29,873	1,990,951
Mont. .	22,178	1,659,017
Mass .	21,558	1,885,655
La. ...	19,677	971,705
Conn. .	18,300	1,372,449
Fla. . .	17,525	1,767,196
S. C. ..	13,402	1,077,936
Ala. ...	13,397	886,450
N. H. ..	13,334	1,341,978
Utah ..	12,047	1,648,400
Wyo. ..	11,791	851,253
Ga. ..	11,195	693,857
Miss. ..	8,993	650,970
Del. ...	8,255	487,668
Nev. ..	3,639	490,727
R. I. .	3,149	293,087
N. Mex.	3,070	110,740
Ariz.	2,505	174,301
U. S	3,251,703	290 427,500

FIG. 54.—Compare this map with the corn map and note how heavy growth of corn and potatoes do not cross. (United States Dept. Agr.)

much labor, be made to yield a large product, such as is necessary in countries of dense populations. The potato harvest, toward the end of summer, leaves the ground in excellent condition for a fine crop of winter grain which usually follows it. The potato also responds well to intensive cultivation, the average yield of Germany being 200 bushels per acre for a ten-year pre-war period, or more than double the yield in America.

Where the potato is most grown. Ireland, a country of few resources and cool moist climate, probably has a greater dependence upon the potato as a crop for the farm and food for people than any other country in Europe. So great was this dependence that in 1846 a failure of the potato crop, due to a blight, was followed by famine from which thousands of people died. In 1924 a wet summer in west Ireland repeated this same performance in miniature, and the call for help went out to foreign lands.[3] Scotland, with agricultural resources like those of Ireland, but much more meager, also has potatoes as an important crop. The plain of north Europe, reaching from the northwest point of France, through Holland and Belgium, Germany, Poland, the other Baltic states and Russia to the Ural Mountains, has in many places a sandy soil, and is the seat of the greatest potato-growing region in the world. The potato is important to the French. With less than half our population they grow as many potatoes as we do (about 400 million bushels). The Dutch and Belgians make their small countries produce a surprising amount of potatoes. The production in Belgium is about 20 bushels per capita while the United States produces only 4 bushels per capita or less.

Germany with her cool sandy northern plains finds the potato one of the best crops she can grow, and for years she has been the greatest potato-producing country in the world.[4] During the World War it was generally understood that a failure of the potato crop any one year would have wrecked Germany, through the reduction in the supply of man food, pig food, cow food and alcohol motor

[3] The misery of the Irish peasant was accentuated by cold because the continuous rain would not let the peat turf dry to supply the fuel gathered annually from the bogs.

[4] The stupendous potato crop of Germany, which, after all, covers but little more ground than Maryland, gives cause for the interesting statement of Professor S. N. Patten that it was the potato that enabled Germany in 1870 to overthrow France, long her superior, in the days when wheat was a more exclusive basis of man's support than it has been since.

fuel. In 1924 our corn export to Germany for distillation was being replaced by German potatoes.[5] Along with Holland, Belgium and the north of France, Germany exports some potatoes to England, which has potato land and potato climate but has not yet utilized her resources as Belgium has. Poland, which emerged from the re-making of Europe as the world's second largest potato producer, grows from two to three times as many as the United States. Russia and the three Scandinavian countries with their cold climate and areas of sandy soils are relatively heavy growers and consumers of the potato. Even Switzerland grows nearly 30 million bushels a year, and usually supplies her own needs, despite the fact that her 16,000 square miles of area are encumbered by the stupendous Alps

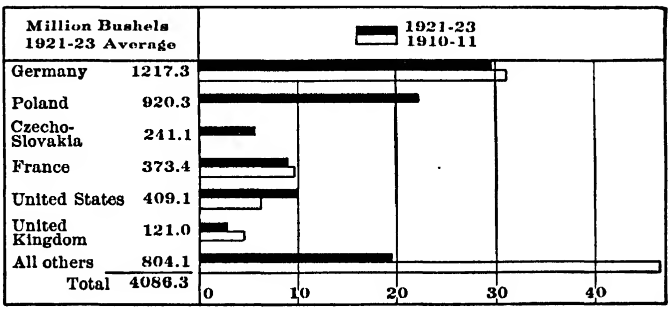


FIG. 55.—World's potato production, three-year average.

and she has 3,880,000 people to feed—another evidence of the value of the potato in intensive agriculture. Switzerland even suffers at times from over-production of potatoes.

In Germany, with her lack of oil and her high chemical skill, a particularly large flavorless potato unsuitable for food but yielding very abundantly, is grown to the extent of about 60 million bushels a year, for the sole purpose of being distilled into alcohol for fuel or drinking purposes. The same practice also prevails, but to a lesser extent, in Holland and Belgium. After making allowance for distillation and export, Germany uses five times as many potatoes per capita as the United States, Belgium and Sweden three times as many. In Italy and in Chile, countries with the Mediterranean type of climate that is ill suited to the potato, the consumption is but half as great as ours. The abundance of the potato in

[5] The distillation refuse is good pig and cow food.

a country with potato climate may, to some extent, be taken as a sign of land scarcity.

THE POTATO IN THE UNITED STATES. Owing to the average American's ability to raise corn and to buy higher priced foods, the potato is less sought as food in America than it is in Europe. The chief centers of its growth lie north and east of the corn belt. The graph showing the production in the eleven leading states shows how distinctly the potato separates itself from the corn crop, only two corn states, Ohio and Minnesota, being in the list. The potato is grown to a great extent as a money crop in certain sandy areas in Minnesota, Wisconsin, Michigan, and also in parts of Pennsylvania, New York, and New England, especially Maine. In the adjacent and similar parts of Canada it is of even greater relative importance, Prince Edward Island, cool, loamy and Scotch, having the astonishing figure of 70 bushels per capita.

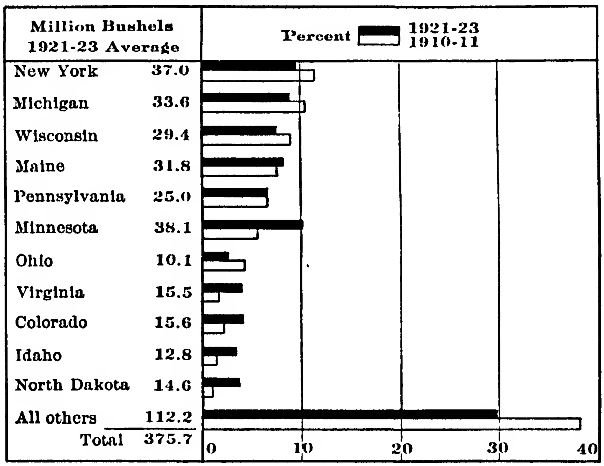


FIG. 56.—United States potato production, three-year average.

The growing of potatoes as a money crop tends to become very much concentrated in certain districts. In Aroostook County, in the St. Johns River Valley in northern Maine, agriculture, which had greatly declined, suddenly revived through the rapid rise of potatoes as an export money crop for that district. Similarly, Monmouth County, New Jersey, between New York and Philadelphia, has become a potato center, shipping in a single season more potatoes than the whole state of Massachusetts produces. The sandy soil of the Atlantic Plain from the east end of Long Island to Florida is much of it better suited to potatoes than to grain crops; and on eastern Long Island, as in the only two counties of Vir-

FIG. 57.—The corn was planted after a 200 bushels to the acre crop of potatoes. Cowpeas were sown among the corn—three crops in one year. Eastern North Carolina. Possible over large areas. This has been called intensive-extensive agriculture. The *yields* are intensive. The *method* is extensive in that it uses horses and machines, and can be carried on over large areas.

ginia that lie east of the Chesapeake, the shipments of potatoes have within a decade made the farmers very prosperous. These specialized centers have become so in part because of coöperative marketing organizations. These organizations stimulate production by improving technique, for example, certified seed.

THE SUPPLY OF EARLY POTATOES. The supply of early potatoes for northern markets from southern lands gives rise to an important industry in many parts of the world. Thus, Algeria derives a large income from potatoes which reach Paris in thirty-five to forty hours. Egypt sends the first potatoes of the season across the Mediterranean to northwest Europe. In American cities the earliest supply of new potatoes comes into the market before Christmas from the islands of Bermuda, situated 600 miles from New York, in the latitude of South Carolina, in the frost-free climate furnished by the Gulf Stream. This greater evenness of temperature of the oceanic as compared to the continental climate thus becomes the basis of Bermuda's chief export. The next potatoes for the northern cities of the United States are from Florida, where frost is rare and often absent, and potatoes can commonly be grown any time during the winter. Then, as the spring advances northward, other accessible points in the Atlantic Plain, such as Savannah, Ga., Charleston, S. C., New Bern, N. C., southeastern Virginia near Norfolk, the peninsula east of the Chesapeake Bay, southern New Jersey and Long Island, in turn send their carloads and trainloads or shiploads of new potatoes to the northern and western states. Throughout the winter and early spring the price of new potatoes in northern cities steadily declines as spring moves up the coast from Florida to Long Island and each locality holds the market but a short time. Yet this warm, coastal plain is not the ideal place for the potato; and the whole of it south of Chesapeake Bay does not produce half as many potatoes as the state of Maine. To keep the potato plant from degenerating, the Coastal Plain crop is regularly grown from seed potatoes produced in Maine and other northern points where the species maintains the desired vigor and rapidity of growth.

The main supply of the country for the winter months comes from the northern potato districts between Maine and Colorado.

The potato is important in the irrigated lands of the Rocky Mountains and Pacific states where the cool nights forbid the growth of corn. The expense of getting the water requires a heavy yielding crop. Production under irrigation is limited only by the demand. Sometimes our Rocky Mountain potatoes go to the pigs by the wagon load.

THE POTATO IN FOREIGN TRADE. On account of the great bulk and weight of potatoes in proportion to value, and because of their perishable nature, they are much less important in international trade than in home production. As a whole, they have a tendency to become a national supply crop, with commerce limited to emergencies and early supplies. When, as occasionally happens, we have a shortage in this country, they come to us by the hundreds of thousands and even millions of bushels from Canada, Ireland, Scotland, Germany, and Egypt. We have normally a small export of potatoes to Cuba, Mexico, Central America and the West Indian Islands, where the warm climate makes their growth unsatisfactory,[6] and where a part of the population has a taste for this northern form of starch supply.

Considered in relation to the total value of the crop, the figures of our foreign trade in potatoes are conspicuous for their smallness and for the irregularity of the amounts.[7] In normal years our export is larger than our import, with Cuba as our customer for about half of them.

Potato production is limited by the home market and not at all by the land possibilities. Our 6,730 square miles in potato fields are an insignificant patch. A large crop gluts the market, and actual overproduction or the fear of overproduction and the consequent low price is the limiting factor in potato production. The price to the grower fluctuates between five cents and four dollars a bushel, between absolute loss and large profits.[8] The existing farms

[6] The potato varieties now in cultivation are from the wild potato of cool plateaus in South America. Those in low-lying tropic lands have thus far been neglected, one of the almost innumerable avenues by which agriculture might be enriched by crop creation—a line of work at which we might do so much and are doing so little.

[7] United States Foreign Trade in Potatoes.

United States	Potato exports, million bushels	Potato imports, million bushels
1918	3.85	1.20
1919	3.64	5.54
1920	4.15	6.06
1921	3.50	2.01
1922	2.90	1.77
1923	2.70	.73

[8] In 1924 we produced about four bushels per capita in the United States, although the acreage was 15 percent less than that of the previous glut crop of 1922. As a result they sold for a dollar a barrel in Aroostook County, Maine, the next winter. This was not profitable, despite a yield of 296 bushels to the acre.

and men and equipment of America could, if assured a price of a cent and a half a pound, easily double the potato crop without producing any corresponding lessening of other crops, and there is abundant room to grow ten or twenty times as many potatoes without interfering with other crops. If we could sell a surplus of 40 million or 400 million bushels of potatoes in the form of flour, cow feed, starch, and alcohol, as in the case of Germany, it would be a boon to agriculture and might help to stabilize the production of this perishable and valuable foodstuff.

The point is that in this country the price levels are such that we cannot afford to grow potatoes for stock food. Since the human demand is fairly constant the fluctuating crop means alternate glutted markets and starved markets, with throw-away prices and run-away prices. The fact that Germany has a steady outlet for potatoes as stock food at a reasonably profitable price gives a steady market price. For example, in five years before the World War, when Germany was drying 800 million bushels a year for stock food, there was a price fluctuation of twenty-seven cents a bushel in Berlin, while Chicago had a price fluctuation of $1.34.

As the potato fits admirably into spring wheat farm conditions, a reliable potato market might cause billions of bushels of them to be grown on the northern edge of the corn belt and the spring wheat belt with no serious reduction to the output of either grain. Since it has been well established that milk and potatoes are a balanced, wholesome and sufficient human ration (albeit a bit monotonous perhaps), talk about food scarcity in America borders on idiocy.

2. THE SWEET POTATO

The torrid zone is often said to have great possibilities for the support of human life. One evidence of this is the great abundance of starch-producing plants. One of these is the sweet potato, which causes the tropic denizen to have small regret over the fact that the white potato will not grow there. The sweet potato supplies the same need in human diet, and differs from the white potato only in the greater amount of sugar and nourishment that it contains (see table, page 111.) The sweet potato is a perennial where there is no frost, yet it will grow a crop in the warm summer as far north as Iowa or New York, and is a crop of considerable importance in American agriculture. Fortunately the sweet potato requires even lighter and sandier soil than the white potato and is, therefore, much grown on the sandy lands of the coastal plain in New Jersey, Maryland, and Virginia, where it is largely produced for shipment to the northern states. Similar sandy spots in Iowa, Illinois and the North-central States render similar service for the interior of the United States and western Canada. This crop is also very widely grown throughout the Southern States as a local food supply, where the people have the alternative of rice or sweet potatoes as their chief starch food in addition to corn bread.

Like the white potato, the sweet potato has enormous possibilities of increased production, if demand should arise. Unfortunately, it is even more difficult to market than its white cousin. A temperature of forty-five degrees gives it a chill which causes it to spoil in a short time. Therefore, it must be kept in warm cellars, although a pit of sand beneath the kitchen floor in many a southern home has kept them for many months. Should sweet potato flour meet with large demand the production of this crop might easily rival wheat in quantity of human food without serious interference with any of the world's existing agriculture. It is not difficult to obtain three to four hundred bushels per acre on southern sand of low fertility.

Importance of the sweet potato in the tropics. Although the United States has the largest recorded production, the sweet potato is a universal food crop in the torrid zone, its original home, whether it be in the Spanish-speaking settlements of South America, the English-speaking Honduras, the West Indian Islands, the coasts of Africa or the Malay Peninsula. Some varieties called yams grow large enough to weigh 40 or 50 pounds, but they have almost no commercial importance in the tropics because of their many rivals, the universal ease of their production, and the fact that there are few tropic cities large enough to require large movement of agricultural products.

3. CASSAVA

The garden in the rainy tropics always has some form of starch roots ready to dig. Cassava is one of these rivals [9] of the sweet

[9] In Jamaica, one of the few tropic territories with statistics, cassava ranks third among the ground provisions which are the principal articles of food among the natives, yams coming first and potatoes second.

potato that helps to fill the local need for a principal starch or bread-substitute food. To the peoples of the temperate zone it is a source of tapioca. (See Manufactured Starch, page 131.) To the tropic native it is both potato and bread. Like the sweet potato, cassava grows best in rich, sandy loam and needs abundant moisture. The plant reaches a height of 8 or 10 feet, and develops roots about 2 inches thick and sometimes as much as 6 feet long (usually much less). It is a native of America; but it is distributed throughout the tropics and is extensively used for food in many districts, especially in equatorial South America, Guiana, the West Indies, West Africa, the East Indian Islands and the Malay Peninsula. In all these lands cassava cakes are a standard article of diet for the natives and replace to a considerable extent the corn bread of the American negro, the boiled potatoes and rye bread of the European peasant, and all other breadstuffs of the temperate zone.

Experiments along the Gulf coast seem to indicate the possibility of extensive cassava growth in the United States.[10] In addition to its nutritious starch, the cassava root also contains the virulent poison known as prussic acid. Fortunately this poison is volatile and is dissipated by exposure to the sun or moderate heating, so that the cooked roots may be eaten with perfect safety.

4. THE BANANA

The banana is another great starch food, a rival of the potato, the sweet potato, rice and cassava. It has been cultivated so long it has ceased to produce seed. Wherever the climate is always warm and the rainfall suffices to support a dense tropic forest, the banana is at home. The banana belt goes around the world and reaches slightly into the north temperate zone, as at Madeira. With its great bunches of fruit it stands almost without a peer among nature's gifts to man. Wheat, corn, rice, and the potato we get by arduous labor and tillage, but one only needs to stick a root of a

[10] The dasheen, a variety of the Polynesian taro, has a starch-yielding root and is cultivated in the tropics to the extent of 100 species. It was introduced into the United States from Porto Rico in 1905, but only since 1913 has its use as a vegetable been slowly increasing in competition with our other starches. As it requires a rich, loamy soil, an abundance of moisture, and a frost-free season of at least seven months, its commercial production is limited to the coastal plain lands from South Carolina to eastern Texas.

banana tree in the favorable tropical earth and give to near-by rival plants a few blows with the machete (a sword-like knife common in the tropics) to keep the young banana plant from being overgrown. By the time the first stalk has produced its great gift of fruit, other young shoots from the original plant are coming up to replace the old one and bear fruit in their turn, a continuous and prodigal process. The amount of food per acre is greater than from any grain but far less than is often reported. Two hundred bunches per acre is considered a good crop in most banana lands, and the drain upon the soil is less than that made by a small crop of wheat. The common absence of plowing reduces to a minimum the soil waste from erosion which has so nearly destroyed the ancient world.

This ease of banana production should be emphasized in its effect on tropical life. More than any other one plant, it helps to make life easy in the tropics. In the Congo Basin and other humid parts of central Africa, where the climate is so bad for the white man, the nutritious banana is said to be the main article of diet for many, probably scores of millions, of the negro race. It merely replaces the potato of the north European peasant, and the rice of the southern Chinese. Scores of varieties are grown throughout the East Indies, south China, much of India, many of the West Indian Islands, Central America, the Philippines and other tropic lands from Mexico and Hongkong to Argentina and Queensland.

BANANA IN COMMERCE. Owing to the perishable nature of the fruit and consequent necessity of quick transportation, it was unknown to most people in the temperate zone prior to 1870. Following the first successful shipments its advance in popular favor was rapid, consumption in the United States doubling every five years from 1870 to 1900. The banana competes with our home-grown fruits and, to a limited extent, with the cereals and the potato, of which it is almost a duplicate in nutritive content. (See table of food values, page 111.)

Because of the difficulty of transportation, only certain favored locations in the tropics are near enough to the markets to export the banana. Central American and Jamaican bananas reach New Orleans or Galveston in from three to five days; the trip to New York or Philadelphia takes seven or eight days. The supply in Europe is inferior to that in the United States because that part of the tropics lying nearest Europe is the Desert of Sahara, where the banana cannot grow. The European supply has for a long time come from Madeira, the Cape Verde and the Canary Islands off the west coast of Africa; but fast steamers now carry the product of the West Indies and Central America to England in 14 days.

FIG. 58.—Bananas at New Orleans. The unloading machine (see bunches at the right) delivers them to the horizonal conveyor, thence to the trains (see left). (Courtesy United Fruit Co.) (From *North America*, published by Harcourt, Brace and Company.)

IMPORTANCE IN CARIBBEAN COUNTRIES. The nearness of the United States to the steaming hot plains that border the Caribbean Sea and the Gulf of Mexico has given us a favorable place from which to draw our supply of bananas. Owing to the unwholesome climate along the Central American coasts, nearly all the people live on the more healthful interior plateaus and the best banana lands have long lain idle. The comparatively new banana commerce, however, has caused recent rapid increase of settlements, mostly West Indian negroes, along the low eastern coasts.

The indolent native raises a few bananas for his own food; he does not ordinarily grow fruit for the international trade. Banana cultivation on a commercial scale requires capital such as only big industry can provide. The large plantations, with their railways, stores, villages, docks and ships, are owned by private corporations, and manned by thousands of native laborers under the supervision of northerners. One of the largest American companies owns hundreds of thousands of acres of land scattered in half a dozen countries, and annually ships millions of bunches to the United States and Europe in specially constructed steamers.

When the shiploads of bananas reach our ports, they are unloaded by elevators, carried to the doors of the refrigerator cars in mechanical conveyors, and hurried on express trains to the interior. From New Orleans, latitude 30°, whole trainloads are sent northward and northwestward into the lands of cotton, corn, and wheat, latitude 40°–50°, and across the continent to the Pacific coast. As a result of this highly organized international trade a hungry man on the streets of an American city finds in the ripe bananas the cheapest portion of nutritious, palatable and easily digestible food within reach.

This comparatively new trade has been little short of revolutionary in the effects it has had in the economic development of the Caribbean countries. While nearly all of them have at least a small banana trade, the six leading sources from which we obtain our fruit are Honduras with 11.6 million bunches shipped to the United States in 1923, Jamaica 9.2 million bunches; Panama 4.5 million, Guatemala 4.4 million, Nicaragua 3.4 million and Costa Rica with 3.1 million. In practically all of them bananas are the leading cash crop. There is also plenty of room on the Caribbean for more plantations should the demand arise, but the outbreak of a new disease, the banana wilt, has devastated many plantations. Immune strains may be expected.

Banana flour is now an article of commerce. This seems to offer room for expansion of banana growing, as the ease of transporting the dried product will permit remote localities to send them to market without the use of expensive refrigerator ships. *But we change our food habits slowly.*

DIFFICULTIES OF BANANA GROWING IN THE HURRICANE BELT. The people who live upon the shores of the Caribbean and the Gulf of Mexico have a double dependence upon the banana. It is to them a great supply crop because it is a standard article of food,[11] and to many of them it is also a very important money crop. Jamaica shows its importance as a money crop. Fruit exports of that island, chiefly bananas, have risen from $15,000 in 1869 to $350,000 in 1879, $1,500,000 in 1889, $4,000,000 in 1899, $7,500,-000 in 1909; and nearly $10,000,000 in 1922.

The banana is a vulnerable crop with special hazards of its own. Thus, in July, 1922, when two successive hurricanes swept across Costa Rica, the crop was completely wrecked, because the banana trees, with their heavy burdens and weak stems, were an easy prey to the violence of the storms. When the storms had passed whole fields of bananas were beaten to the ground. It was estimated that the total loss was 2,500,000 stems. Although the plants themselves were not destroyed the flowering of the next crop was also damaged by the incessant rains which followed the hurricanes. Consequently, the banana export, which is one of Costa Rica's chief sources of income, was reduced by one-third. Similar storms have sometimes damaged the Jamaican bananas so greatly that steamers carrying the fruit to the United States have to lay up for a few months pending the growing of another crop. In Bermuda, which often comes under the influence of several tropical hurricanes each year, the wind is so strong that the bananas can grow only in a few limestone sink holes which, like protecting walls, shelter the plants on all sides.

5. MANUFACTURED STARCH

STARCH IN THE FORM OF A DRY POWDER. Manufactured starch serves many uses among civilized men and is produced from a large number of starch plants by methods which, in nearly all cases, are similar. As starch can be easily washed out of the finely divided pieces of a starch-producing substance, a plant is simply torn to bits, the starch washed out in water, and allowed to settle. After a few washings the starch is ready for market. By this means the starch is separated from cassava roots and then is collected into lumps by being slightly heated, after which it is sold as tapioca. The cassava starch industry might be carried on almost anywhere

[11] Vendors peddle push-cart loads of fried plantains (cooking bananas) among the dock laborers in Caribbean harbors.

in the moist parts of the tropics where the labor supply is sufficient to do the work. The chief supplies come from Java and other islands in the East Indies, and from the Straits Settlements of the Malay Peninsula, where they are produced mainly by Chinese workmen living under the British rule. Brazil, with a large population of negroes and Portuguese in and near the coast cities, is another important tapioca producer.

The United States imported 89 million pounds of cassava and tapioca (mainly tapioca) in 1922 at an invoice cost of 3.1 cents per pound—a low figure for such a valuable starch food.

Starches from different plants have a different shaped grain and serve different uses. In some of the New England States, New York, and Wisconsin, much starch is manufactured from potatoes simply by washing the potatoes, grating them into small bits with rapidly revolving machinery, and soaking out the starch.[12] This variety is of value chiefly in sizing, that is, to hold together the fiber ends in the manufacture of textile goods.

Laundry starch is made from rice. A small amount of starch is made from wheat for use in dyeing textiles. The form of manufactured starch most commonly made in the United States is derived from corn. Many towns in the corn belt states have starch factories. This cornstarch is used in American cookery and more especially as the raw material for the manufacture of glucose, one of the sugars discussed in another chapter.

SAGO PALM. In the Far Eastern Tropics a form of starch is produced from the sago palm tree and extensively used as local food supply in Java, Borneo, Celebes, and adjacent islands. When a sago palm tree is about fifteen years old it blossoms profusely and produces a large amount of fruit. Before blossoming all the material for the production of this fruit is stored in the trunk of the tree in the form of starch. To get this accumulation of years the Malays, just before the tree blossoms, chop it into pieces 2 or 3 feet long, soak out the starch, dry it, make it into flour for cakes, or the "pearled" rounded masses which are to be bought in grocery stores as sago.

[12] In the last third of the nineteenth century, before the collapse of New England agriculture, remote country mills, water-driven, ground up potatoes, which were the chief money crop of isolated New Hampshire communities. Cheaper starch from other localities annihilated this industry about the same time that western produce annihilated New England grain and meat prices.

Future supply of starch. Considering the wide variety of plants (and parts of plants) and climates and soils yielding starch, and the fact that the tropic sources have scarcely been touched by modern scientific enterprise, it is plain that there is no scarcity of starch foods in sight.

REFERENCES

See General References

Stuart, William. *The Potato.* J. B. Lippincott Company. 1923.
Stuart, William. "Potato Production in the South." U. S. Department of Agriculture, *Farmers' Bulletin,* No. 1205 (1923).
Fiske, G. B. "Marketing the Early-Potato Crop." U. S. Department of Agriculture, *Farmers' Bulletin,* No. 1316 (1923).
Sherman, W. A., and others. "Marketing Main-Crop Potatoes." U. S. Department of Agriculture, *Farmers' Bulletin,* No. 1317 (1923).
Miller, F. E. "Sweet-Potato Growing." U. S. Department of Agriculture, *Farmers' Bulletin,* No. 999 (1919).
Fawcett, Wm. *The Banana, Its Cultivation, Distribution and Commercial Use.* Duckworth and Company. London, 1921.
Reynolds, P. K. "Story of the Banana." United Fruit Company.
Adams. *Conquest of the Tropics.* Doubleday, Page & Co. A description and eulogy of the United Fruit Co.

CHAPTER V

THE ANIMAL INDUSTRIES

I. MEAT AND THE MEAT SUPPLY

Meat tastes good. It is a great substitute for good cookery, but he who says it is a necessity shows his ignorance—double ignorance, ignorance of the world and ignorance of the science of nutrition.[1]

Among most peoples of the world, meat is something of a luxury and is becoming more so. That it is not a necessity is shown by the fact that millions of people rarely eat it and many never do. Some are even forbidden by their religion to eat flesh. An examination of the table of food values shows the sufficiency of vegetable foods, a fortunate fact, for many millions of the human race in Asia and Europe can rarely afford to eat meat because of their poverty.[2] It is a luxury possessed chiefly by the people of lands of sparse population, where for that reason meat is cheap. Man always has the choice of eating plant products directly or, if land is cheap and plant products abundant, he can feed them to animals and then eat the animals. The latter is much the more expensive form, for the making of a pound of meat requires the grass from much land or 5 to 10 pounds of grain, the equivalent of eight to fifteen 1-lb. loaves of bread. In densely peopled regions where there is not food enough

[1] Mr. Bernard Shaw, who is a vegetarian, put it thus when asked whether he thought an apple a day would keep a revolution away:

"I have repeatedly commented on the characteristic ferocity of vegetarians. The bull rhinoceros, elephant and human vegetarian philanthropist are typical examples of dangerous animals undulled by corpse eating. Armies fed on barley have conquered half the world; clans fed on oatmeal or potatoes have had to be exterminated because of their incorrigible pugnacity.

"Meat keeps people quiet, if they get enough of it. A week of beefsteak would change me into the mildest of men. Meat has not much value as a food, but it is incomparable as dope." (*New York Times*, October 24, 1924.)

[2] The French eat twice as much meat as the Italians; the Germans three times as much; the English four times as much, and the Americans slightly more than the English.

for both man and beast, man eats the food and does without the beasts.

Relation of meat animals to the density of population. Japan probably presents the most extreme example of a people who maintain a high civilization with few animals. With the exception of the northern Island of Hokkaido, the whole country has a population of from 400 to 500 people per square mile; and the

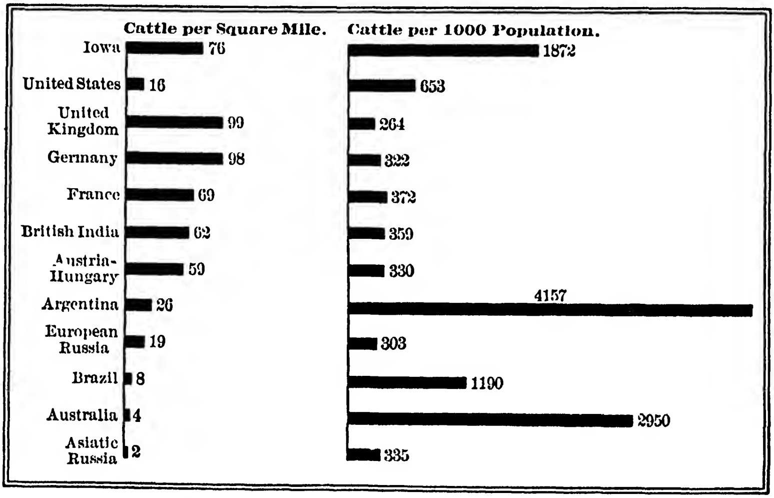


Fig. 59.—The chart of ratios of cattle to land and to population shows how the frontier, as Argentina, leads the old lands like England and Germany in cattle per capita. The per capita consumption of meat in Australia and Argentina is about 250 lb. per year. In United States it is about 160; United Kingdom, 120; France, 80; Italy, 45. Prewar figures are here used because they show a norm which only settled conditions can establish.

rough and steep country permits but a sixth of the land to be cultivated. The apparent room for pasture does not exist because of a dense growth of bamboo grass wholly unfit for food and impossible to eradicate. The effect of this absence of pasture and pressure of population in limiting the production of domestic animals is most marked. The Empire has over 55 millions of people, and of horses and cattle combined but 5½ percent as many, while the number of sheep and hogs is but ⅛ of 1 percent of the number of people. Both of these figures are utterly insignificant in comparison even to those of Europe. For the United States the ratios were 86 and 95 percent respectively in 1923 (113 and 130 in 1911).

Denmark is an agricultural country where some meat is eaten and animal products are an important factor in commerce. This country, three-fourths of it in fields and pastures, has four or five times as much of its area suitable for farms as Japan, and has passed the limit in the number of animals it can support on native food, since cattle foods such as wheat bran, cottonseed meal, linseed oil cake. and other grain products are being imported in large and

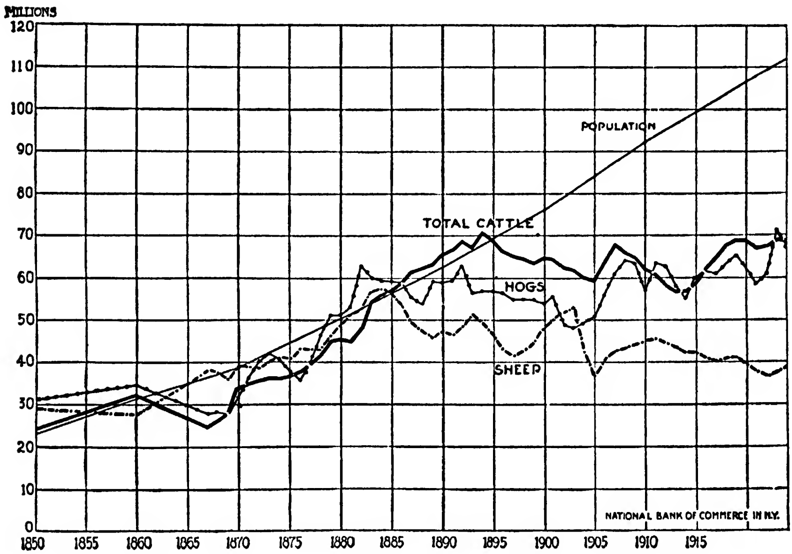


FIG. 60.—Livestock supply and trend of population in the United States, 1850 to 1923. This graph explains beautifully why the year 1900 marks the beginning of the rising cost of meat and of land in America.

increasing quantities from the United States, from Argentina, and (before the war) from Russia. The state of Iowa, practically all arable, a strictly agricultural state in the midst of the corn belt, is far better fitted than Denmark to support livestock; but it has far less horses and cattle per square mile. (Iowa 105, Denmark 187). Iowa, on the other hand, with 43 persons per square mile to Denmark's 136, has 212 hogs and sheep while Denmark has 194, the hogs greatly predominating in both cases.

Holland and Great Britain are examples of countries where the density of population has carried them beyond the position of Denmark over toward the condition of Japan. The population is 649 to the square mile in England and Wales, 127 in Scotland, and

138 in Ireland. There are 29 percent as many cattle and horses as people and 59 percent as many sheep and hogs. Ireland, with a relatively sparse population for west Europe, has a considerable export of meat to England, and maintained horse and cattle ratio of 127 percent and sheep and swine ratio of 102 percent of the population, thereby also exceeding Iowa in cattle units per square mile. Yet the people of the United Kingdom are the greatest meat-importing nation of the world.

On each square mile of the fertile and well-tilled Holland are 544 people, with cattle and horses 35 percent as numerous, and the sheep and swine 32 percent. Meat is imported into Holland, although the Dutchman eats less meat on the average than does the Englishman. Intensify agriculture as we may, dense populations inevitably find meat scarcer than do sparse populations.

MEAT ANIMALS IN SPARSELY PEOPLED LANDS. By turning to a country with sparse population, the reverse of the above conditions is met—cheap and abundant supplies of meat for home use and a large surplus for export. In the United States the average population is about 35 to the square mile; the numbers of the cattle and horses are 86 percent (113 percent in 1911) of the population, the numbers of sheep and hogs 95 percent (130 percent in 1911). The high ratio of animals to men makes the United States a great exporter of meat products, but the countries to which we send meat exceed us in the number of animals that they produce per square mile. In the United States there are on the average not over thirty cattle and horses per square mile. In Great Britain and Ireland there are 114 and in Denmark and Holland 190 per square mile.

The inevitable decline in the ratio of meat animals to man * has raised the relative price of meat in the United States and has, according to some estimates, cut in half the per capita meat consumption in the United States since 1840. Most of the increase in prices has occurred since 1901. The figures do not entirely show

* NUMBER OF MEAT ANIMALS PER 1,000 POP. IN U. S.

	1893	1903	1913	1923
Sheep	751	841	558	361
Hogs	733	617	665	618
Beef cattle	571	587	391	397

the facts because the average size of the slaughtered hog has declined.

The southern hemisphere with its newer and sparser settlements gives us the most striking examples of animal abundance. Argentina is half as large as the United States, but the population, less than in some single states of the American Union, is but 7.5 people per square mile on the average, and only 18 per square mile in their best agricultural province (excluding the city of Buenos Aires itself). The wealth of animals is astonishing in comparison with Japan, Europe, or even the United States. The percentage of cattle and horses to population is 430 percent in 1921 (550 in 1910) and of sheep and swine, 540 percent (1,000 percent in 1910).

In Australia, similar conditions prevail. The continent has nearly 3 million square miles, and while much of it is a desert, there are large areas suitable for keeping animals. The sparse population of about 1.8 per square mile has for each 100 people 290 horses and cattle and 1,400 sheep and hogs—chiefly sheep. South Africa is another large and empty land where the animal population exceeds the human. These figures show why meat and other animal products make up such a large proportion of the exports of these sparsely peopled south temperate zone countries.

2. SWINE

QUALITIES AND DISTRIBUTION OF THE HOG. Swine are meat animals of grain-growing lands, as the sheep is of grass-growing lands. Thus pastoral Australia has 100 sheep to one hog, and Iowa, a great corn state, has 13 hogs to one sheep. The hog was originally an animal of forest countries living upon acorns, nuts, roots, grubs, and other highly nutritious foods. Consequently, in domestication he must have somewhat similar foods, since his small stomach is not adapted to a complete diet of bulky grasses. In his original forest home he converted the abundance of autumn nuts into a layer of fat which covered his body and carried him through the hungry time of winter. Therefore, the rich grains of the farm suit him exactly. He is still fond of the nuts and acorns of his original forest home, but is able to eat anything from a piece of meat or garbage to the weeds which his owner pulls from the garden. This catholicity of diet may partly explain a higher meat yield for food consumed than is given by our other farm animals. Tame, harmless, hardy, and fecund,[3] the hog is an admirable door-yard scavenger and meat producer for the cottagers of many lands, and has attained an almost world-wide distribution, being of great local importance as a food supply in many countries where he is of no commercial value. He is the friend of the Irish and Russian peasant and of the new settler in British Columbia. He lives around the shack of the half-breed Indian of Mexico and South America, and is as friendly to the Spanish and Italian immigrant in the Argentine as he was around the stone house in the old countries of Europe. He is as much at home beneath the shack of the negro in the West Indies as by the palm leaf hut on the banks of the Congo or the coast of Guinea. In the eastern world he is common in China,

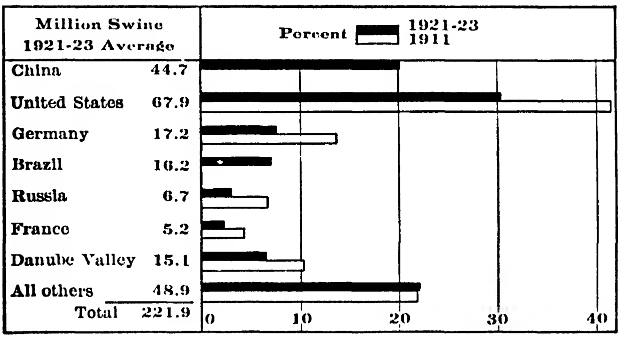


FIG. 61.—World distribution of swine, three-year average.

Malaysia, Australasia, and the mid-Pacific, where, in at least one group of coral islands, the price of a dusky bride is from ten to twenty pigs.

HOGS THAT RANGE IN FORESTS. In many parts of the United States it is customary to let the hogs run in the forest where the fallen mast provides a large part of their food. This occurs in the Appalachian Highlands, in the Ozarks of Missouri and Arkansas, and in many parts of the South Atlantic and Gulf States. Great injury to the southern pine forests often results from the up-rooting of the young pine which the hog kills by eating the succulent tap root. The excavating abilities of this pine rooter, a long-nosed beast

[3] It is a rare flock of sheep that increases 100 percent per year, while ten- to fifteenfold increase of swine is common. All these habits and abilities combine to explain the fitness of the hog as the meat animal par excellence of the lands of garden agriculture.

called "razor back," are an athletic marvel excelled only by his speed. In the southern states, salt pork, easily kept in a warm climate, is the staple meat food of the working man, white and black alike.

Hogs fatten in many south and central European forests. An important hog-raising district is located in southwestern Germany, where the animals can roam the beech forests and live on the beech nuts. In Yugoslavia, hogs, largely mast fed, are one of the most important exports in normal times. The fertile valleys of this mountainous country are carefully farmed chiefly for grain, but in the oak and beech forests of the mountains there is excellent feeding ground for hogs, which are sent to Budapest, Vienna and Germany. But the mast-fed hog is of relatively small importance in comparison

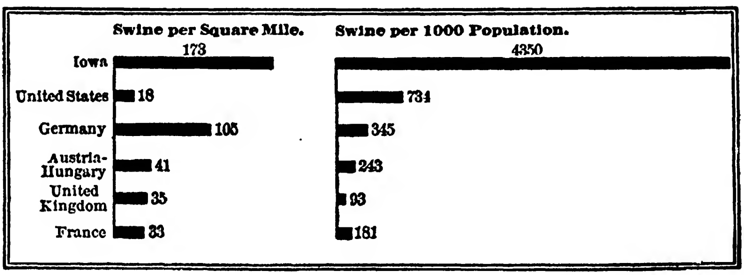


Fig. 62.—The numbers of swine per square mile will probably surprise many.

to the grain-fed hog. The growing of mast as a science has not yet received any serious effort.

Relation of the hog industry to grain growing. Since the hog must have some kind of concentrated food such as acorns, nuts or grain, he is a natural product of the regions producing cheap grains. The chief regions producing hogs for export, therefore, are those in which corn or barley abound. Since corn has long been the cheapest and also the most fattening of the grains, and since corn is much more important than barley for hog feed, the corn belt of the United States has a greater relative advantage than any other large area for the production of those cheapest of animal foods, pork and lard.[4] The corn belt is the leading hog,

[4] The United States Department of Agriculture states that it takes about 6 pounds of grain and 6 pounds of hay to produce a pound of lamb (live weight), 10 pounds of hay and 10 pounds of corn to make a pound of beef,

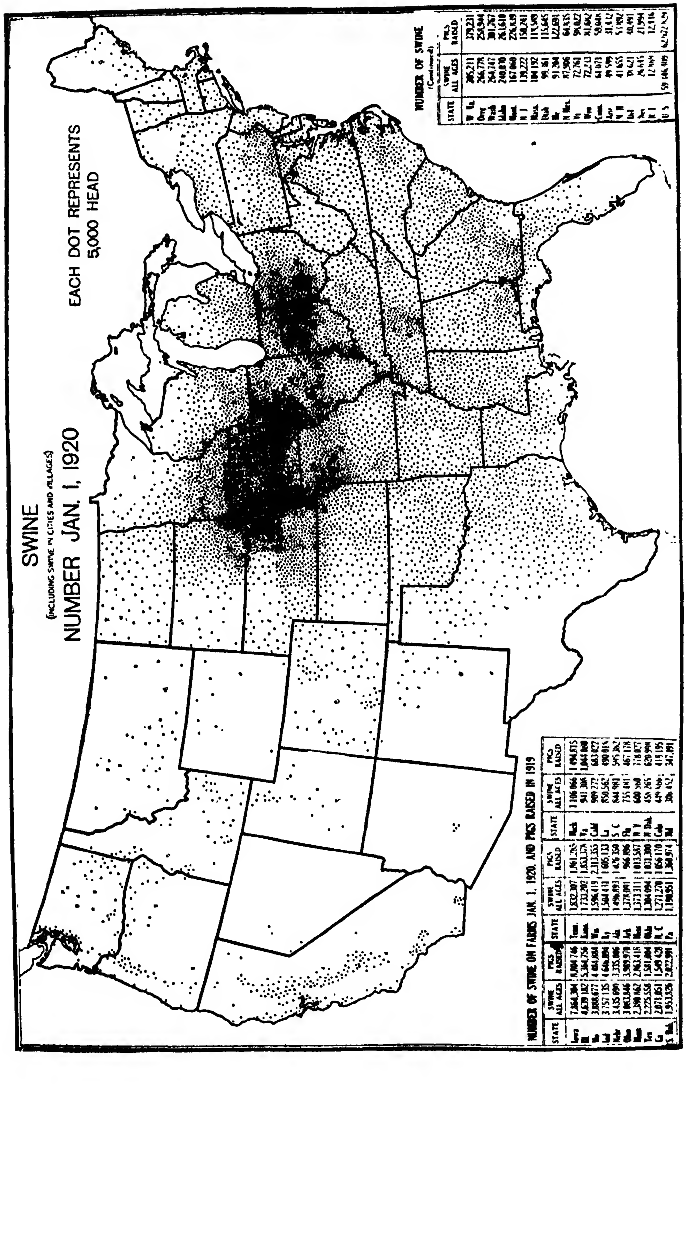


FIG. 63.—Compare this with the corn map. Corn and swine go together. (United States Dept. Agr.)

pork and lard exporting region of the whole world. The farmer in Iowa, Kansas or Nebraska nearly always grows one or two fields of corn, and often keeps from 20 to 100 hogs, which he feeds almost entirely upon the corn. Hog is condensed corn, and fully one-third of the American corn crop goes to the market in the form of pork. Owing to the great ability of this grain to produce fat, the American hog is often called the "lard hog," because of the large amount of lard (melted fat) he makes. He is quite different from the so-called "bacon hog" of the barley-growing districts of Canada and Europe. Owing to the fact that barley yields less grain and therefore costs

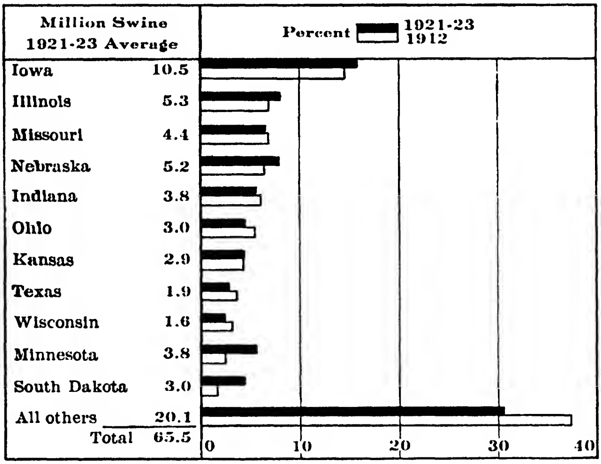


FIG. 64.—United States distribution of swine, three-year average.

more to produce than corn, the pork raisers of Canada and Europe feed their pigs as much as possible on grass, especially clover. This food, rich in protein, produces more lean meat in the pig's body than does the corn diet and the famed Danish or Irish bacon with its streaks of lean with the fat is the favorite on the English breakfast table. While Danish bacon on the British market in 1924 was selling at 22 to 24 cents, and Canadian at 17 to 21, the fatter American bacon was bringing only 14 to 17. (U. S. Commerce Reports, August 25, 1924.) Because of this desired leanness, some European bacon is imported into the United States, although we

and 5.6 pounds of corn or its equivalent for a pound of pork. Steers and sheep also dress off from 35 to 50 percent when butchered, while the waste of a hog carcass is only 25 percent.

have several millions more hogs than any other country, and send vast quantities of cheaper pork to England and Ireland. At the same time that Ireland imports American pork, it produces bacon of high quality, which is exported to the English market. The most important center of European hog production, however, is the barley region adjacent to the Baltic Sea in Germany, Poland and Russia. In China, with what may be called its ultimate agriculture, we see the agricultural triumph of the pig, the most efficient of meat producers. The tiny farm that cannot consider a sheep, cow or donkey, has one pig as a kind of animated, productive, edible garbage can.

3. DISTRIBUTION OF CATTLE

Wherever there are wide spaces of untilled grass lands we are likely to find cattle, especially if the pasture is good rather than poor. They were pioneers during the nineteenth century upon the vast plains that the white man won from the wild animals and natives in North America, South America, Australia, and central Asia. On account of their size, strength, and speed, they can combat dangers, or, if necessary, flee from them. Their ability to withstand heat and moisture has enabled them to go into lower latitudes than sheep. With the exception of the humid plains of the Amazon and central Africa and a few places in the Oriental tropics, they are to be found from the Straits of Magellan to Hudson Bay in the Americas, and from Tasmania to Kamchatka and North Cape in the Old World.

In the first stage of the occupation of new plains, before transportation has been well developed, the only export products cattle can furnish are the non-perishable hides and tallow. Sixty years ago the half-breed Indians on the plains of the Argentine were producing these commodities at the same time that the American Indians and frontiersmen were skinning buffalo for their hides upon the great American Plains reaching from southern Texas to Lake Winnipeg and beyond. This vast plain was a splendid pasture and had been occupied by the buffalo, a close relative of the ox, for an unknown period of time. They wintered in the warm lands from Oklahoma to Mexico and each spring went north across what is now northern Texas, western Kansas, Nebraska, Dakota and on into Canada. With the approach of winter they migrated south, the herds often covering the plains for miles in such great numbers that they actually stopped the progress of trains when the first railroad was built across the plains from Omaha in 1868. In the next four years, many millions of buffalo were slain for sport or for their skins, and now this great animal is practically extinct,[5] except for a few herds in National Parks, private reserves, and zoölogical gardens. His place was promptly taken by the long-horned Texas cattle which had run wild with him for three centuries since their ancestors had got away from the early Spanish settlers. In living

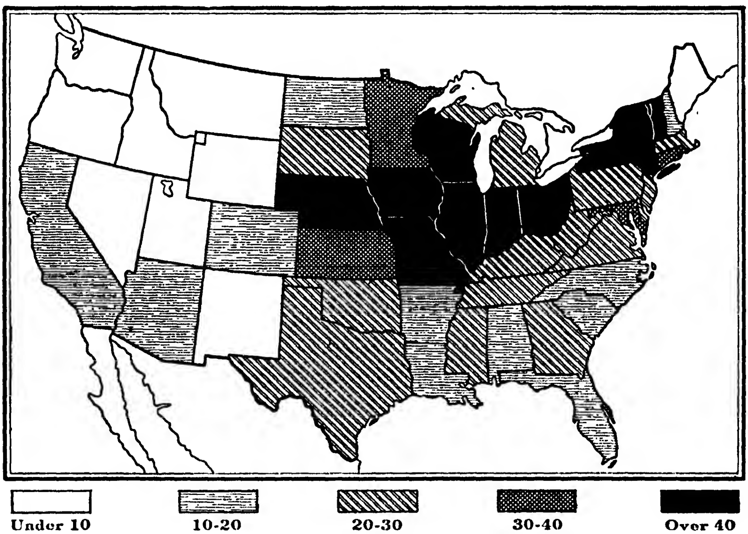


FIG. 65.—Cattle in the United States per square mile by . tates, Jan. 1, 1924.

with the buffalo on the plains they had become well adjusted to the conditions of the life. Their long horns were admirable defense against wolves and bears, their long legs and muscular bodies were efficient in flight. But the animal himself was not very good for beef and so he has been improved (and almost eliminated) by crossing with better breeds brought from England. The recent rapid increase of the buffalo suggests that he may yet become the cattle of the plains to which he is so supremely adapted.

The earlier part of this chapter showed, however, that cattle

[5] A small wild herd, now called the Woods Buffalo, is reported to have fled this slaughter by taking refuge in the forests near Great Slave Lake. Zoölogists are already reporting change of form.

reach their greatest density in districts of comparatively dense population.

CATTLE ON THE GREAT PLAINS OF NORTH AMERICA. The great open plain west of the one hundredth meridian was too dry for good farming; therefore the pioneer farmer could not take it, as he had taken up all Iowa and the eastern parts of Kansas and Nebraska. The United States Government, to which the land belonged, would not sell it, for fear of great estates and land monopolies. Although

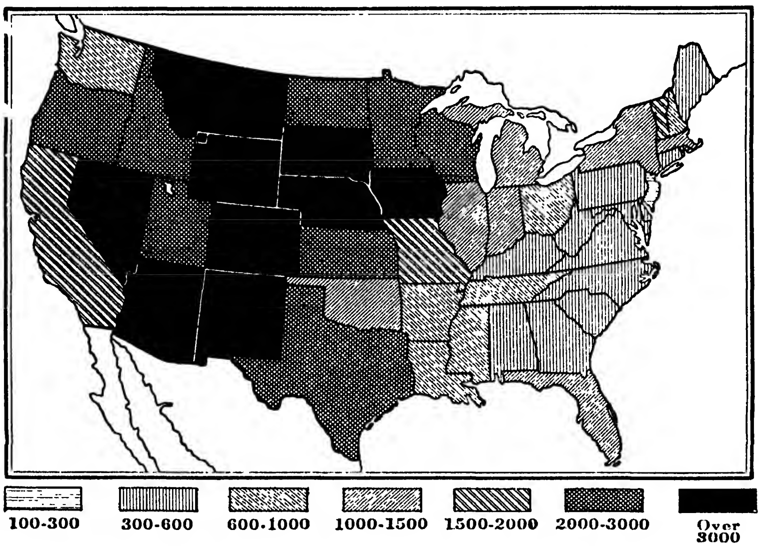


FIG. 66.—Cattle in the United States per 1,000 rural inhabitants, by states, Jan. 1, 1924. Population, 1920.

it was excellent pasture for a few cattle per square mile, no one could afford to take it even as a gift; under the homestead law which gave 160 acres to each settler, but limited his acquisitions to that amount. In a land fit only for scanty pasture, a man needs hundreds of acres. So this vast area of the plains, larger than any European country except Russia, remained every man's land, as the Government would not sell it and people could not take it as a farm homestead. People branded their cattle, turned them out upon the plain in great numbers, and then, after an annual round-up when all the cattle in a large area were brought together, each man took the cattle that had his brand and sold them. This was a very cheap

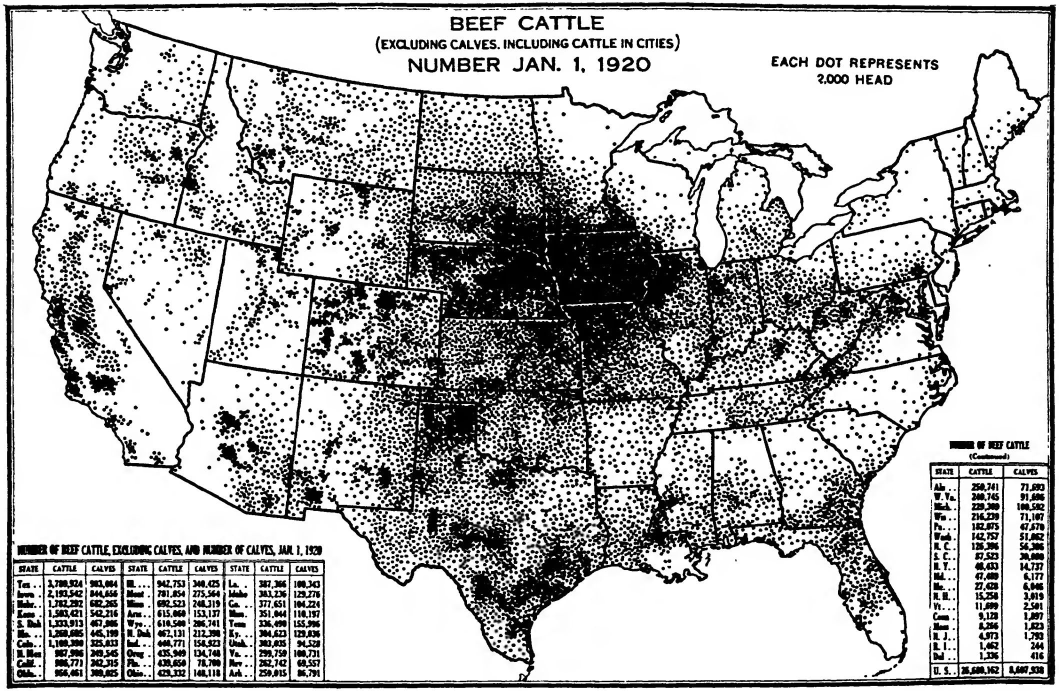
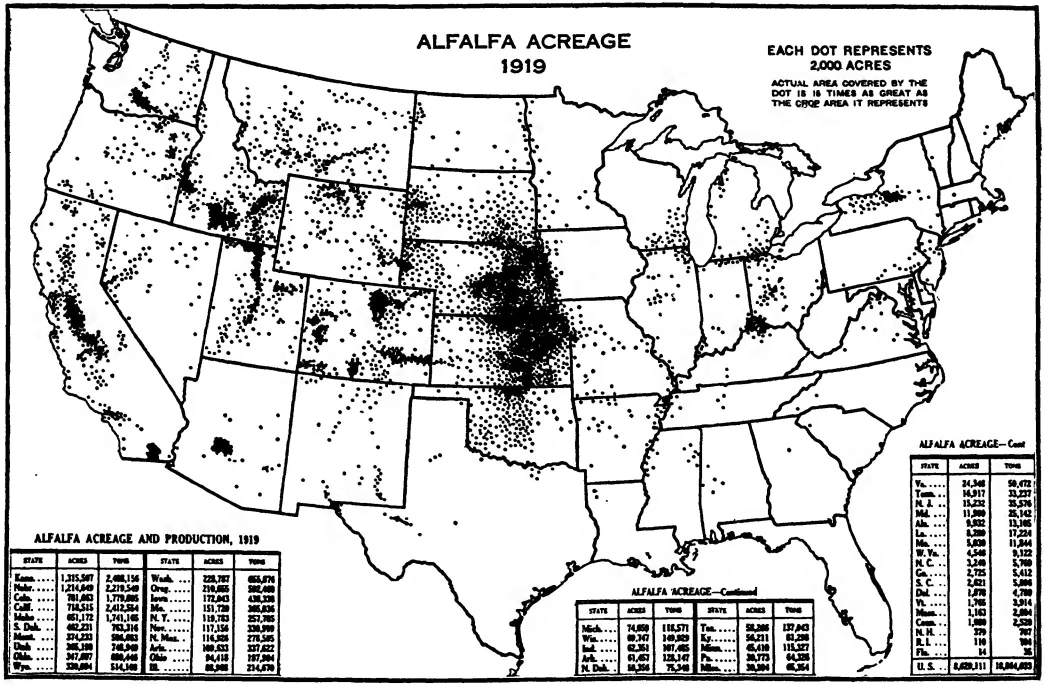


FIG. 67.—Cattle from western ranges stop in western Corn Belt to get fat. Compare with Fig. 68; irrigation, alfalfa and cattle go together in much of the far west. (United States Dept. Agr.)



ALFALFA ACREAGE AND PRODUCTION, 1919

STATE	ACRES	TONS	STATE	ACRES	TONS
Kans.	1,315,507	2,408,156	Wash. ...	228,787	665,676
Nebr.	1,214,649	2,219,549	Oreg.	210,665	582,400
Colo.	781,063	1,779,085	Iowa	172,043	438,338
Calif.	718,515	2,412,554	Mo.	151,720	365,836
Idaho	651,172	1,741,165	N. Y.	119,783	257,785
S. Dak. ..	462,231	763,316	Nev.	117,156	330,990
Mont. ...	374,233	586,083	N. Mex. .	116,926	278,585
Utah	365,180	748,940	Ariz.	100,533	337,622
Okla.	347,087	680,446	Ohio	94,418	187,904
Wyo.	330,604	514,168	Ill.	88,988	214,670

ALFALFA ACREAGE—Continued

STATE	ACRES	TONS	STATE	ACRES	TONS
Mich.	74,059	118,571	Tex.	58,206	137,043
Wis.	69,747	149,929	Ky.	56,211	83,298
Ind.	62,351	107,405	Minn. ...	45,410	115,327
Ark.	61,457	123,147	Pa.	38,773	64,325
N. Dak. .	58,356	75,348	Miss. ...	30,304	65,354

ALFALFA ACREAGE—Cont

STATE	ACRES	TONS
Va.	24,348	50,472
Tenn. ..	14,917	33,237
N. J. ..	15,232	35,576
Md. ...	11,900	25,142
Ala. ...	9,932	13,105
La.	8,290	17,224
Mo. ...	5,030	11,044
W. Va. .	4,548	9,122
N. C. ..	3,240	5,760
Ga.	2,725	5,412
S. C. ..	2,621	5,006
Del. ...	1,878	4,700
Vt.	1,765	3,914
Mass. ..	1,163	2,004
Conn. ..	1,000	2,520
N. H. ..	379	787
R. I. ...	110	184
Fla. ...	14	35
U. S. ..	8,659,111	18,864,683

FIG. 68.—The sudden ending of alfalfa near the Missouri River is a clear-cut response to increasing rainfall which enables clover and timothy to replace alfalfa. (United States Dept. Agr.)

way to raise cattle and very profitable for the cattle companies. It made cheap beef for market and along with the settlement of new cowlands west of the Missouri River, it led to the high figures for animals as shown in the table of animals and population. The freedom of the range naturally led to an overstocking. The grass, especially in periods of drought, was eaten so close that it could not produce seed, and in many places it died out so that the plains do not now support so many cattle as they once did and are being greatly injured by both wind and water erosion and by the advance of inedible weeds.

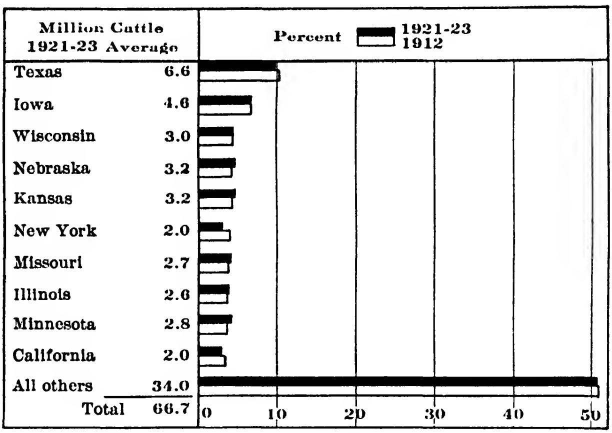


FIG. 69.—Cattle, including dairy cows, in United States, three-year average.

Among the other changes now taking place in cattle ranching methods of the west are the passing of much land into private ownership and the fencing off of the free range. Many of the huge ranches which contained thousands of acres are being cut up into smaller units and general farming supplements cattle raising. The industry is becoming more careful and scientific.

THE MIGRATION OF BEEF CATTLE. The range cattle spend one or two years upon their native plain, living on grass. and are then shipped into the corn belt where the farmers keep them for a few months, fattening them on corn before sending them off to the great markets for slaughter. To some extent, these cattle are fattened in the farms of Pennsylvania and other eastern states, as many as 60,000 a year being distributed at the city of Lancaster, Pa., among the fertile and well-cared-for farms of that district. To a smaller extent this same emigration is repeated in the Southern Highlands. In the hilly country of southwestern Virginia, northeastern Tennessee and West Virginia, there is a section of good grass country where young cattle are raised and sent to the farm lands of the great valley and the Piedmont sections of Virginia and Maryland for fattening.

IMPORTANCE OF CATTLE ON ARID LANDS WITH SOME IRRIGATION. Irrigation in the West is important to the cattle industry. Indeed, beef is the chief commodity shipped from most of the irrigated districts of the United States. Alfalfa leads all other irrigated crops

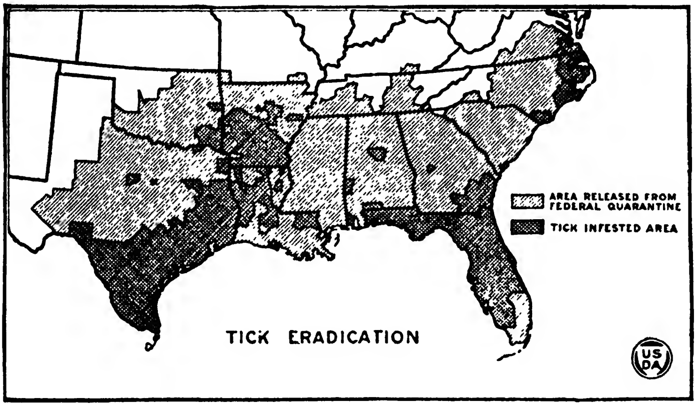


FIG. 70.—The line of battle between man and the tick which kills the cow. (From *North America*, published by Harcourt, Brace and Company.)

in the area under cultivation. This plant is the richest of all the clovers. It sends its roots to great depths in the ground and when the moisture supply is abundant it yields heavy crops of hay, in from two to ten cuttings a year according to climate. Fortunately, the irrigable valleys are widely scattered throughout the cattle range from Canada to Mexico, from western Kansas to western Oregon, so that these favorable alfalfa fields are really scattered oases in the scanty and semi-arid pastures. During winter and the seasons of drought, alfalfa hay supplies the cattle from the ranges with abundant food and fattens them for market.

CATTLE IN SOUTHERN STATES. The southern states have great but as yet unappreciated cattle-producing possibilities. The Minnesota farmer must build large barns to protect his animals and their food from the cold and storms of winter. He must feed his animals full half the year from the results of his summer's toil. In Alabama there is so little winter that a barn is scarcely necessary and the growing season is so much longer that more forage can be produced on a given piece of land than in the Northern States. The cattle can also pasture nearly all the year, thus making the industry require less capital and labor than in the North. The great advantages of the South for stock raising were for many years practically unused, because of the ravages of the cattle tick, and because of the almost exclusive dependence of the farmers on cotton, a money crop of unusual excellence. The ravages of the cotton boll weevil have had the effect of recently turning the cotton planter's attention to high grade beef cattle as a new money crop.[6]

THE SHIPMENT OF LIVE ANIMALS. During the past fifty years there have been great improvements in the handling and marketing of meat. Formerly live cattle were carried in trains from Kansas to Chicago, and on to New York and Boston for slaughtering to supply the eastern market. About 1874 we began to ship live cattle to Europe. This long-distance movement of animals still continues, to a certain extent, owing to the preference of the British for beef slaughtered in their own country. They are at times even taken alive from Argentina to England. It is, however, much more expensive to transport live animals than slaughtered ones, because the live animals occupy more space than dead ones, some die on the way, all must be fed, and they always lose weight. The dangers and hardships result in such losses that hogs are not exported alive at all and sheep to but a limited extent.

THE EFFECT OF IMPROVED METHODS OF SHIPPING AND PRESERVING MEAT. The invention of artificial refrigeration has done much to make possible the slaughtering of animals nearer the place where they are raised. About 1875 the refrigerator car made it possible to send dressed beef from Chicago to Boston more cheaply than the live animals could be sent. In 1879 came a sure method of hermetically sealing meat in cans so that it would keep for a long period, thus giving another force to locate the slaughtering industry

[6] The breaking up of the one-crop system of cotton production by the Mexican boll weevil has done more to force an interest in cattle production in the south than anything else. In one place, possibly two, this blessing has been recognized in the semi-ludicrous form of monuments to the weevil—real monuments of masonry and genuine bronze.

at the great cattle markets. Attempts, however, to operate packing plants upon the great plains where the cattle themselves are produced have resulted in failure. This is due to the lack of a market for many of the by-products and less desirable kinds of meat which the varied market of a large city will consume. Consequently, packing plants are located in the great city nearest to the places where the cattle are fattened. Cincinnati and Chicago were the

Fig. 71.—United States Federal inspectors examining meats in a packing house. (United States Dept. Agr.)

first packing-house centers, but St. Louis, Omaha, Kansas City, and, to a lesser extent, Minneapolis, have now become great centers. Plants have been established also at Forth Worth and Waco in northern Texas, but Chicago is yet, as it has long been, the greatest meat-packing center in the world.

The modern meat-packing plant handles cattle, hogs or sheep, according to the demands of the market, and is one of the most wonderful examples existing of speed, mechanical perfection, and the use of by-products. A procession of live animals goes through a gate and in a few seconds their lifeless bodies are hanging on a little

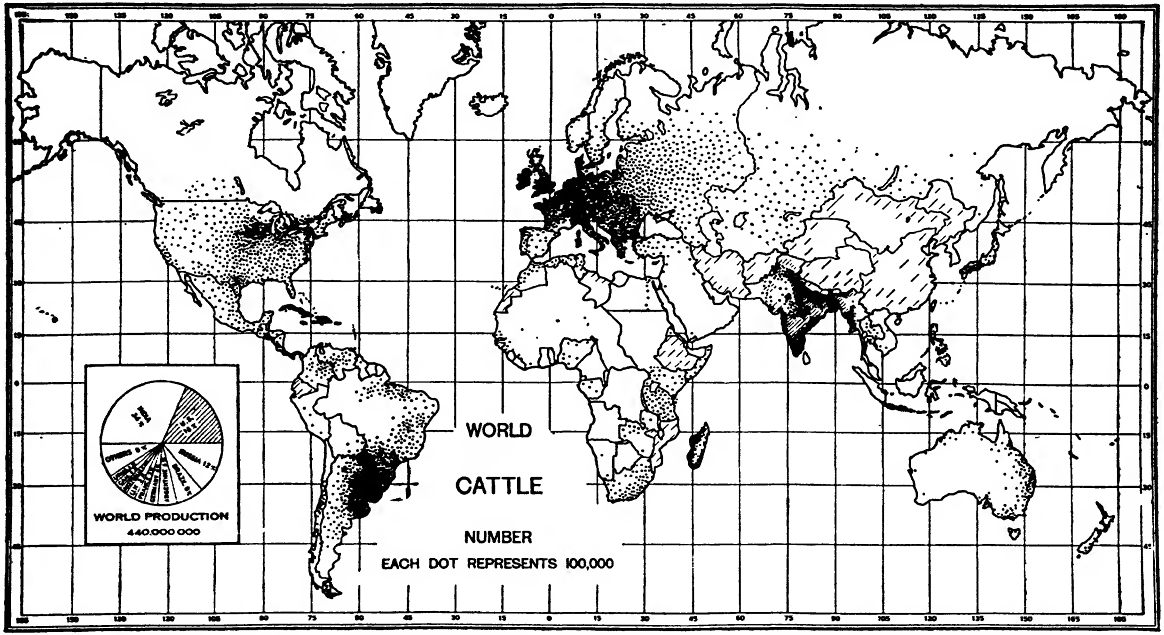


FIG. 72.—It usually comes as a surprise to us to learn that India has more cattle than the entire western hemisphere. The western hemisphere could be made to feed two or three or four times as many cattle as India, but India has more people by far than the western hemisphere, and their animal wealth is largely centered in cattle. (United States Dept. Agr.)

trolley on which they travel past a long row of men, each of whom has his perfectly definite work to do. In a surprisingly short time every particle of the animals has been taken for its particular use and the chief part of the carcass rolls into the cold storage room. So perfect is the utilization of the refuse that absolutely nothing is wasted and the phonograph has even recorded the pig's last squeal. Bones are made into knife handles and buttons, small pieces and chippings are ground for fertilizer; the hair goes for mattresses and plastering; the intestines for sausage casings; the hoofs are made into gelatine and glue. Even the blood is used for buttons and other industrial purposes, the total number of inedible products being over 100. Grease, not fit for culinary use, is made into soap. All other parts, not otherwise used, go for fertilizer. The

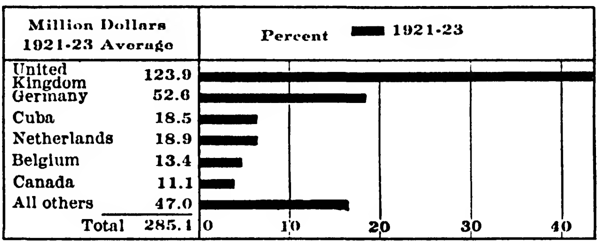


FIG. 73.—Distribution of United States exports of meats, three-year average.

meat product of the packing house goes out as fresh, salt, smoked, canned, or pickled meat.

Owing to the development of cold storage and refrigerator cars, an ever increasing proportion of fresh meat is now distributed from the great packing centers to cities and small towns, chiefly in the northeastern part of the United States. It is also put into the chilled chambers of the ocean steamers at Atlantic ports, and sent to Liverpool, London, Antwerp, and Hamburg to feed the dense populations of Europe. There is a considerable export of pork to the West Indian Islands and other tropical countries. For this trade it has the advantage of being cheap and keeping well.

THE EUROPEAN CATTLE INDUSTRY. While the export of meat and by-products to western Europe is an important part of our trade, the production of meat in Europe is much more extensive. The total number of cattle in the United States, Canada, and Mexico is 81 million; Europe has 123 million. In many sections of Europe cattle are an important money crop, and the outlying districts send them to the more populous regions. Thus, Hungary and Poland send stall-fattened cattle to the industrial cities of western Europe. Owing to the heavy rainfall and great grass growth, west England and Ireland are very important cattle-raising districts. The moist climate and low-lying lands along the Baltic Sea and English Channel are admirably located for the production of grass and the keeping of cattle, and a previous discussion has pointed out the great development of the industry there. The north of France is well tilled and possesses many cattle. Denmark is a model cattle country, formerly a heavy beef exporter, but now specializing in dairy products as befits the more intensive agriculture. The upland pastures of southwestern Germany and the mountain pastures of the Alps are also famed for their cattle. Most of the cattle of western Europe live in barns and have their food brought to them because by this means the ground can be kept in the cultivated crops which are more productive than pastures. In a day's journey across Germany one will see no cattle at pasture unless it be a field unsuited to the plow. This carrying of food to the cattle is the explanation of the large number of cattle per square mile.

Russia, normally the greatest cattle-keeping country of Europe, and third of the world, has her vast plains, a part of which, like those of our western states, is too arid for any use but pasture. In eastern Russia there are districts so remote from transportation that cattle are kept for their hides and tallow, as they were years ago in Argentina. . Before the World War railroad building was fast bringing this epoch to a close. Post-war famine and misrule seriously depleted Russia's herds, but a stable future should see her again leading Europe in beef production.

CATTLE IN THE OLD WORLD ARID BELT. The dry summers of the Mediterranean climate do not produce good pasture, so that in those countries cattle are not so important as in north Europe. Thus, Italy, Spain and Portugal have fewer cattle than France, and the cattle in Italy are only 16 percent as numerous as the people. Cattle are, nevertheless, widely distributed in the arid region and are to be found in limited numbers from Spain to Palestine, Persia, Turkestan, and Mongolia. In the last province the scanty pastures furnish the principal exports of the inhabitants. In these lands of little rain, which find their closest counterpart in the American ranges between the Sierras and the Rockies, the methods and the difficulties of the industry are shown by the following excerpts from a pre-war U. S. Consular Report from Harput, Asia Minor. "A great portion of the cattle, sheep, and goats are owned by nomad tribes of Kurds that wander about this whole country (upper Tigris and Euphrates drainage) with their flocks and herds. This last winter, however, was the most severe ever known in this country, the snow extended south even down into the subtropics, and over this winter-grazing land the snow was several feet deep and lasted throughout the entire winter. The people were helpless to provide against such conditions. There was no food procurable for the livestock and little for the inhabitants. Twenty percent of the people and 70 to 80 percent of the livestock starved to death."

THE CATTLE INDUSTRY OF THE SOUTH TEMPERATE ZONE. The refrigerator ship, refrigerator car, and the cold-storage plant have made possible the carriage of meat to market halfway around the world, so that the ranchers of the south temperate zone need no longer keep cattle for their hides and tallow alone. Prosperity has resulted for Argentina, New Zealand, and Australia—countries so admirably adapted to pastoral industries. Packing plants like those of Chicago and Omaha now stand at Wellington, New Zealand; at Sidney, Brisbane, and other places in Australia; at Buenos Aires and Rosario, in Argentina; and at Paysandu, across the La Plata River in Uruguay. From these plants, the frozen carcasses of cattle and sheep are wheeled by the thousands into the freezing chambers of the ships which carry them across the entire torrid zone to deliver them, still frozen, at the cold storage warehouses of Antwerp, Liverpool, London, Glasgow or Lisbon. Here they are distributed to the butchers' carts of a hundred English and continental towns. This means cheaper food to the European and better prices to the farmer of the south temperate zone, but it has not sufficed to keep down the price of meat.

The high price for meat makes marked industrial changes. The Argentineans now pay tremendous prices (at times over $10,000 per animal) for prize-winning breeding stock of the English cattle shows and turn them out to increase on the fine level estancias (ranches) and fatten on the alfalfa which is becoming so important a crop in that country. The possibilities of the extension of meat production in the Paraná Valley appear to be very great. It was in rapid increase during 1924. Alfalfa has proved to be especially adapted to large areas and its use is spreading rapidly. It increases from three- to sixfold the number of cattle that the land will support. The open winter of Argentina, as of Texas, makes cattle ranching easy because barn building is unnecessary.

Before the invention of refrigeration the cattle industry of the Paraná (River Plate) countries had advanced beyond the shipments of hides, tallow, and bones, by the manufacture and export of tasajo and beef extract. Tasajo is a peculiarly well-preserved kind of dried beef cured in the sunshine of the great pasture plains (pampas). It has the quality of keeping indefinitely in such hot humid climates as Cuba and Brazil, so that transportation becomes

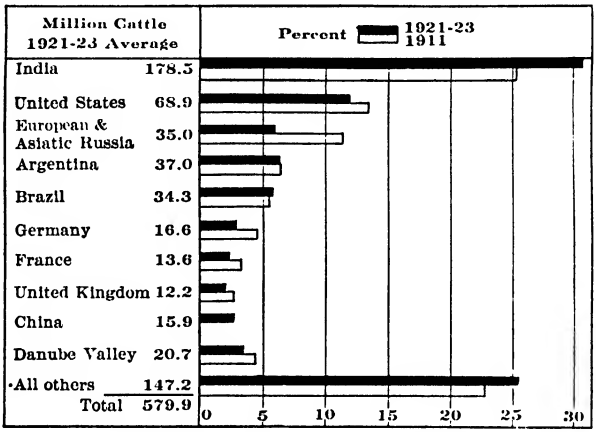


FIG. 74.—Distribution of world cattle, three-year average.

easy and for many years it has had a wide distribution over tropic America. This same ease of transport also makes possible the production of tasajo in remote corners. Thus the growth of the frozen meat business in Argentina and Uruguay has sent the tasajo business upstream to Paraguay and to interior and southern Brazil.

Beef extract is a convenient means of putting a big roast in a small bottle, the manufacture of it therefore being an industry that could go to the farthest corner of the globe to find cheap beef. Almost every drug store in the world keeps a well-known brand of beef extract that has for some decades been manufactured on the banks of the lower Paraná from the cheap beef of Uruguay and Argentina.

American meat-packing firms from Chicago have opened branches in Argentina, Uruguay, Paraguay and Brazil, and now compete with the meat extract manufacturers in the purchase of fat cattle and sell the meat in Europe[7] in competition with the product of American farms. Argentine chilled beef is gaining in popularity. The present objective of the Argentine cattlemen is to produce nothing but baby beef for export—killing the steers as two-year-olds, when they should yield from 650 to 800 pounds of succulent meat. The United Kingdom provides the chief foreign market for this meat. Efforts are also being made to develop a market for South American beef in the United States and meat shipments to New York, interrupted by the war, have now been resumed.

CATTLE IN TROPIC AMERICA. The cattle of American countries north of Argentina and south of the United States have little to do with international trade, but they are important locally. The people in the highlands of Mexico and Central America and the Andean countries of Colombia, Ecuador, Peru, and Bolivia have not the facilities to export meat even if they had a surplus of cattle, which they do not now possess. Cattle in large numbers are produced in small herds and consumed in all of these countries. Their hides, however, are a general and important export, since they keep indefinitely and can stand nearly all conceivable abuses in transportation.

Tropic America has important unused resources for cattle production. For example, the grassy plains of the Orinoco with their alternating periods of rainfall and sunshine, exported a little meat during the World War and might export a great quantity. Other lands, as in Colombia and Central America, produce grass the year round and are well suited to cattle. Small shipments of dressed beef to England from Puerto Cabello, Venezuela, are exceedingly suggestive, but the greatest possibilities lie in the large areas of unused or little used grasslands in the interior of Brazil and adjacent areas of Paraguay and Bolivia. During the high price boom of the World War new meat-packing plants were built in Paraguay, and at São Paulo and other places in Southern Brazil the modernization and extension of the industry made great progress. Much

[7] At a hearing before an English Royal Commission in February, 1916, Lord Vestey, the English cattle king, owner of 450,000 head of cattle in Australia, Colombia, Paraguay, Brazil and South Africa, employer of 30,000 employees, owner of ranches, steamships, and one-third of the cold storage warehouses of Great Britain, and 2,300 retail meat shops, testified that the American companies brought 60 percent of the meat into England while his company brought less than 20 percent.

of it was stopped and some of the plants closed by the post-war price slump that so depressed the United States farmer. Plainly higher price levels can bring out more meat.

Cattle raising in africa is not commercially important at the present time. The climate in large parts is ill-adapted for it. In humid equatorial Africa, such as the Congo Basin, the climate is too wet and hot for the white man to live comfortably and it is almost equally bad for cattle production. In addition, extreme

Fig. 75.—Long-horned cattle of the tropic grasslands of Africa—one of the meat reserves of the more high-priced future. (Courtesy H. L. Shantz, United States Dept. Agr.).

aridity makes much of both north and south Africa resemble the less favorable parts of our own arid west. In between the tropical forest belt and the arid extremes of the continent, however, are belts of grassland where grazing is the favored occupation and the scattered natives measure their wealth in herds of long-horned cattle. At present these herds are too far away to feed meat-hungry Europe, but the African grasslands, sometimes called savannahs, which are found in a great horseshoe around the equatorial forests from Sudan to Rhodesia form a reserve cattle pasture for the high-priced future. Abyssinia with its heavy seasonal rains and abundant grass, is also a land of promise, cattle promise at any rate.

The Union of South Africa, in spite of its aridity, is at present the most important cattle-raising country on the African continent. The scanty rainfall of the veldt favors grazing rather than grain-farming and South Africa has about as many cattle (9 million) as Texas, Oklahoma and New Mexico combined. A number of years ago a fatal disease called the rinderpest swept from the Zambezi River to Capetown, killing almost all the cattle as it went. The Boer who was dependent upon his ox cart was deprived of means of transportation, and the farmer who had been keeping cattle had to turn to some other resource. Science finally conquered the disease and the industry was reëstablished. The cattle tick and other pests are still a persistent menace and the successful cattle raiser must build dipping tanks to disinfect the live animals and remove disease-carrying vermin. The government is encouraging the improvement of herds and there were in 1922 over 3,600 farms reporting pure-bred herds of Friesians, Africanders or Shorthorns.

Cattle in Asia. India leads the world in cattle, but not in meat production. She has two and one-half times as many as the United States and five times as many as Argentina, the third cattle country in the world since the Russian famine. In some sections of Asia because of religious aversion to meat-eating they are used only as work animals.

Asia is not likely to furnish the other continents any great amount of meat although her hide export is important. China has 16 million cattle (estimated), but she should eat them at home. Asiatic Russia with more than Texas (1922) may be expected to render to Europe the same service in cattle that Texas does to the United States. In southeastern Asia, Siam, Indo-China and the Philippines there is about the same possibility of meat export as from Venezuela. The land is there but it needs energy like that of the Yankee or North European to fight disease and produce better meat animals.

4. THE FUTURE SUPPLY AND PRICE OF MEAT

The nineteenth century was a period of industrial discovery and commercial expansion by means of railways, steamboats, refrigerator cars, ships and scientific production. This permitted the western world to have for a few decades the cheapest meat supply we are ever likely to have.[8] There are no more great plains to discover, and the population is increasing much faster than the numbers of meat animals; and as a result meat has risen sharply in price, in practically all parts of the world since the close of the free land epoch in the United States, about 1900 A. D. For this there is no remedy in sight, and it may not be an entirely fanciful prediction

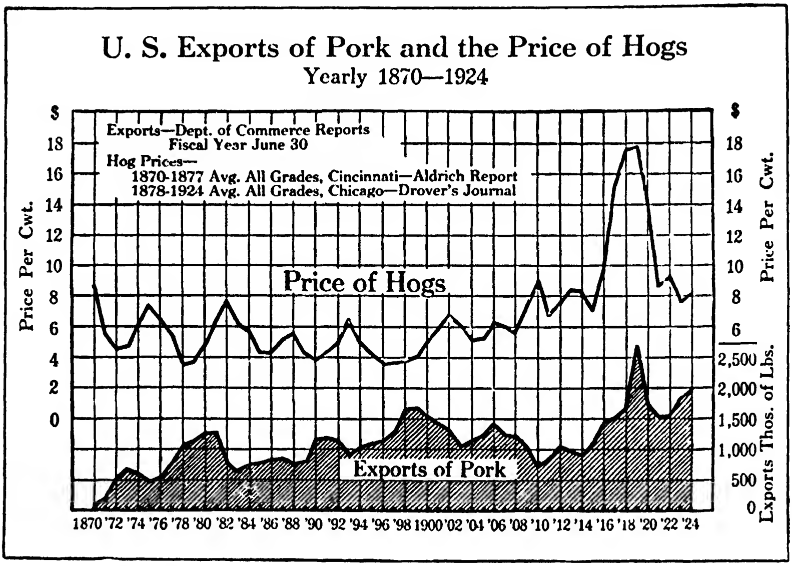


FIG. 76.—During years of large hog production and low prices in America, our exports increase. During years of shortage, our exportable surplus is small. The export market acts as a shock-absorber for the American hog raiser, relieving the situation and buoying up the domestic price during years of heavy production. (Courtesy Swift & Co.)

that fifty years hence a juicy beefsteak will be the centerpiece at the banquet table.

Paris complained that between 1902 and 1910 the wholesale price of meat increased 45 percent at her abattoirs and the war caused a still greater increase. At the same time similar conditions in Ger-

[8] The trade devastation produced by the post-war chaos and starvation in Europe reduced European meat imports and gave temporary low price and consequent temporary increase to the declining meat consumption in the United States. Thus the consumption went from 171 pounds per capita in 1907 to 130 in 1917, but it rose sharply from 142 in 1921 to 166 in 1923 at the time when corn belt farmers were going into bankruptcy because of the abnormally low price of American pork.

many caused an absolute decline in the number of animals slaughtered, and that empire imported $120,000,000 worth of forage per year at the outbreak of the war. Far-fetched supplies from new producing regions may be expected to afford some relief, but the best lands on the agricultural frontier are already producing. The occasional export of pork from Hankow, 600 miles inland in China, to Liverpool is interesting, but not indicative of an important new source of supply. It is chiefly promoted by the very low level of prices now prevailing in China and the fact that her people are too poor to eat much meat.

5. HAY

Relation of hay to the animal industries. Grass is the natural food of most of our domesticated quadrupeds. Pastures or grass fields where animals can feed in summer are the commonest feature of American farms. Hay, the dry grass kept over in barns or stacks for winter use, is almost equally common. In the harvesting of this crop we see one of the direct results of intermittent climate which stops growth. It is not necessary to make hay in lands where grass will grow the year round, as it does in parts of the torrid zone. Hay is usually a supply crop, to be eaten by the animals of the farm and become saleable in the form of work, meat, butter, cheese, milk, wool, hides or live animals. Practically all of the pasturing animals except the reindeer can get along well on hay. It is relished at the zoo alike by the elephant whose native food is the fresh green of the tropical jungle, and by the camel who at home contents himself with the bushes, the harsh grasses, and the young thorns of the desert. The deer and the moose also like it, although in their native homes they nourish themselves in winter almost entirely upon the twigs and branches of bushes which project above the snow, and such forage as they can get by digging in the snow.

Hay and city dwellers. It may seem that this supply crop of the farm is of little interest to the city dwellers, but nearly all of them are indirectly dependent upon hay. Every time one eats beef, mutton, butter, milk or cheese, he uses a commodity that could not have been produced in usable quantities as agriculture is now practiced but for hay, and when there is a shortage in hay, dairy products and meat are high in price. Even bread itself is usually the product of the labor of hay-fed beasts of burden. "All flesh is grass," says the Old Testament.

NATURAL HAY. In the semi-arid regions, like the Great Plains of the central part of America, nature herself makes good hay. Here the rain comes in the early summer making the grass grow rapidly. With the increasing dryness of late summer, the grass dries and stands for months rich and nutritious. The best kind of American grass for natural hay is the so-called "buffalo grass" which for centuries has been an important part of the food of the vast herds of buffalo, antelopes, and other wild animals of the trans-Mississippi. This natural hay, being the product of a typical climate, is to be found in the other semi-arid regions. Human life depends on this wild hay when tribes live through the long dry season as do hundreds of nomad tribes by moving with their flocks from place to place in search of pasture.[9]

DISTRIBUTION OF HAY PRODUCTION. The cultivated hay crop is general in the north temperate zone and also in parts of the south temperate zone, except on the pasture plains above mentioned and there it has had rapid increase in irrigated sections. In the United States, Canada, and Europe it is a very important crop. In the United States it exceeds the wheat crop in value, and about equals it in area. In value, corn of course far exceeds it and cotton sometimes does. In Manchuria, Japan, and China it is much less important because of the small number of animals to be supported.

RELATION OF HAY TO OTHER AMERICAN CROPS. Cultivated hay is usually made of the grasses known as clover and timothy (the only one of a thousand native American grasses[10] yet domesticated).

[9] This great dependence upon wild hay is said to have crystallized itself into law. In the dry part of the year a fire once started in the hay will destroy it for miles. The fire itself may overtake flocks or camps and also destroy them. As there can be no more pasture until months later when the rains come again, the person who starts the fire may thus bring starvation to herds of animals and loss of human life to the people who depend upon them. As every people punishes most severely those offenses that tend to destroy society, death therefore is the penalty upon the Arab who starts a grass fire. No matter how accidentally it occurred, no matter how well meaning he may have been, no matter if it be the son of the chieftain himself, he has committed the unpardonable offense of imperiling the life of the community, and like the traitor, he must make the supreme payment—an excellent illustration of the influence of environment upon social phenomena.

[10] A striking evidence of the possibilities yet awaiting American agriculture in an age of scientific agriculture—if it comes.

Throughout large parts of the United States, and to some extent in Europe also, the common practice is to sow the grass seed in the fields of wheat, oats, rye, or barley when these small grains are sown, or in the early spring when the freezing, thawing, and drying of the ground open little cracks to receive the seed. The grass starts in the grain and fully establishes itself after grain harvest. In America it is a common practice to sow both clover and timothy. The clover being a quick and vigorous grower comes first, making

FIG. 77.—Cutting irrigated alfalfa in Montana. Third crop of the season, with yield of two tons per acre. (United States Reclamation Service.)

a clover hay crop the year after the wheat crop. In the next year or two the timothy takes possession of the ground so that altogether several hay crops may be gathered if the farmer so desires, before the grasses die out and the field is plowed for grain.

THE DISTRIBUTION OF THE HAY CROP. In the United States the corn belt is the great hay center also, a fact which shows very clearly that zones producing one farm crop only are not common. The corn belt farms are frequently the original 160 acres or one-quarter of a square mile which the Government gave away to settlers from forty to seventy years ago. They are often divided into four fields of about 40 acres each, and it is not uncommon for one field to be in corn, one to be in oats, wheat or barley, one to be in pasture for the cattle in summer, and one to be in hay for the cattle in winter. The cattle and hogs are fattened, it is true, largely upon corn, but the horses, cattle, and sheep are by nature grass eaters, and can no more live entirely upon corn than we can live entirely upon meat; they must also eat the more bulky foods as hay, which is an essential part of the system of mixed farming (cattle and grain) that so commonly prevails.

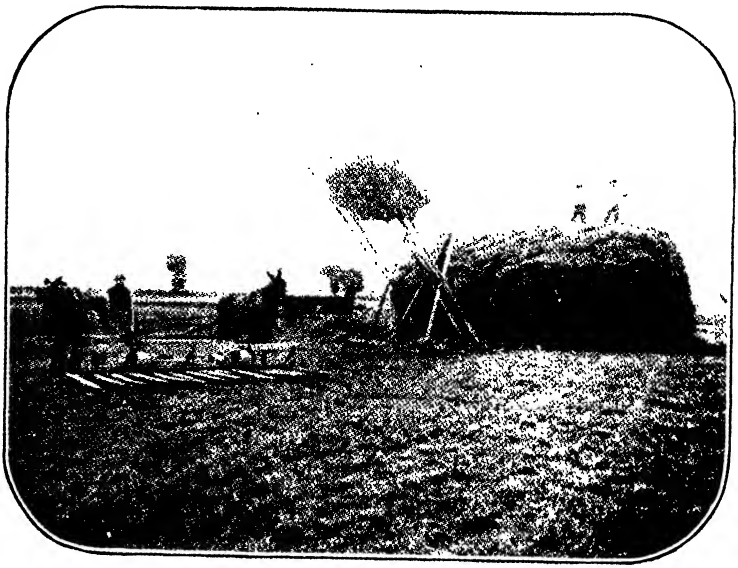


FIG. 78.—By the use of these devices alfalfa hay is cut, gathered and thrown upon the rick without wagon or pitchfork, or the force of human muscle. (United States Reclamation Service.)

METHODS OF MAKING HAY. Methods of making hay have greatly improved through the recent invention of machinery. The mowing machine to-day cuts a swath, 5, 6, or 7 feet in width as fast as the horses can walk. To let it dry out more rapidly, a horse-drawn tedder stirs it up with many kicking feet. Big rakes drawn by one or two horses pull it into heaps. A kind of elevator called a hay-loader, often attached to a wagon, picks up the hay and puts it on the top of the load with the power of the team (or tractor) that pulls the wagon. Upon reaching the barn or stack, it is lifted off, hundreds of pounds at a time, by a hay fork or sling operated by the horses. So great is the saving of labor that hay remains one of the cheapest of animal foods.

Hay in commerce. The bulkiness of hay in proportion to value makes it comparatively unknown in foreign commerce. Compressed into bales of small bulk a small quantity of it is shipped from the American corn belt to west Europe, where the large number of animals required by the meat- and milk-consuming and horse-using populations of manufacturing districts makes it necessary that they shall import animal food. Alfalfa hay is at times sent from Chile to England, but European forage imports are closely restricted to the more easily transported grains or concentrates.[11]

Our domestic hay movement is much larger than the foreign. It is regularly sent from the corn belt to the cotton belt, where in a region that might produce all its own forage and produce for export, the people are devoting themselves so exclusively to cotton growing that they frequently buy food for their work animals. Hay is also of considerable importance in local commerce in various parts of America where horses and mules work in mountainous regions or forest regions, at lumbering and mining. To the city horse also it is evident hay must be sent, so that, in the aggregate, there is a large internal commerce in hay in this country. The many cities of New England and the Northeastern States make this region the greatest American hay market and therefore the farmers of New York and New England find the selling of hay more important to them than do the farmers of other states. In many districts of New England it is almost the only crop grown and sold on many half-abandoned farms. The soil is so rocky that it is difficult to plow, but once the ground is sown with grass and the surface stones are picked up, hay can be cut year after year, with the result that in New York and New England hay occupies 70 percent of the total crop area. The total hay crop of New England is, however, much smaller than that of an equal area of the corn belt, because of the much smaller proportion of the hay land that is in active cultivation, and the low yield of old fields.

Hay in irrigated countries. The best of all hay plants is the alfalfa, a clover which lives for many years, can slumber through months of drought, can spring into rapid growth the very day that

[11] To offset this the Europeans grow root crops for stock feed—mangel-wurzels, turnips, and rutabagas, in quantities entirely unknown in the United States, where corn silage more easily fills the hungry void.

water is applied, and can produce 5 or 6 tons of hay per season in three or four cuttings on rich irrigated land. It succeeds in altitudes ranging from below the sea level in the Imperial Valley, California, to 8,000 feet above the sea in the mountains of Colorado. To crown its virtues, alfalfa hay is rich, richer in protein than wheat flour, and has a forage analysis equivalent to wheat bran. Like the other clovers it is a legume and enriches the earth with the nitrogen

Fig. 79.—Converting into meat the alfalfa grown in an irrigated valley in Arizona.

nodules of its roots. Hay, therefore, reaches its greatest importance on the irrigated districts interspersed among the arid and semi-arid lands of the West, where alfalfa alone makes satisfactory stock raising possible. The same combination is common in other arid regions, such as Chile, Argentina, and many parts of the Old World, alfalfa being a plant of world-wide distribution.

The european hay crop. As a whole, hay is more important to European animal husbandry than to the American. Europe has more cattle to the square mile than we have, and since cattle are rarely pastured, a larger proportion of European land is in hay. Swedish hay is so vastly important that the poor peasant must in those unfavorable climates actually spread the grass out under sheds to protect it from the rain until it dries, and then shelter it for winter use. To get it to the barn it is at times brought down from the heights on trolleys, traveling on wire cables. Such laborious conditions of agriculture as this explain the emigration of Scandinavians to America, and we see why people who had been able to live in such a country quickly prosper in roomy America, with its more favorable climate and many opportunities.

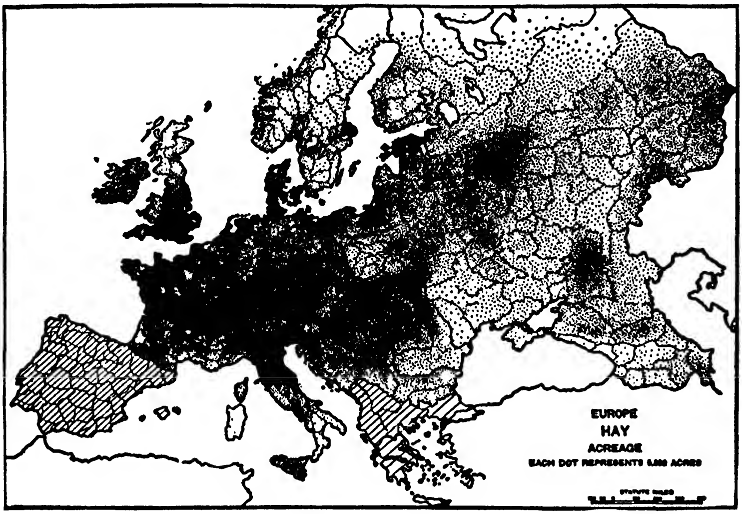


FIG. 80.—The hay map shows the extent of Europe's animal industry. (Finch and Baker.)

To the Icelanders, hay is a necessary link in a hard existence. The summer is too cool for grain. Wool is one of their chief money crops and to feed the sheep through their arctic winters, they literally shave their hummock hay fields with scythes.

As east Europe resembles western America, it is Russia with its great plains and millions of cattle that furnishes the region of greatest hay production. Part of the crop finds its way to the London market in the form of butter which is shipped from places as remote as central Siberia.

Upon the plains of the Po in northern Italy where the irrigation water, sometimes rich with the mud ground by glaciers from the Alpine cliffs, is turned upon the fields, it is said that as many as nine crops of hay per year are gathered, thus enabling the district to export butter to less favored sections.

6. DAIRY PRODUCTS

THE DAIRY PRODUCTS AND THEIR USES. Milk, intended by nature only for the offspring of the particular species producing it, has been taken by man at various times and places from camels, mares, sheep, goats, reindeer, cows, the Indian water buffalo and probably other animals. As a result of long selection and improvement, the goat and the cow have become especially adapted for this service and give quantities of milk which would have astonished our primeval ancestors who first domesticated the animals.[12] By artificial selection the breeds of domestic cattle have been specialized into two broad classes—the beef animals that get fat if well fed, and the dairy or milk breeds that give much milk if well fed.

The dairy products are first raw milk and then a number of manufactures of milk, chiefly cheese, butter, and condensed milk. Milk is a perfect food, in that it completely sustains life, but very dangerous because of the ease of contamination in its collection, and the further fact that it is a perfect germ culture.[13] Cheese, a condensed form of milk, is a substitute for meat (see table of food analyses); and butter is a fat, supplying well the deficiency of the albuminous and starchy foods. For this reason it is so well liked with bread. All three of these major dairy products, especially milk and butter, are valuable in the preparation of many other articles of food.

CHARACTERISTICS AND LOCATION OF THE DAIRY INDUSTRY. Dairying as an important industry depends almost entirely upon cow's milk. It has arisen in lands of moderate coolness where the rainfall is sufficient to make the succulent grass and other forage

[12] These animals render mankind an enormous service by making the best food in the world out of a product which we ourselves cannot eat. The achievement of a record-breaking Holstein cow in this respect is astonishing. In six years and six months she produced 156,776 pounds of milk. The food consumed during a test year was as follows: pasture, four hours a day for nine months; concentrates, 5,872 pounds (ground barley, oats, bran, soy bean meal, cottonseed meal, linseed meal); roughage other than pasture, 31,550 pounds (dried beet pulp, silage, alfalfa hay). This cow seems to have been a veritable factory.

[13] The relationship between the condition of the milk supply and a high infant death rate is often astonishing.

required by cows giving profitable quantities of milk. Owing to the bulk weight and perishable nature of milk, it must be produced near to the market if it is to be consumed while fresh. The great demand for fresh milk in the vicinity of New York City has caused it to be brought over 400 miles in special express trains, such as those running from Wayne Co., Pa., and from the banks of the St. Lawrence to New York City. Because of its nearness to large

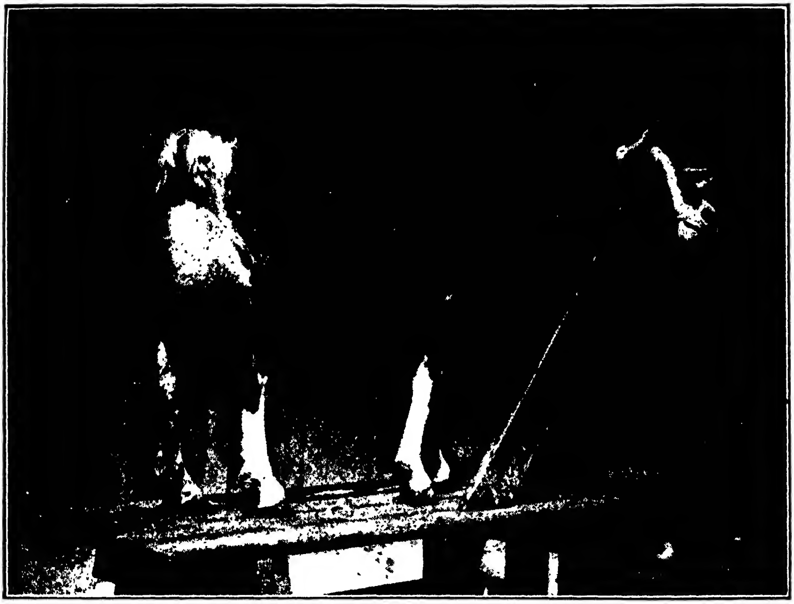


FIG. 81.—Swiss Toggenburg goat, Fanette, weight 135 lbs., product 2,440 lbs. milk in 10 months. One of the most efficient milk producers in the world. (Photo. Howland & Hurd, Redlands, Cal.)

centers of population New York, the empire state, leads all other states in the quantity of milk shipped to city markets. Fortunately for the supplying of distant localities there are methods of condensation and preservation of dairy products. That part of the milk which separates as cream can be condensed into butter and kept for weeks, or, in cold storage, for months; the milk can be converted into white fleecy curds and the curds into cheese which keeps for months; and, by the processes called condensation and evaporation, along with hermetic sealing, milk can be reduced in bulk and canned so that it will keep for years. Thus, many parts of the world hitherto unaccustomed to dairy products have, since the development of world commerce, adopted their use. The West Indian planter opens tins of Danish butter in Jamaica or Porto Rico, while condensed milk is to be found in the uttermost ends of the world where it is too hot to produce and keep milk, as in Guiana, or too dry, as in Cape Colony, or too cold, as in Alaska, or too mountainous as in Rocky Mountain mining towns, or wherever camper, prospector, or lumberman pitches his tent or builds his shack.

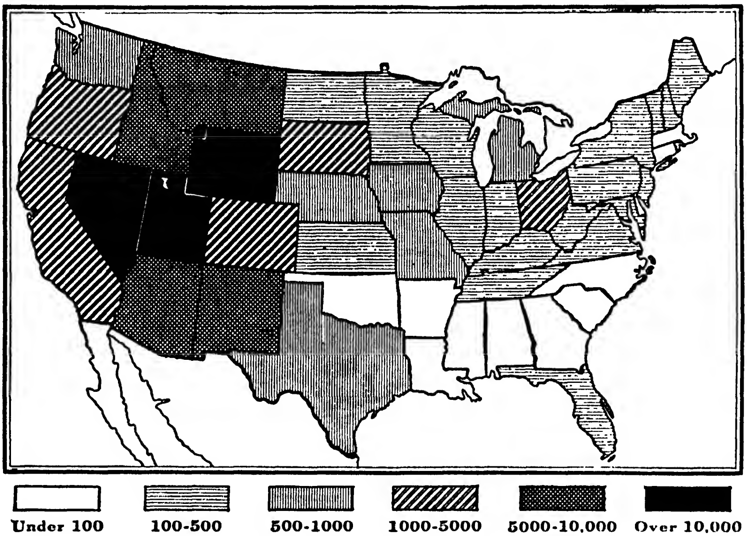


FIG. 82.—Dairy cows in the United States per 1,000 rural inhabitants, by states, Jan. 1, 1924. Population, 1920.

RECENT IMPROVEMENTS IN MANUFACTURE. Within a few decades great improvements have been made in the process of manufacture of dairy products. Milk formerly required much labor and care in cooling. It had to be set away in shallow pans for a day or two before the cream could be skimmed off. Now a centrifugal separator takes the fresh milk as it comes from the cow, and by centrifugal force separates the cream into one vessel and the milk into another. The little hand churn of the kitchen is being used less and less as big, power-driven churns in the butter factory (creamery) make more and more of the butter of the world. Most of the cheese is now also made in factories rather than upon the farms of the people

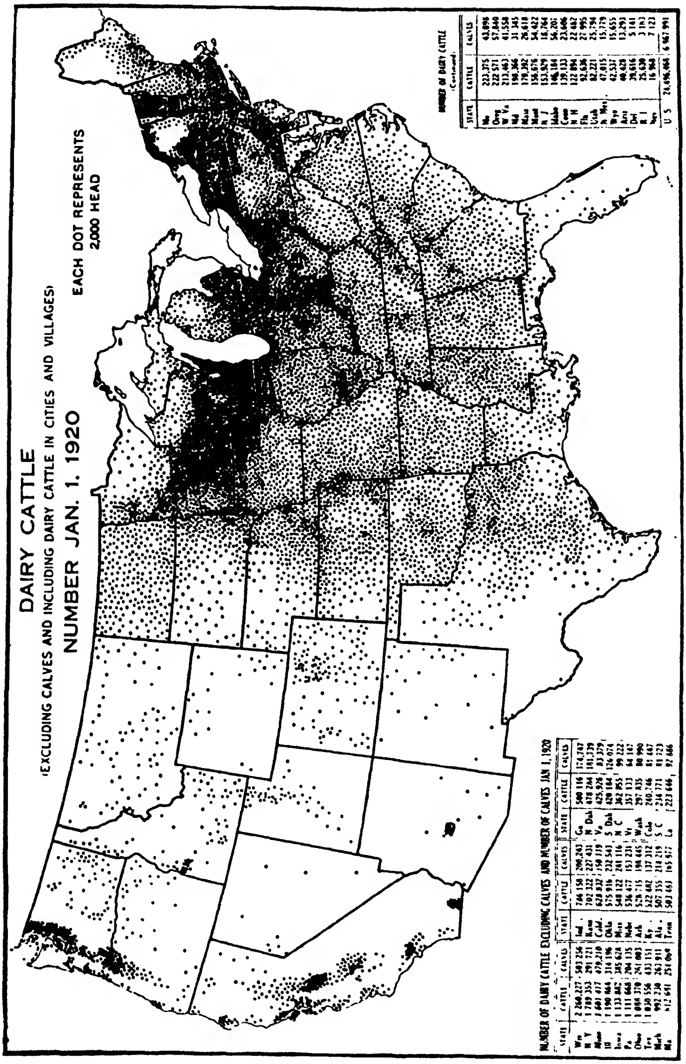


FIG. 83.—The greatest centers of dairy production are Wisconsin and New York, but the industry is spreading into adjoining states. (United States Dept. Agr.)

who keep the cows—another example in the long series of victories of the factory over home industry.

Dairying and intensification of agriculture. Dairying marks an important stage in the intensification of agriculture, which means increasing the income from a given piece of land. There are two ways by which a farmer may get more product. One is to take more land, the other to put more care and labor on the land he has. Where the population is sparse, little land is needed to produce the food, the price of land is low and the farmer can pay interest on its small value by cultivating a small part of it and pasturing the rest, and with a minimum amount of labor. Such is the characteristic of new countries, which are rarely dairy countries. The Great Plains of the United States are an excellent illustration. There are millions of cows, but the local production of butter, milk, and cheese in many localities is inadequate for the use of the few people who live there. The cow with little care from her owner runs upon the great range, and the calf which drinks all of her milk may never be seen by the owner until the day he is branded or sold. The new level plains of Manitoba, Saskatchewan and Alberta furnish another example of extensive agriculture, this time in wheat. Wheat lands of low price make adequate returns with similar small labor, small expense, and low yield. In New York and other eastern states,[14] on the other hand, the land is often hilly, the farms are usually small, and the farmer cannot grow grain so cheaply as does his brother upon the flat lands of Canada. His farm is so small

[14] DISTRIBUTION OF CLASSES OF CATTLE, 1924

	Milk cows, 1,000	Other cattle, 1,000
Populous East:		
New Jersey	151	31
New York	1,628	393
Pennsylvania	1,071	486
Massachusetts	189	39
North Central Dairy Belt:		
Michigan	987	611
Wisconsin	2,217	858
Minnesota	1,674	1,276
Cattle-fattening States:		
Kansas	732	2,537
Missouri	793	2,063

and high priced that he cannot raise enough cattle to support him if he uses the method of the beef producer of the Plains. (See ratios of classes of animals in table of cattle in 1924.[14]) But a few cows eating his pasture grass, his hay, his corn fodder, and much of his grain will day by day produce enough milk to make him a comfortable income. Therefore, it comes about that the dairy cow is of great importance to the farmer on the rougher land from Maine to Minnesota. This operator of pastures, hay fields and silos produces vast quantities of market milk and the material for the manufacture of butter and condensed milk. These latter products concentrated and easy to transport tend to come from locations somewhat remote from the large cities, and their production is replacing the less intensive meat and wheat industries.

For several decades New York and Pennsylvania, our greatest centers of population, were also our greatest centers for dairying, but since 1900 the territory to the northwest of Chicago has taken the lead. The main dairy belt of the United States now lies just to the north of the region where corn and winter wheat are sure crops. The census of 1919 showed Wisconsin for the first time as the largest milk-producing state. Minnesota is turning from grain growing to the dairy cow and is now disputing second place with New York state. North and South Dakota are also steadily increasing their milk cows and so are the adjacent Canadian provinces.

This gain of the dairy over the wheat and the meat industries is largely a result of high land values. Farm lands in the north central states have in many districts tripled in value during the

[14] DISTRIBUTION OF CLASSES OF CATTLE, 1924 (*Cont.*)

	Milk cows, 1,000	Other cattle, 1,000
Range States:		
Texas	1,063	5,597
Arizona	46	1,092
Wyoming	48	793
Total United States	24,675	42,126
Europe:		
Netherlands	1,085	977
Germany	7,596	9,057
Denmark	1,339	1,198
Canada	3,746	5,974
New Zealand	2,003	1,478
Australia	2,343	12,098

last twenty-five years. This is partly due to the high price of corn and partly due to the element of speculation in land values. The farmer there now buys an expensive farm. If he keeps cattle and sells beef, he has difficulty in earning the interest on his investment. If he sends milk to the creamery or cheese factory, the cow will each year give an equal or greater value in milk than does the bullock in meat at the end of his two or three years of life, and the meat producer eats as much as the milk producer. Thus, the greater intensity of milk production causes it to displace meat production and the table of cattle in 1924 shows an interesting and suggestive change in ratio of dairy to other cattle as we go west.

In dairying the farm becomes a kind of factory, using its own raw materials. A thousand dollars' worth of hay, corn, and bran may with little labor be turned into $1,400 worth of beef (more or less) or into $2,500 worth of milk (more or less) by the much greater amount of labor required in the care and daily milking of a herd of 20 or 30 cows. This often doubles or trebles the number of families living on the same farm and enables dairy districts to support a larger population than meat- or grain-selling districts. Farmers in some parts of North Dakota have been driven into the dairy business on account of low wheat prices or because the Canada thistle choked out the crop and broke up bonanza wheat growing or one-crop farming. This proved to be an economic blessing in disguise. The farmers were compelled to rotate crops (which killed out the thistle) and, instead of wheat, to raise forage crops and then keep cows to dispose of the product. This intensification of production increased the farm income and raised land value from $15 per acre as wheat farms to $40 or more as dairy farms.

Wisconsin and the lower peninsula of Michigan developed a dependence upon dairy products earlier and to a greater degree than the states of the corn belt proper because their land is not quite so well situated for corn, and therefore the people were compelled to turn earlier from grain growing and make their land profitable by other means, such as potato growing and dairying. In Wisconsin, the State University has, through its school of agriculture, given conspicuous aid to the dairy industry by investigations, lectures, bulletins, class-room work and actual inventions, witness the very important Babcock milk tester. It has thus spread among farmers knowledge of the most scientific and profitable methods of dairying, and it has been an important force in bringing the state toward leadership in this industry. In 1919 Wisconsin had 2,872 factories for the manufacture of butter, cheese and condensed milk, which was over one-third of all such establishments in the United States, and three times the number to be found in either New York or Minnesota, the next two states in the value of dairy products.

CANADIAN DAIRYING. That part of Canada lying between Lake Huron, the city of Quebec and the American boundary, comprising the populous parts of Ontario and Quebec, is like Wisconsin and New York in its inability to compete with the level West as a grower of either corn or small grain. Consequently the people have long since turned to dairying and have reached a high degree of success through skillful use of state instruction and inspection. The provinces of Ontario and Quebec have more than 2,800 factories where butter and cheese, especially cheese, are manufactured. Great care is taken to maintain the high quality of the product, and it is consequently much esteemed in Great Britain, whither nine-tenths of the Canadian cheese goes.[15]

The wheat-growing Prairie Provinces of Canada are also beginning to keep cows and make butter. As settlement increases we may expect to see many western Canada farmers take up dairying, as has happened in the Red River Valley of Minnesota, a region once devoted exclusively to wheat.

DAIRYING IN NORTHWESTERN EUROPE. Northwestern Europe with its good soil, cool humid climate for making grass, and dense population, has every requirement for a great dairy region and the

[15] INTERNATIONAL TRADE IN DAIRY PRODUCTS (1922)

Exports			Imports		
Country	Butter, million pounds	Cheese, million pounds	Country	Butter, million pounds	Cheese, million pounds
Argentina	52.3	14.4	Argentina	....	14.4
Australia	78.9	....	Belgium	41.7	48.1
New Zealand ...	125.4	130.0	Norway	7.6	1.5
Canada	21.5	120.1	Sweden	5.6	1.9
Denmark	210.5	19.6	France	64.9	60.2
Finland	18.3	5.9	Germany	2.3	51.9
France	6.7	22.0	Italy	2.9	15.5
Netherlands	50.9	143.7	Switzerland	15.0	1.7
Italy	1.6	32.0	United Kingdom.	427.4	294.9
Switzerland	....	46.1	United States ...	6.9	46.5
United States ...	10.9	5.0			

scarcity of meat causes cheese to be used far more than in meat-eating America.[16] The European demand for cheese and butter is so great that Canada and other parts of the world must supplement the enormous home production. England and Wales—an area smaller than Missouri, but with a population about a third that of the United States—consume in fresh form a large part of the milk that can be produced at home. Ireland, on the other hand, with a sparser population and a better grass supply, because of the moister climate, is too far away to send milk to England, but sends large quantities of butter to help supply the huge demands of the English people with whom bread and butter is an important article of diet. Consequently the British import more butter and cheese than any other half dozen nations (see table of international trade in dairy products). An important source of supply is the great continental dairy belt which stretches along the northern plain of Europe from western France to Denmark, Sweden, and Russia. Throughout this whole belt the farms are small, and the rural population is dense, and while grain-growing is practiced on most of the farms, the keeping of dairy cows is also exceedingly common.

The north of France makes much excellent butter that goes to the great capitals of London and Paris. The Channel Islands between England and France, with daily steamers to London, have so long been important dairy centers that each of them, Alderney, Jersey, and Guernsey, has given its name to a breed of dairy cattle now widely scattered throughout the world. The town of Camembert in Normandy has given its name to a well-known brand of cheese and in the south of France is the town of Roquefort, where for generations the peasants have handed down from father to son the art of making from sheep's milk their famous cheese which is ripened in stone caverns deep under the ground.

Holland has been famed for its cattle since the days of Julius Cæsar. Meadows, which the Dutchman has won from the sea by pumping out the water, are made of the rich mud that the Rhine has brought down from the fertile highlands of central Europe. These moist, rich lands, too wet for tillage, make pastures of great richness. Here drainage ditches separate from each other the little green fields, dotted with feed boxes from which the black and white cows eat bran and grains imported from America. By this

[16] A bulletin of the United States Department of Agriculture lists 242 kinds of cheese, most of them European.

means farmers increase the number of cows they can keep. Since comfortable cows give the most milk, they are blanketed in the pastures during cold and rainy weather. These richly fed and carefully tended herds of the well-known Friesian or Holstein breed make dairy products the chief of all the farm products of well-tilled little Holland. The Dutch make 24 pounds of butter per capita per year. This is several pounds more than we make in the United States, but the Dutch being poorer eat less of it per capita than we do. Their cheese output exceeds that of butter. The town of Edam, west of the Zuyder Zee, has given its name to a kind of cheese produced largely in that part of Holland, and, along with other Dutch brands, it goes to England, to the United States, and

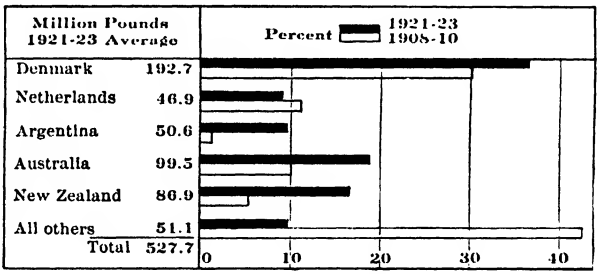


FIG. 84.—World export of butter, three-year average.

to many other countries where the fame of Dutch cheeses has spread. Holland has since the war become the leading producer of condensed milk, also, exporting a quarter of a billion pounds of it in 1923.

In butter-making Denmark is the teacher of the world. Only about half the size of Maine, it is visited by the agricultural scientists of all the world who would learn in its best form the art of dairying. Forty years ago she was a meat exporter to Great Britain, but the need of greater income for a growing population has turned this democratic kingdom into a vast dairy farm. The Danish peasant owns a farm of from five to twenty-five acres. The land is usually sandy and was originally infertile but has become rich by good care and imported fertility in the form of cow foods. More than half of the surface of the land tilled is in oats, hay, grass, and root crops to feed the cows. The increase of land used for forage has encroached upon the grain fields until there is not wheat land enough for bread. In addition to a large import of bread grain there is a considerable import of grain and grain products from America and Argentina to feed the cows. As a result, Denmark with a poorer soil rivals Holland in having more farm animals for its area than any other country of the world; there are more than a thousand factories for making butter; the cows are inspected once a month to insure healthy stock; and the dread disease of tuberculosis, so common among housed cattle of the entire world, has been entirely stamped out of the kingdom of Denmark. The thrifty Danes import margarine to eat, and export their butter, over $40,000,000 worth being sent each year to Great Britain alone. Through careful catering to the demands of the market, Danish butter preserved in tin cans has become the standard article for consumption in the tropics and in all the remote corners of the globe where there is no local supply.

The southern parts of Sweden, which are not far from Denmark, have also recently learned the art of making good butter; and the country, which in 1870 was a butter importer, is following Denmark's example and sending dairy products to England to pay for coal and steel. Russia, which we have been prone to think of as a country of backward people, was making great strides in butter manufacture before the World War. Butter was being exported to England with the aid of coöperative associations in which 13½ million farmers were members, including about two-thirds of the peasants of Russia. The product of 1914 was 300 million pounds. It sank to 25 million in 1919 and rose to 65 million in 1923.

THE INTENSITY OF EUROPEAN DAIRY FARMING. Dairying is also carried on to a very large extent in northern and western Germany, but the large population consumes the entire product despite the fact that dairying here, as in France and other northern European countries, is carried on in its most intensive form with the cows kept in barns and food brought to them. In such a dairy district near Cologne, farm lands were worth $400 to $680 per acre before the World War.

Switzerland has an interesting and unique dairy industry. Relatively large areas of land upon the high mountains, habitable only in summer, produce an abundance of rich grass as the melting snow recedes and lets sunshine upon the saturated earth. The villagers of the valleys take their herds of cows to the higher pastures in summer, and, because of the distance, stay with them through the whole season, spending the nights in little huts that have been built for the purpose. At intervals members of their families bring up the necessary supplies and take away the accumulations of cheese and butter which the herders have produced. On the lower slopes of the Alps the water from snow field and glacier is often conducted out over the fields to fertilize and irrigate the grass for winter hay. As a result of this careful industry, Switzerland is an exporter of excellent cheese, Gruyère being one of the best-known brands. She also exports 50 million pounds of condensed milk a year. Milk is also an important factor in the manufacture of milk-chocolate, in which Switzerland (like Holland) is

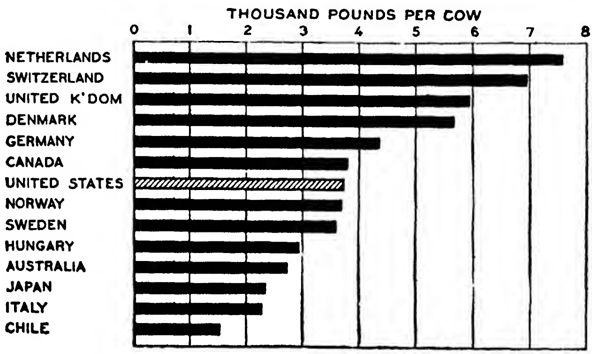


FIG. 85 —Average milk production—largely a measure of the extent to which intelligence of the simpler sort has been applied to an industry.

important, sending abroad annually about three-fourths of the total product.

The small quantity of milk that is used, chiefly by children, in the Mediterranean countries of Europe with their summer drought is largely supplied by goats which can live on a poorer and drier diet than is possible for the cow. Some varieties of milk goats give a greater amount of milk in proportion to their weight and food consumed than does any other animal in the world. Furthermore, goat's milk is richer than cow's milk in both fat and solids. One of the characteristic street scenes in these countries is the milkman driving herds of goats through the street and milking them at the door of the customer, being able thus to guarantee the absolute freshness and purity of the milk—matters of importance in an iceless land.

In Italy commercial dairying is in the main limited to the irrigated lands of the Po Valley. The Alpine streams furnish water for the succulent pastures and hay crops which are responsible for the few brands of Italian cheeses that are well known in many countries of the world. One of these, the Parmesan cheese, is made

FIG. 86.—Italian woman carrying fresh grass from field to farm animals—a common scene in densely peopled lands.

of goat's milk.[17] Cheaper cheeses are imported into Italy to feed her own people just as the Dutch and Danes import oleomargarine from Chicago for their own use and sell the butter that they make.

[17] Europe is losing some of her old supremacy in special varieties of expensive cheeses. Factories in Pennsylvania and elsewhere are preparing from specially treated cow's milk a Roquefort cheese which resembles closely the famous sheep's milk Roquefort from France. The Italians are also complaining that they have lost their foreign markets for Parmesan cheese since the war, as America has started the industry, and Argentina with her new dairy industry is making large quantities of it. (*London Times Trade Supplement*, May 17, 1924.)

Oleomargarine, a butter substitute, has virtually the same chemical analysis as butter. Being made chiefly from suet (body fat of beef) the possibilities of cleanliness of manufacture are ahead of those in butter.

The comparison of dairy exports (see table) from the United States—vast, rich, and agricultural—and from mountainous and populous little Switzerland, with half her used land in hay, is striking even in absolute quantities. On the per capita basis, Swiss cheese and milk exports before the war exceeded the entire exports of the United States in grain and grain products, animals and animal products. Thus the Schweitzer, like the Dane, makes the most of his limited opportunities and the American, with more resources, does not have to refine them so closely. It is evident that commercial dairying depends more on the distribution of laborers (density of agricultural population) than on resources—another example of production in a place not best fitted for it. In dairy possibilities America greatly exceeds Europe.

America's greatest superiority over Europe as a place for the production of dairy products is the priceless boon of corn, the king of forage crops for which the people of all European dairy regions must substitute the laboriously produced beets and other root crops and the less productive barley. The American cotton belt has even better dairy possibilities than the corn belt, but it imports from glaciated Wisconsin. In the eleven months ending May, 1924, the United States exported 4 million pounds of cheese and imported 60 million pounds of cheese and cheese substitutes.

Australasia and refrigeration. The refrigerator ship which has revolutionized the meat supply has made possible the importation of butter and cheese from the most remote countries. Thus New Zealand, which is almost exactly on the opposite side of the world from Great Britain, has been able to attain front rank in dairying. This country, nearly as large as Italy, has a splendid rainfall owing to the prevalence of the constant west winds, from off the great southern seas. The Government has taken great pains to inspect and guarantee the quality of exports with the result that New Zealand butter and cheese are prime favorites in Europe, particularly in England. This Wisconsin of the southern hemisphere is even reaching out for American markets, and several 5-million-pound shipments of creamery butter from Auckland have reached New York. In exports of butter she is at present second only to

Denmark; in exports of cheese she passed Holland during the war and has since held first rank. Her combined butter and cheese trade easily gives New Zealand world supremacy in the export of these dairy products.

Australia, the Texas of the antipodes, being further north, and out of the latitude of steady rains, has her production of dairy products sadly interfered with by the droughts. Consequently the industry, less important than in New Zealand, is chiefly limited to New South Wales and Victoria, the most southerly, the coolest, and rainiest part of a warm dry continent. Australia has become a regular butter exporter, but drought makes the quantity fluctuate.

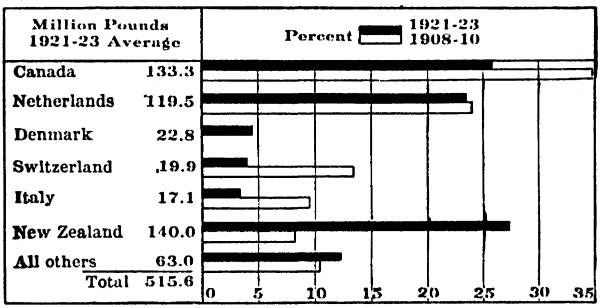


FIG. 87.—World export of cheese, three-year average.

ARGENTINA has a climate particularly favorable for livestock raising and is just beginning to turn from beef production to dairying. While considerable butter is made and exported to Europe the dairy industry as a whole is slow in getting a foothold. There are several reasons for this condition. One is that the cows are only pastured and do not receive concentrated foods, hence the butter yield varies with the season. Another is that it takes great care to make good butter and cheese in a warm climate. The sparse population of this new country does not furnish the labor which such intensity of agriculture as dairying demands, and the labor supply in Argentina has not yet developed a propensity for that class of work. The vicious landlordism of the absentee Spanish owners of the great haciendas (estates) is another reason.

Dairying, of all the great agricultural industries, is the most exacting in its labor requirements. The cow must be milked morning and evening the year around; she must be treated gently; the product and utensils must be kept clean. These qualities have been developed chiefly in connection with the keeping of cattle by the Teutonic peoples from north Europe. The Spanish and Italians who make up the bulk of the population of Argentina have not had ancestral training in keeping cattle but they are gradually creating a new source of dairy products in the southern hemisphere because steadily rising prices demand new sources of supply.

Possible extension of dairy areas. The keeping of milk products without ice or cold spring water is so difficult that people in most warm climates were virtually unable to make good butter or cheese before the recent improvements in dairy machinery and artificial cooling. Now that the steam engine can make ice and a cold room anywhere, the tropics or the cotton belt of the United States can, so far as climate is concerned, compete on an equal footing with Wisconsin or Switzerland. It requires a large number of cows, 200 to 500, to support a creamery with cold storage attachment. This number is, however, merely the normal number for a modern creamery and the way is now open for the geographic extension of dairying. At the present time it is an industry unnecessarily restricted to the cooler parts of the world. It may become common for the warm lands rather than exceptional, as is the present export of small quantities of native African butter, which is sent to Europe for re-working from the highlands east of Tanganyika. (Authority of Dr. H. L. Shantz, agricultural explorer.)

Alabama reported its first coöperative creamery in 1922. Thousands of cotton plantations could maintain their cotton output and also become dairy farms if demand created effective labor there. But the fact is that our dairy produce demand is already well supplied.

In many parts of China and Japan dairying is almost unknown for reasons made evident in the section on meat and cattle, and any large increase is improbable.

7. DAIRY SUBSTITUTES

The butter substitute of the dry sub-tropic climate. Milk production is at a low ebb in lands of little rainfall, or of summer drought, such as we find in California and the Mediterranean countries, because of the scarcity of grass. During the months of summer drought, the cost of supplying milk animals with green and succulent food is so great as to make milk relatively expensive and something of a luxury.

Fortunately the Mediterranean climate furnishes a partial substitute in the fat of olive oil which is chemically almost exactly like the fat of butter and replaces it in the diet of the people of southern France, Italy, Greece, Asia Minor and North Africa. Where the Canadian eats 27 pounds of butter every year, the Englishman 17, and the American 15, the Italian consumes only 2½ pounds. Olive oil takes the place of butter in southern Europe to such an extent that every Spaniard eats an amount estimated at 25 pounds per year. In 1921–22 Spain produced 30 pounds of olive oil per capita, Greece about 60 pounds per capita, and the whole Mediterranean basin a total of 1,540 million pounds.

The olive is a wonderful food producer. It grows in poor, rocky hillsides from Gibraltar to Jerusalem and from the Sahara to southern France. Its oil, unlike most of the animal fats, does not become rancid.

I have seen prosperous trees thriving in the gulches of central Tunis where the rainfall was only seven inches per year. Again I have seen Tunisian trees prosperous and bearing which were undoubtedly planted before the incursion of the Arabs in 648 A.D. This lends possible truth to the legend that the olive trees under which Jesus walked in the Garden of Gethsemane may still be standing.

Many restaurants in American cities, run by people from the Mediterranean basin, serve good meals, satisfactory to the American taste, using olive oil entirely in place of butter.

Dairy substitutes in the rainy tropics. The hot and rainy regions of the earth favor neither the white man nor his milk-giving animals. For the production of dairy substitutes, however, the tropics are well fitted. Butter and cheese are but digestible fat and protein plus the indispensable vitamins. Many vegetable oils furnish very similar fat and there are many cheaper proteins than that of cheese. Two of the most promising dairy rivals are found in the oily cocoanut and the nutritious peanut. These little-used plant products have recently made a late start on a career of usefulness that is exceedingly suggestive and carries the possibility of a partial revolution in food supply and production.

Nearly half of the meat of the cocoanut is fat or oil, and the nut has the quality unusual among oily vegetables of keeping for many months without becoming rancid. Some chemist worked another atom of hydrogen into cocoanut oil, which changed a strong-smelling liquid into a firm, tallow-like, white solid, and the butter substitution process began apace. In a short time the German chemists had made a nice-looking butter substltute, golden yellow with egg yolk and flavored with a little cream. It spread through Europe like new styles in clothes. Boatloads of copra went up the Elbe to central Europe. Oil mills arose in every great port and by 1912 the European margarine factories, using cocoanut oil as a base, had a greater product than the whole international trade in butter.

Then came the war, with its imperious demands for food and the vegetable oils had a great inning.[18] It was much more economical to let a ship carry copra to Europe than to carry bran and cotton-seed meal to feed a cow to produce the nutritive equivalent of the oil to be crushed from the copra. Between 1913 and 1920 copra imports changed as follows: United States 30 million pounds to 215; United Kingdom, 69 million pounds to 128; Denmark, 68 to 125; Netherlands, 221 to 195 (she lost an export, chiefly to Germany, of 160 million pounds during this period). In these same years the cocoanut oil imports rose as follows: United States, 72 million pounds to 216; United Kingdom, 130 to 148; Netherlands, 36 to 114; Norway, 8 million to 26 million. Since 1920 the post-war stagnation of trade in many European countries has curtailed their imports of vegetable oils, but it is fairly certain that cocoanut oil as a source of edible fat is here to stay.

With increasing demand, additional cocoanut oil can be produced more easily than butter, because large areas of unused land on nearly all tropic continents and islands are suited to the cocoanut palm. In the Dutch East Indies, the Federated Malay States, the Philippines, and thousands of lonely islands in the South Seas the cocoanut has for an unknown time been an important element in the economic life of the natives. It is easy to raise a product that grows

[18] Among the many results a firm in Wisconsin, our leading dairy state, advertised nationally that it made a butter from cocoanut oil. Another firm advertised, for cooking purposes, a "filled" milk made by taking skimmed milk from the creamery and restoring the normal amount of fat from vegetable sources. Owing to its non-content of vitamins the dairy interests, through Congressional law, were able to get this commodity barred from interstate commerce, although the reasoning cannot stand the test of rationality.

without cultivation, falls from the tree embedded in a thick cushion of husk, and lies for weeks safe and sweet, waiting to be picked up. A good cocoanut tree produces 50 to 100 nuts annually;[19] 4,000 to 7,000 nuts make a ton of copra yielding 100 gallons of oil. The food possibilities of cocoanut-growing sound almost too good to be true.

The peanut may be considered as a partner of the cocoanut in this vegetable onslaught on the animal industries. It has gone from the peanut roaster on the sidewalk into the eight-story factory and is rapidly becoming a staple article of food and a staple cooking fat. The peanut per pound is nearly as nutritious as cheese, contains more protein than a pound of sirloin steak, plus more carbohydrates than a pound of potatoes, plus one-third as much fat as a pound of butter. It has more nourishment than a pound of sirloin steak and a pound of white bread combined.

Now that we are in a period when growing population and high prices force us to look about for new food sources, the peanut offers a most valuable addition to our diet and to the diet of our animals. In Europe its chief use is in the form of edible oil, taking the place of lard, butter and olive oil, for which it is now the most prized substitute. A bushel of peanuts weighing thirty pounds (hulls included) will produce a gallon of edible oil when crushed, and twenty pounds of cake, a stock food high in protein and especially suited for dairy cows and the feeding of growing animals.

The fact that this leguminous plant is at home from latitude 37° north, clear into the south temperate zone, and can be grown successfully in sandy soils of low fertility, marks it as one of our greatest crops for the future. It has already become a staple of cotton belt agriculture.[20] Tributary to Norfolk and a few miles back of the truck center is the greatest peanut-growing center in the United States. It is exported from Senegal, Gambia and Nigeria in west Africa, Mozambique (Portuguese East Africa), India and China, being one of the few crops that are produced and sold by the white, black, yellow and brown races. Like the cocoanut in its husk, the unshelled peanut keeps in perfect condition and can wait while man takes his time to prepare and ship.

These two nuts are an admirable example of the shift from ani-

[19] It is not rare to find individual trees which mature 15 nuts per month or at the rate of 180 nuts a year.—E. V. Wilcox in *Tropical Agriculture*.

[20] The fact that it can be harvested by the pigs adds to its importance.

mals to plants as a source of food supply, and the shift of support from cool to warmer lands. As population, land values, and cost of living steadily rise in the cool temperate zone, the pressure comes most keenly on the animal products because of the large amounts of land required by the animals. It is decidedly comforting to find such satisfactory substitutes in the palm and peanut which so nearly furnish diet equivalents and are so well suited to the vast areas of the fruitful tropics, and to growth by the native populations already inhabiting those lands.

A few years ago cottonseed was a waste product, the main problem being how to get rid of it at the least expense. Then chemical research showed that the seed contained a valuable food oil and that the cottonseed cake left after the oil was pressed out made a nutritious stock feed. The manufacture of cottonseed oil is now an important industry throughout the South, over 4 million tons being crushed annually. A ton of cottonseed makes from 36 to 40 gallons of oil, of which about 90 percent is made into lard or butter substitutes.[21] It resembles olive oil in food value and is sometimes refined and used as a salad oil. The great richness of the cottonseed meal in protein, of which it is now the cheapest available source, has led to its utilization as food for dairy cows, for which it is shipped to every important center of butter and cheese production in the United States, Canada and Europe. Its satisfactory use as a breadstuff for human food has been demonstrated, but humans change their diet much more slowly than cows do.

Cocoanuts, peanuts and cottonseed are merely members of a class.[22] The soy bean, so promising in American agriculture, has 18 percent oil, which has long been an important fat food for the Japanese. At $2.00 per bushel, the 10 pounds of oil would be far cheaper than butter. The sunflower seed has 30 percent of oil,

[21] The United States consul at Stavanger, Norway, said before the war that nine-tenths of the population ate margarine instead of butter. The butter price was nearly five times that of the cottonseed oil from which the margarine was made.

[22] The special report on Vegetable Oils and Oil Materials in International Commerce, Dept. of Commerce, Miscellaneous Series 108, 1922, calls attention to the fact that there are to-day fifteen major vegetable oils and oil materials from four continents in our own import trade. This report gives interesting statistics for many of these oils, of which the following are the more important edible oils: cottonseed, cocoanut, peanut, soy bean, palm, olive, mustard, rape seed, sesame, hemp seed, sunflower, and castor bean, which, by the way, when boiled is a good, edible oil.

also edible, and from Nigeria come reports of vast amounts of oily nuts of the shea tree which promptly begin to be exported by thousands of tons as soon as the railways open up new districts. This is prized as a butter material by the people of the interior, as is the palm nut of the coasts, and like it promises quickly to enter commerce. In Sierra Leone, palm-nut and palm-oil shipments furnish over one-half of the total export of $6,400,000. The fact that we get all these products without the care of the intervening beast as in butter and cheese is of great importance in considering the food possibilities. The resources of the tropics for oil from nuts grown on trees are quite beyond present computation.

8. SHEEP AND OTHER WOOL BEARERS

It is generally thought that our ancestors found the sheep upon the mountains of central Asia, a mottled animal of black, white, and brown, whose pelt has made us the best of all protections against the cold and aided our advance into the land of frost and snow. To this day millions of Asiatics in the interior of that continent protect themselves from the bitterness of its winter with sheepskin coats and caps, and history contains no record of the origin of cloth making, so remote was its beginning.

For many ages before the coming of cheap cotton (about 1800) (see chapter on textiles and world commerce), woolen cloth was the chief clothing material in the temperate zone, and sheep were much more universally kept than they now are. In the springtime their winter coats were shorn to serve their masters the next year, and lamb flesh had been prized long before it was prescribed in Hebrew Law as an offering to Deity.

The Old Testament shows that sheep were of great importance to the peoples at the eastern end of the Mediterranean Sea and they were but little less important to the early Greeks, Romans, and the barbarians who overwhelmed the Roman Empire.

SHEEP BREEDING IN BRITAIN. For several centuries both before and after the discovery of America the export of wool from England was the great basis of foreign trade in that country. The island location gave it security from foreign invasions, and peace led to the internal order which is necessary for the satisfactory development of sheep flocks. People may return from war and find their cattle, but sheep, weak, defenseless, stupid, subject to disease, the easy prey to accident, dogs, and thieves, need constant care. Thus it came about that England, the most peaceful country of Europe, had a relative monopoly in wool and it has developed most of the important breeds of sheep. English pastures also are among the best in the world and very *dependable.* Dependability is a geographic factor to which more emphasis will be given by future writers.

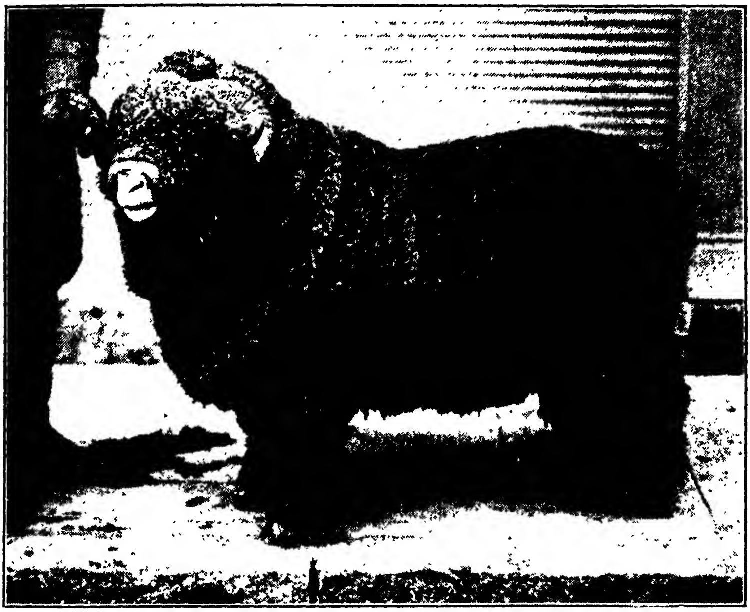


Fig. 88.—By artificial selection for one quality some strains of Merino sheep have become racks for wrinkly skins, and every wrinkle covered with fine wool until the sheep is almost blinded by it.

The names of the breeds show their British origin—as Lincoln, Dorset, Southdowns, Hampshiredowns, Oxforddowns, Leicestershire, and Highland sheep. The judges of the highest English court have for centuries sat upon a wool sack—symbol of the commercial importance of that commodity and also of the origin of British courts. The best breed of sheep for wool production, however, is the Merino, a breed developed on the high plateau of Spain from sheep whose ancestors originally came from Africa. This sheep, famed for its wool, was jealously guarded by the Spanish and for centuries they would not let any of them leave their country, but during the eighteenth century they spread to Germany, France, England, and America.

Factors affecting the distribution of sheep industry. Before the beginning of the railway epoch, sheep were distributed upon the farms of Europe and America, and most countries were nearly self-supporting with regard to supplies of wool and mutton. But the period of world settlement and world commerce following the railway and steamship about 1850 led to an entire revolution in the sheep and wool situation of the world. A sheep industry on the largest scale that has ever been or is ever likely to be seen, resulted from the throwing open of large areas of land in North and South America, South Africa, Australia, and central Asia which could be best used as sheep ranges.

Probably because of mountain ancestry, the sheep is a good climber for rough pastures, and a good traveler. He can go far for his food and water or to market. By eating dewy grass at early morn he can get along with little water. His sharp nose enables him to reach into the crannies of rocks for scanty herbage. His cleft lip lets him almost eat the roots of grass, often to the detriment of the grass. Altogether he is well fitted for the utilization of land not fit for the plow, and regions with greatest dependence upon sheep are those parts of the earth's surface which for some reason are not thus available for cultivation. It may be that the land is too rough and too wet, as in the Scotch Highlands with their heavy rains. These hills would naturally be covered with luxuriant forests, but are entirely barren of trees because for centuries sheep ranged the forests and ate every young tree that came up until finally when the old trees died, the land was left for grass and heather upon which the sheep flocks have in some cases subsisted for several centuries. Similarly, certain hills in the south of England bear to this day the names of forests, although for many generations they have been treeless pasture lands devoted to sheep flocks. Thus, Cotswold (meaning wood) Hills, like the South Downs, long ago gave their name to a breed of sheep.

Semi-aridity, however, is the greatest reason why land is devoted to pasturage of sheep rather than to cultivation in grain and other crops.

Thus, the plateaus of dry Spain have been famous for sheep since the times of Hannibal and Cæsar, and, although the finewooled Merino breed originated there, most of the Spanish flocks are those yielding coarse wool. The greatest flocks in the world are upon such semi-arid plains in Australia, South Africa, Argentina, and western United States, yet the fact that some of these lands are hot, and do not naturally suit the sheep, is another illustration of an industry in a place that is not best suited to it. The sheep with his warm coat is equipped for cold climates; the fleece degenerates in hot lands, the wool entirely disappearing in Cuba and Brazil, leaving only the hair coat of which all sheep possess a little. In Australia, the tendency to degeneration because of heat has been overcome by the constant importation of fresh breeding stock from England, Vermont and other localities where the sheep is at his best.[23]

VALUE OF SHEEP TO REGIONS REMOTE FROM MARKETS. A third reason why land may be devoted only to sheep is its inaccessibility for the marketing of the heavy and less valuable products of agriculture in which transportation costs must be relatively high. Grain requires a railroad close at hand. Cattle, unless their meat can be marketed, have nothing to yield but the hide and tallow which is relatively of less value than the fleeces, skins, and tallow of sheep. Consequently, sheep flocks give the people of remote plains the greatest possible cash income, and the opening of new lands between 1850 and 1890 caused an enormous increase in the number of sheep throughout the whole world.

The Falkland Islands afford an excellent illustration of the service of sheep to the people of a remote land. This group of islands, more than half as large as Maryland, is located in the South

[23] NUMBERS OF SHEEP (*Selected Countries*)

(United States Dept. Agr.)

	Millions			Millions	
	1911	1923		1911	1923
Semi-arid countries:			*Countries of scanty population, good rainfall and remote from markets:*		
Australia	92.4	82.2			
Union of South Africa	30.7	31.5			
Algeria	9.0	9.0	Uruguay	26.3	14.5
Spain	15.1	19.3	New Zealand	24.0	23.0
Italy	11.2	11.7	*Countries with highly developed agriculture:*		
Greece	4.6	5.8			
Turkey	6.9	11.2	France	17.1	9.7
Asiatic Turkey	45.0		Germany	7.7	6.1
Asiatic Russia	38.0	9.3	United Kingdom	30.5	24.1
Chile	3.6	4.5	Belgium	.2	.1
Mexico	3.4	.3	Denmark	.7	.3
Countries partly semi-arid:			Switzerland	.2	.2
United States	52.8	38.3			
Argentina	67.2	30.6	Total of the World	615.2	500.0
Russia	47.0	32.4			

Atlantic Ocean opposite Cape Horn in a latitude corresponding to southern Alaska and Scotland. The rainfall of the islands is good, but the climate is cool and there is no tillage because the prevailing westerly winds of that latitude blow so hard that even trees cannot live because they are blown out of the ground. Yet these windy plains and hills produce good grass and each of the 2,087 inhabitants who give Falkland a population of two-fifths of a person per square mile, owns, on the average, two horses, four cattle, and 320 sheep. The non-perishable wool, skins and tallow, of the sheep, comprising practically the entire exports of the islands, enable the people to command the goods of all the world, to become well educated, and to receive a heavier mail per capita than the people of any other land. It requires a very small population to utilize the land in this way and as a result, the people are so scattered upon their large sheep ranches that the public school masters must travel from ranch to ranch to teach the children in their homes. The Islands of Faroe and Iceland in similar but northern latitudes also have a great dependence upon the export of sheep products.

IMPORTANCE OF SHEEP IN SOUTH TEMPERATE ZONE. The south temperate zone with its large plains in South America, South Africa, Australia, and New Zealand, is the part of the world having the greatest dependence upon sheep. This zone, with less than 1½ percent of the world's people, has about 40 percent of its sheep. Taking the world over, there is about one sheep to three and two-thirds persons, but in the south temperate zone which combines the qualities of remoteness, semi-aridity, and sparse population, there are six sheep per person.

Where sheep are kept upon the open plain there is a special method of caring for them. Owing to the defenseless character of these stupid animals they require constant care and may not be allowed to shift for themselves as do cattle or horses. In all regions of large sheep production the method of caring for them is much the same. The herder with a couple of dogs and usually a camp wagon and pair of horses takes a flock of one to three thousand sheep and follows them for days and weeks, being met at appointed places by supply wagons sent out by his employer. The sheep dogs, with the inherited qualities of many generations, are much more skillful helpers in driving them than men could be, and the herder's rifle protects from wolves, foxes, and dogs, while the flocks are commonly put into corrals or fenced enclosures at night.

Australia has long been known as the greatest of sheep countries and the leader of wool exporters, with one-third of the world's total. That continent, which is about as large as the United States, has a mountain barrier parallel to the eastern coast which shuts off from the interior most of the rain brought by the southeast trade winds. The narrow plain along the coast is good for corn and other agricultural crops requiring moisture, but west of the mountains the wide expanses of plain that slope gently away from the sea have only enough rainfall to produce good grass. Some

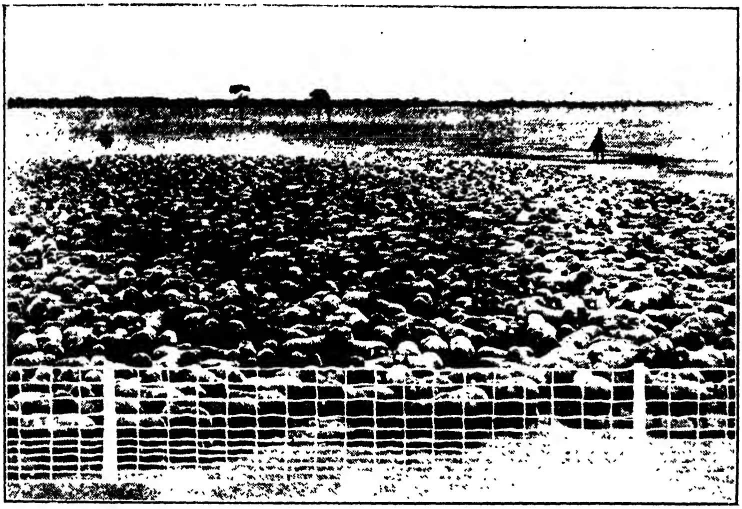


FIG. 89.—A flock of sheep in Australia. The fence is American.

of the finest sheep ranges in the world lie between these mountains and the grassless desert which occupies the central and western parts of the continent. The railroads that connect the ranches with the eastern ports reach almost to the desert and all the land that has any value has for some decades been occupied by the sheep flocks. Australia is unfortunate in the arid nature of much of her territory and also in the irregular character of the rainfall. Droughts sometimes last for long periods, cutting off both grass and water so that the sheep starve by millions, as in the period 1894 to 1898 when continued drought reduced the sheep flocks from 110 million to 84 million. The great dependence of the flocks upon rainfall and rainfall fluctuations is shown by the observations of a scientist [24] who says that with 10 inches of rainfall per year, an Australian plain will support ten sheep per square mile; with 13 inches of rain, twenty sheep; and with 20 inches of rain, seventy sheep. With less than 10 inches of rainfall, the land is of no value even for pasturage. The deadliness of these figures appears when one remembers that an Australian average rainfall of 15 inches may be made up of the following: 22, 18, 12, 8.

New South Wales possesses nearly half the sheep of Australia, while Queensland, farther north (nearer the torrid zone) with more rain and heat and better forage, and, therefore, the leading cattle state, since they can stand heat and moisture better than sheep, and require better pasture, has one-fourth of the sheep. South of New South Wales is Victoria which lies far enough from the equator to be in the region of prevailing westerly winds and gets more rain than New South Wales, and has better pastures but only one-third as many sheep.* The market for the frozen beef of Queensland and frozen mutton of New South Wales, is almost entirely in the mother country, Great Britain. The wool is more widely distributed, but a large part of it also goes to the United Kingdom.

NEW ZEALAND. New Zealand, further south than Australia, with the good rainfall of the prevailing westerlies, is an excellent sheep country, and is largely given over to that industry.

Some of the mountain pastures upon the western coast of New Zealand, continuously wet from exposure to the sea winds, have such splendid grass that they will support five sheep per acre throughout the year. These mountains make the eastern side of

[24] See Hann: *Hand-book of Climatology* translated by Ward.

* SHEEP AND CATTLE IN AUSTRALIA (1921)

	Sheep in millions	Cattle in millions
New South Wales	33.8	3.3
Victoria	12.3	1.7
Queensland	18.4	7.0
South Australia	6.3	.3
Western Australia	6.5	.8
Tasmania	1.5	.2
Northern Territory		.6
Total	78.8	13.9

that island drier, and thus cause the Canterbury plain on the east, the best stretch of arable land on the islands, to be largely used for wheat growing; [25] but owing to the sparse population, somewhat over a million people in a good grazing territory as large as New York, New Jersey and Pennsylvania, agriculture cannot be very much developed and the 23 million sheep and 3 million cattle are the chief wealth of the country. There are about 7,000 ranches of over 1,000 acres each and the newness of the country is shown by the fact that between the years 1891 and 1901 the occupied land increased from 20 to 27 million acres, and the latter figure is less than half the total area. The good pasture and regular food supply of New Zealand causes the frozen mutton of that country to be considered the best that is imported into England.[26] The sheep are often fattened by being turned into large fields of turnips from which they first eat the tops and then the entire root, and mutton can be produced at a cost so low that it often competes in our own markets with American-grown mutton.

Argentina and Uruguay. The sheep district that most closely resembles Australia in character is the La Plata (the English call it Plate) or Paraná Valley of South America comprising the best of Argentina and the little country of Uruguay. Here, as in interior Australia and in western United States, is a level plain of vast extent. For hundreds of miles it seems as level as the sea. One railroad runs westward on a perfectly straight line for 278 miles, a distance greater than from New York to Washington. Near the Paraná River, the rainfall is sufficient for the growth of corn, wheat and flax, but as the distance from the river increases, the rainfall decreases, and, as in the region beyond the Missouri River, a corn belt is followed by a wheat belt and the zone of farm lands is succeeded by a zone of ranch lands in which the industrial future must, like the present and the past, be devoted to roving flocks. Fifty or sixty years ago, when there was a great demand for hair-cloth, herds of horses valued at $2.50 each were driven into pens twice a year by their owners to have their manes and tails clipped to furnish horsehair for the crinoline looms in England and France.

[25] The likeness of this island to England is striking.

[26] New Zealand's contributions to British imports of meats for 1923 were 387,549 quarters of beef, 4,490,017 carcasses of lamb, and 1,724,730 carcasses of mutton. The lamb section is the most important, being more than double the combined quantity imported from Australia and South America in that year. (*London Times Trade Supplement*, May 31, 1924.)

Then came the Merino sheep, whose wool and tallow, skin and bone also went to Europe, while his meat was thrown away because there was no possible market for it. Then came the refrigerator ship and the export of mutton. The pastures of the Paraná Valley are so fine that the sheep fatten entirely on grass, which is uncommon.

It is interesting that the present vast sheep flocks of Argentina are very largely owned and cared for by English and Scotch people, who for many generations in their own countries have been thoroughly acquainted with sheep and know their ills, their wants and

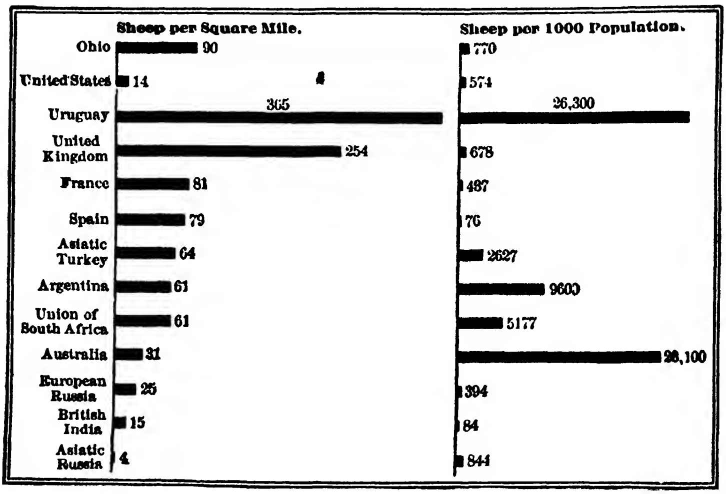


Fig. 90.—Pre-war ratio of sheep to land and to population, in leading countries.

their ways. The cattle, requiring less care, are usually owned by the people of Spanish descent and cared for by the gaucho or half-breed cowboy of that country.

In northern Argentina, the greater heat and rainfall make cattle more important than sheep, and toward the cold south the plains of Patagonia, long a little known region, have been taken up as sheep ranges, often by young men of British stock from the Falkland Islands who are accustomed to sheep herding and to life on the cold plains. Sheep farms have been established on the faraway island of Terra del Fuego, at the extreme end of South America, the sheep being better able to live in this country than cattle since their wool protects them from the severity of the winter; they will scratch away the snow to get at the grass that lies beneath it, and, if necessary, they can fast for several days when the snow lies too deep.

Uruguay, across the Paraná River from the best part of Argentina, is from end to end an undulating grassy plain. Twenty times as much land is devoted to sheep and cattle pasture as to grain growing, and 95 percent of her exports consists of live stock and related products, of which about half is made up of wool and mutton. While the growing of wheat, corn and other agricultural crops is increasing a little, Uruguay is likely to remain a pastoral country for many years.

SOUTH AFRICA. South Africa is fourth among wool-exporting regions. Like Australia, this region has mountains near the ocean which shut off the southeast trade winds from the interior, leaving a moist plain near the sea for agriculture and cattle raising. Back of the mountains is a wide expanse of interior, much like western Kansas, too dry for the plow, and with climate and the pasture conditions suited to sheep where not too dry for pasturage, as in the Kalahari desert, which corresponds to the central desert of Australia. Wool has been one of the most important factors in the development of South Africa, and the number of sheep in the Union has doubled in the last twenty years.

WESTERN UNITED STATES. The plains of the United States have not been at any time so exclusively devoted to sheep raising as have similar parts of Australia and Argentina, because the vigorous and hostile Indians held the American plains against the advance of the white man until the railroads came. Then cattle could be sent to market, and the sheep-growing and wool-exporting stage so common in the Southern Hemisphere was less necessary. The first industry of our West was the rounding up of cattle on the plains by the cowboy. Sheep herding came later and has had large development, especially in the mountain states and in Texas.[27] Outside of Texas sheep often roam on Government land, an open, unfenced range where the grass belongs to any beast that eats it. The sheep eat it more closely than cattle do, leaving nothing behind them for the cattle, and often destroy the grass itself by pulling it up by the roots. A bitter animosity between the sheep owners and cattle

[27] Sheep in millions, 1924: Texas, 3.0; Wyoming, 2.7; Idaho, 2.4; Utah, 2.4; California, 2.4; Montana, 2.3; Colorado, 2.3; New Mexico, 2.2; Oregon, 1.9.

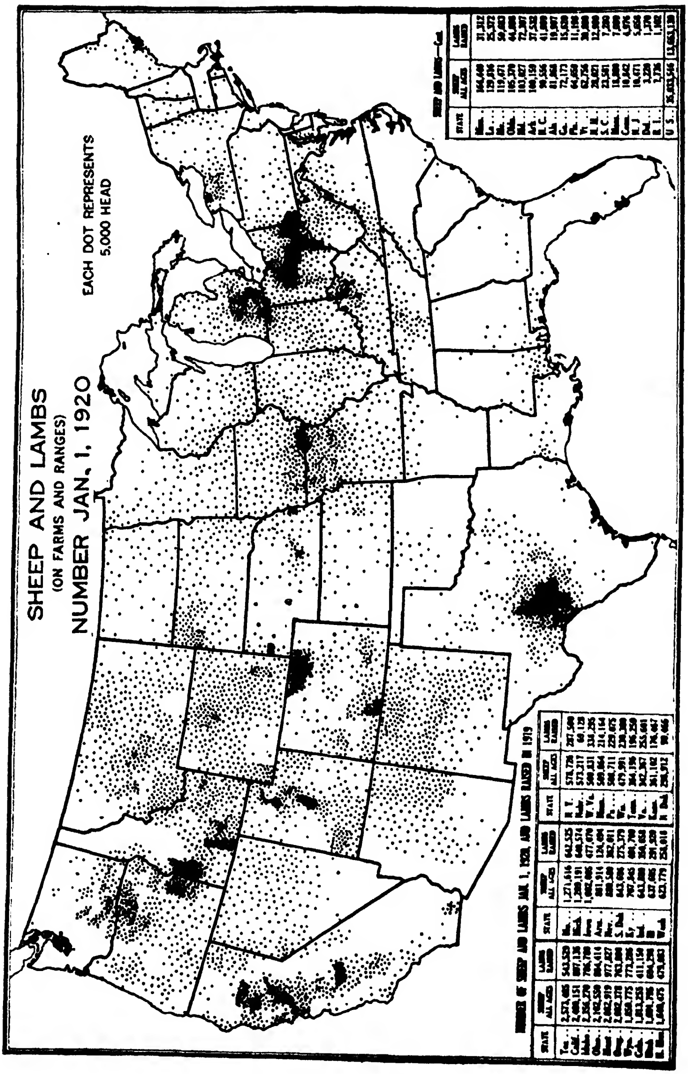


FIG. 91.—The absence of sheep from the warm moist southeast is noticeable. (United States Dept. Agr.)

owners has resulted, sometimes leading to fights involving loss of human life and the destruction of herds of sheep and cattle. The relation of sheep to irrigation and alfalfa is the same as that of cattle. (See section on cattle.)

Wool sheep, mutton sheep, and refrigeration. In the newer quarters of the world, where the object of sheep keeping is the production and sale of fine wool, the Merino is the best breed of sheep. By careful breeding and selection through many centuries it has been developed into a little bony animal, with a wrinkly skin, thereby furnishing for a minimum of food a little frame with a maximum amount of surface covered with a long, fine fleece which has at times been known to comprise with the grease 36 percent of the weight of the entire animal and have 48,000 strands per square inch of skin.

In the decade between 1880 and 1890, the perfection of cold storage and refrigeration suddenly caused a demand for mutton at Buenos Aires, at Wellington, New Zealand, at Melbourne and Sidney, Australia, as well as at Chicago, Kansas City, and Omaha. The rising price of meat since 1900 has emphasized that demand and made the carcass more valuable by far than the fleece. The Merino sheep, with his excellent fleece, had no plump fat carcass, while the mutton-loving English had carefully bred and selected the Lincolnshire and the Southdown and other breeds for the ability to grow large and fat and make fine mutton, regardless of their coarse and meager wool. The refrigerator ship suddenly made the big, fat sheep more valuable in Argentina, Montana, and Australia than was the little Merino with its fine fleece, *provided* the sheep could be fat. As a result, the sheep breeders at once began cross breeding their flocks for mutton rather than wool, and in a little while the sheep were half Lincolnshire (or some other mutton breed), then three-quarters, and often seven-eighths. As a result, the people of Europe can now eat antipodean mutton, but the wool market has been disturbed by the great increase of coarse wool and the decrease of fine wool. New Zealand and Argentina have changed the sheep more rapidly than Australia, because in the latter country the great droughts often make it impossible to fatten sheep for market, so they have perforce clung to the wool sheep.

Sheep upon the farms of eastern United States. The older sheep regions, namely, the farms of eastern United States and Europe, which were the sole dependence for sheep before 1850, still keep sheep but they are in small flocks grazing in fenced fields. When the remote regions took to producing so much fine wool there was an added reason for the farmers to devote their attention to the mutton breeds. In the United States these sheep are, like the cattle, usually migrants. The full-grown ewe is brought from some place in the West to Kansas City, Omaha, or Chicago, and then sent to the farms of Iowa, Ohio, and eastern states where the farmers keep them for several years. Each year a crop of lambs is sold

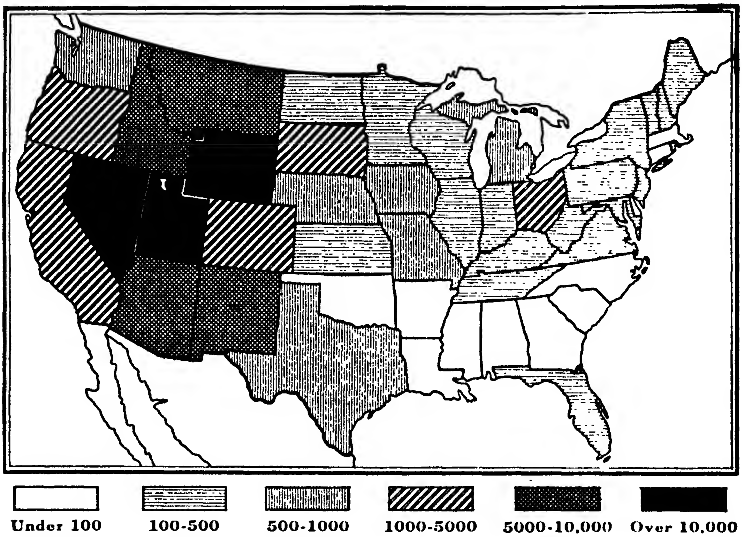


Fig. 92.—Sheep in the United States per 1,000 rural inhabitants, by states, Jan. 1, 1924. Population, 1920.

and finally the fat old ewes are sent to market and another supply purchased from the distant regions where the young sheep, like the young cattle, can be raised to maturity more cheaply than upon the small farms. These small flocks that can receive the personal care of their owners fare much better and produce a larger proportion of lambs than can be raised in the large flocks upon the range, where less attention is given them. It is a common practice of some corn belt farmers from southern Michigan to central Nebraska to buy carloads of lean lambs from the western range in the autumn, and fatten them on corn and hay for the winter market. Many of the eastern sheep owners make a specialty of rearing their lambs in the winter season and sending them to market early in the year when they command a very high price.

There is a considerable area in the southern Appalachian highlands of Tennessee, Virginia, and West Virginia where ewes are grown and sold to the farmers of the Great Valley and the Piedmont sections of Virginia, Maryland, and also lower Pennsylvania.

New England, with its rocky and little used farms, offers one of the best places in the United States for the extension of sheep growing. The rocky lands produce grass and there might be worked out a combination of hill pasture and valley-grown winter forage such as exists in the arid West with its irrigated valleys. This would require the massing of several farms into one tract. At the present time rather less than a fourth of the sheep in the United States are east of the Mississippi River.

Sheep in western Europe. The great increase of sheep in the Southern Hemisphere has helped local causes to produce a general and heavy decline of sheep keeping in Europe, specially in the densely peopled parts of it. Throughout western Europe the sheep industry resembles that of the eastern United States and lambs and mutton are of more value than wool. The field in grain will produce more food than in sheep pasture, so that the grain field, the garden, the dairy farm and the sugar field, have taken the place of the sheep pasture in Germany as the valuable wool can be imported more easily than the cheaper food products. In France also the grain fields have replaced some of the sheep pastures. Some fine mutton sheep, however, continue to be kept in the most intensely cultivated parts of Europe, as in Belgium, Holland and Germany, but they are usually in the poorer, rougher, more scantily populated parts of these countries. The European sheep are fed much on barley and rape, a succulent cabbage-like plant that grows in sandy soil.

There has been less change in the sheep industry of Great Britain than in any other country of western Europe. The English had an early start at sheep keeping; they prize mutton and especially British mutton; their moist climate gives abundant grass, their policy of free trade makes easy the importation of grain, which is cultivated much less than in France or Germany, and in its place are sheep and cattle pastures. The chief British sheep districts are the highlands of north England and of Scotland and the eastern plain, where the Lincolnshire sheep has developed an unusual ability to survive on moist level land. Great Britain, with over 20 million sheep, about one-half as many sheep as people, has more sheep per 1,000 people than the United States, and in actual number about one-fourth as many as Australia, twice as many as France, 3½ times as many as Germany, but only two-thirds as many as Russia, which on account of great size and somewhat arid eastern part, is the leading sheep and cattle country of Europe. But sheep have declined in Russia as in all western Europe. The economics

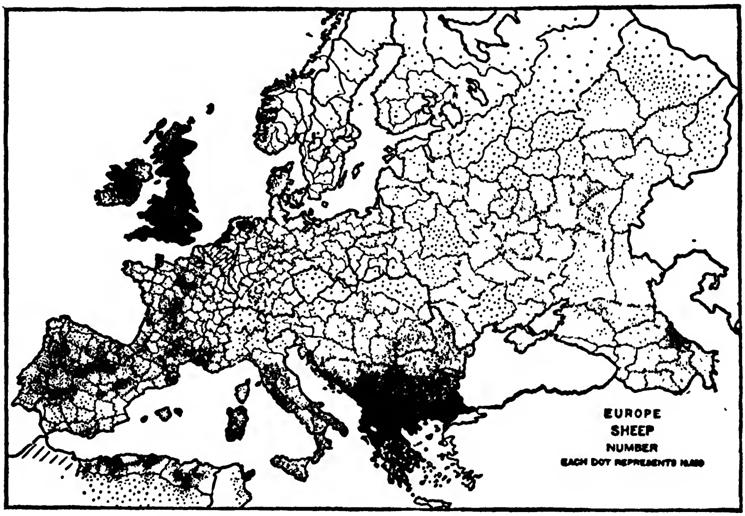


FIG. 93.—The value of sheep in humid Britain, semi-arid North Africa, and the rough and semi-arid Balkans, is apparent. (Finch and Baker.)

of this decline is simple. The sheep with wool and meat makes more return than the beef animal but less than the cow with meat and milk.

SHEEP IN THE MEDITERRANEAN BASIN AND CENTRAL EURASIA. The California climate, with its winter rain and dry summer, is very wholesome for sheep, especially if they can have mountain pastures. The similar climate of the Mediterranean countries of north Africa and west Asia produces another region where sheep do well if the food be present. In this belt is Spain, with nearly 20 million sheep.

Sheep are very important in Greece, Albania, Yugoslavia and Bulgaria—mountainous, isolated, primitive.

In the dry region of southeastern Russia the conditions of the American and Argentine ranch are nearly duplicated, with similar conditions of sheep production. Much of Siberia and central Asia with its thousands of miles of plains or steppes is too dry for anything but pasturage, and some estimates credit Asiatic Russia with a much higher number of sheep than that given in the table.

Sheep are very common and very important in Turkey, as in semi-arid Asia Minor, Persia, Afghanistan, the mountainous parts of India, Tibet, Manchuria, and the interior dependencies of China. From all these countries there is an export to the western world of the coarse wool yielded by the hardy native sheep belonging to those careless Asiatic peoples who have never possessed themselves of the better breeds of western Europe. Throughout this whole region from the Bosphorus to the Amur Valley the sheep live almost entirely by pasture, which is subject to the cruel uncertainties of climate; and despite the shifting of flocks from place to place, as described in the book of Genesis, disasters occasionally occur. Unlooked for heavy snow storms occurred in January, 1911, in Asia Minor. In the autumn months of 1910 almost 300,000 head of sheep, one and two years old, had been started from Suleimania, Kerkook and Mosul toward Aleppo and Alexandria to be shipped to Alexandria, Egypt, for mutton; 90 percent perished en route.

Sheep in tropic highlands. There is some sheep husbandry for local use throughout the mountainous regions of Mexico, Central America, and the Andean regions of South America. In Ecuador, Peru and Bolivia, the Andean plateaus spread out in greater expanse and, with their rough surface, cool and semi-arid climate, are a good place for sheep and there is an export of wool. (Peru has more sheep than any three American states.) It is true these countries are in the tropics, but the natives of the Bolivian plateau wear woolen masks to protect their faces from the biting blasts of the winds that sweep across the landscape 2½ to 3 miles above sea-level. Such a climate is the natural home of fleece-bearing animals and in the llama, the vicuna, and the alpaca it has produced three with commercially important coats. Two of these animals, the llama and alpaca, furnish for export some very fine, long, soft wool, but the animals themselves have never appealed to the people of other countries as suitable for propagation.

With decline of sheep flocks in the old countries and the stationary conditions in the important new countries it is interesting to note the appearance of a possible new region in highlands of east Africa. The British Colony of Kenya has 2,500,000 sheep, the original stock being of the native woolless variety. Experiments at breeding up from these hardy sheep resulted as follows:

The sheep of the first cross shears 1½ lb. wool.
The sheep of the second cross shears 3 lb. wool.
The sheep of the third cross shears 4–5 lb. wool.

THE GOAT. The goat, a producer of wool, zoölogically a cousin of the sheep, is associated with him throughout the world; the chief factor of separation between the two being the goat's ability to survive a less hospitable environment and food supply. The goat's much jested ability to eat almost anything indicates that it is one of the hardiest of animals, capable of living under the most severe conditions. Accordingly, where land is good and pastures are fat, goats are few; but where sheep can scarce subsist, the goat thrives on the browse of desert and mountain shrubbery. He fights enemies that kill the sheep or else scrambles to an inaccessible rocky pinnacle for safety. The semi-arid countries therefore greatly predominate in the possession of the world's 100 million goats. Thus Spain and Algeria are each credited with nearly 4 million, more than any other country of Europe and more than the United States. Nigeria has 4 million; the Union of South Africa 8 million, and British India an enormous preponderance with 24 million. The result is that goat skins, which with sheep skins are so important in the leather supply of the world, come from the poorest pastures of the world. Many are exported from China, where they are brought by caravan from Mongolia and the central deserts of Asia. They come from the arid parts of India, from Persia, from Italy, and from the edge of the Sahara. Most goats are of commercial value only through their skins, but in the district of Angora, Asia Minor, near Anatolia, has been developed the angora goat whose long, silken fleece, called mohair, competes with wool in making the finer fabrics.

MOHAIR. The demand for mohair for making cloth has caused a great increase in the keeping of angora goats. They are now especially important in South Africa, where the dry pastures bordering the Kalahari desert produce a large quantity of the world's mohair; and its quality is said to exceed that of the parent Asia

Minor district, which exports millions of pounds annually, largely to England and the United States. Recently these animals have received favorable attention in the United States and are quite widely scattered over the country, especially in New Mexico and the Edwards Plateau of Texas. They eat leaves of trees as readily as grass and they are utilized to some extent to destroy bushes and underbrush where it is desired to convert forests and thickets into cleared lands and pastures. This same browsing ability of the goat and camel has made them effective agents in the denudation and destruction of Mediterranean lands—one of the accomplished tragedies in man's relation to the earth.

THE FUTURE SUPPLY OF WOOL AND MUTTON. Unless we change our habits with regard to wool and mutton, the future supplies of these articles must be more extensive than that of the present time to keep up with increasing demand. Yet it is true that during the last quarter of the nineteenth century the world's sheep reached their maximum number under present conditions of production. As most of the new pasture plains have been fully occupied, increases of wool and mutton can only be made by improvements in the wool-yielding quality of the sheep themselves and by the greater intensity of agriculture which must cause a greater and greater portion of the world's sheep to be kept on farms in small flocks as they are in western Europe and eastern United States. As this method, with costly land, its building of barns and storing of winter food, is more expensive than that by which a single herder drives 2,000 or 3,000 sheep over a fenceless, barnless plain, costing little or nothing, rising prices for mutton and wool seem inevitable if demand increases.

9. DRAFT ANIMALS

OUR DEPENDENCE UPON BEASTS OF BURDEN. Although man dominates the earth, he is physically weak in comparison to many other animals and has been able to possess the earth only by bringing their greater strength to his aid. The European discoverers found no draft animal whatever in the United States, a fact which goes far to explain the Indian's lack of civilization. Without animals, he could not make the start from primitive economic status. Lacking animals to do his work and give him food, he was always so poor that he had to live from hand to mouth and it was much harder to get the necessary surplus to give him the leisure to learn, educate, accumulate and advance.

Had there been less room for roaming, and more natural protection for settlements and property in the United States, the bison might have been domesticated here as were reindeer and the yak of Asia. Some draft animal seems necessary in the ascent of a people toward an elaborate civilization, although in parts of Japan and China it has been shown that the animals can ultimately be reduced to a low minimum. Fortunately, while strong enough to work and intelligent enough to be trained, the animals are stupid enough to be ignorant of their powers and thus obey us (see *McClure's Magazine,* June, 1909, for detailed exposition.)

Most of man's work has been done by ten animals—five of them of almost world-wide distribution, the horse, ox, ass, mule and dog —and five of very special location—the camel, elephant, reindeer, yak, and llama. Our methods of using them vary according to the nature of the work, climate and roads, but our dependence upon them is so absolute that if they should suddenly disappear from the earth, western civilization would be shaken to its foundations and millions of men would probably starve. Despite all our improvements in machinery it is upon the muscles of trained animals that we depend for the production of nearly all the food we use in Europe and America.

GROUP I. DRAFT ANIMALS OF GENERAL DISTRIBUTION

I. THE HORSE. The horse, the aristocrat of draft animals, probably does as much work as all the other draft animals put together. He lives throughout the temperate zones except in the most extreme deserts, is only barred by the tropic forests and the snow-covered north and even there he is of value, as shown by the surprising efficiency of Manchurian ponies in an English Antarctic expedition of 1908–09. Chiefly because of the attacks of insects, the horse does not do so well in the more humid parts of the tropic and subtropic regions as in dry climates where there is sufficient food. He is largely limited to the peoples of the Caucasian race. Thus the United States (20 million), Canada (3.5), Europe (36 million), and Asiatic Russia (5.5 million) have about 65 million out of the 97 million horses reported in *Yearbook* of United States Department of Agriculture. By contrast, India had 2.2 million horses, 142 million cattle, and 35 million buffaloes—convincing proof of the superiority of the bovine over the equine genus as tropic denizens.

For many centuries the Arabian horses, fed partly upon the barley of the oases, were supposed to be the best of all horses, but several importations of the best Arabian steeds throughout the nineteenth century have shown them to be inferior in speed, though rivals in strength and endurance to the breeds of western Europe. Partly Arabic in their origin, the European horses have for several hundred years been bred with greater care in the selection of only the best parents for each new generation, with the result that the horse of the West now surpasses his distant cousins in the old home in Asia. The English especially are great lovers of the horse and of the horse race, and for several hundred years have been the leaders in the improvement of the breeds.

THE TYPES OF HORSES. There are three general types of horses. First, the heavy draft horse to draw heavy loads. This class originated in the good agricultural lands of west Europe. The second class is the thoroughbred or running horse, a product of England's race courses, and the third class is the driving horse now rapidly becoming extinct because of the automobile. Of these latter there are many kinds, including the trotting horse, or roadster, developed in America. There are various sizes and minor classifications in each of the three classes.

As an industry, the production of horses for sale is always carried on in regions that are good for the production of cattle because both animals have the same physical and climatic wants. The farmer with his hay and his pasture grounds has the choice of selling his crops in the form of grain and hay, as cattle, or in the more valuable form of horses. The form he selects depends largely upon his skill and taste and the district in which he lives. A given amount of forage will usually be of more value when converted into a horse than when converted into a bullock or cow, but owing to the nervous, sensitive, high-strung character of the horse, it takes more care, watchfulness and labor to bring him to maturity, without accident, which so often reduces or destroys his market value.

THE BREEDS AND GROWING OF HORSES IN EUROPE. In northwestern Europe many horses are raised, but, as with cattle and sheep, their number is insufficient to meet the needs of the people. Britain has two heavy draft breeds, called the Shire and Clydesdale. Liége in Belgium is a famous market for the sale of the heavy Flemish draft horses grown in that vicinity. The north of France produces many horses of the Belgian breed and also the Percheron named from the French department De Perche. This breed, owing to an infusion of Arabian blood, is the quickest of the heavy draft animals, and was long used to draw the omnibuses on the streets of Paris, but in 1913 was finally replaced by the automobile. The Percheron is the leading draft horse in America, the Clydesdale, Shire and Belgian breeds being used to a lesser extent. The motor truck on city street and country highway has done much to lessen the demand for these noble beasts.[28]

In Germany the greatest horse-growing region is the grassy country near the North Sea. Denmark has been an important exporter of heavy draft horses to Germany and England, but the Danish farmers are finding that they can get better returns from their oats, barley, and hay by converting them into dairy products. In Hungary horses and mules are allowed to run in large herds on the level plain which comprises most of that country and which in the central part is rather too dry for grain growth but excellent for pasture land. Russia, with 132 million people and almost half the area of Europe, including an enormous region of level pasture plains, had before the World War half the horses of all Europe and about the same number as the United States.

The War and the revolutions have killed off many of these horses, many more were slaughtered for food, and it will be years before the Russian grain fields again have a sufficient supply of work animals.

THE AMERICAN HORSE INDUSTRY

Horses of the European breeds early made their escape from the Spanish settlements in Mexico and ran wild on the western plains and mountains for three centuries until, with the buffalo, they vanished before the American settler in the last quarter of the nineteenth century. A few bands have survived in New Mexico and Colorado and they are probably on the increase in some of our national forests. These wild or half wild horses, usually called Indian ponies or cayuses, when tamed had degenerated in size but

[28] In June, 1925, the complete barring of horses from the streets of certain parts of Philadelphia was under consideration.

developed wonderful endurance. After the first settlement of the Plains, they ran on the range and were cared for like range cattle, being caught up at intervals, branded, and sold when ready for the market. Like the wild cattle this breed has now almost disappeared through admixture with the European breeds brought from the eastern states.

One of the best-known centers of American horse production is the blue grass region of central Kentucky, with the city of Lexington as its center. This plain of eight or ten thousand square miles is underlaid by a bed of limestone which upon exposure to the air breaks up into a soil of great fertility and one in which blue grass grows to perfection. This is one of the best of pasture grasses, especially for horses, which are one of the money crops of this region. Trotting and saddle horses are the chief kinds and despite our present-day preference for automobiles, horses from the Lexington district are still to be seen prancing through our city parks. The small area of the Kentucky blue grass region causes it to be of far less total importance in horse production than is the corn belt.

Throughout the whole extent of the corn belt alongside the farms where some men are fattening pigs and others fattening cattle, still others have droves of colts usually of the heavy draft breeds originally brought from France, Scotland, or Belgium. When four or five years old, these horses are sent by carloads to the eastern cities and to many agricultural districts in the east where the farmers find it more profitable to raise crops suited to near-by markets and buy their horses because they can so easily come from afar. Industrial depressions in the United States are always particularly severe on the horse market. The demand has sometimes been so small that a five-year-old would bring no more than he could have been sold for as a six-months-old colt. The export demand for horses from the United States is never large but there is a fairly steady shipment abroad of registered animals for breeding purposes.

There are occasional horse ranches on the Great Plains of the United States from Canada to Mexico, whence horses are sent to the mining and timber camps of the mountains.

The raising of a few colts is a widely scattered supply crop and an occasional money crop on some farms in almost all parts of the United States. It is of greater importance in the Piedmont section of northern Virginia than in any other district east of the Appalachians. Excellent cavalry horses are produced here and the United States Government maintains a remount station at Fort Royal and guarantees the quality of the breed by loaning stallions of approved breed.

While the United States still uses more horses than any other nation (European Russia is second with 14 million) the use of the automobile, the truck and the tractor has decreased the number of horses in this country from 24 to 20 million head in the last ten years. Still, it is unlikely that the horse will be seriously displaced as a draft animal in our agriculture for years to come. On many small farms a team of heavy draft horses can do the varied work at lower cost than a tractor and even make a neater job of the plowing. On the large farms men have come to realize that some horses are also necessary, and that there is room and to spare for horse and truck and tractor, each doing its special work more efficiently and for less money than any other form of motive power.

I. THE PONY. Where the horse has been long in regions of scanty food supply, he has degenerated in size. Ponies have been thus produced, the breeds usually bearing the name of the region of origin—Russian, Manchurian, Welsh, Iceland, Orkney, Shetland, Zacetecas, and many of them show pronounced adaptation to their environment. The Zacetecas pony from the Mexican state of that name is of Spanish stock, sleek of coat, long of limb and fleet from the climbing of high mountains and going far in an arid country for his food and water. The slow, strong, short-legged Shetland pony with his block of a body, his veritable overcoat of mane and tail, and his long and shaggy coat has been produced by the humid, raw and cold climate on the heather-clad hills of Shetland near the latitude of southern Greenland. Grant them pasture, hay, and a shed in Iowa and they increase in height 10 percent in a generation.[29]

II and III. THE MULE AND THE DONKEY OR ASS. The mule, which has a donkey for a father and a horse for a mother, is in some respects a better draft animal than either parent. The donkey is conspicuous among the common draft animals because of its extreme hardiness, longevity, and ability to thrive like a goat upon rough food and under poor conditions. It has larger bones than and greater strength than a horse of similar size. The burdens borne by the Asiatic donkey are an almost unbelievable amazement.

[29] Eli Elliott: *The Shetland Pony.* Shetland Pony Club, Lafayette, Ind.

The wild ass is still found in the most desolate parts of Mongolia and Turkestan, where his fleetness and hardiness enable him to survive even in the home of the wild camel.[30] From this parent the mule inherits long life, a hard small hoof, sure-footedness, and the ability to thrive on little food, in all of which respects it excels the horse, from which it inherits size and spirit. The chief reason why the mule has not displaced the horse in many more lands than it has is a question of pride. Men love their horses and admire

FIG. 94.—The Shetland pony with its long coat is an interesting response to an environment, the cold, raw Shetland Islands. (Photo C. S. Plumb, Columbus, Ohio.)

them, but the mule (sterile because of hybrid origin) with his long ears, his noisy bray, and a superior intelligence which makes him resent abuse with his heels, is not so much loved or so popular. For nearly all kinds of service he is really the superior animal, yet the world's horses are five times as numerous as the mules and asses combined.

[30] The Roy Chapman Andrews expedition to Central Asia in 1924 caught a four days' old infant ass. His almost unbelievable achievements at kicking indicate that the mule comes honestly by his most famous characteristic.

THE DISTRIBUTION OF DONKEY AND MULES. The mule and the donkey (especially the donkey) prevail where conditions of life are hard. Thus China, Turkey and India have two-thirds of the donkeys of the world and Spain, Italy, Egypt and Morocco have a fourth. The north of France, with its rich pastures, produces the fine, fat percherons and the French coach horses. But southern France, with the drier climate of the Mediterranean, has poorer

FIG. 95.—The donkey, servant of the peddler of American oil in Portugal (Standard Oil Co.). This wasteful pack transportation is used to a surprising extent in Spain and Portugal, and often where roads do not require it.

pastures and here mules and donkeys are bred. Spain has half the mules of Europe, and from its arid plateaus exports to all the world the finest asses to be used in the breeding of mules. Spanish horses are but one-fourth as numerous as the donkeys and mules. Throughout the desert region from Morocco to Pekin the mule and the donkey climb the hills, thread the mountain passes, browse on the arid plains in companionship with the camel, which braves the worst desert, the ox that draws the creaking cart, and the horse that bears the proud chieftain.

In the mountains of every country, every province and every state between Alaska and Patagonia, the mule and the donkey are of great relative importance. They serve wherever work is difficult, as in climbing the mountain trail, hauling loads of logs in lumber camps and cars in mines. They toil alike upon the fearful trails from the ocean to the Andes beneath the equator, or before the mine car filled with gold ore in Colorado, with coal in Pennsylvania, or lead in the Altai Mountains of Siberia.

Good mules are grown and used in Manchuria and north China and have sometimes been exported from Tientsin for service in the British army in India. In Pekin the mule has the favored position of being the chosen driving animal of the government officials as they travel about the city in their "Pekin carts," but here also the automobile is playing havoc.

The ability of the mule to stand greater hardship and a more humid climate than the horse has made him the favorite in the tropics and the southern part of the United States. In Iowa, Illinois, and Indiana (in 1924) the mules comprised only one-tenth of the 3½ millions of equine draft animals but more than half of the 6 millions in the nine cotton belt states. The cotton area contains nearly three-fifths of the mules in the United States, for the cotton cultivator is almost universally mule-drawn. The mule often stays in the state of his origin but two or three years, but plows cotton for twenty years.

THE AMERICAN MULE INDUSTRY. The finest mules in the United States are grown in the horse belt of Kentucky and adjacent districts of Tennessee, where the mothers are the culls of the driving horse breed. Missouri is probably the greatest mule-producing region of the United States and under a single roof in St. Louis 5,000 mules are sometimes for sale. From this market, and from Kentucky and Tennessee, they are distributed over a very wide area in the United States and in foreign countries. Whenever there is war, the demand for mules arises to bear the army burden. When Spain was at war with Cuba, she bought American mules for the use of her armies in that island and during the three years of the Boer War in South Africa our mule export was six times the normal figure. The English dependence upon American mules was so great that officers of the British army opened headquarters in all the American mule markets, bought mules by the thousands, sent them from New Orleans to Cape Town by shiploads, and so reduced the number in America that for a decade their price was higher than that of horses. The World War was primarily a war of motor trucks but the quadruped was not entirely displaced, and the American mule again saw war service, for which, as in peace, he is more efficient than the horse.

There is little doubt that with the increasing cost of horse feed in the United States the good qualities of the mule are being more appreciated and his use is growing. From 1903 to 1923 the number of horses increased about 14 percent and that of mules over 100 percent.

IV. The ox. In almost all cattle-keeping countries oxen are used, to a slight extent at least, as work animals, but not so much as in past periods, because of the competition of the more efficient horses, mules, and donkeys. Among the peasants of northwestern Europe and many other lands, even the cow that supplies the family with milk is at times harnessed to the wagon to help with the farm labor. Although very slow, the ox is unquestionably stronger than the horse, and, deep in the mud of a swamp, will pull where a horse would not even make a try. Consequently, their most general use in the United States is to haul logs in the lumber operations in the woods and they are also of value on the rocky lands of New England where the ox is more common than in any other part of the United States. In the muddy sugar-cane fields of Cuba and on the very bad roads in parts of tropic America the ox-drawn cart is generally used because it is the best wheeled equipment for the special conditions, which often resemble those of the morass or lumber camp. The ox will also stand more abuse without injury than the horse will.

Oxen and agriculture. The general use of oxen in agricultural labor is usually an indication of an industrially backward people who are willing to content themselves with slow helpers or who must take advantage of the factor of cheapness arising from the fact that the ox can eventually be sold as a beef animal.[31] Such a combination of oxen and primitive agriculture we find among the Armenians, Bulgarians, Turks, and other peoples of southern and eastern Europe, and in places throughout central Asia to Pekin

31 "You see, Señor, it is this way," said the manager of a Portuguese estate, in defending his use of ox teams rather than the more speedy mules. "The ox eats straw, while the horses and mules need some grain, and then we eat the ox."

and Manchuria. The Boers of South Africa still continue to use teams in which several spans of oxen draw a wagon of enormous size.

In India it is probable that there are as many oxen used as in all the rest of the world. The hundreds of millions of people there use almost no other beast of burden. As cattle can survive the tormenting tropic insects better than horses or even mules, oxen are probably the most used agricultural work animal of the tropics. In Porto Rico, for example, they are the mainstay. On the muddy roads and muddy rice fields of the Philippines and southeastern Asia the carabao or water buffalo, an economic duplicate and a zoölogic cousin of the ox, is the prevalent beast of burden, although his slowness probably makes him the least efficient of all the larger draft animals. India's 142 million cattle make that country far and away the leading cattle country of the world without counting the 35 million buffaloes that really belong in the same class economically.

V. THE DOG. Least important of the general draft animals is the dog, rival to man in his ability to live in all climates. He goes wherever man goes, living on a diet of meat and fish if upon the shores of the Arctic Sea, or of beans and bananas mixed with a little meat in Equatorial Africa. As a draft animal he is to the snowy parts of North America what the reindeer is to Lapland. He had drawn the sledge of the Aleut and the Eskimo, the Hudson Bay fur trader, the Labrador explorer, and the gold prospector in Alaska and the Klondike. In Alaska alone 18,000 work dogs were reported in 1920. He does the same service in some of the colder parts of Europe and Asia, but it is probable that the dog is most used in the densely peopled agricultural regions of northwestern Europe. In the north of France, Holland, Belgium, and western Germany, regions where the horse predominates, it is a common sight to see a team of two, three, or four muscular dogs hitched to a surprisingly heavy cart, taking to market a load of milk, vegetables, or other farm products. It is not uncommon to see a peasant woman on one side of the wagon tongue and the dog on the other. This hard labor is due to poverty, and the poverty is due to the density of population, which only leaves a small patch of land for each family so that they cannot feed any larger work animal than the dog. In parts of Germany the pet dog is heavily taxed, but the work dog is untaxed. In Japan, the population being still greater in proportion to resources, man is of necessity his own beast of burden.

GROUP 2. THE DRAFT ANIMALS OF SPECIAL LOCATION

The five draft animals of special location are generally inferior to the horse and the mule, but have some peculiar adaptation to environment that enables them to work in places or services where the horse and mule are less efficient, if they can survive at all.

I. THE REINDEER. The reindeer is a specialist at surviving cold and a poor diet, such as Arctic shrubs, scanty grass and even the moss which grows on the otherwise bare ground of the almost continually frozen Arctic plains, called tundras. Over this bleak, treeless, and uninviting Arctic region the caribou and other species of the reindeer family are widely distributed. The herds of wild caribou in uninhabited parts of Canada, numbering possibly millions, are undoubtedly the greatest collections of meat animals in the world.[32] Two domesticated kinds of reindeer are used by the sparse populations from the Atlantic Ocean in north Norway to Kamchatka and Bering Straits. Their southern limit in central Asia reaches almost to the Amur River and Lake Baikal. In this vast region the population is very sparse, and the people use the reindeer for work, chiefly as a sled animal, although they occasionally ride him. The reindeer are essential to the life of many of these people, for in addition to acting as beasts of burden, they furnish milk, skins, and meat to the herdsmen, who count them as their sole wealth. In 1891 reindeer were successfully introduced into Alaska, a country similar to their own; the herds have since that time increased to approximately 200,000, and it will probably be but a short time before they are distributed throughout the Arctic and sub-Arctic regions of North America. Commercial shipments of reindeer meat are now coming to the United States by way of Seattle, and the industry is thoroughly established with hundreds of thousands of unoccupied square miles in which to spread. Santa Claus travels through the streets of Nome, Alaska, with real reindeer drawing his sleigh.

II. THE YAK. The yak, a close cousin to the ox and the buffalo, is a native of the Himalaya Mountain regions and is adapted to

[32] See Smith, J. Russell, *North America.*

high elevations and scanty food, but especially to deep snow. The under parts of his body have long thick hair reaching nearly to the ground, so that he can lie on this natural mattress with warmth and comfort on the deep snows of high mountains. This animal is at present used only in Tibet and the adjacent high regions of central Asia, where he draws carts and carries burdens on his back. The naturalist, Mr. Thompson Seton, has pointed out that large areas of Canada, not well suited to ordinary cattle, might well be given over to yak pasturage. The yak has shown his fitness by thriving for six generations in an English park.

FIG. 96.—The Llama. A beast of burden in Andean countries.

III. THE LLAMA. The llama of the highlands of Peru and Bolivia does for the Andean Highlands the service rendered by the yak in the Himalayas. The llama is a small animal resembling both the sheep and the camel, and is used only for carrying packs which cannot exceed a hundred pounds in weight. He does not have great amounts of snow to contend with, but for sure-footedness in climbing the exceedingly precipitous Andean heights, the llama has no superior, especially as he can pick his living from a very unpromising wayside as he goes. It is possible that the llama, as well as the yak, might be a source of profit in some other mountainous regions. Unfortunately, this is not the kind of an experiment that an individual may undertake with the expectation of profit.

IV. THE CAMEL. The camel is well known as a specialist in the ability to survive in comfort for several days without food or water and to live upon the harsh vegetation of the desert. For many centuries this animal has been distributed from the western Sahara through Africa and central Asia to eastern Mongolia, and has lately been introduced into the Australian desert. There are two kinds, the one-humped and the two-humped or Bactrian camel. This latter is found all the way from the Crimea in south Russia to Pekin, and from the trans-Siberian railroad to northern India, where it crosses the territory of the yak. Without the camel many parts of the desert region of Asia and Africa could not be inhabited and many deserts over which caravans have passed for ages could not be crossed. The largest heavy draft camel can slowly carry a pack of from 700 to 1,000 pounds, the fastest saddle animals can take a man a hundred miles a day; and they can carry these burdens for several days, living the while upon the accumulated fat which has been stored in the humps upon their backs. This storage of energy in the camel's hump is like that accumulated by the pig and the bear in autumn to enable them to lie for days contentedly in their beds when the winter season makes hunting for food difficult. The fat-tailed sheep (tails of varied shapes), the fat-rumped sheep, and the fat-backed sheep of various Old World deserts rival the camel and the pig in fat storage. The camel, unlike the others, uses his surplus to carry him over a hard region rather than a hard season. One attempt was made to introduce the camel to southwestern United States, but it was interrupted by the Civil War. There is no apparent reason why he should not thrive and be useful there.

V. THE ELEPHANT. The elephant has a restricted field of usefulness because he lives only in the tropical forest regions of Asia and Africa. He is an enormous feeder, eating in proportion to his weight more food than any of the other work animals, so that he can be used only where the humid tropic climate makes forage most abundant. Only Asiatics have been energetic enough to domesticate him in modern times. Many of the work elephants are caught wild in the forests, and then, with the assistance of tame elephants, are laboriously broken to do the work of man. They draw plows and wagons and carry passengers on their backs, but are most useful in lumber yards where with great skill and dexterity these live cranes lift and pile logs which a dozen men would have difficulty in handling. In times of war they have even carried, lifted, and placed cannon for artillery regiments, and are a regular part of the British army equipment in India.

Two thousand years ago the Carthaginian armies invaded Roman territory with war elephants. Africa still has wild elephants but they have been pursued with relentless vigor by ivory hunters and slaughtered in such countless thousands that their complete extermination is threatened. This, too, in a region where none of the other domestic animals can live because of climatic conditions and where land transportation of necessity falls upon the backs of men. It would seem that the moderns, if possessed of any spark of appreciation for resources, should duplicate the achievements of the ancients, redomesticate the elephant and give to central Africa the most powerful of all beasts of burden where it now has the least efficient—man.

10. POULTRY AND SMALL ANIMAL INDUSTRIES

There seems to be small discernible relation between the importance of industries and the amount of attention that is bestowed upon them by economists and publicists. Wheat, cotton, gold, silver and iron seem constantly before the scientific and financial mind if we may judge by the number of books, treatises, articles, and statistical analyses and price quotations pertaining to them. The intellectual neglect of the lowly hen is not due to unimportance, for poultry and eggs of the United States (worth over one billion dollars in 1923) are now exceeded in value by only four crops—wheat, corn, hay and cotton. Hen produce far overtops that of iron or silver or gold. This lack of interest may be partly explained by the universality of production, the non-capitalistic production, the difficulty of securing statistics, the absence of large financial or speculative operations in connection with poultry and eggs, the small influence of legislation upon them, and the small part they play in international trade. Poultry keeping is none the less important and is undoubtedly the most universal form of animal industry in United States and also in Europe, east Asia, and other foreign countries. The names of breeds attest their world-wide distribution—Pekin and Muscovy ducks; Cochin, Brahma, Leghorn, Hamburg, Minorca, Indian Game, Wyandotte and Plymouth Rock chickens; Brabant geese.

Fowls are raised commercially to some extent in the vicinity of our great cities and are kept in villages as well as on farms throughout the United States. They are usually a kind of by-product, often a perquisite of the farmer's wife. The very large majority of the fowls in this country are found in comparatively small numbers (about 60 per farm), on our 5 million farms, where they gather most of their own subsistence, and receive practically no care. The consequence is that the eggs are produced at little cost, though their value is the astounding total of half a billion dollars each year. The development of this industry to an extent incredibly larger than it is at the present time is among the easy possibilities.

There has been a marked increase in the number of specialized poultry farms since 1900. One of the causes of this change is the work done by the mechanical incubator. It works on a very large scale, and is as successful as the hen, who is now free to devote her whole time to the production of eggs. The brooder, a successful mechanical mother, has at last been achieved and completes the necessary equipment for large scale production.

Poultry keeping is equally well fitted to be a by-product in extensive agriculture or a main product in intensive agriculture with a strong tendency to be important where agriculture tends to be intensive. Half of the poultry in the United States is in the corn belt and around its margin where feed is cheap. There are two notable districts of poultry specialization. Six counties in southeastern Pennsylvania had nearly 5 million poultry in 1920, or 4,000 to the square mile. Intensive poultry raising crops out still more sharply in California with her high land values. Sonoma county, where Petaluma is the poultry center, had 3 million poultry with sales of $12,000,000 in 1920.

The relation of poultry to intensification is well shown in Canada. In 1902 Canada's egg export amounted to nearly $2,000,000. It decreased rapidly and since 1910 the Canadian egg imports have been greater than the exports. The great development of railroad building and wheat growing in west Canada has enlarged the Canadian market and afforded a new business opportunity for the people of the eastern provinces who had before exported eggs. During a similar period of western development the United States poultry industry went through the same fluctuation. In 1870 a great railroad building and western development began and in 1872 our egg imports suddenly rose to 5 million dozen. From 1882 to

1890 they were 15 million dozen per year, then suddenly fell away during the next four years; their export has risen steadily from 1897 to 1923 when it was 30 million dozen.

China affords the best evidence of the suitability of the poultry industry for lands of dense population and low standards of living. Travelers testify to the fact that chickens are seen everywhere, a few being raised by each family on table scraps and other refuse, so that the cost is negligible. Eggs at two cents a dozen in the

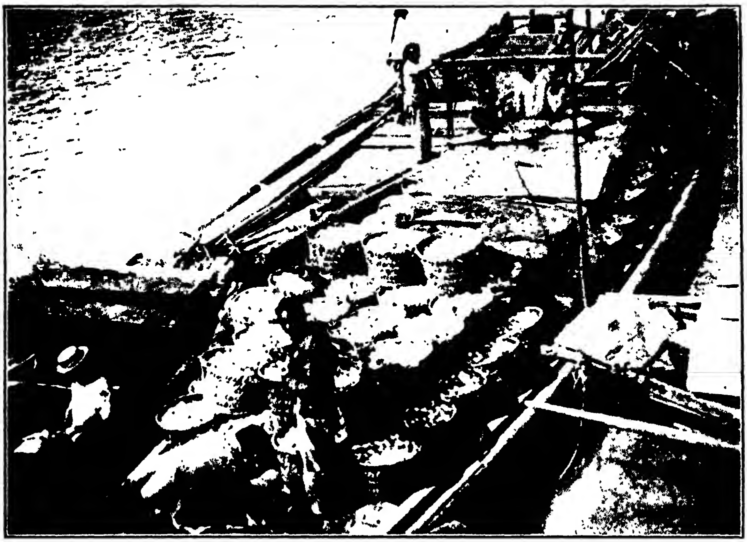


FIG. 97.—Boatload of eggs on Chinese canal. Evidence of intensive agricultural industry. (From *Farmers of Forty Centuries*, F. H. King, Madison, Wis.)

interior of China help to explain the ridiculously low cash wages paid in that country. Near the coast egg prices are higher because of access to the world market. The Chinese egg is now a staple of trade. Factories on the Shantung peninsula and elsewhere convert millions of dozens yearly into dried eggs, dried yolks and albumen (dried white of egg). By this means 1,000 eggs can be reduced to 22 pounds' weight, easily transported and said to keep indefinitely. China has an export of about 57,000,000 pounds of egg albumen and yolk and 36,000,000 pounds of frozen eggs.

The greatest commerce in eggs and, with the possible exception of China, the greatest production, is in Europe. Great Britain imports far more eggs than all the rest of the world combined, nearly 150 million dozen per year. China, Denmark, the United States, Holland, and Italy are important contributors, and even Poland, Rumania and the Ukraine export eggs to England by way of the free port of Danzig (*London Times Trade Supplement*, March 15, 1924). The European peasant farmer finds it more necessary to sell eggs than does the American with more land, but we are tending rapidly in that direction, as shown by our great poultry increase.

The poultry industry, especially egg marketing, responds readily to the fostering care of government or other outside aid. Developed in Denmark to a degree unheard of in most countries, it is a prime example of coöperative efficiency. The 60,000 or more Danish poultry raisers are members of an Egg Export Association which collected, packed and marketed over 600 million eggs in 1922. The rules of the association are stringent. Eggs must be collected daily and delivered to a branch of the association at least once a week. By a simple control system of numbers stamped on each, any egg can be traced from the English breakfast table back to the individual producer. A bad egg costs the farmer a fine of $1.38. The second bad egg costs him still more and the third is worse than three strikes at baseball, for he loses his membership in the egg association. With such attention given to the satisfaction of the customer, it is no wonder that the Danish egg has become a prime favorite in England, which takes the largest share of the output, and that the busy Danish hen has been able to raise her product to third in value of exports.

Owing to the high value of output in proportion to food, it should be emphasized that the distribution of the poultry industry depends more on man and less on the environment than any other of the animal industries thus far discussed. It should also be noted that in its large scale prosecution the failures in the past have far outnumbered the successes, because of the unusual amount of detail involved.

Turkeys, ducks, and geese comprise about 3 percent of the poultry of America, but despite the feathers of the ducks and geese, these birds, because of their small number of eggs, lack the double source of income furnished by the chicken. In Germany the tractable and thoroughly domesticated goose is esteemed as the untractable and not thoroughly domesticated turkey is in America, and it is common to see boys herding them in large flocks at pasture.

The rearing of rabbits and hares is, in its economic aspects, close kin to the poultry industry. Hares have the advantage of being able to thrive in closer confinement than poultry, and they will feed on a very wide range of vegetable food—weeds as well as hay and grains. They are quite generally kept by the small farmers of northern France and Belgium, whence they are exported to England by the hundreds of tons. Relief workers helping to restore devastated France had a regular practice of giving to the repatriated peasant among other things a cock and two hens and a pair of hares.

In ostrich farming we have an interesting example of a new domestic animal and a new industry.[33] This feather-producing bird is a native of semi-arid Africa, being found over most of the Sudan and large areas in South Africa. The British in South Africa are the real founders of the ostrich industry, having discovered that when enclosed by a strong fence and supplied with suitable food of grain and good grass the ostrich will thrive about as well in domestication as the sheep. In fifty years the Afrikanders have reduced ostrich keeping to a science, established systems of registry for pure bred birds and improved them to the point where $5,000 has been paid for a single bird for breeding purposes.

Ostrich plume growing, a luxury industry dependent mainly on styles in millinery, is subject to extreme fluctuations. The European war, combined with a subsequent change in styles, injured the plume market[34] and the 1913 export of over 1 million pounds of feathers valued at $14,000,000 has not been duplicated since.

[33] It is astonishing and it should be humiliating that we who boast so much of our one and only civilization should have inherited from the prehistoric ancestors the domesticated horse, cow, sheep, goat, chicken (Indian), turkey, duck, goose, reindeer, camel, dog, and have ourselves thus far added nothing to the list save the plume-bearing ostrich, and have let the African elephant run back wild where he now faces extinction through the merciless trapping of the ivory hunter.

We have recently started in on fur farming. We have confined several species of fox, skunk, muskrat, but none of them, like the ostrich, have as yet been domesticated in the sense that like all of our other animals they will stay about our abode and consider themselves a part of the place.

[34] The women of gay Vienna were heavy buyers of plumes for head-dresses and the outbreak of the war in 1914 lost the ostrich farmers one of their most profitable markets. Vienna is now too poor to buy plumes.

The number of birds in the fields of the Cape Colony farmers has decreased from 750,000 to 268,000 in 1922, and the clip is now only about one-fifth that of 1913. Another change in styles may revive the plume business.

An ostrich farm in southern California has attracted much attention and the climate of that district (save for a few winter extremes) resembles that of the ostrich's native habitat. A few ostriches are being raised in Arizona, Florida, Argentina, Australia, New Zealand and other places.

Bee keeping, with its products of honey and wax, preys upon the blind thrift of an insect. Like poultry it depends (as an industry) to an important extent upon the human element, but it also must have an environment affording nectar-bearing flowers. Where rainfall permits abundant vegetation, the tropics are the best bee lands, especially as many tropic forest trees are nectar bearers. Honey and wax are important exports from the Greater Antilles, and there seems to be plenty of room for extension of the industry. Bees are among the most highly developed of animals.[35] Their care is, if well done, one of the most scientific of the animal industries. A small amount of bee keeping is common in nearly all the warmer parts of United States and Europe, but it is a by-product industry which, owing to its dependence upon a very minor product of blooming plants, cannot be intensified.

The rearing of song birds is an interesting avocation or by-industry that might in its economic side be considered as a sort of miniature poultry industry—the artisan's poultry as compared to the farmer's poultry. The canary bird is the most important of these birds[36] and the Harz mountain region of Germany, where there is a dense industrial population in a mountainous district, is the greatest center of their production. These people are well educated, but receive low wages, and the rearing of song birds is carried on at small expense in the home. The house climate lets this native of the warm Canary Islands live in lands of frost.

The keeping of cage birds is a custom worldwide, and of unknown age, but large traffic in the birds has arisen only since the coming of fast transportation by steamships. The United States imports

[35] The elaborate social order which prevails among the bees even to the extent of a physiological adaptation thereto is astounding when compared to man's crude efforts.

[36] Like the hen and the cow, the canary has now many recognized breeds.

about 200,000 birds per year, mostly German canaries. Belgium, Scotland, and England, especially the textile districts of Norwich and Bradford, also grow them. The more abundant relation of people to resources in United States is well attested by the practical absence of commercial bird raising in a country where they are bought by hundreds of thousands.

REFERENCES

See General References

"Animal Industries Review." See *Yearbook*, U. S. Department of Agriculture, 1922.

ROMMEL, G. M. "The Function of Livestock in Agriculture." *Yearbook*, U. S. Department of Agriculture, 1916.

BURCH, D. S. "Harnessing Heredity to Improve the Nation's Livestock." *Yearbook*, U. S. Department of Agriculture, 1919.

BURCH, D. S. "From Scrubs to Quality Stock." *Yearbook*, U. S. Department of Agriculture, 1920.

ROBERTS, JOHN. "Food Animals and Meat Consumption in the United States." U. S. Department of Agriculture. *Department Circular*, No. 241 (1924).

MORSE, W. J. "The Soy Bean; Its Culture and Uses." U. S. Department of Agriculture. *Farmers' Bulletin*, No. 973 (1918).

WRENN, J. E. "World Trade in Vegetable Oils and Animal Fats." Department of Commerce, Miscellaneous Series No. 123, 1923.

"The Sheep Industry." *Yearbook*, U. S. Department of Agriculture, 1923.

WILLIAMS, G. P. "The Angora Goat." *Farmers' Bulletin*, No. 1203 (1922).

WILLIAMS, J. O. "Mule Production." U. S. Department of Agriculture. *Farmers' Bulletin*, No. 1341.

HADWEN, SEYMOUR, and PALMER, L. J. "Reindeer in Alaska." U. S. Department of Agriculture. *Bulletin*, No. 1089 (1922).

KINGHORNE, J. W. "Better Poultry through Community Breeding Associations." *Yearbook*, U. S. Department of Agriculture, 1918.

BAILEY, L. H. *Cyclopedia of Farm Animals*. Macmillan, 1922.

CHAPTER VI

THE VEGETABLE, FRUIT AND WINE INDUSTRIES

VEGETABLES AND GARDEN PRODUCTS. Nearly every farm has a vegetable garden and some plants are cultivated and eaten by almost every people. Owing to the large yield of a small plot of ground under intensive care such gardens are very common in villages and small towns of both Europe and America.[1] Through the food and income from this source, the retired farmer of America is able to live comfortably in villages and country towns on surprisingly small cash income from other sources.

In the European and American gardens are to be found a large variety of plants that represent in their origin every continent and almost every country in the world. In many cases they have been cultivated until they bear little resemblance to their original form, and in our list of vegetables is found in edible form every part of a plant—roots, stems, leaf stalks, leaves, blossoms, pods, seeds, fruit.

THE NITROGEN-PRODUCING LEGUMES OR PULSE. The most important of all the plants which we commonly call vegetables is the group of legumes, comprising the many kinds of peas and beans called pulse in the Old World. These differ from all other vegetables in the large amount of protein or nitrogenous food, meat substitutes, which they contain. (See table of food analysis.) Nitrogen, as food for man, beast, or plant, is expensive to buy, yet over three-fourths of the air is nitrogen, which owing to its chemical inertness, is hard to obtain in available forms. Hence its high cost. The legumes have the ability, great for the present, and greater for the future, of producing upon their roots nodules which are colonies of the microscopic plants called bacteria. These organisms catch nitrogen freely from the air and thus enable the legumes upon which they live to render to mankind a service of incalculable value by

[1] In the section on the economic possibilities of the tropics the great importance of vegetables in the tropic garden is discussed.

giving nitrogenous food for man, beast, or plant. By the aid of these bacteria the legumes can grow in poor soil and leave it the richer in nitrogen because of the nodules on the roots that remain in the ground. Experiments have even shown that non-legumes

Fig. 98.—The roots of the sweet pea, one of the legumes, with the nodules made by the nitrogen-gathering bacteria.

growing beside living legumes are richer in nitrogen content than similar plants not so placed.

The pulse plants are represented chiefly by peas in northern climates and beans in southern climates, and are of less use in the United States than in any other large region. This is because the people of the United States get their nitrogenous food in the more expensive forms of meat, cheese, and milk.

In the United Kingdom, before the potato was introduced, and a world trade in meat established, pulse plants were more important than they now are, but there are several hundred thousand acres of them grown each year and thousands of tons of peas and beans are imported; the former chiefly from Canada, much of the latter from Egypt and Manchuria.

IMPORTANCE OF PULSE TO POOR PEOPLES. In the Mediterranean countries the pulse plants are much more important than among the richer peoples of north Europe. The lower wages of the Spaniards and Italians make it impossible for them to buy meat from abroad, as do the British, and the dense population combined with the lack of grass make impossible the rearing of adequate numbers of meat animals per capita. The poverty of the Spanish and Italian people even causes them to export some of the little meat they have, whereas England, with more meat animals, is the heaviest meat importer in the world. To get their nitrogenous food the Spaniards, Italians, and other people of the Mediterranean turn therefore to the cheaper forms of peas and beans. The gram or chick pea is said to be the leading article of diet in Spain, and is also greatly used by the peoples of Morocco, Algeria, and Tunis, whence it is carried by caravans into the desert in exchange for dates. With this, as with other staples of food, the western European supply is insufficient. Spain imports them from Mexico. England imports them especially for making soup, while France gets thousands of tons per year from northern India. Lentils, vetch, and lupine, other pod-bearing pulse plants somewhat like our peas and beans, are much grown throughout all Mediterranean countries, and from the Isle of Cyprus there is considerable export of the sugary pods of the carob tree, a legume sometimes called locusts.[2]

As the people of the United States are more able than those of England to buy meat, they use less pulse, and as the people of England are richer than the peoples of the Mediterranean and use less pulse, so are the peoples of the Mediterranean richer than the hordes who occupy southeastern Asia. To the latter, accordingly, foods of the pulse family are an absolutely indispensable article of diet. Rice, substi'ute for bread and potatoes, is deficient in

[2] Widely used as a substitute for oats in horse feeding and said to have been the food of John the Baptist in the Wilderness. If so, his food was not so bad. Almost any child will eat them if given a chance, and they are regularly sold on the streets in New York's East Side.

nitrogen, but peas and beans are grown throughout these countries to supply this need. In India, the chief dependence is the lablab pea, the product of a climbing vine, eaten by both man and beast.

In China and Japan the chief dependence is the soy bean, a nutritious legume with three times as much protein as wheat. It is a summer crop and is a remarkable drought resistant. There are several hundred varieties of the soy bean and it comes in many colors including green, black, brown, all the colors in between, and almost all the shades of yellow. This great food plant, which has

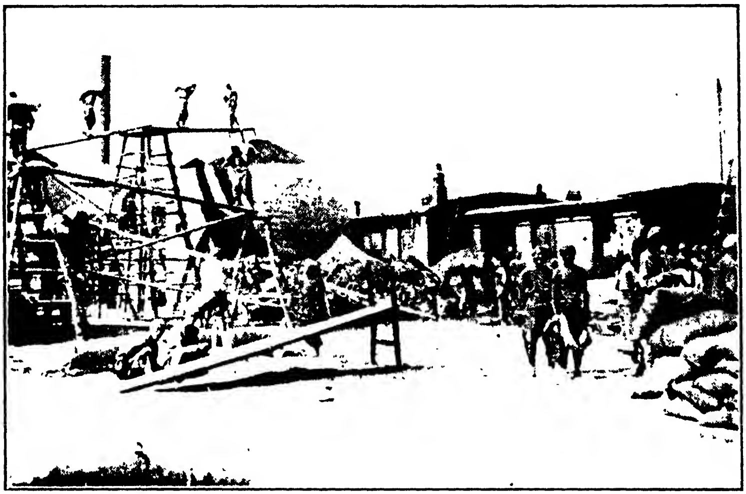


FIG. 99.—Chinese coolies carrying soy beans up to storage stacks for oil manufacture. Newchwang, Manchuria. (F. N. Meyer, explorer, United States Dept. Agr.)

undoubtedly seen several thousand years of service, is used in all the forms in which we use beans, and oil is extracted from the beans to take the place of butter. Even more surprising is the soy bean milk, made by slightly fermenting the meal in water. This milk is used for many of the purposes that we use cow's milk, even including the precipitation of the curds and the manufacture of cheeses widely used in China.

Aside from this the plant is now an export crop of great importance. The sudden rise of the Manchurian bean export before the World War was one of the trade wonders of the decade. The soy beans of Manchuria cover more ground than the American potato crop. In Manchuria and Korea the beans are crushed between heavy rollers to extract the oil, and the resulting cake has for centuries been carried in junks to Japan to feed cattle or to be used as fertilizer by the Japanese garden farmers. Experiments have shown it to be more economical stock food than linseed cake or meal.[3]

THE COMMERCE IN VEGETABLES. On account of the large bulk and perishable nature of fresh vegetables they have been unimportant in commerce until the recent improvements in transportation.

FIG. 100.—Intensive Chinese agriculture. Lifting water by hand power from well to irrigate Chinese gardens at Liao Yang, Manchuria. The fence in the background is made of sorghum stems, and is used as trellis for cucumber and bean vines. (Photo F. N. Meyer, explorer, United States Dept. Agr.)

Owing to the fact that statistics of domestic trade in America are hard to get, Europe affords us the best opportunity to see the magnitude of the present commerce in these products. In the United Kingdom alone the importation in 1920 was $65,000,000, chiefly potatoes, onions and tomatoes. In addition to this there is a lively local trade between south and southwest England, the Channel Islands, and the colder parts of that country. These islands in the English Channel have a relatively mild climate, because surrounded

[3] The soja, soya, or soy bean has been introduced into the United States, where its growth, after a long period of stagnation, is increasing rapidly. We do not eat it but it is gaining in importance as a forage crop and as a green fertilizer because the crop following it is richer for the nitrogen left on the roots.

by a comparatively warm ocean, which gives them the advantage of early maturity in their crops and the ability to grow those usually found further south, so that the newer vegetable and flower industries are competing severely with the Islands' old specialty of dairying.

Daily steamers now take large quantities of garden stuffs, grapes, small fruit, and flowers to the English cities. Most of the vegetables imported into Britain come from the south of France, Spain, and Italy. When business is normal the whole region north of the Alps receives large quantities of these southern products that are grown so easily in sunny Italy and Spain, while frost prevails in the colder north. France has a large traffic in early vegetables from her warm colony of Algeria, sheltered from the cold north winds by the waters of the Mediterranean. Egypt's sunny climate becomes of value to her through the tons of early onions she exports between March and May to Liverpool, London, Hull, Hamburg, Trieste, and even the United States.

Resemblance of flower and vegetable industry. The French have a flower industry so closely akin to vegetable growing in its economic and climatic aspects that the pre-war prosperity merits mention here. Every night during the winter months the "Cut Flower Limited Express" picked up ten carloads of flowers between Nice and Toulon for delivery in carloads to Paris, Frankfort-on-the-Main, Munich, Berlin, Vienna, Leningrad, and London, and Manchester, via Calais. This industry began about 1880 and made such growth that a single Commune (Hyères) had in its sheltered plain between the mountains and the Mediterranean 3,000 irrigated acres on which nearly 6,000 persons were busy raising violets to sell between November and March. This trade has been sadly injured by the post-war chaos but prosperity will restore it.

The american trade in vegetables. The trucking industry is located partly in reference to near-by population centers, partly where climate (and to a lesser degree soil) is advantageous. Fifty years ago each town and city depended upon its immediate locality for vegetables and most cities still have near-by farms where truckers grow all the garden crops in season. In addition an ever-increasing number of markets now have a supply of green beans, lettuce, tomatoes and other vegetables every week in the year. Some are produced in hothouses, but the chief supply is grown in warmer regions farther south, and brought north by the refrigerator car, fast freight and steamer. In emancipating the city from dependence on local fields and local weather, these transportation facilities have caused the development of an enormous trucking industry in rather concentrated areas throughout the whole length of the Atlantic Plain from the east end of Long Island to the tip of Florida. So important is this traffic now that sometimes a passenger train filled with wealthy northerners bound for Florida has to take a siding while an express freight loaded with cabbage, lettuce and tomatoes rushes north to supply those who remain at home.

VEGETABLE PRODUCTION ON THE ATLANTIC PLAIN. This Atlantic Plain is a nearly level area lying between the Atlantic Ocean and the first stratum of hard rock that limits the sands and clays of the Plain and causes in the rivers crossing it a series of waterfalls extending in a nearly straight line from New York southwestward through the cities of Trenton, Philadelphia, Baltimore, Washington, Richmond, Raleigh, N. C., and Columbia, S. C. This plain, largely composed of sandy soil, is one of the least developed parts of the United States. Much of it is still in pine forests [4] because the sandy soil has little plant nutrition in it and when first cleared is unsuited to the growth of grain or of grass and has for generations been considered barren by the grain and cattle growers of America. Fortunately, however, this sandy soil suffices for the growth of excellent peas, melons, cabbages, strawberries, etc., which are composed very largely of water, and which have a much earlier planting and harvest-time on light sandy soil than on heavy clay soil, which does not dry or warm so quickly as sand. Thus the Atlantic Plain has an advantage over the Piedmont and Appalachian districts lying to the west, with their fertile but heavy clays.

The fitness of this infertile sand for certain kinds of production is attested by the shipment in one season of $300,000 worth of berries (chiefly raspberries, blackberries, and strawberries) from the town of Hammonton, a station between Philadelphia and Atlantic City. These crops are grown on soil that looks almost like Sahara.

The possibilities of sandy soils for garden products are shown by the practice of some New Jersey growers who harvest on the same field a pea crop June 1, a cantaloupe crop August 15, and

[4] The wild deer lives within 15 miles of New York City, on land smooth enough to permit the easy use of agricultural machinery.

turnips October 1, and at the same time have the land well set in crimson clover, or vetch, legumes which gather nitrogen, make humus, and are plowed under the next April or May, when nearly knee-high and full of scarlet or lavender blossoms. Another New Jersey truck combination is Canada peas picked May and June, followed by a crop of corn with a legume side crop of vetch, cow peas, or crimson clover—to fertilize the earth. These are not average practices but they might easily become so. They are the exceptions where intelligent and industrious men show the possibilities of a land most of which is entirely unutilized.

From this sandy Atlantic Plain there comes throughout the cooler part of the year a procession of vegetable products that follows the advance of the seasons.

When October's breath of winter turns the fields of New Jersey and Long Island brown, the huckster and the groceryman of the northern city begin to sell beans, lettuce, eggplants, and cucumbers from southern sands, and at Christmas come Florida strawberries which New Jersey can produce only in May and June. The Florida truck farmer often has a rapid rotation of crops. A skilled farmer ships heads of lettuce in January, the ground is immediately set to tomato plants from which the crop is shipped in March, then potatoes are planted for shipment in May, while, through the summer, the velvet bean, a rapidly growing legume of the tropics, makes food for his mules and leaves nitrogen in the soil for the crops of the succeeding winter.

As the spring advances northward so does the location of the truck harvest. Next after the supplies of south Florida come those of north Florida, then those from Savannah, Ga., then Charleston, S. C., districts including the near-by islands have their turn, followed by New Berne and Wilmington in eastern North Carolina, while Norfolk, Va., with steamboats running to Washington, Baltimore, Philadelphia, New York, and Boston is one of the greatest trucking centers in the United States. This port ships enormous quantities of early potatoes and strawberries to the northern cities, to be followed in its turn by the peninsula between the Chesapeake Bay and the sea known as the "Eastern Shore," which, with its ramification of navigable bays and estuaries, with railroads on the land, has one of the finest systems of transportation and is one of the finest agricultural districts of the United States. In early June potatoes are grown here and sold by an efficient coöperative association in all parts of the country and Canada. Lastly come the heavy shipments of truck crops from the fields of southern and eastern New Jersey, Long Island, and the smaller areas near the New England manufacturing cities.

The bulky nature of products of this class gives a great advantage to the producer who can haul the crop to market in his own motor truck. Hence there is a much greater concentration of production near the larger cities, especially within a 30- or 40-mile radius of Philadelphia, where good vegetable land is within easy reach of city market.

A BUSINESS WITH THE GAMBLER'S CHANCE. The price of the vegetables varies from season to season, indicating that the business is uncertain and, as shown by the extent of the variation, a perilous one. The earliest products on the market bring the best returns, so the truck grower always aims to be as early as he can and therefore is in constant danger from the frost, of which the cold waves always hold possible store. A promising harvest may be blackened by frost in a single night, or spotted by fungus encouraged by one or two muggy days, or a severe January freeze may cost Florida a million or two of dollars. Rains and cool weather in one section at times retard the development of the plants, causing the product of two or three great centers to mature at one time and produce more than the market demands, so that the price goes down to the point where the shipments will not pay the freight. This is even more common than frost. Indeed it is this lack of profits, this loss because of over-supplied markets, that checks the development of the industry. The coast plain has many times as much land as is needed for truck and the ever-recurring losses stop the indefinite expansion of the industry.

THE VEGETABLE INDUSTRY OF MISSISSIPPI VALLEY. Chicago and the central part of our country draw off-season supplies partly from certain sandy districts in Tennessee, Mississippi, northeastern Texas, and in southern Texas on the Gulf plain near the mouth of the Rio Grande. In the main, these trucking districts duplicate the products of the Atlantic Plain, but the Rio Grande district is especially famed for its onions. This locality has a very early season. There is in all these centers a tendency for almost national supply for a short period of time.

THE CALIFORNIA VEGETABLE INDUSTRY. The open winter of California gives that state an important vegetable industry which probably reaches its highest development on the reclaimed delta lands ("tules") at the mouths of the San Joaquin and Sacramento Rivers. These deltas are especially fine for the production of asparagus, which is grown in vast fields, shipped to the Atlantic states, and also canned. The California truckers produced 44,000 carloads of vegetables in 1921 and many thousands of carloads went to the eastern markets, despite the great drawback of long distance and high freight rates. This is less of a deterrent on the dried beans, concentrated and non-perishable, which are grown in great quantities (18 million dollars, 1922) on the semi-arid lands near the sea in southern California.

American foreign trade in vegetables. The building of a new railroad through the whole length of Florida and out across the coral keys to the island city of Key West, where it connects with car ferries to Havana, has given the quickest, but not the cheapest route for vegetables and fruits from a tropical oversea port. Boats from Cuba and Jamaica carry some vegetables to the United States but Porto Rico is a more important source of supply. Other West Indian and Caribbean regions have excellent resources to produce these crops, but as yet lack marketing facilities, a condition of affairs that was until recently found also in Porto Rico, where the vegetable growers and the steamship lines each waited for the other to begin.

Another difficulty in vegetable growing on a commercial scale is related by an American business man of experience and ability. He found that plenty of good tomatoes could be grown in the Bahamas, that the New York prices were good, that schooners could be secured to carry the tomatoes across to Jacksonville, where fast steamers would take them to New York. But he did not dare make the venture because he did not feel able to trust the Bahama worker to inspect rigorously and pack skillfully so that the packages would reach market in good condition.

Garden seed. The production of garden seeds is a part of the vegetable industry well suited to isolated or distant locations where the marketing of the fresh product is difficult. The American onion crop is grown largely from seed produced in California and the Canary Islands, where an important onion seed industry has sprung up since 1895 in the isle of Teneriffe. The cantaloupe crop of the Atlantic Plain is in large part grown from Colorado seed. In western Kansas and Nebraska enormous crops of watermelons and squashes are fed to the farm animals (which are the chief product of that region) after the seed has been saved for the planters of localities more favorably situated to ship carloads of melons or squashes. On the east end of Long Island a small locality grows most of the cabbage seed used in the United States, while the other end of the island adjacent to Brooklyn grows the bulky cabbage and other products for the near-by metropolis.

2. THE APPLE

Distribution of the apple tree in America. The apple tree is the longest lived (palm and olive not considered) and, excepting the cherry, the largest of all our fruit trees. Its trunk frequently attains a diameter of 2 feet (a girth of over 12 feet is known in Pennsylvania). A large tree will often produce ten to twenty barrels of fruit. From New England to North Carolina it is not uncommon to find trees healthy and bearing at the age of 100 years. The tree is hardy and adapted to a wider range of soil conditions than any other important fruit. It grows wild along the fence rows and in fields from Nova Scotia to North Carolina and throughout most of the Ohio Valley. In the long and humid summer of the cotton belt it is not at its best, and is grown only to a limited extent for local use. It does well (when the buds are not destroyed by frost) on the plains and prairies of the corn belt, reaches a high degree of perfection in the Ozark Plateau, while the handsomest and highest-priced apples in America are produced in the Rocky Mountains and north Pacific coast states.

In the northern part of the North Central States the severity of the cold waves of winter combined with the heat of summer has somehow served to make the trees short lived and there are few varieties that can survive even for short periods the rigor of that climate, and most of those varieties are of Russian origin. In the early settlement of Dakota one man planted some thousands of apple trees and seeds each year, getting varieties from all parts of the world, and as a result of many years' experiment he found just one apple tree that could resist the winter climate. That survivor has become the parent of most of the apple trees in that part of the country. Continued hybridization and testing (now in progress) will probably produce apple trees for the Canadian wheat farmer.

There are over 1,400 named varieties of apples in the United

States, most of them of local value only. Some growers manage to have fresh fruit on hand from their own cellars throughout the entire year, and while this is uncommon, apples are now in the market of most cities every day in the whole twelve months.

THE APPLE AS A SUPPLY CROP AND AS A MONEY CROP. In regions where the tree will thrive, a few apple trees for the family supply were until recently a part of the equipment of almost every American farm. The growth of perfect apples is difficult, much more difficult than it was before world trade and the introduction of new plants brought their evil accompaniments of foreign insects, rusts and blights. Transportation of the fruit to market without bruising is also difficult; the packages are expensive and the fruit has large bulk in proportion to its value, hence the development of apple growing as an industry to supply distant markets is comparatively new. Since we have such a wide territory suitable for apple culture, the origin of apple-shipping districts has been a matter dependent upon some minor advantage of location or upon some pioneer grower showing the people of his locality that this crop could be profitably marketed. Commercial apple growing in America is an important industry in localities as widely separated as Nova Scotia, Ontario, Delaware, Virginia, northern Georgia, Missouri, Michigan, New Mexico, Arkansas, central California and the Pacific Northwest.

APPLE GROWING IN NEW YORK AND MICHIGAN. New York is the leading state in commercial apple growing with Washington as a threatening rival. Four counties on the shore of Lake Ontario in western New York have for a number of years been the most important shipping district in the United States. The Erie Canal and the railroads that followed it gave this region an early advantage of transportation to New York and other eastern markets, and also made low prices for grain and animal products that had been staples there. In addition to this disadvantage for growing staples, and the advantage for apple transport, there is also an advantage in production. The large bodies of water with their melting ice in spring serve to delay the blossoming time until there is small danger of injury from frost. Likewise in autumn the warm waters of the lakes delay the killing frosts. These advantages for apple growing were not fully appreciated until after the Civil War, when grain growing had become unprofitable, owing to the competition from the new, rich, cheap lands of the West. The farmers in New York had to find some other crops than grain in order to realize satisfactory profits, and in this district of the Lake shore plain the alternative was apples, as in other districts it became dairying. But even here, although apples are the chief money crop, there is no county in which the orchards cover more than a tenth of the land surface, a rather surprising fact, tending to show the rarity of the entire dependence of any locality upon only one crop. The prediction has been made that within fifty years the south shore of Lake Ontario will become one continuous fruit orchard, a prophecy which appears reasonable.

The lower peninsula of Michigan is important in the production of apples for reasons very similar to those prevailing in western New York. The great development of apple orchards along the eastern shore of Lake Michigan and their striking absence on the west side, serves to emphasize the combined influence of the lake and the prevailing westerly winds.

Ohio, pennsylvania and virginia. A small field in apples is a not uncommon feature of small farms in both Ohio and Pennsylvania, both of which states rank high as apple producers, but it is probable that Virginia has two apple districts with quite as large a proportion of the land planted in apples as is to be found anywhere east of the Rocky Mountains. First, in the Great Valley of Virginia and West Virginia not far from the cities of Winchester and Martinsburg is a low ridge called Apple Pie Ridge, upon which 60 years ago an enthusiast planted a large field in apples which promptly brought him the ridicule of his neighbors and eventually brought him many thousands of dollars. This started his neighbors to planting apple trees, until now the ridge for 25 miles is almost one succession of apple orchards, and they have since been extensively planted on the ridges near the Potomac to the west of the Great Valley.

Along the eastern slope of the Blue Ridge Mountains in central Virginia is another apple district from which large quantities of finely flavored varieties are annually exported to England. It is claimed that where the Chesapeake and Ohio Railroad crosses the Blue Ridge west of Charlottesville, one can walk along the slope of the mountain for 7 miles and pass continuously from one apple orchard into the next. Neither of these Virginia apple districts has any known advantage either in production or transportation over other territory in the United States except for the accident of an early start, which means that the industry is well established with a full equipment of satellite industries, trained labor and business organizations. The same thing may be said of nearly all American fruit localities despite much local belief to the effect that *this* place is unique.

THE OPEN MISSISSIPPI VALLEY AND THE OZARK PLATEAU. On the southern edge of the corn belt in Illinois, northern Missouri, Iowa, and Kansas have been planted some very extensive apple orchards, some of them covering more than a square mile, but the sweeping cold waves that come unimpeded down the open Mississippi Valley have frequently frozen the fruit buds in April and May. In the winter of 1910–11 one corn-belt orchard of 64,000 apple trees (1,600 acres) was pulled up because two crops in ten years showed it to be less profitable than corn growing. In the Ozark Mountain region of Missouri and Arkansas, however, an extensive apple culture has developed. About 1880 a pioneer in commercial apple growing planted an apple orchard of 1,400 acres. He took magnificent specimens of the fruit to the World's Exposition at Chicago in 1893 and advertised to the world the virtues of the Ozark Mountains as a place for apple growing. Seven years later, the Census of 1900 showed that Missouri led all the states in the Union in the number of her apple trees. Orchards of from 100 to 1,000 acres in size are common. The rapid extension of the industrv was made possible by the very low price of the land in the Ozark plateau and ridges, an old, worn-down mountain system ill suited to grain farming, but very well suited to the production of fruit. The elevation and the protection of mountain location causes it to escape many of the freezes that are so destructive to the open plains to the north and east.

THE ROCKY MOUNTAINS AND THE NORTHWEST. In the more newly settled states of the Rocky Mountains and north Pacific coast there are many irrigated districts that produce beautiful apples. Some of these, as the Hood River Valley in Oregon, and the Yakima and Wenatchee valleys in Washington, have become well known in the eastern part of the United States through the beautiful fruit they send out. In recent years the state of Washington, aided by irrigation and care, has led all others in steady apple production, furnishing 16 percent of our total crop in 1923. Parts of Idaho, Montana, Colorado, and a few sections of northern California are equally well fitted for the growth of this fruit. Becau of the bright sunshine of the semi-arid district, the apples grown here are the most beautiful produced in America. These western fruit districts, which must be in the valleys, are of restricted area, because of the limitation imposed by soil requirements, irrigation, water drainage, air drainage, and protection from strong winds.

During the past decade production in the Pacific northwest has increased more rapidly than that of any other section of the United States, ' profits have not been satisfactory. Owing to the small

FIG. 101.—The concentration of the apple industry in the irrigated valleys of western Washington has made it the leading apple state.

population of the Rocky Mountain and Pacific region, the apple growers of the Northwest must depend for their market very largely upon the eastern states and Europe, which subjects them to a heavier transportation cost than must be borne by their competitors in the east.

THE EXTENT OF THE APPLE INDUSTRY. 'Ordinarily, we grow one to two bushels of apples per capita each year in the United States. The crop of the year 1923 was 196 million bushels, of which 37 percent were grown in the states of New York, Pennsylvania, Ohio and Michigan. That figure proves little, owing to the fact that the apple crop of any locality fluctuates constantly from 20 to 100 percent of a full crop. An apple tree will rarely bear two heavy crops in succession and this fact, in combination with occasional injuries by frosts, hail, fungus and drought, makes it exceedingly rare that all the different export apple districts have a full crop at the same time. When they do, as in the year 1896, the crop exceeds the demand, and they have almost no value (seventy-five cents per barrel in March, 1897). The apple crop of the Pacific Northwest, grown under irrigation and the best care given in America, is less subject to these yearly fluctuations.

INSECTS AND OTHER PESTS. As a result of our world commerce and the introduction of new varieties of plants, each locality also gets nearly all of the world's weeds and plant enemies. Thus came many insects, fungi, rusts, and other plant enemies which combine to destroy nearly all the fruit that forms on the trees of the unprotected orchard. Fortunately they can usually be held in check by skillful care, much of which consists in spraying poisonous liquids on the trees. This makes the production of good fruit one of the most scientific of all pursuits, and is transferring it from the small orchard of the general farmer to the large orchard of the specialist in the better located fruit districts. This is causing rapid increase in the commerce in the apple which is more generally used by all classes in the United States than in any other country.

THE EFFECT OF REFRIGERATION. Under good storage conditions some varieties of apples will keep well for a full year, so that cold-storage warehouses, refrigerator cars, and refrigerator ships have made possible the easy distribution of American apples all over this country, and their export to Europe, and have also made possible their sale and use every day in the year. The United States now exports over 1½ million of barrels each year, chiefly to the United Kingdom. A few thousand barrels each year are sent to Cuba, Brazil, Mexico, and other tropical American countries, where the apple cannot be grown.

The greater distribution of fresh apples has caused a marked falling off in the use of dried apples.

CANADIAN APPLE GROWING. Canada is an apple exporter of nearly as great importance as the United States. The apple does well from Lake Huron to the mouth of the St. Lawrence and two localities have utilized their especial advantages for developing the apple as a money crop for the foreign trade. The most famous of these is the Annapolis Valley in Nova Scotia with an average yearly crop of 1,500,000 barrels. This narrow valley in the western part of the Peninsula is protected by the Bay of Fundy and a sheltering mountain range, and is well suited to the apple. These advantages, together with an early start, convenient access to the sea coast, and its relative unfitness for other forms of agriculture, have given it a development of apple growing which has made its product famous in Britain. The export apple is the chief money crop and

FIG. 102.—Spraying an apple orchard in Virginia with poisonous mist to kill insects. (United States Dept. Agr.)

financial dependence of its people. The other eastern Canada apple district is near Niagara Falls on the peninsula between Lakes Erie and Ontario, where it has the protecting influence of the water similar to that which benefits the New York lake shore apple belt, of which it is really an extension separated only by the Niagara River.

Canada west of the Rockies also has an important apple region, the Fraser Valley of British Columbia, where the fruit is grown under irrigation as in Oregon and Washington. Apples are the leading agricultural development of the Fraser Valley and are grown chiefly around Okanogan Lake, which is a glacial lake about 40 miles long. It is probable that the climate of this section is one of the best in the world for apples, because there are no midwinter thaws. British Columbia apples compete in the United States with those of our own Pacific Northwest and are also exported to Europe by way of the Panama Canal.

EUROPEAN APPLE GROWING. Apples are at home in Eurasia from Edinburgh to the Mediterranean, from the Bay of Biscay to Tokio. They are quite commonly grown throughout western Europe, being the chief fruit crop in the 200,000 acres of British orchards. But western Europe does not supply enough for its own use. The regions of greatest production on the continent are the mountain valleys in the highlands of south Germany, of Switzerland, and of the eastern Alpine regions in Austria. The individual orchards of Europe are smaller than those of the United States because of the small size of the farms in all the above-mentioned apple-growing regions. The total European production is large and there is a heavy traffic to the cities of Berlin, Paris, and London, and the numerous small towns of the manufacturing districts of the Rhine Valley and the adjacent territories of France, Germany, Holland, Belgium, Switzerland, and Austria. In some cases canal boats are loaded with apples in bulk, taken to the city, and tied up to the bank until the load is sold out to consumers who visit the boat.

In some parts of Germany and near Paris, apples of exceptional quality and local repute are grown under conditions which typify the painstaking methods of the European gardener, fruit grower, and small farmer. When of the finest quality and size, these apples brought the fabulous price of a dollar a pound in the markets of London and Paris before the World War. Only a few of them can be grown on each tree, which by careful pruning is sometimes kept in a form resembling the grape vine. (See FIG. 103.)

THE APPLE IN ASIA. From Constantinople eastward throughout the central regions of the Asiatic Continent the apple can be grown in almost any location where there is sufficient water, but this must usually be supplied by irrigation, although it grows wild in many mountain districts. The fruit is quite commonly grown by the

Chinese farmers of the upper Yangtze Valley and in all cooler parts of China and to some extent also in Manchuria, Korea, and Japan. Although important in meeting the wants of the local population, it has not in this region of undeveloped transportation become an important article of commerce.

THE APPLE IN THE SOUTH TEMPERATE ZONE. The south temperate zone, with the reverse arrangement of its seasons, can send its fresh autumn fruits to the North at the end of winter when ours are gone or have been longest in storage. The south temperate zone has climate and resources that seem well suited to the apple, particularly southern Chile, New Zealand and the Island of Tasmania, which is about as large as West Virginia. It much resembles this state in its mixture of mountain and valley, its good rainfall, and its suitability to the apple, and in its mountain orchards. South New Zealand with a similar climate is another important producer. Australia has had a marked increase of apple growing in the past ten years, particularly in Victoria, where they are the main fruit crop. In addition to supplying the local demand these countries have a growing export, principally to Great Britain. The total export from the southern hemisphere, however, is small in comparison to that of the United States and Canada.

South Africa also has an apple district with over 2½ million trees, and the fruit is grown for local use on the fine central plain of Chile near Santiago.

FUTURE SUPPLY AND ADAPTION TO NATURAL RESOURCE. The apple and other fruits are unlike meat and grain, in which we have reached a limit of resource so that greater product means higher price. The yield of the apple (100 to 800 bushels per acre) is many fold that of grain. It is capable of being produced on rough unarable land of which there is a great deal, especially east of the Mississippi River. Some of the finest apples grown in the eastern part of the United States are produced on hillsides which are too steep and rough for grain growing. This suggests that as our agriculture becomes better adjusted to the geographic conditions of the country, and human numbers press upon resources, the hillsides are likely to produce a greater and greater proportion of our fruit, leaving the level lands for tillage and grain production.

The large yield from small area (with great land resources available) suggests that low prices may be expected, and overproduction is possible. In this respect it belongs distinctly with the potato, the truck crops and all the other fruits. Recent achievements at breeding new apples are very suggestive.[5]

3. THE PEACH

THE PERISHABLE NATURE OF THE PEACH AND ITS COMMERCIAL EFFECT. This delicious fruit is regarded as more of a luxury than the apple, chiefly because by its perishable nature it is less adapted to being a staple of commerce. The standard market peaches[6] cannot be kept in good condition more than ten days or two weeks without excessive cost, while some varieties of apples will keep in good cellars from October until June. But such is the high esteem of this fruit that since the coming of fast trains, refrigerator cars and steamships, it is marketed all over the United States and Europe and even sent across the ocean. Owing to the perishable nature of the peach there is but one day upon which it can be picked for market. The day before it is too green, a day later it is too soft. A thousand-acre peach orchard must have a perfect succession of varieties so that each day the labor force may be fully employed, from the first ripenings in July to the last in October, when the little army of peach pickers breaks camp and the men disperse to their distant homes. Wide demand, in combination with difficulty of production, gives a high value to the peach and makes it an excellent money crop for the favored localities that can produce and market it successfully.

THE SUSCEPTIBILITY OF THE TREE TO CLIMATIC INFLUENCE. The peach tree is apparently a native of Persia, and grows well from the Atlantic coasts of Portugal and Africa to the Pacific coasts of Japan, but like the apple, the peach is nowhere throughout this vast region an important article of commerce except in small sections of Europe. The tree, unlike the apple, yields well only in restricted localities under special climatic conditions. It has two chief climatic perils—early bloom and spring frost injury and winter killing of buds and trees by very cold weather. In Germany, Holland, Belgium, the north of France or Great Britain, the tree can only be grown under

[5] See Geneva experiment station, New York, for Mr. Hedrick's new McIntosh crosses.

[6] It is a misfortune to the industry and to the people who eat peaches that the commercial varieties having flesh hard enough to ship are notoriously poor in quality in comparison to many which can only be transported short distances and kept a short time.

the artificial conditions of hothouses or on the south side of walls where it is trimmed so that it spreads out like a fan against the flat surface, thus catching the direct rays from the sun and the heat reflected from the wall. The European settlers brought these varieties to the United States. The peach tree in north Europe needed heat and by the strange adaption to the environment which plants

Fig. 103.—This fine old English yard at Hampton Court, just outside of London, displays a splendid specimen of the European wall-trained apple tree. (Courtesy *House and Garden.*)

possess, it gradually acquired a reddish bark, a color which absorbs more heat from the rays of the sun than a light color, which reflects more of the sun's rays, just as light clothing reflects heat and is cooler than dark colors which absorb heat. But by acquiring ability in England to absorb heat, the peach was fitting itself for destruction in America, where over the whole eastern half of the country with its continental climate, the peach has a tendency to bloom in the first warm days of spring and then have the blossom or young fruit killed by a subsequent frost. This has set the plant breeders to searching for hardier varieties,[7] but at best the peach can only become an important money crop in regions somewhat immune from early frost. The United States has at least seven such districts, where a peach industry is already developed.

THE PEACH BELTS OF THE GREAT LAKES. Two of these localities where peach growing is specialized, and has become an important money crop are furnished by the Great Lakes whose cold water surface makes the cool spring temperature that delays the blooming of the peaches until after the frosts. The peach area is important in the part of western New York where apples are important. Its production is sometimes so great that large quantities of the peaches spoil for lack of a market. Some peaches are also grown along the shores of these lakes in southern Ontario.

The second peach belt, determined by the Great Lakes, is on the eastern shore of Lake Michigan where the prevalent west winds, blowing inland from the lake, give the necessary temperature control over a belt, less than ten miles in width, in a latitude where upon the opposite shore of the lake the peach is often not grown at all or is of no commercial importance. The history of peach growing in this Michigan district gives another good example of the dependence of industry upon science. An incurable and fatal disease called "the yellows," still of unknown cause, spreads from peach tree to peach tree. Unchecked it worked destruction in the west Michigan peach belt and reduced the number of trees in one county from 600,000 in 1870 to 30,000 in 1884. This reduced the value of land to $10 or $20 per acre when it had been worth from $50 to $100, and brought communities to the verge of bankruptcy and social disorganization. At this point it was discovered at the State Agricultural Experiment Station that if every tree having the yellows was removed when the disease was first discovered, only one or two percent of the trees per year would be killed, and the peach industry could thrive. The Michigan peach industry rose again. The county

[7] The hardiest varieties of peach, like those of many other fruits, have come from Japan and China rather than West Europe. This is but natural because West Europe has the oceanic climate, mild in winter, cool in summer, like our own Pacific coast, where West Europe varieties thrive, while Japan and China have continental climate, cold in winter and hot and humid in summer. While West European plants often perish of blights in the southeastern part of the United States the Far-Eastern plants usually thrive with a veritable riot of prosperity.

that had but 30,000 trees in 1890 had over a million in 1906, and throughout the peach belt prosperity again prevailed. Nearly every farm here has its money crop of peaches, which are sent in boat-loads to Chicago, and carloads and trainloads to New York, and many other distant cities.

THE CHESAPEAKE AND ALLEGHENY PEACH BELTS. The third peach belt is in the peninsula east of the Chesapeake Bay in the states of Delaware and Maryland. Here, upon sandy soil ill suited for growing grain, grass or live stock, and somewhat protected from frosts by the adjacent waters, arose shortly after the Civil War the first great centralized peach business in the United States. It has been discovered within recent years, however, that the cooler climate of the mountains in the Allegheny Region, to the west of the Great Valley, delays the blossoming of the peach tree and makes an orchardist sure of four crops in five years, while the greater prevalence of frost upon the low peninsula east of the Chesapeake Bay reduces the average number of crops there to about three in five years. The advantage of the hill over the plain is due to two climatic factors. First, the coolness of elevation makes a later start in spring growth. The second advantage is air drainage. Cold air is heavier than warm air, and upon frosty nights it settles to the lowland where fruit buds freeze, while the hills are frost free. Due to this advantage the fourth peach belt developed rapidly upon the mountain slopes of the Blue Ridge and the Alleghenies in the Potomac drainage basin in southern Pennsylvania, western Maryland, and the eastern part of West Virginia. Here are some of the most highly organized of all agricultural industries. Single peach orchards comprise from 100 to 500 acres and there are cases of single orchards 1,000 acres in extent.

THE OZARK PEACH DISTRICT. In the central part of the country the Ozark ridges furnish some frost protection in a vast plain where cold waves are perilous to the peach. There have been large peach plantings in Arkansas and southwestern Missouri, but the crop seems to be less certain than that of Appalachia or New York.

THE SOUTHERN PEACH DISTRICTS. In all these northern peach belts the main crop is not ready for the market before August. Since the express service has been perfected upon the railroads it has been found possible to grow fine crops of peaches on cotton land in central Georgia and market them in northern cities some weeks before the crops of Maryland, New York or Michigan are ready.

The industry has developed to such proportions that Georgia sometimes ships several hundred cars a day in the height of the season. Georgia's chief advantage in peach growing is the absence of rival producers rather than surety of production: The uncertainty of the peach as a crop dependence leads to the occasional uprooting of large orchards and the planting of the land to the more reliable corn and cotton. In the Southwest, in eastern Texas, another such belt is coming into prominence. This is a counterpart of the Georgia belt and normally supplies the southwestern and central part of the country, but the practical certainty that there will never be a full crop in all of the peach districts at one time causes each peach district to have an ever-changing place for its product. If one or two districts happen to have a monopoly the profits for that year are very large.

CALIFORNIA PEACH GROWING. California, with the seventh and last peach belt, grows about one-third of the American crop. In the seven-year period, 1917-23, California had a steady production ranging between 12 million and 17 million bushels each year. None of the other peach districts except Georgia have escaped bad years. Bordering upon the Pacific Ocean with the prevalent warm westerly winds from that great body of water, California has a normal oceanic climate free from the cold waves and strong winds that spread over all territory east of the Rocky Mountains. Peaches can, therefore, be raised with reasonable assurance of getting a crop, but frost destruction is also known there and the glutted market has wielded its traffic-stopping hand.

Peach orchards are of great extent, and, owing to the perfection of the California methods of picking, packing and shipping, the fruit is sent to all the larger eastern cities and at times even as far as London. The bulk of the crop, however, is grown for the purpose of drying or canning, the large-sized, firm-fleshed California canned peach being a favorite on the market.

EUROPEAN PEACH GROWING. In England the peach is always a high-priced luxury, the small import into that country coming chiefly from the south of France, and from Italy. There appears to be no good reason why proper development of transportation facilities should not give western Europe a cheap and abundant peach supply from Spain, Portugal, and North Africa. The increasing export from the United States and Canada shows that the fruit can stand the transportation.

THE PEACH IN THE SOUTH TEMPERATE ZONE. The peach does as well in the south temperate zone as it does in the north temperate zone. It is said that peach tree wood was for many years one of the chief sources of wood supply for the city of Buenos Aires in Argentina, and peaches of excellent quality are grown in Chile, Australia, and New Zealand, chiefly for home consumption. South Africa has 5½ million peach trees (half as many as California), and for a time it was the only south temperate zone exporter of fresh peaches. Of late Argentina and Chile have joined in this export. Because of the difference in seasons small shipments of excellent fruit are carried by mail steamers to Europe in February and March. They are also sent to the United States, but many of them decay in the two or three weeks that they are in transit, with the result that they retail at exorbitant prices (often twenty-five cents each) and the market is naturally very limited.

4. THE CANNING OF FRUITS AND VEGETABLES

THE CANNING PROCESS AND ITS SERVICE TO MANKIND. The process of canning food, which was discovered in 1786, is one of the great boons to humanity. It consists in hermetically sealing the food product, and then cooking it, often above its boiling point, to destroy all bacteria. Under these conditions the food keeps almost indefinitely.

The first experimenters found that food could be preserved in bottles by means of heat. A half century later another pioneer was declared mad because he proposed to preserve foods in tin instead of in glass. It took the American Civil War to make us use this wonderful process and people still young can remember when "tinned foods" were regarded with almost superstitious prejudice.[8] By 1883 canning methods had been so improved that machinery did nearly all the work, including the soldering of the cans and even the pasting and trimming of the labels. The industry is now thoroughly established as a source of food supply for the masses. Between 1909 and 1923 the output of canned vegetables increased 120 percent in the United States, that of canned fruit 268 percent, while population increased but 22 percent.

Before the coming of railroads, steamboats and canning, a crop

[8] The industry was so little esteemed that until 1872 it had not produced a can opener.

of tomatoes could be consumed only within a few miles of the place in which it grew and within a few days from picking time. After transportation by rail and boat was organized and improved, the tomatoes might be carried several hundred miles, but they still had to be consumed within a few days. After the canning process was perfected and developed into an industry, the perishable products of field or orchard could be preserved for consumption at any time within several years and in any corner of the world to which they could be cheaply carried. This elimination of the time limit on perishable commodities has revolutionized food habits. It has also revolutionized agriculture in many localities by suddenly giving perishable products access to the world market. The distribution of crops and of production now depend, not upon a near-by market, but upon geographic and economic conditions which make certain localities best able to produce certain products.

The importance in consumption is even more marked. Most parts of the world can now have many kinds of cheap foods previously unused or even unknown. The workers in a paper mill in the woods of Maine may now eat the tomatoes and peaches of Maryland, the cherries and apricots of California. The same is true of the gold digger upon the Klondike, of the engineer on the Panama Canal, of the rubber gatherer in the jungles of the Upper Amazon, and the whaler who spends a season in the Antarctic Ocean. A century ago, the whaler on a voyage of a year or two often came home, if he came at all, sick with scurvy, a disease due to undernutrition from poor food of insufficient variety. But when Nansen and his men drifted in the Arctic ice for years in an attempt to reach the north pole, they returned in perfect health because they were nourished with all kinds of canned and preserved meats, vegetables, fruits, fruit juices and extracts.

Canning, more than any other invention since the introduction of steam, has made possible the building up of towns and communities beyond the bounds of varied production.

THE EXTENT OF THE INDUSTRY. Practically all classes of food, fruits, vegetables, soups, fish, meat and even nuts, bread and pudding are now preserved by canning. The canning factories of the United States prepare yearly from 40 to 50 pounds of fruits and vegetables for each man, woman, and child in the country. Among the vegetables beans, tomatoes, corn and peas are of nearly equal importance, while among the fruits the peach leads, followed by apricots and pears. The output amounts to many millions of dollars per year, and is produced in nearly all parts of the United States. Canning tends to be scattered in small towns wherever a surplus of some product is available, such as may occur in a truck farm or orchard district. Furthermore it is capable of being operated on a comparatively small scale, even by a farm family. Owing to the seasonable nature of the work, the labor is nearly all done in the

FIG. 104.—A food factory. Cans are traveling horizontally, vertically and diagonally on endless conveyors. In front of the girl they are being filled by a filling machine.

summer time and often by new immigrants who flock in from near-by cities for temporary residence of a few weeks or months. Although widely scattered, the canning industry in the United States has three distinct belts showing greater development than other regions.

THE ATLANTIC PLAIN. The first of these regions to develop the industry was the Atlantic plain. Maryland is the center and most important part of the Atlantic plain canning district, which extends from North Carolina to New York. This section has become important for the same reason that made it important in the shipment of truck crops to the city markets, namely, the sandy soil which is exceptionally suited to vegetables, and not well adapted to the growth of other agricultural staples, especially wheat and grain. Maryland is the leading state, canning on an average one-third of our tomatoes and a large share of our corn. The exceptional transportation facilities, centering in Baltimore, have made it the only important city center of canning in the United States. Ordinarily, canneries are located wherever a few farms grow a surplus of any crop. But the ease and safety of navigation on the many far-reaching arms of the Chesapeake gives Baltimore remarkable facilities for assembling farm products. They are brought in steamboats from points as far away as Fredericksburg, Richmond, and Norfolk, in Virginia, a great number of places on both sides of the Bay in Maryland, while the Chesapeake and Delaware Canal opens a way for the Baltimore fruit boats to go up the navigable creeks of New Jersey to such towns as Salem and Bridgeton.

The Baltimore canneries have another advantage in the fact that the oyster pack gives employment to both labor and equipment in winter season—a cost factor of great importance.

The sandy southern part of Delaware gives that state an importance in the canning industry that is quite disproportionate to its small area. Maryland and Delaware are important also because they are large peach and pear growing and fruit canning states.

THE NEW YORK, NEW ENGLAND, AND LAKE REGION. New York, which is both a great agricultural state and a fruit grower, is the center of the northeastern belt, a region with great diversity of canned products. Although not the best possible place to grow it, New York and the New England States have long been important canners of corn. The New England summer is almost too cool and short to ripen the corn grain. For that reason Maine with a very small corn acreage cans a great deal of corn, since corn for canning does not ripen, but is harvested a full month earlier than it could be if used as ripened grain. Sugar corn is more valuable than common corn for the market, so that a small sugar corn crop on a New York or New England farm is worth as much as a larger crop of Illinois corn.

The center of corn canning has now moved west to the corn belt, with Illinois and Iowa as the leading producers. Wisconsin and Minnesota, farther north, have a large corn pack for the same reason Maine has.

The somewhat cool summer that makes of parts of New York, Michigan, and Wisconsin second-class corn producers, makes them first-class growers of peas, Wisconsin producing over one-half of the annual pack. If the same factory can lengthen its season by canning several kinds of fruits and vegetables it is a great advantage through the better utilization of the plant. Thus a plant at Janesville, Wisconsin, begins its season in June with peas, and ends it late in autumn with sauerkraut, and usually packs the following, employing 250 to 300 persons in height of season:

35,000–40,000	cases peas =	600 acres peas.
65,000–80,000	cases corn =	1,200 acres sweet corn.
50,000 cases canned	kraut =	300 acres cabbage.
	pickles =	900 acres cucumbers, 75,000–100,000 bushels.

In northwestern Ohio is a good example of the specialization of agriculture through canning. Near the west end of Lake Erie, especially in Sandusky County, it has been found that the black swamp land with its mixture of sand is well suited to cabbage growing, with the result that there now are several large sauerkraut factories within 10 miles and 3,000 acres of cabbage are annually grown.

Pacific coast. The most important canning district is California. This state has become important from the combined influence of the climate, excellent for the growth of fruits and vegetables, and the great distance from eastern markets which makes it possible to ship in the fresh condition only an uncertain fraction, and that the most perfect, of the total crop. This state cans nearly all the apricots, the largest share of the peaches and other fruits, except apples and berries, and is very important in the output of canned tomatoes, peas, and asparagus.

The canning industry also has large possibilities in the other Pacific coast states. The Willamette-Puget Sound valleys of Oregon and Washington have a damper, cooler summer than California and for that reason are producing and canning large quantities of blackberries, raspberries, loganberries, and other small fruits.

The possibility of increased production and of overproduction. The possibilities of increase in the production of fruits, vegetables, and canned goods in the United States are very great. If, for example, the farmers of the United States could be assured 15 or 20 cents a peck for tomatoes at their farms for the next ten years, it is probable that their production would be increased tenfold, for they are now commonly grown for less than that price and occasionally the crops are so great that the factories cannot handle them and the tomatoes rot upon the ground by the hundreds of tons. The same thing is true of many other vegetables, including potatoes. This is a great deterrent to industry.

Even with the aid of the outlet afforded by canning, the small fruits and vegetables yield so enormously that overproduction,[9] with its glutted markets and frequent losses, is a factor which, like frost, is ever in the mind of the producer and almost annually visits each locality of varied production.

FOREIGN TRADE IN CANNED FRUITS AND VEGETABLES. Canned fruits and vegetables are an important export from the United States to Great Britain and many other countries. England herself is an important manufacturer of preserved fruits—preserves being fruits so rich in sugar that they will keep without sealing. Certain brands of English jams and preserves made from the fruits grown in the south of England and even on the mainland of Europe are known throughout the world, are widely exported especially to British colonies and are extensively consumed in Britain, where bread and jam is a favorite article of diet.[10]

The possibilities of the production of canned fruits in the tropics are much greater even than that of canned vegetables in the United States, although little has as yet been done in this direction. Pineapples grown largely by Chinese and Japanese labor on the fertile lava slopes of the Hawaiian islands (300 million in 1922) go mostly to canning factories. The export demand for Hawaiian canned

[9] A most convincing illustration comes from Perthshire, Scotland, where the light soil is well adapted to the raising of raspberries and strawberries. About 1900 a growing demand for raspberry jam increased prices so rapidly that by 1903 growers were making profits of from $195 to $245 per acre. With the rush of new growers into this attractive field, lands renting as low as $5 to $8 in 1900 brought eight or ten times as much per acre in the next few years. Production of raspberries increased until the market was glutted and prices fell from $112 a ton in 1906 to $44 a ton in 1909. This was accompanied by a like rapid decrease in land values, one plantation purchased at $487 an acre being offered for $49 three years later. This is an admirable description of the typical agricultural boom-overproduction-glut cycle which has been repeated with variation of detail thousands of times. Sometimes the Spanish pig has to help finish up the crop of Spanish onions and even China has overproduction of vegetables.

[10] Fruit jams, and especially marmalade, are found upon every British table, private and public, and are always served with afternoon tea.

pineapple has made the industry second in value to sugar. The product is widely distributed throughout the United States and Europe. In the Strait Settlements, at and near Singapore, canned pineapples are produced by Chinese labor and exported largely to Europe.

5. DRIED FRUITS

THE SHIFTING OF THE INDUSTRY TO LANDS WITH A DRY SUMMER. Before the coming of steam transportation, when each locality lived to a great extent upon the local resources and the farmer's family lived almost entirely upon the products of the home farm, the drying of fruits on shed roof, garden fence and kitchen drier in humid America and Europe was almost as common as their production. The only other methods of preservation were the then expensive ones of preserving them in sugar or brandy or of pickling them in vinegar, which latter processes make of them merely a condiment. Steam transportation and world commerce have worked a quick revolution by developing a large traffic in dried fruits from those parts of the world having unusually favorable conditions for their production.

It is often easier to dry fruit in the sunny and rainless summer of countries having the Mediterranean type of climate and ship it great distances than to combat the difficulties of drying it at home with alternating cloud, shower and sunshine or artificial heat in evaporators. The only exception to this is the drying of apples, an industry suffering from the competition of the commerce in fresh fruit. It is still extensively carried on in the eastern apple districts, especially New York, from which state thousands of barrels of dried apples are sent to Europe, chiefly to Holland, Germany, and Sweden, where they are used for food and for the making of wine. From some isolated farming districts in the Appalachian Mountains and the southern and eastern parts of the United States, there is still a small shipment of dried peaches, apples, cherries and even dried blackberries laboriously prepared over the kitchen stove or on trays in the sun, but the humid climate and the cloudy air with occasional showers blacken these products so that they bring a low price in the market.

COMPETITION OF CALIFORNIA WITH SOUTH EUROPE. In almost any grocery store in the United States to-day, boxes of dried prunes, apricots, peaches, dates, raisins, figs, and currants may be seen, and the names and addresses stamped on the boxes will show that they have come into these American communities from many distant parts of the world. Most of them are from districts with a

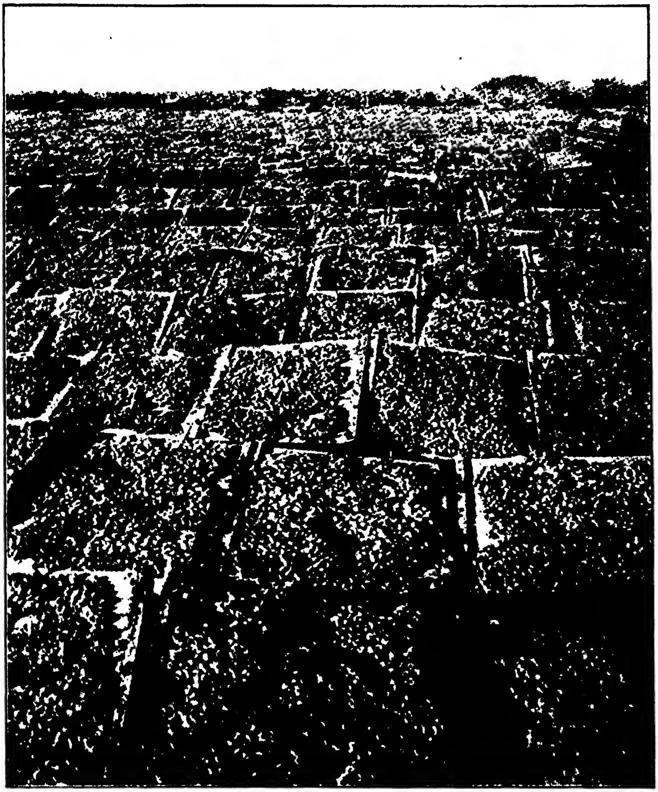


FIG. 105.—A rainless summer helps to locate the dried fruit industry in California by permitting it to be dried upon trays in the orchard. (United States Dept. Agr.).

long dry summer, in which fruit exposed on trays beside the trees is dried by the constant sunshine with little labor except piling the trays and covering them on those rare occasions when rain threatens.

California names predominate in the list of addresses on dried-fruit boxes, although thirty years ago the labels usually showed European names. These industries grew up first in southern Europe but since coming to southern California have developed with surprising rapidity and now supply almost the entire home market and a large surplus for export.

THE PRUNE. One of the first of California dried-fruit exports to compete with Europe was the prune, a dried plum which has long been exported from several Mediterranean districts, chiefly France, where Tours is the best known center of prune production. Italy is second and Germany produces some for home consumption. The recent large export to the United States has almost entirely ceased, and California prunes now compete with European fruit in the European market. England, the leading importer, took 18 million pounds of American prunes in 1922. In comparison with canned fruit, the dried fruit has the disadvantage of becoming wormy in summer, but it is much more concentrated and easily transported. Prunes in large quantities go from California in steamships through the Panama Canal or by rail to our eastern ports for shipping to Europe.

THE RAISIN has for centuries been an export of Almeria in eastern Spain, where the peasants for generations have kept vineyards and dried the grapes. Sultana raisins, produced from a seedless variety of grape, are grown along the eastern Mediterranean, the chief center being Smyrna, with other centers of production upon islands in the Ægean Sea, and to a less extent in Greece itself.

This old-world industry has been transplanted to the Great Valley of California with such success that the city of Fresno is now known ail over the world as a raisin center. Vineyards of raisin grapes cover the land for miles around, making Fresno county the second richest agricultural county in the United States. The preparation and marketing of this great crop is managed on a coöperative basis by the Raisin Growers' Association, which includes about 85 percent of the raisin growers of the state. Each member dries his own grapes in his own vineyard beside the vines, then hauls them to the great Fresno raisin plant where machinery does all the rest of the work until the seeded raisins are packed into a variety of boxes for shipment. Men worked for years to develop a seeding machine which takes the raisins and, by a process similar to that of the cotton gin, puts the raisins in one place and the seeds in another.

Before 1890 the United States imported an average of 38 million pounds of raisins a year, which decreased rapidly with the growth of raisin production in California. In 1923 our raisin imports were less than 10 million pounds, while we exported to other countries

California raisins to the amount of 78 million pounds. California has available enough additional grape land to easily supply not only the home market but a greatly increased export demand.[11]

CURRANTS (really a kind of dried grape) are not produced to any large extent in this country and the American import (chiefly from Greece) has stayed around 25 million pounds a year since 1890.

THE APRICOT is a close cousin of the peach which it resembles in many physical features, but because of early blooming, it is more sensitive to frost, and fruits regularly only in locations with good frost protection. In the United States it is dependable only in California, which state produces enough to supply the whole country with dried apricots and a few fresh ones during the early months of summer. The fruit is also exported both fresh and dried. It is also grown in northern India, and the dried fruit transferred by caravans over the snowy and perilous Himalayas to Tibet and western China, where the product is greatly prized.

For thousands of years dried apricots and other fruits have been a local food supply for the peoples in the old oases settlements of North Africa and western and central Asia such as Bokhara and Samarcand. These densely populated communities live upon irrigated lands where streams fed by snows upon the central Asian mountains permit fruit and vegetable gardens to spread over a few square miles of the level plain. It was not until the Russian government established rail and water connections between the Black Sea and these isolated areas that the apricots became important as a commercial crop. With cheap transportation rates these desert oases quickly developed a valuable dried fruit export and serve as a California to bleak Russia.

THE FIG. Commercially the fig is a sub-tropic product. The tree is hardier than the orange, thrives over most of southern Europe and even survives in sheltered places in England, Texas, and many parts of the Southern United States, but the production of the fruit was successfully managed in California only at the end of the nine-

[11] The response of the fruit industries to market conditions and the limiting effect of demand is well illustrated by the California raisin industry. Improved marketing methods and increased prices made profits, with the result that plantings of new raisin grapes were as follows:

1920—78,000 acres; 1921—90,000 acres; 1922—92,000 acres; 1923—51,000 acres. Since the acreage in 1920 was less than 250,000 acres and it takes four years for a vineyard to come to full bearing, and the 1923 crop of 265,000 tons of raisins was nearly half unsold at the end of the season, the growers were in consternation for fear of overproduction and dull times.

teenth century. For many years the trees had grown well but bore no fruit because of the absence of a certain insect that lives in Mediterranean lands, and crawls into the hollow cavity of the fig and fertilizes the many blossoms therein contained. The establishment of fig growing in California waited for the successful acclimatization of the insect, which was difficult and required many expensive attempts. The industry in this large sense is still an Old World industry. Fig drying, during which sugar exudes from the fruit and clings upon it in white particles, is a laborious process which has until the present time had its chief center in Turkey and Asia Minor, where in the valley around Smyrna figs are largely produced, making Smyrna the best fig market and Smyrna figs the best known in the world.

THE IMPORTANCE OF THE DATE IN DESERT COUNTRIES. The date, more nutritious than beef (see table of food values), the fruit of a tall palm growing in many warm arid lands, is the bread of the desert, and also food for the beasts. Even milk cows in Oman, Arabia, are fed principally on dried fish and date kernels. The date is called the tree of the desert, but it really requires much water, and is a tree of the oasis. Underground streams of water occasionally reach the surface in the Sahara Desert, either by natural flow or by pumping, and create most fertile oases. These are carefully cultivated and support a surprisingly dense population.[12] Their scattered locations make possible the caravan routes which cross this great desert from oasis to oasis. Millions of date trees yield the chief crop, both supply crop and money crop, of all this region. The French Government has built railroads across the fertile agricultural plain which faces the Mediterranean throughout the whole coast of north Africa and Tunis, through the Atlas Mountains, with their pastures and cork forests, down into the oases in the Sahara itself. Biskra quickly became one of the greatest date markets in the world when it became the terminus of one of these roads. Caravans brought dates there from many other oases

[12] The date may well be called the king of crops. Certain oases are known to have been in continuous production for 2,000 years. Apparently desert dust or some other mysterious source feeds them. The date crop yields many times as much food as wheat. Beneath the date trees grow apricots, figs, olives. Beneath these lesser trees there is enough light to grow beans and many vegetables, giving a three-story agriculture and making it very natural that the writer of the allegory of the Garden of Eden should have chosen a date oasis to be Eden.

and they were shipped by rail to Constantine and Algiers, thence by steamer to Marseilles for distribution to many lands.

The date grows through the desert parts of north Africa and western Asia as far as Mesopotamia. It is the chief export from the little independent Sultanate of Oman in southeastern Arabia, whose arid coasts look like the desert itself and whose population and products are to be found in the irrigated gardens of a few inland valleys where the date tree enables the Arabs to have food and also

FIG. 106.—Eight-year-old seedling date palm with phenomenal yield of 400 pounds fruit. Phœnix, Ariz. The trunk gets longer each year until it becomes a tall tree. (Photo W. T. Swingle, United States Dept. Agr.)

purchase the goods left at Muscat by the steamships from England, France, Germany, Italy, and America.

In Mesopotamia, a land of aridity and oases, the date, as in Morocco and Algeria, is one of the important food products. Date trees line the Tigris for long reaches as far up as Bagdad. Mesopotamia is at the present time the chief source of the world's commercial supply. To the city of Bagdad with its river steamers and to Basra with its ocean steamers, caravans of camels and mules bring the dates for shipment by steamer to the western world.

INTRODUCTION OF THE FIG AND DATE TO THE UNITED STATES. The date tree, like the fig and the olive, has been found to grow well in southwestern United States, where the climatic conditions resemble those of their old home in western Asia and north Africa.

Fig. 107.—Furrow irrigation of four-year-old apple trees at Wenatchee, Washington. (United States Dept. Agr.)

As with the fig, date culture has now passed the experimental stage in the United States, and the results are very promising especially in the lower Colorado Valley. While the date industry is expanding rapidly in the southwest it is unlikely that American dates will soon compete with the cheaper imported product. American growers are concentrating on the very finest grades which sell for eight or ten times the price of the cheap bulk dates shipped in from the Persian Gulf. At present the California crop is largely consumed on the Pacific coast, few of the dates reaching the eastern market. It may only be labor costs that prevent the American imports of these Old World desert fruits from sharing the fate that has met our import trade in prunes, raisins, and apricots, of which we now export a surplus, which amounted in 1923 to prunes, $5,200,000; raisins, $7,600,000; apricots, $2,400,000.

Each continent has a natural dried fruit district. Since each continent has its region of summer drought and irrigation, there is prospect of world competition in dried fruits as other countries of the world become better developed. In the Australian state of Victoria, for example, the well-known irrigation colony of Mildura on the Murray River has under irrigation a quarter million acres of land under the same kind of arid climate that prevails in California, Spain, and Asia Minor, and the people are already producing prunes, dried peaches, dried apricots, dried currants, and raisins for the Australian market, and occasionally exporting to Great Britain, where they compete with the products of the Mediterranean countries and California.

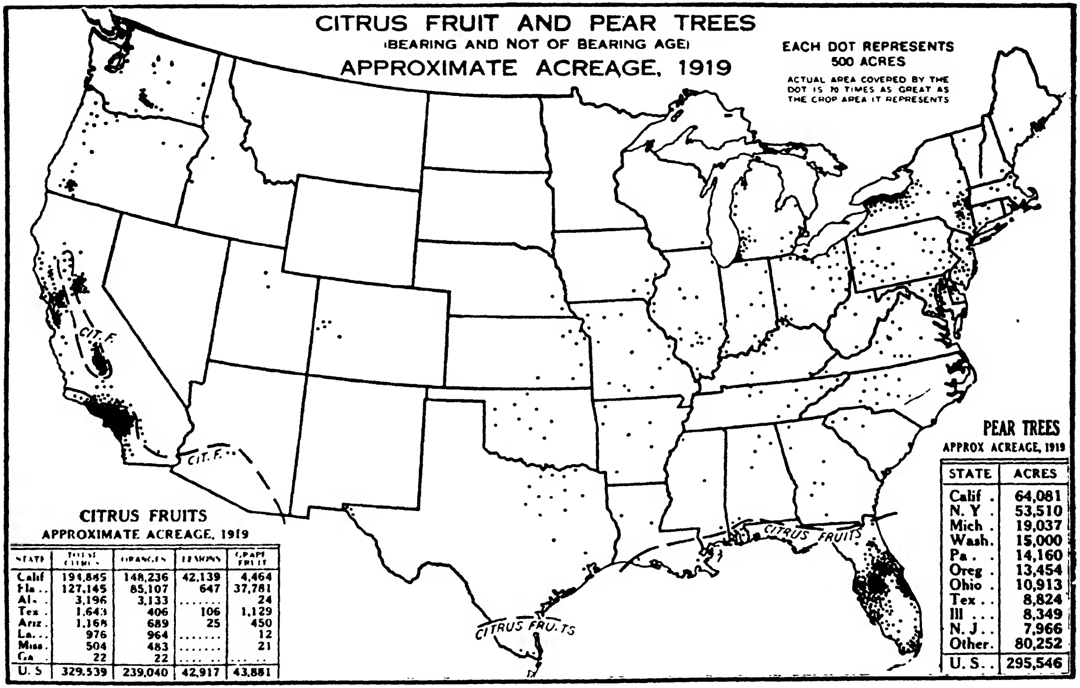
South Africa has an increasing dried fruit industry, the principal fruits being raisins, prunes, dried peaches, dried apricots and figs. The production of raisins has grown rapidly in recent years, the chief export market being Great Britain, but it is significant that South Africa can compete even with California, shipping over 3 million pounds of raisins to the United States in 1923, when our price was artificially held at a high figure. Chile has her California on the plains and irrigated fields near Valparaiso and Santiago. Over the Andes from these Chilean orchards are the foot hill settlements of San Juan and Mendoza in Argentina (somewhat comparable to the Lower Colorado Valley of Arizona) producing raisins, dried fruit, and wine for that country. The South Americans have as yet done nothing worth mentioning in export, but, as in Africa and Australasia, the natural resources are there, awaiting the labor and care of the husbandman.

6. THE CITRUS FRUITS

THE DIFFICULTY OF TRANSPORTING TROPIC FRUITS. The citrus fruits, including the orange, the lemon, the grapefruit or pomelo, the tangerine, the lime, and several others of small commercial importance, are the advance guard of the tropic fruit supply. People of the north temperate zone are enabled to have these fruits on their tables because of the tough, thick, oily and bitter skin which serves as an effective protection against insects, bruises and decay, while a host of delicious tropic fruits remain practically unknown to commerce because they lack such natural protection and could not enter commerce until recently. It is now possible to bring many of these tender tropic fruits, as, for instance, fresh pineapples, to temperate zone cities and the chief deterrent of large traffic is the lack of demand resulting from our ignorance of them. The natural conservatism with regard to new articles of diet is surprisingly strong, but may be expected to diminish and permit the gradual introduction to our markets of many new southern fruits. The avocado (alligator pear), the Japanese persimmon and the mango,[13] good examples of this, are already arriving in small quantities.

THE ORANGE. The orange is a native of southern Asia, possibly China, where, as in India, it has been used for many centuries. It was brought by the Portuguese to Europe in 1458, and became the basis of an important industry there, as it has become within recent years in the United States. The orange grows throughout the tropics and on the edges of both temperate zones, and is everywhere much prized by the inhabitants of those lands. Like many other trees it produces its finest fruits near the colder limit of its growth, so that the fruit of the United States is superior to that of the West Indies. It is to be had at almost all seasons of the year, since an orange tree carries ripe fruit and green fruit at the same time that it is in blossom. Its wide distribution makes possible an almost unlimited production, but inasmuch as the fruit is quite bulky and its commercial handling expensive, like the banana, it can only enter into commerce in large quantities where transportation facilities are of the best. Consequently, while it is important in commerce, the

[13] The mango, a delicious fruit as much used in the tropics as we use the apple and peach, is cultivated in India to the extent of a hundred named varieties. Being more durable than the peach we could easily get them from the West Indies if the demand existed.



STATE	TOTAL CITRUS	ORANGES	LEMONS	GRAPE FRUIT
Calif	194,865	148,236	42,139	4,464
Fla..	127,145	85,107	647	37,781
Al. .	3,196	3,133	....	24
Tex .	1,643	406	106	1,129
Ariz.	1,168	689	25	450
La...	976	964	....	12
Miss.	504	483	....	21
Ga	22	22	....	.....
U. S	329,539	239,040	42,917	43,881

STATE	ACRES
Calif .	64,081
N. Y .	53,510
Mich .	19,037
Wash.	15,000
Pa . .	14,160
Oreg .	13,454
Ohio .	10,913
Tex . .	8,824
Ill . . .	8,349
N. J. .	7,966
Other.	80,252
U. S. .	295,546

FIG. 108.—The commercial growing of citrus fruits in the United States is practically confined to California and Florida. In addition to oranges which are produced by both, California specializes in lemons, and the grapefruit (pomelo) is grown largely in Florida.

Commercial pear growing is most important in California and New York. (United States Dept. Agr.)

world's great supply is from a few localities readily accessible to the world's great markets. It is possible that more oranges waste beneath the tropic orange trees than are eaten by the people of the north temperate zone. This wasting frequently occurs even in such near-by places as Jamaica and the other West Indian Islands, whence it is almost impossible to get a profitable outlet for oranges except in the very early weeks of the season.

IMPORTANCE IN MEDITERRANEAN COUNTRIES. It is in the Mediterranean countries that the citrus fruits first gave rise to great commerce. The combined warming influences of the Mediterranean Sea, the Sahara Desert, the Atlantic Ocean, and of mountains protecting from the north wind, make this the most northerly of all regions with climate warm enough for these fruits. A short distance away are the millions of people of northern and western Europe, connected with the orange lands of the South by steamer and numerous railroads.

The three peninsulas of Europe which project far south—the Iberian, the Italian and the Grecian—are all important citrus producers. The orange is found on the west coast of Portugal as far as 40° north. Orange districts skirt the southern and eastern coasts of the Iberian Peninsula, but the interior is too high and cold for this fruit except in the plain of Andalusia. The most important Spanish orange-growing district is on the irrigated plain of Valencia, near the central part of the eastern coast. The steamship lines that skirt this coast carry thence to Great Britain over four-fifths the orange supply used in that country. Much British marmalade is made of Spanish oranges. Spain is by far the heaviest exporter of oranges in the world, shipping 11 million boxes in 1922.

The citrus industry is nearly as important to Italy as it is to Spain, Italy possessing an orange or lemon tree for every two persons in the whole country. Although the orange reaches its highest northern latitude for the world, 44°, on the protected coast of Italy not far from Genoa, it is not important north of Rome, and the lemon, being more susceptible to cold, will not grow north of Rome at all. The Italian orange export was 2½ million boxes in 1922.

Oranges, mandarins and lemons are grown in the Grecian peninsula but the export trade is not important.

The French colonies of Algiers and Tunis are the leading citrus growers of the north coast of Africa, France receiving a large part of her orange supply from Algiers, the center of production being near the port of Oran. Palestine at the east end of the Mediterranean ships through the port of Jaffa over a million cases of oranges every year, most of which go to England.

THE IMPORTANCE OF ISLANDS IN EUROPEAN CITRUS FRUIT GROWING. It is upon islands that the growing of citrus fruits seems to reach its most extensive development in the Mediterranean chiefly because the surrounding waters afford frost protection. The Azores have long been important shippers of oranges. Majorca grows them. Malta has long been known for the excellence of its oranges, while in Sicily and the neighboring shores of Calabria we have the greatest development of the Italian orange and lemon industry. Sicily greatly predominates over the mainland in both these fruits, having almost a monopoly of the production of lemons, whence they have for a century been distributed to the lemon-consuming regions of Europe and America. The Italian and Sicilian peasants give these fruits the greatest care. South of Naples they can only be grown in those few spots that can be irrigated. The ground is usually cultivated with the hoe and the spade, garden crops are often grown between the trees, and much of the soil is so steep that it is kept from washing into the Mediterranean only by the laborious building of terraces restrained by stone walls. It is chiefly this intensive kind of agricultural industry that has given to rugged and arid Sicily a population of 415 persons to the square mile.

CITRUS FRUITS IN ASIA. Although Asia is the native home of the orange, its culture has not been as highly developed as in North America and Europe. While grown successfully in most parts of sub-tropic Asia from the Mediterranean to the China Sea it rarely enters into commerce. The Japanese, being vegetable rather than meat eaters, consume less fruit than do the western peoples. Southern Japan is producing the equivalent of eight million boxes of citrus fruits a year, principally mandarins and grapefruit, of which a few come to the United States. Throughout south China various citrus fruits are grown, the loose-skinned varieties being favored.[14]

NEW CITRUS LANDS IN THE SOUTHERN HEMISPHERE. The fruits of the southern hemisphere have the immense advantage of ripening

[14] Native Chinese orange groves around Foochow yielded a harvest of 16 million pounds of tangerines during the season ending April, 1922, practically all of them being shipped to various parts of China.—United States Department of Commerce.

at about the time when those of Europe and the United States have been consumed. South Africa has a climate belt of the Mediterranean type, grows fine citrus fruits, and is now shipping half a million boxes of oranges and grapefruit to England each year.[15] The orange is equally successful in parts of Australia, but the Australian orange has not as yet played much part in world trade. The increasing ability of the new countries of the southern hemisphere to put fruit on the market during the European summer, however, is already causing alarm among the Italian and Spanish export growers.[16]

The citrus possibilities of South America are largely undeveloped. Far up the Paraná River in Paraguay oranges are regularly used for fattening hogs but it is only from the districts adjacent to steamboat landings that they are exported down stream to Argentina and Uruguay. These countries have in Paraguay a sub-tropic garden spot whence they derive, as does Pennsylvania from Florida, fruits and vegetables of a warmer clime. Citrus fruits are also grown in Brazil and exported to a small extent. Bahia, for example, has abundant labor, suitable land and good steamer service. The central valley of Chile, a South American California, has a local production of oranges and lemons.

THE EARLY IMPORT INTO THE UNITED STATES. This country began to import oranges from Italy and Sicily (where the industry had long been established) about 1835 when the American sailing vessels were perfected to great speed. With the development of the steamship this import became large and regular and the West Indies also participated in the supply, the chief sources being the near-by Bahama Islands and the British colony of Jamaica. Recently the home production has almost ended the import into the United States.

THE INFLUENCE OF RAILROADS AND COLD WAVES IN FLORIDA CITRUS GROWING. Although the orange and grapefruit were grown in Florida by the Spaniards more than three centuries ago, it was not until the building of railroads and the establishment of through

[15] In 1925 a great citrus planting boom was on in South Africa and going at a rate that promised a production of seven to eight million boxes by 1933 or 1934.

[16] In a report dated April 1, 1924, the American Consul at Rome brings out the fact that the expansion of the citrus industry in the United States has hurt Italian exports, and its rapid development in South Africa and Australia foreshadows still more severe competition.

train service between Florida and the north in 1886 that citrus fruits became a commercial crop. The planting boom which followed the railroads spread also from Florida to the adjacent southern states. It is possible to grow good oranges throughout much of the Gulf region, but there is always the danger of a cold wave coming from the center of the continent. If not in rapid growth at the time, the orange tree can resist some frost, but the warmth and moisture of the Gulf region may make the tree grow rapidly at any time during the winter. As a result freezes soon destroyed most of the commercial orange groves in Louisiana, Mississippi, Alabama and Georgia.

Before 1895 the commercial groves of Florida were located mainly along the St. Johns River, where a frost sometimes spoiled a crop without damaging the trees. In the winter of 1894-95 two severe cold waves not only destroyed the fruit but ruined the orchards of the entire state by killing the trees down to the ground. Thousands of groves were so completely ruined that the owners did not even try to restore them.[17] Another killing frost followed in 1899. The result was a partial abandonment of citrus growing in the old northern area and its gradual relocation in central and southern Florida. Even this move did not bring with it frost immunity, for other freezes have killed young orchards until, from experience, the margin of safety from ordinary frost is now fairly well defined. Systematic frost-protection has not become as well recognized a practice as in California, but some of the growers keep oil heaters in their groves, or piles of wood ready to be ignited at the approach of a cold wave. In the central lake region of Florida the numerous lakes reduce the frost hazard; during the freeze of 1917 groves on the south shore of Lake Apopka suffered little damage, while others two miles farther south were severely set back.

While oranges are grown to some extent in every county in Florida, the heart of the citrus belt at present is the central lake region, the so-called "Backbone of Florida," famous for its timbered hills and innumerable clear lakes. This central belt is producing over one-half of Florida's orange crop, and orange groves line the highways like cornfields do in Illinois or Iowa. Citrus exchanges and packing houses are found in every small town, and most of the

[17] The extent of the catastrophe is best realized by a glance at the production figures; the Florida orange crop of 1893-94 was 6,000,000 boxes; there was no crop at all in 1894-95, and in 1895-96 it was only 75,000 boxes.

crop is shipped to the north through the central marketing agencies. The Florida orange crop of 1923 totaled 12 million boxes.

Florida has developed almost a monopoly in the production of the pomelo, better known as the grapefruit. Although known and grown for many decades the grapefruit has only attained popularity in the last few years—a striking example of the possibilities of developing the public taste for many other now little known fruits. The grapefruit production of Florida has increased from less than 25,000 crates in 1901 to about 8,000,000 boxes in the 1923-24 season.

The tangerine and other kid-glove varieties are also grown all through the Florida citrus belt. Lemons and limes do not meet with as much favor in Florida, being delicate and easily frosted. The lemon can be commercially grown only in the warmest sections of the peninsula, as the trees are subject to great injury when the temperature falls below twenty-eight degrees.

CITRUS FRUITS IN THE WEST INDIES. Throughout most of the West Indies islands and in Central and South America along the borders of the Caribbean, oranges and other related fruits grow easily and are cheap and abundant in every local market. As a commercial crop for northern lands they are but little used, although Porto Rico canned grapefruit is a suggestive new commodity.

The fear of frost destruction in Florida caused a boom in orange planting in Cuba immediately after 1899 when Cuba became independent. Orange and grapefruit groves were planted, chiefly by Americans, at an expense of $10,000,000, but the tariff and shipping costs leave so little money for the Cuban growers that there seems to be small prospect of large orange shipments from that island to the United States, or to Europe with its Mediterranean supply. The Cuban orange [18] seems, like the Jamaican orange, destined to lie upon the ground rather than enter into foreign trade unless calamities overtake Florida and California, or the manufacture of orange products takes unwonted strides.

[18] Since the American occupation there has been a slow development of the grapefruit and vegetable industries in the Isle of Pines, south of Cuba. This isle was colonized by several hundred Americans under the erroneous impression that it would belong to the United States. Grapefruit of the Isle of Pines reach the American market in August and September before those from Florida are ripe. In the season of 1922-23 a quarter of a million boxes were sent, but the industry was larger in 1910 than it is at present. Distance, tariffs and rival foods are against it.

The lime, excepting the new kumquat, the smallest of the commercial citrus fruits, does best in the tropics and the chief supply comes from the Lesser Antilles. The leading producer is the little island of Dominica (Leeward Islands), where the fruit is grown on the steep, rocky limestone hills to the amount of about 400,000 barrels a year. Here are plantations and factories owned by the great candy manufacturing firms of Europe who import lime juice and lime oil for use in their products. The neighboring island of Montserrat also produces limes.

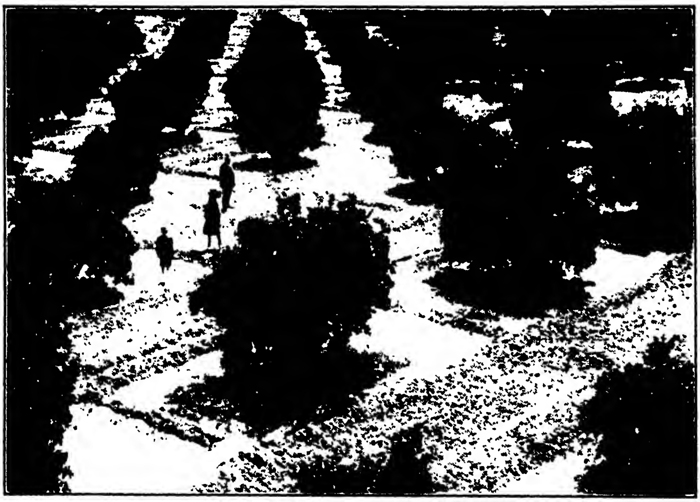


FIG. 109.—Irrigation of Arizona citrus fruit tree by the basin method, economical of water. (U. S. Reclamation Service.)

CALIFORNIA ORANGES AND LEMONS. Florida's misfortune in 1894 proved to be California's advantage. The northern limit of the orange in Florida is about 30° north latitude while, in California, owing to the oceanic climate of the Pacific Coast, the tree grows as far north as 40° in the northern part of the Great Valley. However, the region in which the industry has had nearly all of its large development is south and west of the coast range in the Los Angeles-San Diego district of southern California. Here the cold wave of the Mississippi Valley is almost unknown and the danger of a destructive freeze is smaller than in Florida, although frosts that destroy the crop and injure the trees are not uncommon in many localities.

The astonishing freeze in the California citrus fruit belt in January, 1913, had not been duplicated in 40 years and cost the growers from $20,000,000 to $40,000,000.

California oranges are grown with the most perfect care on irrigated land of high value, the orchards often being valued at $2,000 and more per acre. This very high value is due not to scarcity of land but to scarcity of water, which amounts to scarcity of orange land, since unirrigated California lands cannot grow fruit. Great pains are taken to get and save water for the irrigation of the California fruit orchards. Tunnels are sometimes dug back in the hillsides to strike the underground flow, wells are dug and pumps lift the water to the land where it is often carried in cement pipes and put around the base of each tree so that the smallest possible amount may make an acre prosperous. The great distance from the eastern market makes transportation costs high, so that only the best fruit can be shipped. To attend to these matters the fruit growers have formed associations which are good examples of coöperative enterprise. In normal years they ship over 50,000 carloads of citrus fruits to Chicago, New York, and Boston, for distribution throughout the East.[10]

In the southern part of the California citrus district the lemon, less hardy than the golden orange, is now being extensively grown for the American market. The California citrus orchards covering over 200,000 acres are about one-fifth lemons, and about 4 million boxes are marketed each year. Our import of about $3,000,000 per year, almost entirely from Sicily, shows that the home supply is still under the demand.

THE FUTURE SUPPLY OF CITRUS FRUITS. The development of the two American citrus regions has reduced our imports of citrus fruits until, except in the case of lemons, they are negligible. In addition to supplying the home market Florida and California are exporting oranges, lemons and grapefruit to the value of $9,000,000 every year, the largest share going to Canada.

California is using for citrus fruit only a fraction of her suitable land. The total area planted is a little over 300 square miles, or one-fifth of one percent of the area of California. Florida has more danger from frosts, and, owing to her moist climate, has more fungous diseases which at times greatly injure the trees, but she is

[10] The shipment of 4,000 cars in 1891 scared the growers who feared that they would soon glut the market.

nearer to the market in the great centers of population of the east. Florida, with less than 7 percent of her area in cultivation, with only 18 persons to the square mile, an abundant rainfall, and about half of her area in reclaimable swamp of great fertility, has a much higher ratio of possible expansion than has California. The comparison of Florida with Sicily is even more striking. Florida is nearly all capable of tillage, Sicily very hilly and rocky; Florida well watered, Sicily dependent upon irrigation for all important crops but wheat and grapes and possessing twenty-three times Florida's population per square mile.

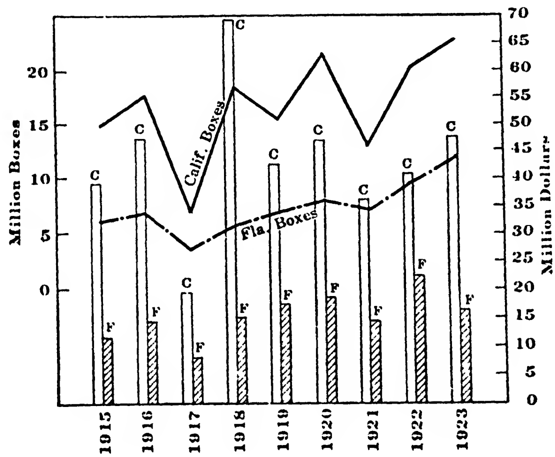


Fig. 110.—The commercial orange crop in California and Florida.

Citrus production in the United States has increased during the past 18 years at a rate nearly six times as rapid as our population increase. This expanding production has so far been met by a constantly increasing demand for oranges and grapefruit. Planting is still going on rapidly. Manifestly the limit of our citrus production is to be set, not by resources, but by prices. Unchecked production in Florida and California can easily produce the same low price that prevails in the tropics where oranges lie unused on the ground. The citrus fruit market is easy to glut, as shown by the shipment of 800,000 boxes from Sicily to the United States in three months in 1895, when the price went down to such a low figure that it only paid shipping costs and duty—the same condition that faced the Cuban orange shippers in 1909.

7. THE GRAPE

HISTORY AND REQUIREMENTS OF THE VINE. The grape is considered a luxury wherever it can be obtained, being a delicious food and material for the much prized wine. These two factors have combined with its importance in classic lands to make the grape the most celebrated of fruits even back to the day when Noah disembarked from his ark. The vine is indigenous in eastern United States and from Hungary to Afghanistan in Eurasia. Grape seeds are to be found in the remains of the Swiss lake dwellings dating back to the bronze age, but it is probable that the Old World industry as we now know it began somewhere in western Asia. Old Testament references to the vineyards show its high antiquity among the Hebrews. The grape was early introduced among the Greeks and Romans and has spread throughout the world wherever the climate and soil permits of its cultivation and even beyond the natural climatic bounds, for large quantities of most delicious and expensive grapes are produced in the hothouses of England, Holland, and France.[20]

The chief requisite for the grape is a summer of considerable heat lasting into September. The vine sends its roots to great depth and can thus search out water in arid soil and will thrive in dry climates when most surrounding vegetation is brown and dead. Thus, it grows in southern Italy and other Mediterranean lands without irrigation on the hills above the orange groves. In California, which is a relatively empty agricultural frontier in comparison to Mediterranean lands, the grape is usually irrigated. This is merely because pressure of other crops for the water has not yet pushed the grape up on the hillsides, above the water line (where it yields, but less abundantly), as has happened in the Old World. Accordingly, the grape is at home upon the edge of the world's subtropic belt in each of the three continents of the northern and southern hemispheres. Too much moisture is detrimental, producing fungi which attack and destroy both the leaves and the fruit. Thus the monsoon climate of India, China, and Japan with its great summer rain makes extensive grape growing impossible.

[20] In England the growing of fancy grapes in hothouses is largely localized in Sussex County. The season for marketing opens in May and during the early selling some of the best grapes bring as high as 30 shillings ($7.00) per pound.

THE LIMITS OF GRAPE GROWING. Although the grape is grown on the sheltered Channel Islands, the line marking the limit of the industry on the mainland is curved from the west coast of France near the mouth of the River Loire northward to latitude 53° in east Germany. This northward trend is due to the increasing heat of the summer as we go eastward from the moderating influence of the ocean into the greater heat of the continental summer. In Russia the summers, though hot, are shorter and the grape line descends to the Sea of Azof and thence runs eastward through south Russia and Asia. In America, there is a similar bend of the grape limit from 37° north in California to 40° in south Ontario where the lake belt gives grape growing a northward extension. In the southern hemisphere grapes grow in the chief centers of population in Australia, South Africa, and temperate South America. Before the coming of extensive and easy commerce in wine, grapes were grown and wine was important in the valley of the Severn in England, and in parts of Germany above the present line, but the quality was poor, the harvest uncertain, and the industry is now limited to districts of more favorable climate.

IMPORTANCE AND DIFFICULTY OF TRANSPLANTING THE INDUSTRY. Grape growing and wine making reach their greatest importance as a national industry in France, Italy, and Spain—countries which produce five-sixths of the world's wine. Other countries of importance are Austria, Russia, and Switzerland. But the three leading European countries have long dominated the wine industry of the world and have held their leadership despite vine growing and the effort to introduce wine making into many other parts of the world. The industry is hard to move. In the first place it is an intensive industry requiring a dense population. Like a garden crop it requires much labor to produce the grapes. The yield is great, in France about 200 gallons of wine per acre. In the second place, expensive appliances and much labor are required for the fermentation of the juice into good wine, and great skill is required to get the desired flavors in the product. Lastly, wines are sold by the name of the country or place producing them, as Burgundy, Madeira, Champagne, etc., and a long time is required to establish a reputation. New countries repeatedly announce good wine but no one takes it seriously. Owing to the soil influence, particular varieties of grapes are often limited to narrow localities, a conspicuous example of this being the species of the vine grown in

Greece and producing the fruit sold in commerce under the name of dried currant. This important little fruit is the best cared for of all the crops of Greece, and the annual product is nearly 150,000 tons a year. The half of the currant crop that is exported makes up about one-fourth of the total exports of Greece. The currant grape, because of peculiarities of soil and climate, is produced only on certain islands and along a certain part of the Gulf of Corinth, from which the word currant is derived.

THE ITALIAN WINE INDUSTRY. Italy depends more upon grapes and wine growing than does any other nation. While her wine is not, unfortunately, so highly prized as that from some other countries, Italy nevertheless exports great quantities of it. The limestone hills and dry summer permit the grape to thrive better than most other crops, and they are grown in all parts of the country. Vineyards cover not less than 16,000 square miles of territory or about one-seventh the entire area of the kingdom, and one-third of all the cultivated land. These figures become more significant in comparison with the corn crop of the United States, which covers about one-twentieth the area of the country. Italy's average wine production is about one billion gallons a year (1,136,000,000 gallons in 1923).

FRENCH WINE INDUSTRY. France is the leader of wine-producing countries, and her people consume on the average at least 25 gallons of wine per capita per year. While the grape area (5,500 square miles) is only one-third that of Italy, the yield (1½ billion gallons in 1923) is greater than Italy's, a measure of the superiority of French land, rainfall and agricultural methods. The French grape crop covers only one-eighth the area given to the grains and although it does not extend into the northwestern part of the country, the wine-growing province of Champagne reaches the Belgian boundary. The good esteem of French wines, among them claret, burgundy, and champagne, makes wine, after textiles, the chief export of the country. Her foreign commerce and prosperity depend to so great an extent on this trade that a calamity to grape growing is a national calamity. Such was the Phylloxera, an insect pest which came from America to Europe, where it spread through all the wine-growing countries, thence to Algeria, and finally reached South Africa, Australia, and South America. The Phylloxera, a tiny insect of the aphis family, gets upon the roots of the grape vine and sucks the juices from them until the vine is killed. No cure has been found, and France, which had nearly 6 million acres in the vine in 1875, had less than 2 million acres of healthy vine in 1885, and another million acres invaded by the Phylloxera. The only thing which prevented the practical extermination of grape and wine growing throughout the world was the fact that in America, the home of the Phylloxera, there were varieties of grape immune to its attacks.[21] These were imported to Europe, set out by millions in the vineyards which the Phylloxera had devastated and tops of the

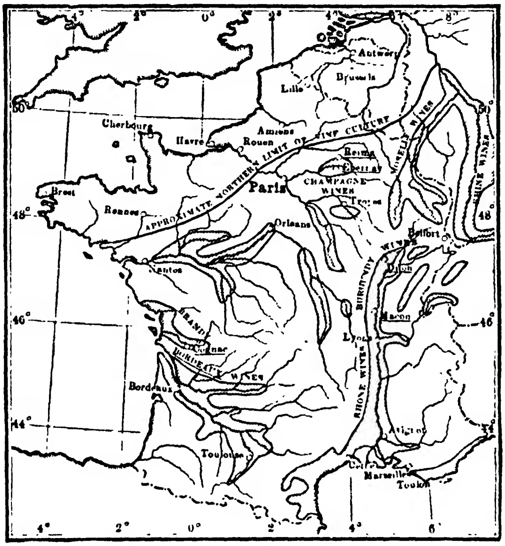


FIG. 111.—Chief wine-producing areas of France. Names of wine and brandy centers underscored. (After Brigham.)

European varieties were grafted upon their roots, making a composite plant with American root to resist the destroying insect and a European top to produce the desired wine grape. Thus, the industry rose again until, at the present time, France has three-fifths as many acres in vines as she had in 1875 and the yield is four-fifths as great as at that time. The province of Alsace which was annexed by Germany after the war of 1870-71 and returned to France in 1918 has added about 77,000 acres of splendid vineyards to the French total.

[21] Substitute the words chestnut blight, China, United States and the analogy of stories is striking.

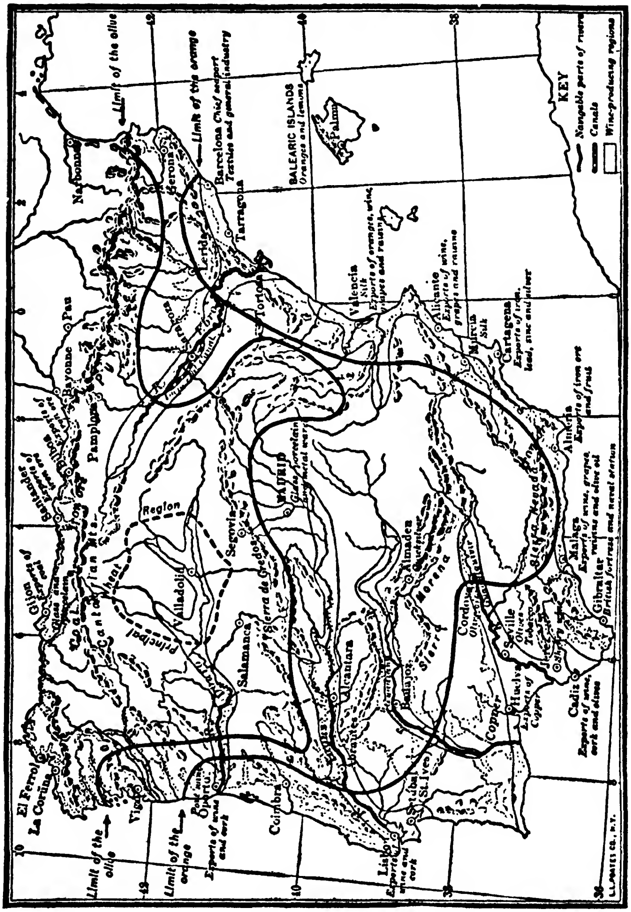


FIG. 112.—Iberian Peninsula—production centers and influence of plateau and sea upon them. (After Brigham.)

While French wines are consumed wherever throughout the world the people wish to drink the best of wine, the French themselves are large wine importers, taking practically the entire crop of Algeria, which is one-seventh as great as that of France, and getting also large quantities from Italy and Spain. Sometimes they sell their own high priced wines and use the cheaper wines of Italy and Spain for home consumption. Much of the import, however, they mix with native wines and flavor, label, and export as French wines. They even import as much as 150 million pounds per year of the dried currants from Greece, which are manufactured into wine for export. Germany also imports these currants for the purpose of enlarging the output of her choice brands of wine.

SPANISH GRAPE AND WINE INDUSTRY. Spain, the third great wine-producing country of the world, is also a grape exporter, sending to England, especially from Malaga and other southeastern ports, most of the 3 to 4 million dollars' worth of grapes which England each year imports. In 1891, before the Phylloxera had done its work in Spain, wine made up one-third of the export from that country, but now the proportion is only about one-eighth, although wine is still the leading export. The best known of Spanish wines is the "sherry" which, since the time of Shakespeare, has been exported from Jerez de Frontera, a town near Cadiz. Jerez has been corrupted into "sherry." Portugal, which resembles Spain in people, resources, climate, and industry, has one-tenth of its cultivated land in vineyards, and wine which goes chiefly to Great Britain and Brazil makes up over one-fourth of the exports of the kingdom. Port wine (derived from Oporto) is the leading brand.

HILLSIDE GRAPE GROWING IN EUROPE. In the northern parts of the European grape belt the desired heat and sunshine can be obtained by planting the vineyards on the southward sloping hillsides. In this way they are protected from the north winds and exposed, by the inclination, to the nearly direct rays of the sun, and often get in addition the reflected sunshine as from the surface of the Rhine, the Moselle, and the Swiss lakes.[22] By this means Switzerland has become a wine producer, utilizing the slopes overlooking Lake Geneva and the other Swiss lakes, but the total, aided by a higher yield per acre, is one-fifth that of France. Germany, with a

[22] It is interesting to find the same kind of hillside grape growing developing in the northern limit of the American grape area along the shores and islands of Puget Sound in Washington State.

production one-fifteenth that of France, is perhaps the best example of hillside grape growing. The most famous of the German districts are upon the steep south slopes that come down to the Rhine, and its tributaries, the Neckar and the Moselle.

The vineyards upon these riverside slopes prosper in latitudes where otherwise they would scarcely exist. Some of the Rhine

FIG. 113.—Stone walls hold the earth in Rhine slope vineyards worth $7,000 per acre. Tower and castle of medieval barons who lived by their exactions from Rhine traders. Freeing the Rhine was one of the great steps in modernizing Germany.

terraces have been in grapes continuously for centuries, and so highly prized have certain brands of wine become that new terraces have been built from time to time in places so forbidding that a retaining wall had first to be built and earth carried up from the river bank (often by women), before the vines could be planted. One particular mountain slope near Bingen produces the most famous Johannesberger wine and was valued before the War at $7,000 per acre, the equivalent of $33 per front foot for a building lot 185 feet deep. These terraces, so steep that horses cannot be used, are cultivated entirely by hand, even to the carrying up of baskets of manure, strapped upon the backs of men and women. So dense is the population of these districts and so great the pressure upon resources that when the green ends of the vines are cut off in August to hasten the ripening of crops, they are carefully saved and fed to the goats, and when the vines are trimmed in winter the cuttings are sold for fuel.

Owing to the scarcity of land, terrace vineyards are common on Italian hills and mountains. Nearly 200 terraces, one above the other, may be seen on the southern slope of the Apennines, near Lucca.

SPREAD OF WINE GROWING TO NEW COUNTRIES. There have been many attempts to establish wine growing in other countries, but for reasons already stated the progress has been surprisingly slow when we consider the vast areas in North and South America, north and south Africa, Australia, and Asia that are probably as well suited to wine making as is Europe. The growth of sheep, cattle, and grains springs up in a new country in a decade, but the amount of capital, labor, and skill required for making wine, combined with the even greater handicap of a new brand, leaves the three original wine-growing countries overwhelmingly predominant. The colonies and frontiers may produce the bread and meat, as for decades they have done, but all of the colonies of Great Britain combined do not produce one-half of 1 percent of the world's wine. Rumania and Russia, possessing the dense population to supply the necessary labor, have made greater progress in the last forty years than any colony. Both have had a small wine export in favorable years, but the War stopped vineyard expansion. Grapes thrive in Turkey, Asia Minor, Syria, Persia, Turkestan, and other parts of western and interior Asia, where travelers and explorers frequently find them of excellent quality and of local use, but not yet affording a basis for any commerce.

AUSTRALIA. Australia has large vine-growing areas near her arid interior and it is admitted by some experts that the product of some of the Australian vineyards is practically as good as any wine in the world. Imports of wine decreased rapidly with the expansion of the local wineries and some is now exported, mainly to the Pacific islands. South Australia is the leading grape state and wine producer, followed by Victoria. In New South Wales the farmers have been driven to grape growing because the droughts, although they ruin the wheat, will not prevent a crop of grapes. In addition to wine making the grapes of South Australia and Victoria are going increasingly into raisins.

SOUTH AFRICA. South Africa seems to have, in the western part of Cape Colony near Cape Town, just the right conditions of soil, sunshine, and moisture to make it one of the best grape-growing regions in the world. The Dutch settlers succeeded well with French and Rhenish vines, and in 1822 this region sent more wine to England than did France. The fungus and insect pests of the nineteenth century, however, have kept the industry down and the present production, though greater than that of Australia, is small in comparison with France and Italy. The government has recently made attempts to foster the industry, and the acreage devoted to vineyards has increased over 50 percent in the last ten years. The ripening of the fruit in the springtime, when we have nothing but expensive hothouse products in northern latitudes, causes the export of some fine grapes to Great Britain along with the peaches and plums previously mentioned. There seems to be no reason why the fresh grape trade to the northern hemisphere should not assume large proportions.

SOUTH AMERICA. South America has its grape districts upon the edges of the desert belt which cuts diagonally across the continent from northern Chile to southern Argentina, between the eastern rain belt of the trade winds and the western rain belt of the westerlies. Chile is a large consumer of wine, and the local production often amounts to over 15 gallons per capita. This is grown on an area half as large as the German vineyard area, and located in the northern part of the great Central Valley of Chile, a region supporting most of the agriculture and population of that country, and much resembling the Great Valley of California. Near Santiago there is a splendid plain given over to intensive culture by irrigation and to the growth of grapes which are made into a wine of local fame. Chile has a small export of wine but, as from all other new wine regions, she has to meet the difficulty of convincing wine users that her output is as good as the established brands of Europe.

In Argentina the chief grape and fruit districts are dominated by French wine growers in the irrigated settlements of Mendoza and San Juan, watered by snow-fed streams from the near-by Andes and separated from the agricultural plains of the east by some hundreds of miles of arid sheep and cattle ranges. Special trains carry fruit and a large part of the wine to Buenos Aires, the largest city in the south temperate zone and in population a rival to Philadelphia. The value of the Argentine wine crop has reached $12,000,000 in one year. Uruguay also has some wine production, but like that upon the coast settlements of the Peruvian desert plain, it simply serves a local need. Some European wine is imported by every country of South America.

GRAPE GROWING IN THE EASTERN UNITED STATES. When the European colonists landed upon the shores of the United States and stocked their gardens with the plants and trees of Europe they were pained to find that all the grape vines promptly died from some mysterious kind of blight that destroyed the leaves. It was fungi thriving in the heat and humidity of the eastern American climate, enemies to which the plant had never been subjected in cool west Europe or the dry summer of south Europe. Yet the colonists found in the American forests wild grape vines growing to prodigious size, climbing to the tops of the tallest trees and often reaching a thickness of half a foot or even more. From this stock plant breeders have in three centuries evolved a number of varieties of edible grapes, their names, Concord, Clinton, Niagara, Delaware, Agawam, Catawba, Early Ohio, etc., showing their American origin.

The grape is widely grown throughout the eastern and southern parts of the country as a garden crop, but the cold waves of the continental climate with their late spring frosts seem to make it uncertain as a money crop except in localities where water bodies give frost protection. Consequently, the eastern grape belt lies close to the shores of Lake Michigan and Lake Erie, to a lesser extent to those of Lake Ontario, and to the five slender north and south lakes of New York, called the Finger Lakes. The vineyards of the Finger Lake district are upon the southern and western slopes of the hills along the eastern shores of the lakes, the prevalent west winds blowing across the waters in spring giving the desired temperature. The fact that New York state possesses the Finger Lakes and touches the two Great Lakes, Ontario and Erie, gives it leadership in eastern grape growing. Michigan, with a group of heavy grape growing counties along the eastern shore of Lake Michigan, ranks second. Ohio with a long stretch on Lake Erie is third, and Pennsylvania with one county on the lake is fourth. All along the southeastern shore of Lake Erie, especially on certain islands in the lake and even on the Canadian lee shore, the grape field is much the most important field upon the farm and is often the entire dependence of the grower. The grapes of this eastern district are chiefly of the Concord and Niagara varieties which are much prized as table grapes and are widely shipped to the cities, small towns, and country districts of eastern and central states. They are far sweeter and cheaper than the edible grapes of central Europe. The American variety of grape makes very good grape juice and this industry is rapidly growing in importance.

CALIFORNIA OUR LEADING GRAPE GROWER. Although the European grape failed in the eastern United States it has succeeded remarkably in California, where it was introduced by the Franciscan fathers during the latter half of the eighteenth century. The earliest variety, now generally known as the Mission, was probably brought over from Europe in the time of Cortez. It was admirably adapted to the purpose of the missions, for besides being a good table grape which kept well and was not too sensitive for primitive methods of handling, it could be used for the making of sweet wine. Even after the American occupation of California, it was for many years the only variety in use. While well adapted to the climate and a prolific bearer it was susceptible to the inroads of the Phylloxera and had to be grafted as previously described.

Over 500,000 acres of land, mostly centering around Fresno in the Great Valley, are now devoted to grapes. This land is comparatively level, in marked contrast with the vineyards of Italy and Switzerland, and the deep valley soil with irrigation gives a yield per acre greater than that of any other in the world. With both table and raisin grapes, California grows seven-eighths of the total United States commercial crop.

From the time of the Franciscan fathers until 1919, California had a growing wine industry with the demand usually exceeding the supply. With the advent of prohibition in America the commercial production of wine ceased, but, contrary to expectation, the grape growers have not suffered from lack of a market. An increasing demand for table grapes has kept up the price,[23] and the shipments of California grapes have increased steadily from 13,000 cars

[23] Several years ago growers in a certain California town were letting their grapes go to waste because the price of $8 per ton offered by the wineries was not sufficient to pay the cost of picking and a three mile haul. In 1922 grapes in this same locality brought as high as $80 per ton.

in 1917 to 53,000 cars in 1923. A large proportion of the crop also goes into the making of raisins. (See Dried Fruits.)

In the Pacific coast states outside of California the growing of grapes is still largely experimental. In parts of Washington, Oregon and Idaho, European grapes of table varieties are giving very promising results in favored locations. The vines need some protection in the winter by covering them with straw or earth.

REFERENCES

See General References

"Home Canning of Fruits and Vegetables." Office of Home Economics. United States Department of Agriculture, *Farmers' Bulletin*, No. 1211 (1922).

Vosbury, E. D., and Winston, J. R. "Pineapple Culture in Florida." United States Department of Agriculture, *Farmers' Bulletin*, No. 1237 (1921).

Beattie, James H. "Tomatoes for Canning and Manufacturing." United States Department of Agriculture, *Farmers' Bulletin*, No. 1233 (1921).

Beattie, W. R. "Tomatoes as a Truck Crop." United States Department of Agriculture, *Farmers' Bulletin*, No. 1338 (1923).

Hunn, Chester J. "The Production of Peas for Canning." United States Department of Agriculture, *Farmers' Bulletin*, No. 1255 (1922).

Vosbury, E. D., and Robinson, T. Ralph. "Culture of Citrus Fruits in the Gulf States." United States Department of Agriculture, *Farmers' Bulletin*, No. 1343 (1923).

Gould, Harris Perley. "Growing Peaches; Sites and Cultural Methods." United States Department of Agriculture, *Farmers' Bulletin*, No. 917 (1918).

Folger, J. C. "The Commercial Apple Industry in the United States." *Yearbook*, United States Department of Agriculture, 1918.

Sharnel, A. D. "Coöperative Improvement of Citrus Varieties." *Yearbook*, United States Department of Agriculture, 1919.

King, F. H. *Farmers of Forty Centuries.*

Bailey, L. H. *Cyclopedia of Farm Crops.* Macmillan, 1922.

Blair, Fred J. "Development and Localization of Truck Crops in the United States." *Yearbook*, United States Department of Agriculture, 1916.

Kinman, C. F. "Olive Growing in the Southwestern United States." United States Department of Agriculture, *Farmers' Bulletin*, No. 1249 (1922).

CHAPTER VII

SUGAR

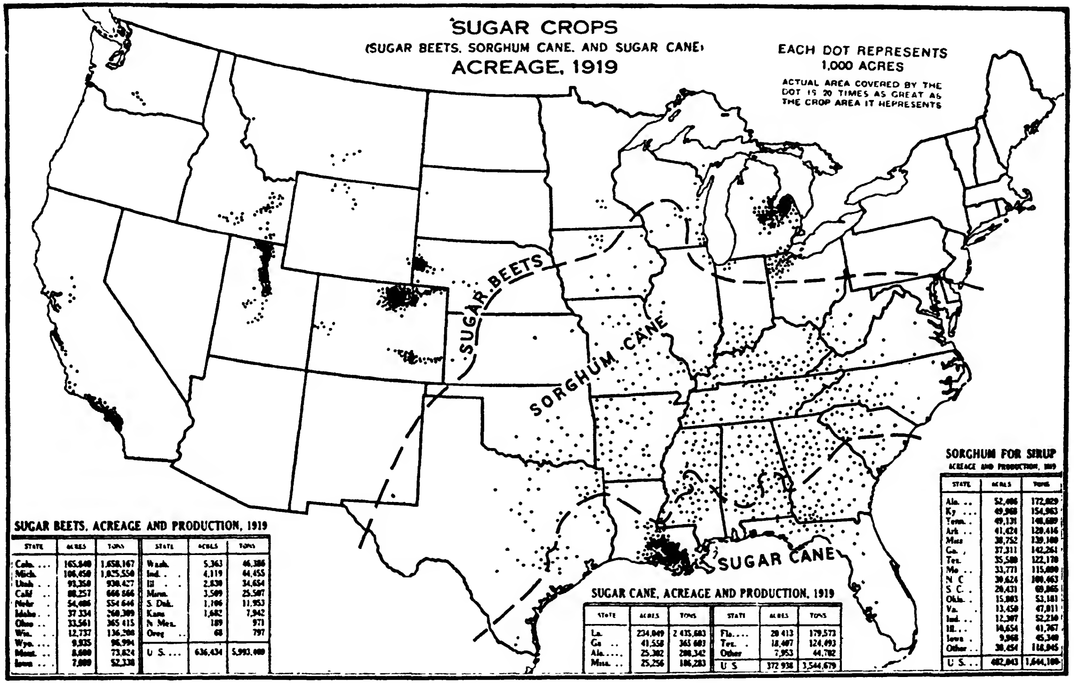
SOURCE AND HISTORY OF SUGAR. As nearly all plants have it in their sap at some time in their growth, there are many sources of sugar. Many plants store sugar which can be used in other seasons, just as other plants store and use starch. All fruits have some sugar, the grape being especially rich, and a considerable portion of sugar is even found in the onion. The more important of the sugar-storing plants are beets, carrots, and parsnips, which hoard it for use in the second year of their growth to make their heavy top, blossom and seed. In the tropical zone the date palm, Palmyra palm, and cocoanut palm, are all used to some extent for sugar manufacture in the lands of their growth. The American Indian got sugar from maple trees. The sugar cane, a plant much resembling an earless stalk of corn filled with sweet juice, grows throughout the moister parts of the tropics and in its natural condition was so superior to other sugar yielders that it was practically the only source of commercial sugar supply until the nineteenth century. An exception should be made for the primeval sugar supply of honey (the sugar of blossoms), which was much more important in past centuries than it is since other sources of sugar have been developed.

The general and heavy use of sugar among temperate zone people is recent and it has rapidly passed from luxury to a necessity. In 1589 a pound of sugar cost as much as a quarter of veal. In 1700, 50,000 tons per year were used in all countries of Europe. At the present time, that quantity lasts the United States about three and one-half days. Within the last century there has been a seven-fold increase in the world's commerce in sugar, and the people of the world are using more and more per capita each year. The demand for sugar does not stop with the kitchen and the dinner table. Enormous quantities are used by the makers of candies, chocolate, jams and jellies, bakery products and soft drinks, of which consumption in the United States, the world's largest consumer, is still increasing astonishingly. We now use more than 100 pounds of sugar each per year in the United States.

THE PERFECTION OF THE SUGAR BEET. Sugar is one of the few commodities in which there is competition in production between the temperate zones and the tropic regions. During the last sixty years, there has been a strong rivalry between cane-sugar producers and beet-sugar producers, and it will doubtless continue for decades to come.

It is probably due to the Napoleonic Wars that the beet has become a great source of sugar supply. The military and commercial blockades of these wars cut off France and often the rest of Europe from the cane-sugar supply of tropic colonies. At the order of Napoleon French scientists examined hundreds of plants in the search for a promising sugar supply. Among them the grape and the beet were most seriously considered because of their high content of sugar, but industrial effort centered itself upon the beet which the Germans first used in 1799. In 1806 the French government offered a bounty for beet-sugar production, and in 1811 Napoleon ordered 80,000 acres of beets to be grown for sugar. Only one sugar factory survived the Napoleonic Wars and the renewed competition of cane, but the industry lingered along until finally by the middle of the nineteenth century it had become firmly established.

The beet-sugar industry affords us one of the best examples of the service that science renders to man. In 1836 it took 18 pounds of beets to make a pound of sugar; in 1882 about 10 pounds sufficed; in 1924 about 7 pounds yielded a pound of sugar. This great improvement has been brought about chiefly in Germany, where on large sugar plantations trained scientists devote their whole time to improving the sugar content of the beets. Samples are cut from the most promising roots and tested; the best beets only are saved to produce seed the next year, and so on for generation after generation, always selecting the best. This process of systematic selection has, within the life span of man, trebled the sugar content of beets and, along with improvements in the process of sugar extraction, made possible one of the great agricultural industries of the temperate zone. The process of improvement has not yet ended. In the twenty years between 1903 and 1923 the percentage of sugar extracted rose from 11.59 percent to 13.41 percent—16 percent increase in the amount of sugar produced per ton.



SUGAR BEETS, ACREAGE AND PRODUCTION, 1919

STATE	ACRES	TONS	STATE	ACRES	TONS
Colo. . . .	165,840	1,658,167	Wash.	5,363	46,386
Mich.	106,450	1,025,550	Ind. . .	4,119	44,455
Utah . .	93,350	930,427	Ill. . .	2,830	34,654
Calif. . .	88,257	666,666	Minn.	3,509	25,507
Nebr. .	54,486	554,646	S. Dak.	1,106	11,953
Idaho . .	37,334	260,309	Kans.	1,682	7,942
Ohio . .	33,561	365,415	N. Mex.	189	971
Wis. . .	12,737	136,208	Oreg. . .	68	797
Wyo. . . .	9,935	96,994			
Mont. . .	8,600	73,824	U. S. . . .	636,434	5,993,000
Iowa . . .	7,000	52,338			

SUGAR CANE, ACREAGE AND PRODUCTION, 1919

STATE	ACRES	TONS	STATE	ACRES	TONS
La.	234,049	2,435,683	Fla. . . .	20,413	179,573
Ga. . .	41,558	363,683	Tex. .	18,407	124,093
Ala. . . .	25,302	208,342	Other	7,953	44,702
Miss. . .	25,256	186,283	U. S.	372,938	3,544,679

SORGHUM FOR SIRUP
ACREAGE AND PRODUCTION, 1919

STATE	ACRES	TONS
Ala. . .	52,406	172,029
Ky. . . .	49,968	154,963
Tenn. .	49,131	148,689
Ark. . .	41,424	128,416
Miss.	38,752	139,100
Ga. .	37,311	142,261
Tex.	35,500	122,170
Mo. . .	33,771	115,000
N. C.	30,624	100,463
S. C. .	20,431	69,065
Okla. .	15,803	53,181
Va. .	13,450	47,011
Ind. . .	12,307	52,210
Ill. . .	10,654	41,767
Iowa .	9,968	45,340
Other . .	30,454	118,945
U. S. . .	482,043	1,644,100

FIG. 114.—Distribution of sugar crops in the United States. Between the two important sugar-producing crops of cane and beet is a broad belt with a thin and scattered acreage of sorghum cane, most of which is made into sirup on the farm and is unimportant in commerce. (United States Dept. Agr.)

Climatic requirement. While the beet will grow in a very wide range of territory from the tropic nearly to the Arctic, the conditions for beet-sugar production are exacting—a moderate amount of spring and summer rain and a summer of moderate heat, but not too hot, and a cool, dry autumn. The crop should have a growing period of about five months, in a warm atmosphere, since long hours of daylight are necessary to produce a high sugar con-

Fig. 115.—Women and children weeding a sugar-beet field, western United States. (United States Dept. Agr.)

tent. Corn-growing climates are in the main too warm in midsummer, but as the cool climates of England and Sweden suffice, it is plain that corn and sugar beets are seldom competitors. Irrigation, especially in America, gives the best conditions for beet growing and this rarely suits corn. In Europe the best region for beets is the great cool northern plain from Normandy to central Russia.

Relation of sugar-beet growing to intensive agriculture. The growth of the sugar beet is an intensive agricultural industry. It can be prosecuted only in fertile mellow soil, rich in lime, and neither too clayey nor too sandy, finely prepared, and plowed so deeply that a sub-soil plow must often follow the ordinary plow.

Caring for the crop is most laborious because of the large amount of hand labor required. The young plant is so small that only human fingers can rescue it from the up-springing weeds, so that men, women, and children, especially women and children, go into the fields in nearly all beet regions, including the United States, and spend days upon their knees weeding the young beets. A little later, when the plants have become established, they must be thinned out with the hoe. Thus far the inventors of machinery have been unable to replace either of these kinds of hand

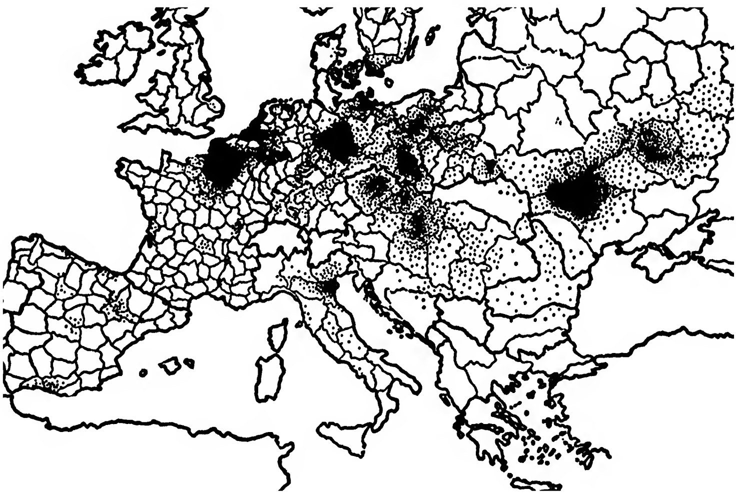


FIG. 116—Northern France, Belgium and Germany have important sugar beet regions. (Finch and Baker.)

labor. The labor required for an acre of sugar beets is six times that for an acre of corn and twelve times that for an acre of hay.

After the plant is established there must be many cultivations, and in the late autumn the beets are plowed out of the ground and the tops pulled off. The roots are then piled, covered with straw and sometimes with earth, until delivered to factories by wagon, train, or boat throughout the winter months. The beet-sugar factory to be economical must be large, costing a million dollars or more. The beets are sliced, the sugar soaked out of them in hot water, and finally crystallized and sent to the refinery to be put into final form. It is common for American beet-sugar factories to have refineries also.

The by-products of the beet field serve to enhance greatly the usefulness of this crop in the intensive agriculture of a populous country. The leaves and tops of the beets were worth in Germany, for cattle food, $4.50 to $5.75 per acre before the war.

The pulp, a fibrous mass which remains after the sugar has been extracted, is taken back by the farmers and fed to cattle. The average value of pulp in Germany was $10.40 per acre before the war, whereas the average American hay crop in 1909–13 was worth on the American farm $16.35 per acre, a figure about equal to the combined pulp and leaves of the German beet crop.

It is, therefore, plain that beet growing plays an important part in cattle-keeping agriculture, especially on the small farms of north Europe. The German beet farms are almost universally well cared for, because the beet-manufacturing companies, to assure themselves an abundance of beets, insist in their contracts with the grower that a careful rotation of crops shall be followed. Furthermore, the care and fertilizing required by the beet leaves the field in excellent condition for the production of a fine crop of small grain the succeeding year. This results in such increased yields of grain per acre that it is said that the addition of beets to the crop rotation has not reduced the total grain yield of the beet districts.

The surprisingly small acreage that produces the European beet crop is another proof of its fitness for intensive agriculture. Belgium, the most densely peopled of all western countries, has only 2 percent of her area in this crop, but has long been a regular sugar exporter. Germany, with the most fully developed agriculture of any of the large nations, was a heavy exporter before the war, yet the table of various acreages and their percentage of the tilled land.[1]

[1] ACREAGE AND PRODUCTION OF LEADING CROPS IN GERMANY FOR TWO AVERAGE YEARS, 1912–13

Crop	Percent tilled land in Germany	Area (Acres)	Production
Rye	24	15,669,000	468,884,500 bu.
Oats	17	10,904,000	628,109,000 bu.
Wheat	7	4,818,500	165,649,500 bu.
Barley	6	4,007,500	174,316,500 bu.
Potatoes	13	8,344,500	1,916,727,000 bu.
Sugar beets	2	1,334,950	16,509,000 tons

shows that but 2 percent of the German farm is in beets, while potatoes, the main crop of all Germany, occupy six times as much, and rye twelve times as much. War disorganization has caused Germany to relinquish her rôle as a sugar exporter and to buy sugar from outside sources, probably temporarily.

European centers of production. The map of beet production in Europe shows that while its growth is scattered throughout central Europe from northwestern Spain to Moscow, there are four centers of importance. The greatest is in central Germany, near Magdeburg, where beets occupy from one-tenth to one-seventh of all the cultivated land. Here the beet fields spread in great expanses over the level, perfectly tilled plains and while the peasant children pull weeds, their mothers may be seen plowing the beets, using at times the family cow for a draft animal. During the winter the manufacture of the sugar occupies much of the laboring population and the by-products help to feed the animals on the farms. This district is well situated for export of sugar because it is on the navigable Elbe, which carries nine-tenths of the traffic in this territory.

Russia was the second largest center of beet production in 1909–13. Poland, which is becoming a second Germany in beet growing, and Russia combined in 1923–24 produced only 40 percent of the former Russian crop. The Russian industry, due to favorable climatic conditions in the level plain of southwestern Russia called the Kief district, is gradually increasing production, but is still a long way from normal crops.

Bohemia (Czechoslovakia) in the plains around Prague, also on the navigable Elbe, had the greatest intensity of beet culture in all Europe, and was the third greatest pre-war region. Czechoslovakia has gradually revived the beet sugar industry for that region and her 1923–24 crop was 60 percent of the former output of Austria-Hungary.

The beet region of Holland, Belgium, and the north of France between Paris and the English Channel is economically one region separated only by political boundaries across which the beets are freely passed to the nearest factories without tax or duty. Southern Sweden and Denmark are also beet growers, and Italy has a crop unexpectedly large for her location and climate.

Governmental influence on sugar production. The sugar industry is one to which governments have given much attention and about which many laws both for protection and taxation have been made. In many countries the sugar industry exists only by the special privilege of government protection. Throughout central Europe sugar is generally high in price because practically all the producing nations have a protective tariff to keep out foreign sugar and in addition an excise or local tax of several cents a pound on sugar.[2]

The industry has been further complicated by the formation of sugar trusts by the refiners in Germany and other countries. There refiners' trusts raised the price to the people of the home country, and because of large profits from this source could afford to sell the surplus abroad at exceedingly low prices. When Germany,

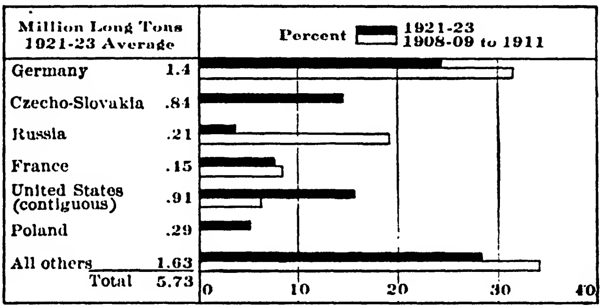


FIG. 117.—World production of beet sugar, three-year average.

France, old Austria-Hungary, Holland, Belgium, and Russia were thus partly paying for the exported sugar, it became an expensive business for those governments, but one from which the two great importing countries, United States and England, chiefly profited. These bounties so stimulated production on the continent of Europe that surpluses of sugar accumulated and the competition with cane sugar became so keen that the British sugar producing colonies of Jamaica, the other West Indian Islands and Guiana suffered great depression through the reduced price of sugar. To protect her colonies, England threatened to lay on all sugar imported into that country a tax that would just equal the bounty that it had received in the export country. This would benefit the British treasury at the direct expense of continental treasuries and to seek means of

[2] The United States has had for many years an import duty that kept our sugar industry from speedy death.

relief, a sugar convention was called at Brussels in 1901 and 1902, at which most of the European countries agreed to stop all export bounties whatever. As a result the world's sugar export went forward on a more normal basis. The removal of export bounties lowered the price in exporting countries and raised it in importing countries. Thus England saved her colonies from the competition of sugar made cheap by export bounty and the people of beet-growing countries had for the first time cheap sugar for home consumption. This made instant increase in consumption in beet-growing countries. In Germany it increased 50 percent in a year and in France it nearly doubled.

COMPETITION OF BEET AND CANE. During the five years just preceding the World War, out of an average world sugar production of 18.4 million short tons, 8.5 million tons, or 46 percent was beet sugar. The five years after the close of the war showed that out of an average world production figure of 18.8 million short tons, only 4.75 million or 25 percent was produced from beets. This decrease was due to the revival of the cane industry in Cuba, and the smaller planting of beets in Europe, especially Germany.

BEET-SUGAR GROWING IN THE UNITED STATES. As a natural result of the labor and climate required, the sugar-beet industry was late in its establishment in the United States, although we have great land resources for it. We had a production of but 3,000 tons in 1890, but, stimulated by a high tariff-made price, it reached 400,000 tons and passed the cane crop in 1906, and the production is still increasing, the crop of 1923–24 being 930,000 tons. The possible beet area of the United States is several times as large as the possible cane area, and seems to follow rather closely the July isotherm of 70° which traverses the whole length of California, thence to Utah, down the west side of the Rocky Mountains to central New Mexico, thence up the Rocky Mountain front through Colorado, Wyoming, and Montana, then bending above the corn belt, passes eastward through Nebraska, the Dakotas, Minnesota, Wisconsin, Michigan, Ontario, past Buffalo and Albany to Portland, Maine.

The sugar beet thus offers a money crop to the American farmer in those regions where the climate is a little too cool for the maximum development of corn.

The beet with its heavy labor requirements did not interest the American farmer while corn land was still to be had for the taking.

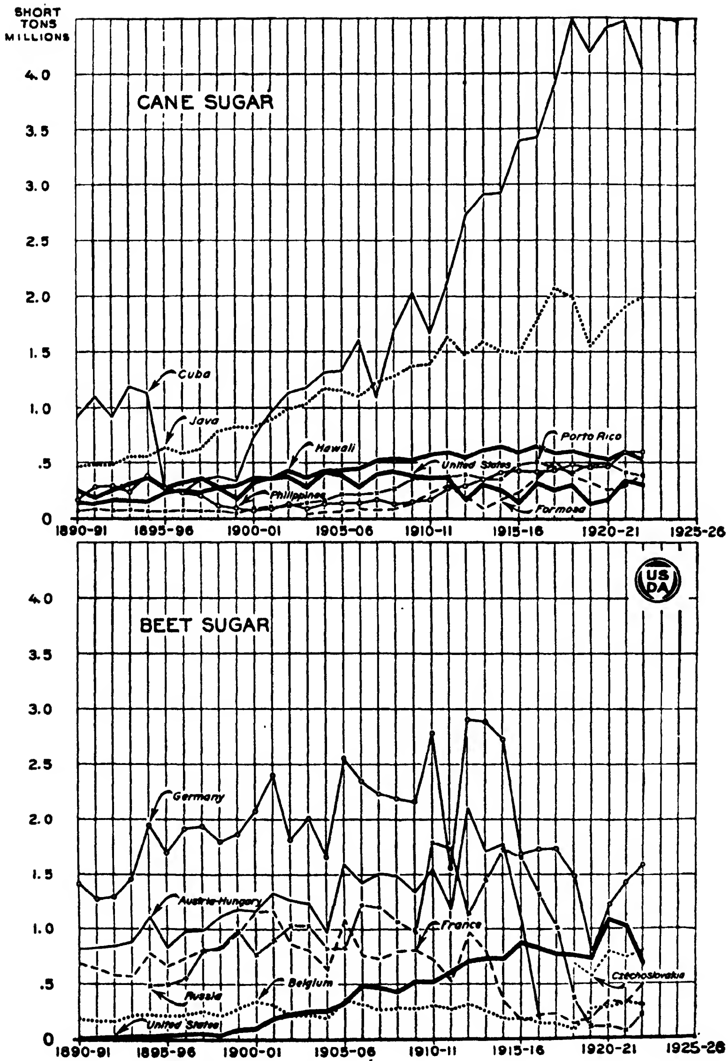


FIG. 118.—Cane sugar production in Cuba and Java has shown a remarkable expansion in 25 years. With the beginning of the war in 1914 beet growing—largest in the warring countries of Europe—fell off greatly. The United States has now risen to third rank in beet sugar production.

It had its practical beginning in the early nineties, 110,000 acres were grown in 1899, 292,000 acres in 1903, 470,000 acres in 1911, and 651,000 acres in 1923. The relative importance to some American localities is as great as in any part of Germany. Thus, Weber County, Utah, had 17.6 percent of the improved land in beets, while Otero County, Colorado, had 14.6 percent, and Orange County, California, had 7.5 percent. (1920 census.)

It is quite common in the beet-growing districts of the United States for the hand labor to be done on contract by newly arrived

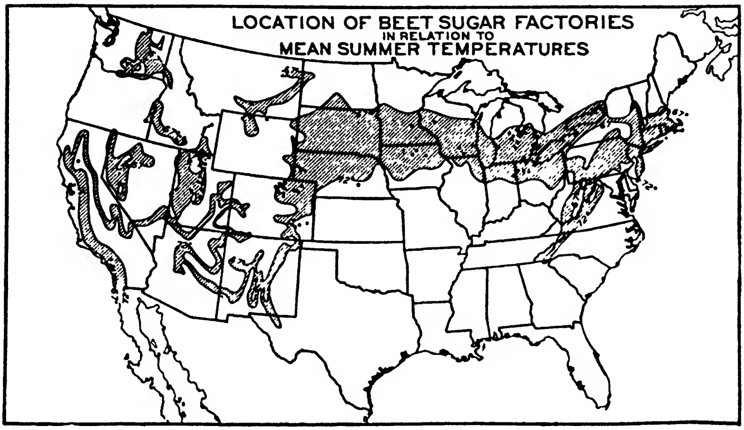


FIG. 119.—The shaded area shows where the sugar beet grows best and the dots indicate the location of beet-sugar refineries in the United States. Notice the isotherms which bound this beet zone. (United States Dept. Agr.)

immigrants. A peasant from Rumania, Hungary, or Poland, accustomed to the growth of beets, and to a low standard of living, will contract at so much per acre to take care of the beet fields. With the assistance of his wife and children he then takes entire charge of the crop for the American farmer. The intensive character, large labor cost, mellow soil requirements and high yield of beet growing fit it especially to irrigated land. Irrigation also insures the dry October, a month in which warm rains can do so much injury to the beets. The adjustment of these factors gives more than one center of beet production to each of the four irrigation states of California, Colorado, Idaho, and Utah. The adaptation of the beet to rather light soil makes it important in Michigan, Nebraska and to a lesser extent in Wisconsin on the glacial areas too far north for corn and not well suited to grass. Ohio, on the southern margin of beet growing, has five beet sugar factories.

The plant for extracting the sugar from beets is so large and costly that it requires hundreds of acres of beets to keep one running through the fall and winter season, and it must run for many years to be profitable to the owners. Hence it is to their interest to encourage beet growing and in America, as in Germany, the

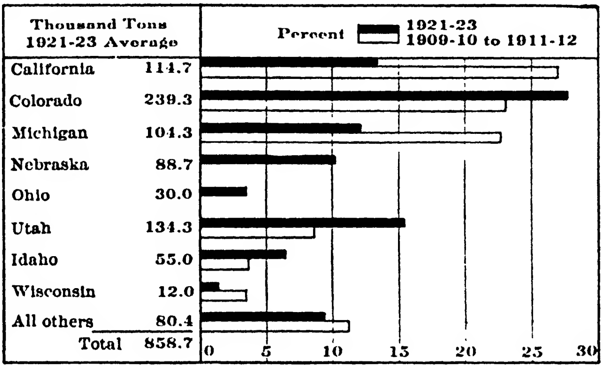


FIG. 120.—United States beet-sugar production, three-year average.

sugar manufacturer, through contracts with the farmer, controls the crop rotation, the method of beet growing and, to the community's benefit, becomes virtually a teacher of agriculture.

THE GROWING OF CANE

CLIMATIC REQUIREMENTS AND CULTIVATION OF SUGAR CANE. The battle between cane and beet is carried on at long range, as the plants themselves never meet. The sugar cane is as distinctly limited to warm climates as beet is to cool ones. It will grow on the edges of the temperate zones in such districts as Louisiana, Natal, New Zealand, and Cape Colony, and has been grown at 32° north latitude in Spain and 31° south in New Zealand, but it is at home and does its best only where free from frost. It invades the frost zone only where there is a long growing season, and freedom from competition, as by tariffs and bounties. The best crops require such conditions as exist in Cuba, Java, Brazil, and India, where there is a temperature of 75 or 80° F. the year round and a rainfall of 60 inches or its equivalent by irrigation. The necessity of much sunshine gives irrigation a great advantage.

Cane does not require such careful handwork as the beet. It is cultivated with plows, not hoes; by men, not by women and children; and even the steam plow may do much of the work, as has been proved in the British island of Trinidad and in Hawaii. The method of planting consists in putting cuttings in the ground, or, as in Louisiana and Cuba, in laying in the bottom of a furrow a row of cane stalks which sprout up from every joint. After eight months' or more growth and cultivation the leaves are stripped off, and the stalks are cut by hand because no machine has been found to do it, and carried away to the factory. The transport of the cane to the factory is a serious problem. A good crop is 15 or 20 tons per acre. The fields are often muddy and the distance to the factory is increasing with the size of the factory, which is large. In backward countries, cane is sometimes carried on mule back, but in the great shipping districts, carts drawn by oxen or mules are used, while the best equipped sugar plantations have portable railway tracks placed in the fields and diminutive plantation locomotives to pull the cane cars. Cane resembles beet-sugar making in the size of the plant required economically to extract the juice and dispose of the by-products. Several thousand acres of cane make a good unit. The guaranteeing of this amount of cane year after year is difficult if many independent tropic farmers must be depended upon. This tends to make the sugar company grow its own cane—a process that is much easier than the growing of beets by a corporation on a huge scale. Cane growing is a far less scientific agriculture than is beet growing. Most plantations in Cuba and even in the United States are still growing the crop year after year on the same ground without adequate crop rotation. As this cannot continue indefinitely, the establishment of crop rotation will require larger area and increase the difficulty of carrying cane to the mills.

THE DISTRIBUTION OF CANE GROWING. The adaptation of the sugar cane to practically all moist lowlands lying between Louisiana and Argentina in the New World and between southern Italy and India, Natal and Queensland in the Old World, gives an easy source of sugar to all tropic peoples. Instead of candy the half naked child sucks a section of cane in many a tropic village. Although cane growing is a local industry in practically all damp tropic countries, only a few of them export it, because, while a crude ox-driven mill will suffice to crush the cane for local use, it cannot compete in the world market. In India, for example, it is estimated that there is an annual production of over 3.3 million tons, second to Cuba, but it does not enter into foreign commerce because all this and more is consumed locally.

Sugar cane is grown in the lowlands of Mexico and of each of the Central American countries, and also in every South American country except Chile. But throughout most of this region the process of manufacture is crude, the conditions of transportation, of labor, and of capital are unsuitable for the development of a large cane-sugar export, although there are in tropic America large areas of excellent cane land. This is especially true on the shores

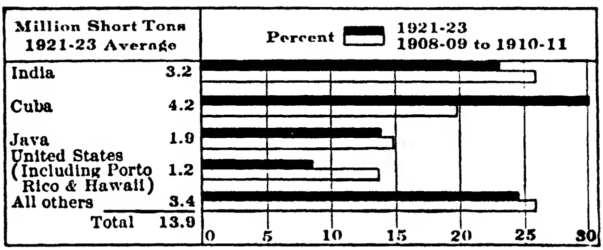


FIG. 121.—World production of cane sugar, three-year average.

where the trade wind blows. The lowlands of the Caribbean coast of Mexico and Central America are excellent examples of such lands.

The main export supply of sugar comes from especially rich plains and favored tropical shores, such as Cuba and Java, with secondary sources of supply in Hawaii, the Philippines, and Porto Rico. At no place is cane sugar grown for export in locations distant from the seashore and from ocean transportation.

SUGAR EXPORT FROM THE MAINLAND OF NORTH AND SOUTH AMERICA. The only export of cane sugar from the North American continent is a little from Nicaragua at times between the intervals of chaos accompanying the frequent civil wars. South America has three regular sugar exporters, each producing under distinctly different conditions.

The British Colony of Guiana on the northeast coast of South America is one of the most interesting of cane-sugar producers, showing intensive cultivation and the untouched wilderness side by side. Large areas of coast swamp have been reclaimed from the sea along the north shore in the same way the Dutch (the original settlers of Guiana) have done in Holland. This is the more unusual because most of the country remains a great forest absolutely uninhabited, save for a few uncounted natives living the primitive life. The explanation of this unused land is to be found in the climate which is so ill suited to white colonists that they are but a small percent of the total population and merely occupy positions under the government and in the management of stores and plantations. In the attempt to people this fertile desert and work the productive lands, the government has permitted the importation of 124,000 East Indian coolies accustomed to growing rice and sugar cane. This has led to the rapid increase of rice growing along with the continuance of sugar-cane growing which has been for many years the main export product of this colony. The reclaimed swamp land is very fertile, has a large rainfall, and, in addition, the flat and level dyke lands are easily irrigated for both sugar and rice. Further than that the drainage ditches serve as canals for the boats that carry cane from field to factory.

The growing of sugar cane, which began in Brazil as early as the seventeenth century, held for many years the economic position in that country now held by coffee. Based on slave labor, it fell into a decline with the abolition of slavery, and until very recent years had made no appreciable progress. Most of the sugar was consumed locally, although the central coast regions usually had a small export. The recent adoption of better growing methods and the building of some modern sugar mills has more than doubled the Brazilian production in the last twenty years (650,000 tons, five-year average, 1920–24), of which over one-third is now exported. The chief sugar-growing states are Pernambuco, Minas Geraes, and Rio de Janeiro. The Pernambuco district, just south of the eastern point of the continent where the southeastern trade winds make heavy rainfall on the moist low plain near the Atlantic, is the leading cane region and has 47 sugar mills, while the Rio de Janeiro district farther south has 40.

Peru is the third South American sugar exporter. In that country the sugar plantations are located in the fertile rainless coast desert from which the high Andes cut off the moisture-laden east winds from the Atlantic. A few streams fed by the Andean snows and flowing down to the Pacific save this Peruvian plain from a condition of hopeless barrenness. There is sufficient water to irrigate parts of the valleys, and to make possible a luxuriant growth of cane, which along with alfalfa, orchards; and gardens makes a strong color contrast with the brown desert beyond the last irrigation ditch. The yield per acre is good, because the cane gets the proper amounts of sunshine and irrigation water, but there is small room for the extension of Peruvian production.

Argentina has an isolated cane-sugar region in the subtropic province of Tucuman, latitude 28° south. The production per acre is rather low, but the total production is sufficient for the national supply, and at times even provides a small export.

SUGAR IN THE WEST INDIES. The history and description of sugar growing in the West Indian Islands is in itself an economic and geographic study of some magnitude with many instructive phases. In the sixteenth and seventeenth centuries,[3] these islands were much prized by the colony-owning powers of Europe, and were the center of the world's sugar production. At the end of the eighteenth century they were in a high degree of prosperity, based on plantations owned by Europeans, worked by African slaves (who died like flies), and largely given over to the growth of export sugar and rum, distilled, then as now, from the cane juice.

The emancipation of the slaves brought decline in the sugar production of the West Indies, as in Haiti where political chaos succeeded French rule and the jungle crowded more and more into the abandoned cane fields. In addition, the cane growers faced the severe and growing competition of European beet sugar, which still further depressed the prosperity of the island plantations. While sugar continued to be an export from islands such as Trinidad, Jamaica and Barbados, the industry failed to advance, retaining until very recently all the old primitive colonial methods. The discontent of British West Indian colonies, some of which desired to become possessions of the United States to get advantage of free import of their sugar into the United States, was one of the reasons leading up to the British action that produced the Brussels sugar conference of 1903.

The advantage of free admission of sugar into the United States is well shown in Porto Rico. After its annexation, twenty-five years

[3] See Stefansson, V., *Northward Course of Empire* for some graphic evidence of the high esteem for a sugar colony.

of free admission of sugar into the United States increased the crop of an island less than half as large as New Jersey from 50,000 to 400,000 tons, and increased the value of the export from $2,500,000 to $40,000,000. The sugar is grown on the coast lowlands, the windward northeastern side having sufficient rainfall for the crop in most places, but the drier southwestern side is forced to use irrigation. Practically all the suitable cane-growing land is now planted. Production costs for sugar are considerably higher in Porto Rico than in Cuba, because of the necessity for using fertilizer and the greater expense of cultivation. The success of sugar planting in Porto Rico has come about largely through the consolidation of many small plantations and the modernizing of factories by American capital and management.

The same process of capitalistic consolidation is in progress more slowly throughout many of the West Indian islands. Santo Domingo, to which Columbus brought sugar cane over four hundred years ago, has some huge plantations under American management, and a growing export of sugar. Large areas of level untilled cane land, underlaid by coral limestone which weathers into a soil of great fertility, give promise of future possible expansion for the Dominican industry. The British West Indian planters are likewise attempting to apply modern methods to this, one of their earliest colonial industries.

Cuba. There is a strong contrast between the small-scale, semi-oriental industry of Haiti and some other West Indian islands and the scientific and large-scale operations of Cuba and Hawaii. Cuba is the greatest cane-sugar producer in the world, yielding at times one-fourth of the total produce, and leading all others in the amount exported. About half of all the cultivated land in Cuba is in cane fields, which shows the great dependence of the people upon this crop. In a recent year sugar occupied 78 percent of cultivated lands in the Province of Matanzas; in Santa Clara Province, 71 percent; in Puerto Principe and Santiago 35 percent; and in Havana, where fruit and vegetables are important, 27 percent; and in Pina del Rio, the tobacco province of the West, it was but 6 percent. The island was producing over 1,000,000 tons a year in 1894 and in 1895, but the rebellion which led to the war with Spain cut this down in 1896 to less than one-fifth and destroyed seven-eighths of the sugar mills. Under the stable government that followed independence, it recovered its normal position by 1903,

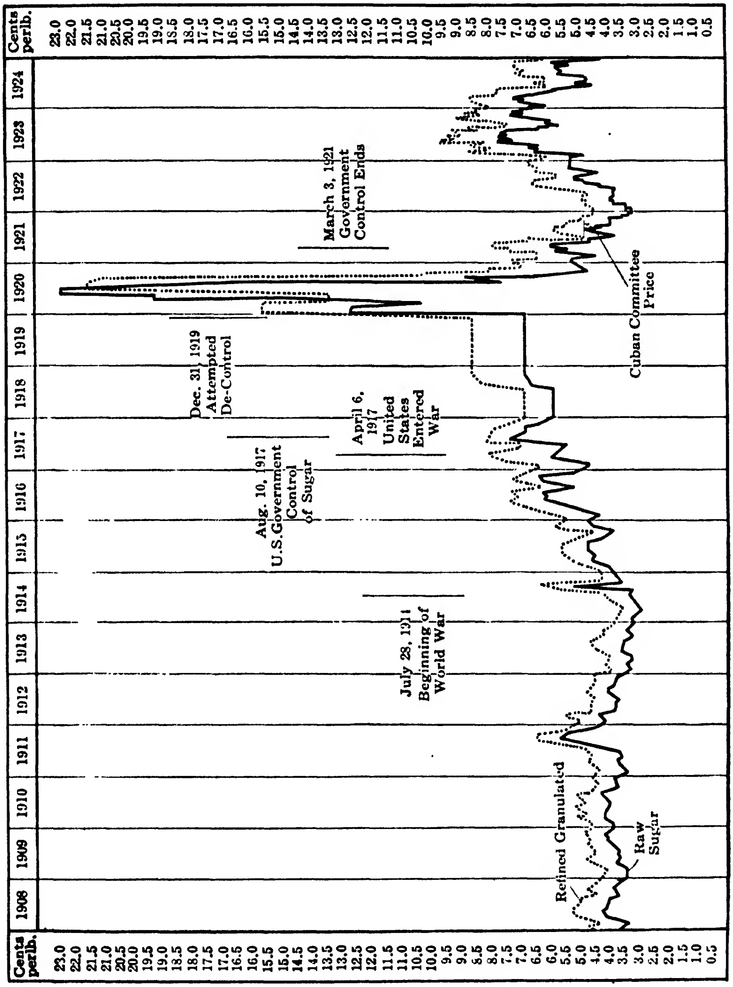


FIG. 122.—This graph of sugar price (1908–24) shows how cheaply raw sugar can be produced and also shows why Cuba had in 1920 one of the wildest periods of speculation since the famous South Sea Bubble in 1720. (Courtesy American Sugar Refining Co.).

and has since taken a higher position than ever in the world's sugar market, with a yearly crop which has exceeded 4,000,000 tons for the past six years.

Cuban sugar plantations are usually of large extent, most of them owned by Europeans or Americans. It is estimated that 77 percent of the sugar production in 1923 was controlled by American or Canadian capital, Americans, with investments in sugar properties amounting to $750,000,000, controlling 54 percent of the Cuban mills. The use of plantation railroads with locomotives to haul the cane to large factories is quite common. The plantations are being enlarged and improved machinery is being put in to reduce costs since labor cost is rising.

Cuba has been able to produce such great quantities of sugar because she has had a fairly stable government, a population superior to that of most tropic countries, and an abundance of good, smooth, rich, well-drained limestone land. Only one-fourteenth of the sugar land is now in use, so that the industry can be very unscientific. When land has been exhausted the industry has been able to move, generally to the eastward from Havana where the industry had its first center. The increasing labor scarcity is at present setting the limit of Cuban sugar growing.

Cuba has a preferred position in our sugar markets due to her advantageous geographical position, and especially the reciprocity treaty with the United States. Under the terms of this treaty, approved in 1903, the products of Cuba are assessed tariff duties 20 percent less than similar goods from other foreign countries. Consequently, Cuba sends more than three-fourths of her sugar exports to the United States.

During and immediately after the war when the price of sugar was high Cuban sugar planters made huge fortunes but in normal times the low price at the plantation leaves only a moderate profit.

Hawaii. The Hawaiian Islands, with a total area nearly as great as Massachusetts, are second only to Cuba as a source of sugar import for the American market. The sugar yield per acre is the largest in the world, due first to the virgin fertility of the phenomenal soil, decayed lava from the great Hawaiian volcanoes. Fine yields are further guaranteed and produced by irrigation on the leeward side of the islands. In the absence of suitable rivers at the right elevation for stream diversion the water is gathered near the sea level from streams and wells and pumped up, sometimes hundreds of feet, through iron pipes and spread over the fertile lava slopes, making some of the most spectacular plantations in the world. Hawaiian crops have averaged over 9,000 pounds of sugar to the acre, twice the harvest of West Indies or Java, and these islands in turn yield better than cane fields upon the rich delta of the Mississippi where the climate is too cool for the best growth of cane.

Hawaii has had the especial advantage of receiving a higher price than any other sugar exporter except Porto Rico. This high price was due, before the islands were annexed in 1898, to the reciprocity treaty of 1876, admitting Hawaiian sugar to the United States without the payment of duty. The 11,000 tons produced in 1875 grew to 250,000 in 1899, and 605,000 in 1924. Since annexation all of the export goes to the United States free of duty.

This special privilege to the sugar growers of Hawaii has caused intensive and careful cultivation [4] and has led to high profits and the suppression of other industries in the islands. These profits began when the islands had a few thrifty white people and many easy-going natives, giving an admirable opportuntiy for the formation of great estates which loudly called for workers. These came from China until the Chinese exclusion treaty shut them out in 1898. Then came Japanese until the Japanese government checked their emigration to the islands. Then came laborers from the Philippines, Porto Rico, Portugal, and Russia.

As an accompaniment and cause of this population condition the sugar is grown on a few vast estates and controlled by a few large companies. Cane production in Hawaii has about reached its economic limit because most of the suitable land has been planted.

THE ADVANCED DEVELOPMENT IN JAVANESE SUGAR GROWING. Java, an island about the size of New York, is very remarkable in the world's commercial geography. Forty percent of the land is cultivated. It supports a population of 35 million who yet have food products for export. The chief export is cane sugar, of which it furnishes about one-sixth of the world's crop, being second only to Cuba. In sparsely peopled countries like Cuba, sugar can often be grown on newly cleared land, and as the cane will live for many

[4] "Nowhere else is there so effective an application of highly specialized machinery to agriculture, such extensive use of commercial fertilizers, such a comprehensive system of irrigation, such attention given to discovering and applying of the principles of scientific agriculture."—The United States Tariff Commission.

years with an annual cutting, new sugar lands are often made to give six or eight or ten crops before replanting. In Java, the larger area under cultivation makes it impossible to keep moving to new land, hence a more scientific agriculture than is to be found in most cane-growing regions.

Since the first cutting of canes, following the plowing and planting, is always the best, a field is allowed to yield but one crop, as is the case in Louisiana because of frost. This is followed the next year by beans, then by corn, then rice, then back to sugar. Under this systematic cultivation and a complex system of government control which at times amounts to compulsory labor, the sugar output increased three-fold in the twenty years following 1884. When the Cuban supply was temporarily stopped by the devastation accompanying the War of 1895–98, Java played an important part in supplying the United States, sending to her in 1899 as much as 71 percent of the crop. This meant that every other day throughout the year, a tramp steamship skirted the coast of Java, loading 600 pound bamboo baskets of sugar for the American consumer, 10,000 miles away. Since the rise of Cuba as a sugar grower the exports from Java to the United States have become unimportant. The natural export market for Java sugar is the Far East—Japan, China, and India. In addition a large part of her 1,700,000 ton export goes to the United Kingdom, which is, next to the United States, the greatest sugar importing country in the world. The present market for Java sugar in Europe may be altered when the beet supply reaches normal again.

THE PHILIPPINE ISLANDS have admirable soil, temperature and rainfall for the growth of sugar cane, which is third in importance among the island crops. Records show that Philippine sugar was imported by the United States as early as 1795, but under Spanish rule the industry failed to expand. The sugar resources are much greater than those of Java, which is but a third as large; but the population is 10 million rather than 35, there is no Dutch Government with a system of compulsory labor, the industrious Chinese are excluded, and the high price of hemp and copra give other outlets for enterprise. The United States also put a tax upon imports of Philippine sugar, which probably did more than anything else to keep the industry from developing.

The import duty on Philippine sugar was removed in 1913, causing an immediate expansion in growing and a demand for modern sugar machinery. New mills and the introduction of better varieties of cane from Java, Louisiana and Hawaii have resulted in the output expanding at a rapid rate in the past decade, until now it is one-third as great as that of Java. The natural market for Philippine sugar seems to lie in the Far East, rather than in the United States which has Hawaii and Porto Rico much nearer, and Cuba with her vast sugar supplies as a next door neighbor.

AFRICA AND HER ISLANDS. Egypt has excellent resources of soil, sunshine and irrigation water to grow sugar, but she plays an unimportant rôle in this respect because her population of 1,061 per square mile demands rice, corn and beans, whereof the acreage far exceeds the sugar acreage. Egypt grows cotton instead for an export crop.

Natal has a suitable cane-growing climate, with small land area, and is the center of the South African sugar industry. Production has been increasing steadily during the last decade and reached 184,000 tons in the 1923–24 season (1909–13 production, 88,000 tons). The Union of South Africa is able to use at home nearly all the sugar Natal can grow, and as all the best lands are now in cultivation, little increase can be expected from this source in the near future.

Sugar is the predominating export from the two tropic islands of Mauritius (British, 720 square miles) and Reunion (French, 970 square miles) in the Indian Ocean near Madagascar. They have a combined population of over half a million, of whom a large part are industrious coolies brought from India and China, so that these small lands play a comparatively large rôle in sugar commerce, exporting nearly all of their quarter of a million crop.

THE SUPPLY AND PRODUCTION OF SUGAR IN THE UNITED STATES. The United States, with a sugar consumption of over 5 million tons, has been growing cane sugar for a century, beet sugar since 1890, yet our import increases year after year, in spite of the fact that our home product has trebled within thirty years. During the years 1918–22, Cuba supplied 50 percent of our sugar, Hawaii 11.4 percent, Porto Rico 8.2 percent, Philippine Islands 2.7 percent, and imports from other countries 5 percent, while our domestic beet 18 percent and domestic cane 4.7 percent amounted to 22.7 percent or about 1,200,000 tons, scarcely one-fourth of the total amount consumed. The average annual rate of increase in our sugar consumption during the past century has been 5 percent, and the

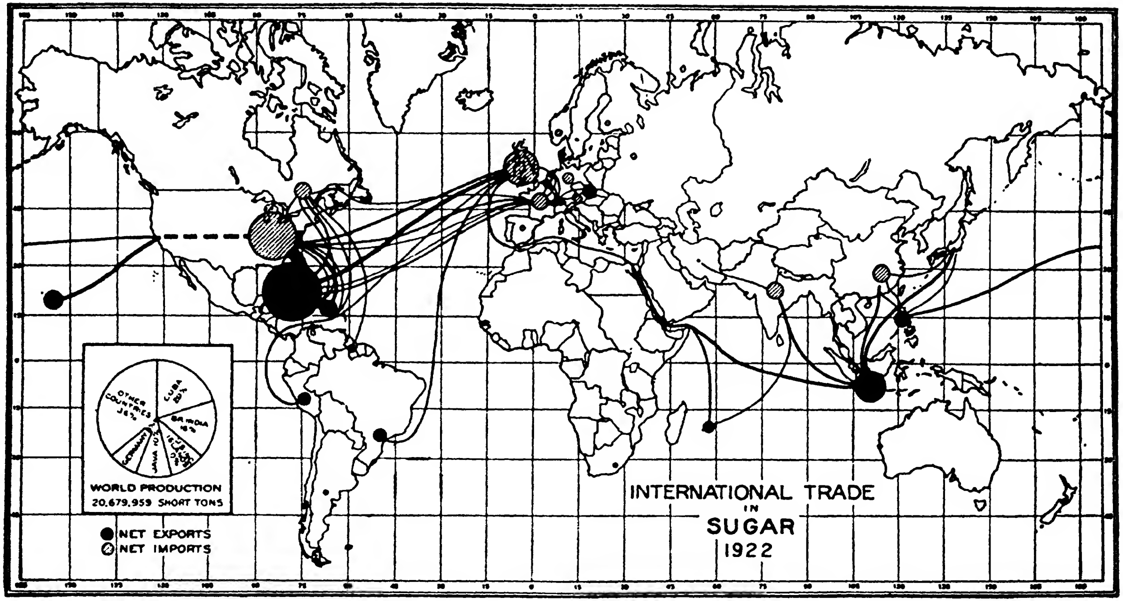


Fig. 123.—Cuba is the world's largest sugar exporter, followed by Java. Other sources of supply are Hawaii, the Philippines, Porto Rico, Czechoslovakia, Formosa, Brazil and Peru. The United States and the United Kingdom are the heaviest importers of sugar. We supplement our domestic production from Cuba and from our island possessions, while the United Kingdom and western Europe obtain their supply more largely from Java and other minor exporting countries. (United States Dept. Agr.)

United States now is the greatest sugar consuming country in the world, with an average of over two pounds per week per person.

CANE SUGAR IN THE UNITED STATES. The home-grown cane-sugar supply has had small chance of supplying the huge home demand because the areas suitable for cane growing are limited, and inferior to tropic districts. The superiority of the tropics is in climate rather than soil. The freezing of the American winter makes it necessary to plant the cane each year in Louisiana and then often interferes with the crop. In the frost-free climates there are records of fifty yearly cuttings from one planting, and in parts of Porto Rico it has lived and been cut for twenty years, while the Cuban plantations regularly cut eight or ten crops from one planting. Those of Louisiana must plant annually four tons to the acre, while the average yield is 14 to 16 tons per acre. There is the further handicap in the expensive labor of planting, occasional frost injury, and the fact that Cuban cane yields more heavily and has one-fourth to one-third more sugar in it per ton than that of Louisiana. These factors combine to make it plain that our cane-sugar industry is one which, like our beet sugar industry, could not survive without the high price produced by a protective tariff.

Owing to these climatic limitations cane-sugar production, even with tariff aid, only attains importance in the southern third of Louisiana, a coast strip in eastern Texas and a few locations in Florida.[5] The sugar territory of southern Louisiana is part of the swampy flood plain of the Mississippi River. The only tillable land is within a mile or two of the Mississippi, or other streams, where the deposits of the overflowing streams have built up a little land a few feet above the general swamp level. In two of the parishes (counties) of Louisiana (St. Mary and Terrebonne) over half of the cultivated area was recently in sugar, while in seven other counties it was over 25 percent and increasing. The total cane-sugar crop of the United States is not increasing and only amounts to about 5 pounds per capita for our people.

The limitation is not set by land possibilities, for it is reported that we have 10 million acres of good cane land and now cultivate one twenty-fifth of it. It should be kept in mind that this same land, where drained, is good for rice, cotton, corn, and many forage

[5] Experimental successes in the newly drained Everglades (requiring fertilizer) suggest a new sugar region in a climate with much less freezing than comes to Louisiana.

plants and meat production. The American cane-sugar growers have always had to combat labor scarcity as well as troubles of climate, and above all the uncertainties of the tariff.

The extraction of cane molasses for local use is a simple process rather widely distributed in the south, and a little cane is grown for this purpose as far north as Arkansas and eastern North Carolina.

CANE SUGAR AS A LOCAL SUPPLY CROP. Beet sugar is only edible after it has been through the machinery of a great refinery, after which it is not unlike that of cane. In contrast to this cane juice is a prized article of food in all stages of manufacture, and is often

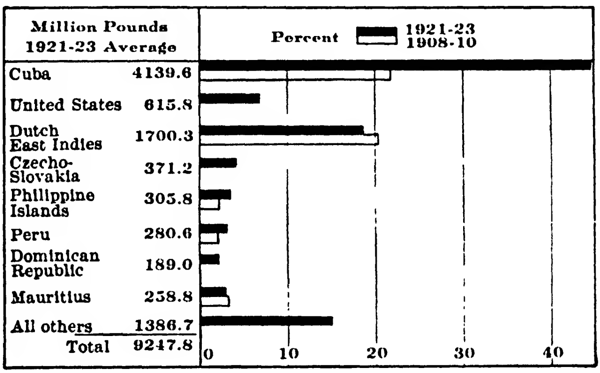


FIG. 124.—World's sugar export, three-year average.

sucked directly from the cane itself, which is nature's stick of candy for the tropics, where it is widely used in that simple way. Living and yielding for years beside the native's thatched hut, the cane patch is a pleasing element in that completeness of support which the tropic climate yields to man with so little labor on his part. Crushed by ox or man power between rude rollers and boiled in the family kettle, it makes a cheaper sugar supply than the grocery store yields in the land of frost.

The cane is an important and widely distributed source of food throughout the thousands of Polynesian islands from Australia to Singapore, and thence to Hawaii, 6,000 miles to the eastward. It becomes an industry where the human element is strong, as in Java. In the Fiji Islands there is an important cane-sugar industry, producing under British management about one-fifth as much as the cane-sugar crop of the United States. The chief market for this sugar is in the neighboring islands of New Zealand. In the warmer part of Australia there is a large area of admirable cane land, but the rainfall is less regular than in some other lands. Considerable sugar is produced in Queensland and a lesser amount in New South Wales. But the Australian population is less than two per square mile, and the strenuous desire of the Commonwealth to remain a white man's land has caused the enactment of laws prohibiting the admission of the colored laborers (Hindoo, Chinese, or South Sea Islanders) who had been the planter's dependence. As white laborers will rarely go to the tropics, the Australian sugar industry

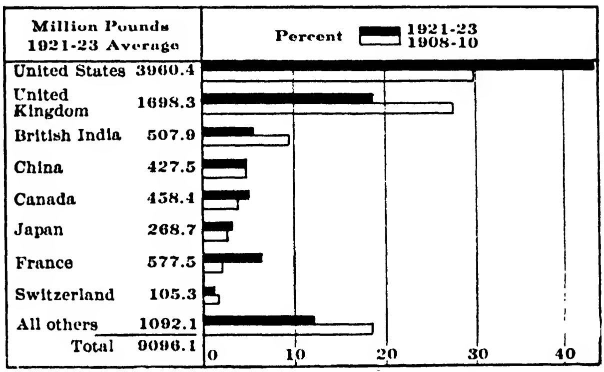


FIG. 125.—World's sugar import, three-year average. This shows the inadequacy of the United States crop.

is under a serious handicap. The annual sugar consumption of the Commonwealth is about 300,000 tons, which Queensland is able to produce in good years.

THE FUTURE OF CANE-SUGAR INDUSTRY. The growing of any large amounts of sugar outside the tropics has only succeeded where governments have shielded the industry from the competition of the tropic cane, and if the time should come when the pressure of temperate-zone population upon land resources makes us need our sugar lands for other crops, an indefinite amount of tropic land is ready to grow sugar for our supply. There appears to be much improvement possible in cane-sugar production in suitable localities.

THE BY-PRODUCTS OF SUGAR MAKING. There is a great difference between the sugar mill that suffices for making the sugar and molasses for local use in the interior of Venezuela, Guatemala, or Porto Rico and the modern mill for making export sugar. The local mill may have two or three small rollers turned by oxen, getting 50 or at most 75 percent of the juice. This is boiled in open vats, a primitive method which leaves much of the sugar in the form of molasses, but the molasses is one of five great staples in the nourishment of the masses in tropic America. (The others are corn cakes, beans, bananas, and cassava.) In great commercial sugar plants, however, enormous rollers with a pressure of many tons are driven by steam, 90 percent of the juice is extracted, and a washing of the crushed cane gets an additional 5 percent. The juice is evaporated in vacuum pans, which save more sugar and require much less skill, because the evaporation takes place in the vacuum at so much lower temperature that there is less danger of burning. The molasses that comes from this more scientific process has so little sugar left that it is not fit for human food or even for the distillation of rum, which has for centuries been the great by-product of the sugar plantations of the West Indies. But rum, like good molasses, is now a by-product only of a cast-off process used in the less efficient plants of small plantations or backward sugar regions.

The tasteless molasses of the modern plant is fit only for the distillation of industrial alcohol and the preparation of cattle feeds. When it is considered that but one-fourteenth of the possible sugar area of Cuba is in use and only one-thirtieth of the island under cultivation, we see here the possibility of an important trade with the live-stock producing countries of the temperate zone, for owing to the rising price of cattle foods, wheat bran and corn are now nearly as expensive as cane-sugar, which is as nutritious and as acceptable to the ruminants as to man. Ten pounds of mill (black-strap) molasses are, with the addition of 2 pounds of cotton-seed meal, almost the exact equivalent as stock food for 10 pounds of corn.

There is no natural reason why we might not in the near future have a very important commerce in sugar and sugar by-products from the tropic countries, which will help to make cheaper meat, milk, and wool in the temperate-zone countries.

Crushed cane, from which the sap has been extracted, is called bagasse, and is chiefly used for fuel in the boilers that run the engine of the sugar mill. A recent improvement permits it to pass directly from the crusher to the furnace, avoiding much labor in spreading it out to dry in the sun, as has been done for a century. Its suitability for paper making is now giving it a new use in a few places.

Maple sugar. Maple sugar is produced by the evaporation of the sweet sap of several varieties of maple which will grow over large areas of eastern and northern United States, where it was a very important factor in the days before world commerce in sugar. The process of manufacture fits the frontiersman. A small hole is bored about an inch into the trunk of the tree when the sap is flowing in the first days of spring. The sap flows out through a tube into buckets, is carried to camps in the woods, boiled in large open kettles or pans until the proper degree of thickness is reached, then poured into molds and crystallized into the delicious maple sugar. Some of the product is sold in a more dilute form as maple syrup. This kind of sugar costs more than either beet- or cane-sugar and would have no place in the world market at all but for its peculiar flavor and fine quality, which make it something of a luxury and enable it to command a higher price. The sap only flows in quantities sufficient for satisfactory sugar making where the days are bright and sunny and the nights are cold. This climatic factor limits sugar orchards to the region from Indiana east and north. It is particularly important in the White Mountain region of Vermont and New Hampshire and the adjacent parts of Canada.

The sugar maple tree that yields from the time it is twenty or twenty-five years old till it is seventy-five or a hundred certainly has all other sugar producers distanced for permanence, but the yield is at present low.

Sugar from sorghum. Another sugar plant, sorghum, a member of the corn family and resembling both kafir corn and broom corn, has long been grown in southern, central and southwestern United States for the manufacture of syrup for local use. The juice is extracted and treated in the same way as the juice of the sugar-cane.

During the Civil War when the blockade between North and South stopped shipments of sugar and especially molasses from Louisiana to the North, sorghum was quite generally grown throughout the corn-growing parts of the North, and in the form of syrup used as a substitute for the product of the sugar cane. A century ago this plant exceeded beets in the sugar content of its juice, but progress in improving it has been slow. Experiments carried on for many years at Fort Scott, Kansas, have at last resulted in the making of satisfactory sugar from it. Now that the laws of plant breeding are better known, its sugar content may be susceptible of as great improvement as has taken place in the beet. It is quite possible that a century hence it may rival, or even displace, beets in the United States, because like corn it can be cultivated with work animals and machines.

REFERENCES

See General References

Brandes, E. W., and Others. "Sugar." *Yearbook,* United States Department of Agriculture, 1923.

Abel, M. H. "Sugar and its Value as a Food." United States Department of Agriculture, *Farmers' Bulletin,* No. 535 (1922).

Townsend, C. O. "The Sugar Beet Industry in the United States in 1920." United States Department of Agriculture, *Departmental Bulletin,* No. 995 (1921).

CHAPTER VIII

CONDIMENTS AND TOBACCO

I. COFFEE

Distribution of coffee. Coffee is grown in many countries and has become a regular article of consumption in many parts of the world. Several factors combine to restrict coffee-producing to limited but widely scattered areas. The plant cannot endure any frost and is therefore limited, with a few insignificant exceptions, to the region within the tropics, although the greatest coffee region, that of Brazil, is close to the edge of the temperate zone. The plant requires a hot climate, yet in many coffee regions the full blast of the sun is too hot for it, particularly for the young plants, and high shade trees are scattered over many plantations to cast some shade, while the young trees are grown with corn, bananas, beans or coarse varieties of peas to protect them from the full rays of the sun. The climate must be moist as well as hot, with a rainfall from 75 to 120 inches, yet the soil must be rich and also well drained, which practically limits coffee growing to hills and highlands where the streams have rapid fall to give the necessary drainage. These conditions, therefore, tend to locate the best coffee-producing districts upon plateaus and hilly regions. As the coffee is usually grown for export, it must, in addition, be reasonably near the seacoast, and a considerable population is necessary to perform the large amount of labor required in caring for the crop.

History of the industry. Coffee, unlike wheat, corn, rice, and beans, is not a staple handed down from distant ages. The plant is probably a native of Abyssinia, whence it was taken to Arabia about the eleventh century. Its spread was slow and it was only in 1562 that the first coffee houses were opened in London. As an important article of commerce, coffee really belongs to the nineteenth century, the quantity consumed having practically doubled between 1855 and 1885 and again since that time and its use is rapidly increasing. The source of chief commercial supply has shifted much. At first, it was the product of Arabia, then the West Indies, then Java had the supremacy, and lastly Brazil has taken the lead with a production far distancing all competitors.

THE GROWTH AND PREPARATION OF COFFEE. The tree naturally grows to from 25 to 30 feet in height, but in the coffee orchard it is frequently pruned and kept down to from 5 to 8 feet in height to permit easy picking of the berries. The berry, which looks much like a cherry, usually encloses two coffee grains in its pulp. After picking, the berry is put through a number of mechanical processes the first of which takes off the outer pulp. After this, the berry is dried in the sun, a process requiring from six to eight days. Other machines then remove the two layers of inner husk, and various sortings and gradings separate the grains so that those comprising each kind of coffee are of the same appearance and size. Rather complicated machinery has been invented to do most of the coffee curing after it has once been picked by hand.

ARABIAN COFFEE GROWING. One of the best places for the growth of coffee is found on the slopes which face the lower plain along the Red Sea in Yemen, the southern part of the Arabian peninsula, and the home of Mocha coffee. Here the shade-loving coffee tree has the advantage of a mist which arises on the lower plain almost every morning in the year and toward noon envelops the coffee-planted slopes in a haze which keeps off the full rays of the sun and also gives the proper moisture for the good development of the plant and the production of its seeds.

The fine quality of this Arabian coffee is due chiefly to the fact that it is carefully prepared, most of the crop being bought on the trees by Turkish and Egyptian merchants who personally superintend the harvest. In Yemen coffee is purely a money crop, and is not used by the natives, who drink a decoction of the dried hulls. Only a small proportion of the Yemen land suitable for coffee is planted to that crop. Most of it is in durra, a grain resembling millet, which will give sixteen crops before the coffee trees are ready to bear. It is a long-time proposition for an Arab to wait for the coffee tree, especially as Yemen is a rather arid country with inadequate irrigation, poor roads, high taxes, and bad government. Methods of growing are primitive, resulting in a low yield per acre, and no care is given to the land except to harvest as large a crop as possible. Aden is the port of shipment, not only for the Mocha coffee of Yemen which reaches the coast by caravan, but for large quantities of Abyssinian coffee, some of which is still picked from wild trees. The coffee export of Aden in 1922 amounted to about 13 million pounds, most of which went to Europe, the United States taking only about one-tenth.

India and Ceylon and Dutch East Indies. The British Government, which has done so much to stimulate agriculture in its colonies, encouraged the establishment of the coffee industry in India and Ceylon. The chief Indian district is located on the eastern or interior slopes of the western Ghats Mountains in southern India, where elevation and climate suit it. The acreage in southern India is declining slightly because of low price of coffee for twelve years following 1897. In Ceylon, with its moist highlands, coffee growing quickly assumed an important place, and by 1880 was the chief export of the island, $15,000,000 worth being sold abroad annually. But a fungous disease producing leaf rust broke out in Ceylonese coffee plantations, so injuring the trees that they could not produce much fruit, or killing them outright, bringing ruin to many coffee planters. Some sought substitutes in growing cinchona, but most turned to tea, which has almost replaced coffee as a crop upon the Ceylonese highlands. The only way to circumvent the blight which killed coffee of the Arabian species was to introduce the more hardy Liberian coffee, a native of west Africa, and even that is not entirely immune to the blight. This species of coffee is now grown in Java, a name under which not only the product of this island is sold, but also the small amount of coffee produced in Sumatra, Borneo, and Celebes and some from other places. The Java coffee has a good quality because it is grown at an elevation of from two to four thousand feet upon government plantations, where careful measures in harvesting the crop are rigidly enforced. Coffee in the Dutch East Indies has not been a profitable crop to the growers, however, and its production is steadily declining, the area harvested in 1922 being 9,000 acres less than the preceding year. The total coffee crop of British India and the East Indies in 1922 (92 million pounds) was about one-twentieth that of Brazil.

Coffee in tropic America. Coffee is one of the best money crops for the tropic highland, and for this reason is well suited to Mexico, Central America, and western South America. In all these regions the ruggedness of the country makes transportation difficult, the roads are exceedingly bad, and the trail for pack animals is often the only means of access. Only valuable products can pay for such transportation, and coffee, worth from 5 to 25 cents a pound, stands in a class alone when compared with wheat worth about two cents a pound, or lumber with its low value and difficult form, or coal, sold at 2 or 3 pounds for a cent. Geographic and economic factors combine in an interesting way to influence coffee production in mountain districts. The elevation that produces the best coffee conditions of moisture, temperature and slope also makes a more endurable climate that has attracted the bulk of the population of nearly all tropic American countries. Into this natural labor situation, coffee fits well with its actual and relative ease of transportation. The high prices prevailing in 1887–1896 made coffee growers very prosperous, and it became one of the chief money crops in Mexico, Central America, Colombia, Venezuela, and Brazil.

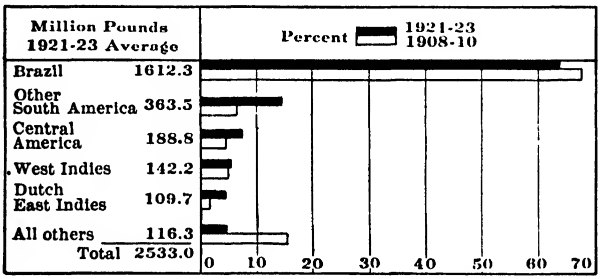


FIG. 126.—World's coffee export, three-year average.

MEXICO AND CENTRAL AMERICA. In Mexico coffee does best in the middle one of the three topographic zones which comprise that varied country. The first division, the hot low plains along the sea coast, are considered too hot for coffee; the second, the high plateau enclosed between the eastern and western cordelleras, is too dry and too cool, but the outer slopes of the plateau, the so-called warm land of the Mexicans, with its good rainfall and its succession of fertile, warm valleys and forest-clad slopes, is a natural coffee zone. Some of the plantations extend south as far as the Isthmus of Tehuantepec, which, however, is not high enough for best coffee growing.

Southward the elevation increases and the plateau of Guatemala and Salvador is an almost continuous coffee plantation from the boundary of Mexico to the boundary of Honduras. These two small states produce more coffee than British India and the East

Indies combined, and it comprises over four-fifths of their total export. Between 30 and 40 percent of the Guatemalan plantations are owned by German capitalists and the Germans import much Guatemalan coffee. At harvest-time the coffee crop employs half of the population. In Costa Rica, the plateaus are even higher and the coffee tree upon the hillside is the chief means by which the people of this cool plateau secure the European and American imports that are brought to them by the little railway that climbs up 5,000 feet from Port Lisbon on the Caribbean to San Jose, the capital.

VENEZUELA, COLOMBIA AND THE ANDEAN HIGHLANDS. Colombia and Venezuela, being in the hottest part of the torrid zone, have such high temperatures upon their lowlands that few persons live upon them except the few necessary to carry on the commerce between the seaports and the interior plateaus among the northern ranges of the Andes. Here again the valuable bag of coffee, upon the back of the mule as he climbs down to the seaport or the river steamboat landing, represents the best money crop that could be produced in these isolated plateau districts. Small quantities of coffee are also produced on the plateaus of Ecuador and on the eastern slopes of Peru, whence it must be carried by mule and railway over the forbidding mountain chain of the Andes. These Andean countries, particularly Colombia and Venezuela, have been gradually increasing their production during the last decade until it is now greater than that of Mexico and Central America combined, but only about one-seventh that of Brazil.

THE WEST INDIES. The coffee tree will grow in nearly all of the West Indian Islands, but the island of Haiti (where coffee grows wild), occupied by the two states of Haiti and San Domingo, is the heaviest exporter of coffee. In Jamaica the "Blue Mountain coffee," the highest priced coffee in the world, is produced. Its fine quality is due to the alternating rain and sunshine that here last throughout the year, but the crop only amounts to a few thousand tons per year, it is ceasing to be a plantation crop, and is passing into the hands of the small cultivator. Porto Rico is well fitted by climate, soil and labor supply to produce the good coffee that has for many years been an important export. Before this island was annexed to the United States, the chief market was in Spain, where the Porto Rican coffee with its peculiar flavor was in demand. When the Americans took possession, the Spanish imposed a tariff upon Porto Rican coffee, depressing its price, and producing hard times in Porto Rico, but the United States government has tried to improve the methods of coffee growing and to introduce varieties that would be acceptable in the markets of the United States.

BRAZIL. Brazil is lord of the coffee world, overshadowing all other countries combined, exporting in 1922 about 70 percent of the 2,360,000,000 pounds entering commerce. Although two-thirds of the world's crop is produced there, the coffee region occupies but a small corner of this country,[1] which is as large as the United States and Great Britain combined. Systems of railways thread the coffee zone and come down to the two great coffee ports of Rio de Janeiro

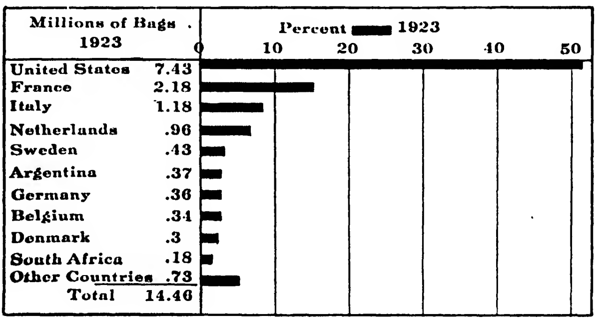


FIG. 127.—Destination of Brazil's coffee exports. (132 pounds to the b:

and Santos. Coffee has long been the backbone of the Brazilian export trade, accounting for $194,000,000 out of the total export of $301,000,000 in 1922. The coffee market of America is practically based on Rio coffee, while Mocha and Java, once names to conjure with, are now insignificant in the coffee trade.

The large and prosperous city of São Paulo, the capital of the Province of São Paulo, is the chief city of the coffee-producing district, which slopes away from the Coast Range, towards the Paraná River in the interior. On this plateau, between 600 and 2,500 feet above the sea, are thousands of square miles of a rich red soil capable of producing several times as much coffee as the world needs. The southeast trade winds bring from the south Atlantic

[1] Brazil's aggregate acreage of coffee trees about equals the area of Massachusetts.

an abundant rainfall, completing the natural conditions for coffee production.

Partly because of this abundance of land the Brazilian coffee estates are often of enormous size. In times of prosperity their owners live luxuriously in the capitals of Europe, while the estates are cultivated by overseers who employ as laborers some of the incompetent negroes who were slaves unil 1892. Of late Italian immigrants have begun to replace the negroes, who are drifting to the coast settlements north of Rio Janeiro. For many years Brazilian coffee did not bear as good a name in the world's market as that of Mocha or Java, chiefly because of the inferior care bestowed upon the harvesting in a country where efficient labor is more difficult to obtain than it is in Java and Yemen. In Java, the ripe coffee berries are picked off, while the green ones are allowed to remain upon the branch, but in Brazil it was not uncommon for green and ripe berries alike to be swept off the branch by a single motion of the hand, making a cheap harvest but a product of inferior character. Great efforts have been made in Brazil of late years to improve the quality of coffee, especially through the introduction of improved machinery. As this machinery is very expensive, large coffee-cleaning and grading establishments are to be found only in the large towns, and on a few of the biggest plantations. Some of the plantations are so large that private railways [illegible] through them to carry the workmen and coffee from one place to another. As the land is cheap, careless cultivation prevails, and the heavy rains do enormous damage to the resources of the country by washing away the fertile soil.

Price fluctuation and valorization. High prices prevailed in the coffee market from 1887 to 1896, and enormous numbers of coffee trees were planted in nearly all coffee-growing countries. The trees begin to bear in about six years and may yield for thirty or forty more. By 1897 the production was so large that the price fell while the yield kept on increasing until 1902, the industry being influenced by the heavy planting of trees in time of high price and the absence of planting in periods of low price, making alternate booms and depressions.[2] The hard times following the fall of prices in 1897 made great hardship in Brazil, as in all the other regions where coffee was the chief export.

[2] Unfortunately this is a very serious factor in tree crop industries because of the long cycle of the tree.

In an effort to restore prices which had gone below the cost of production, the Brazilian Government resorted to valorization, which consisted in buying up large stocks of coffee, holding them until the price improved and then releasing them gradually. In addition the state of São Paulo passed a law (1902) prohibiting the planting of new coffee trees for a period of years. Since that time valorization measures have become a regular part of the Brazilian coffee-marketing program.[3]

THE COFFEE SUPPLY AND THE DECLINE OF THE INDUSTRY IN NEW COFFEE REGIONS. The fall of coffee prices from the profitable level

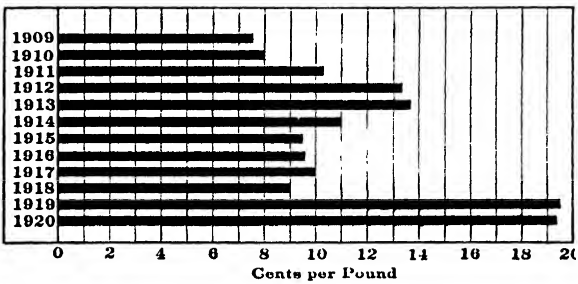


FIG. 128.—United States import prices of coffee. It is a product capable of easy overproduction, resulting in frequent price fluctuations.

of 1895 to the unprofitable level that prevailed for more than a decade after 1897, being a world phenomenon, suddenly checked the spread of coffee growing in other countries where it had been recently introduced. In Nyasaland, central Africa, coffee growing upon the Shire highlands had just been established by the British and led all other exports in value, but the low prices, aided by droughts, reduced the area under cultivation in less than ten years from 17,000 acres to 5,000, and the planters sought a more profitable

[3] "In 1921 the Federal Government issued sufficient paper money, with the help of other loans, to purchase 4,535,000 sacks (1 sack = 132 pounds) of coffee. It soon became necessary to secure further financing of the operation and in 1922 a sterling loan of 9,000,000 pounds was secured on these coffee stocks. While there is still some of this coffee not yet disposed of, the amount is small. In 1922 the President was authorized to . . . undertake the following operations: Loans to growers on easy conditions and the guarantee of coffee deposited in official warehouses; the purchase of coffee for the retention from the market; and the taking care of the propaganda to increase the consumption of coffee."—Commerce Reports, December 10, 1923.

substitute for the coffee upon which they had based their early hopes. A similar fate has overtaken the coffee industry of Hawaii and Paraguay, in both of which countries, as in Nyasaland, the industry was just springing up, but could not compete with Brazil, which is more than able to furnish the 15,000 square miles now needed to grow the world's coffee.

Although coffee was early introduced into England, its use there has been largely replaced by tea. Americans are the leading coffee users of the world with slightly over one pound per capita each month, closely followed by the Dutch, the owners of coffee-growing Java, and by the Belgians and French. Coffee is the chief non-alcoholic beverage of France and other countries of west Europe, and Havre is one of the greatest coffee markets, millions of sacks sometimes being in her warehouses.

2. TEA

Factors affecting the distribution of tea culture. The usual tea of commerce is the dried leaf of a tree native in the hills of Assam, one of the eastern states of British India. In cultivation the tea tree is usually kept down by pruning to a height of from 5 to 6 feet so that the leaves can be picked by hand, but when allowed free growth the tree attains considerable size. Little oil cells give the leaf its flavor, while the stimulating quality comes from a substance called theine which is almost exactly the same as the caffeine of the coffee and the stimulating principle in cocoa or chocolate. The tree is quite hardy, standing a frosty climate, thriving in central China and the cotton belt of the United States, and many places where no tea is produced. The distribution of the tea-growing industry gives us one of the best examples of the combined working of geographic and economic forces. The large amount of skillful hand labor required in packing and preparing tea makes it necessary that tea be grown in regions of dense population with its resultant low wage. The plucking of the leaves, especially the young leaves (which make the best tea), is one of the hardest things a plant has to stand, hence the tea only produces adequately where an abundant moisture supply and a warm summer promote growth.

Consumption of tea. The use of the tea plant has passed through three stages; first, as a medicine; second, as a vegetable (still practiced in Burma and the Shan States); and finally as a beverage, beginning about the sixth century, A. D. Its cultivation began at a rather late date in Chinese history, about the ninth century, and it was long the only Chinese export to the western world. Some of the leaf was introduced into England in 1657, and commanded in that country a price of $15 per pound in 1665, but at the end of that century, it was quite common and Britain with this start became the leading tea-drinking nation. The distribution of the tea habit seems to show a clearly marked influence of national commerce. Britain began with tea at the very time that she triumphed over her great sea rival, Holland, and her shipping has given her a large part of the world's tea trade as well as its tea

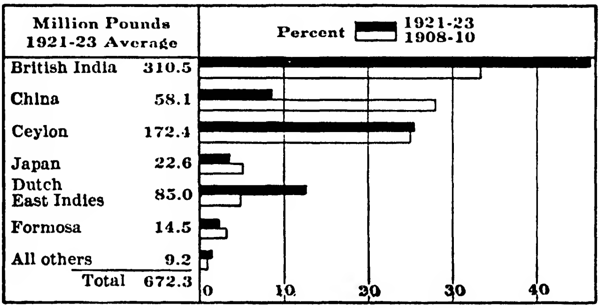


FIG. 129.—World's tea export, three-year average.

consumption. The English-speaking peoples consume nearly four-fifths of the tea which enters international commerce and Russia with her long-used caravan routes to China is in normal times the next largest user. The consumption per capita shows it to be essentially the drink of Orientals and of the English peoples, the average per person being 9 pounds per year in the United Kingdom, 7 pounds among the Australasians who are thoroughly British and more able to buy than those of the United Kingdom itself. Canada averages 4 pounds per capita, Holland 3.5, the United States .8, and pre-war Russia .9. The Russians are generally described as being great tea drinkers, and this is true for the wealthier classes, but the vast masses of the Russian population are too poor to buy it. The Germans consume about one-tenth of a pound per capita, and the French (wine growers and coffee drinkers) but an ounce per year. Its use is very common throughout Siberia, the trans-Caspian provinces, and Persia, as it has for some centuries been a commodity in the caravan trade across the heart of Asia.

Chinese tea industry. It is impossible to say how much tea is used in China. It is widely grown in that country in family gardens for home use,[4] and although it is all grown in the tea gardens of the small land holders, chiefly in central China, that country was for a long time the leading country in supplying it for export.

Chinese tea is usually picked three times a year, the first growth early in April, the second in May, and the third in July or August. The choicest first pickings are so highly prized at home that they are seldom exported; the later pickings of an inferior grade are for the use of foreigners. After the picking, which is usually done by women and children, the leaves are wilted in pans over a fire. They are next rolled into balls by hand to squeeze out the sap, and dried upon screens, care being taken not to let the hot sun burn them. After this, they are further dried by "firing" in copper pans over a fire, being stirred with the bare hands. Inferior teas are stirred with sticks. After this, the leaves are hung up in sacks for a day, then picked over, sifted, assorted, and packed by aid of bare feet into tea chests for export. In some grades of tea, each leaf is rolled by human fingers. The difference between black and green tea is merely a question of curing, although the two kinds are rarely grown in the same locality. If the tea is to be black, rather than green, it is, early in the curing process, piled up in heaps half cured and allowed to ferment, which drives off half of the tannin, of which tea has 10–12 percent. This changes the flavor and gives a quality that is much desired in many markets.

In the province of Szechwan, one of the western provinces on the headwaters of the Yangtze River, is a very large population, estimated at over 16 million, a number about equal to the population of Brazil. They have supported themselves in that inland location for generations by household industries and agriculture, most of their few exports going down the rapids of the Yangtze to Hankow and Shanghai, but they also send into Tibet some of the worst tea in the world. It is made by cutting off 12-inch twigs

[4] The tea habit of the Chinese and Japanese seems to be an attempt to make pleasant the habit of drinking boiled water—a necessity recognized long ago by these peoples living on a land laden with germs resulting from the density of population and habits of fertilization.

of a tea tree, roughly drying them in the sun, chopping them up, twigs and all, sticking all together with rice paste and then compressing the mass into hard bricks for shipment over the fearful passes of Tibet upon the backs of coolies, mules and camels. The greater ease of carrying this compressed form of tea accounts for its shipment by caravan into Russia at an early date. The chief seat of brick tea shipment is Hankow, and while the tea has generally been considered of very poor quality there has been great improvement of late years, and some of the brick tea is now made in that Chinese city under Russian management, and great care is exercised to see that the quality is good. The interdependence of people is well shown by the following series of facts: the collapse

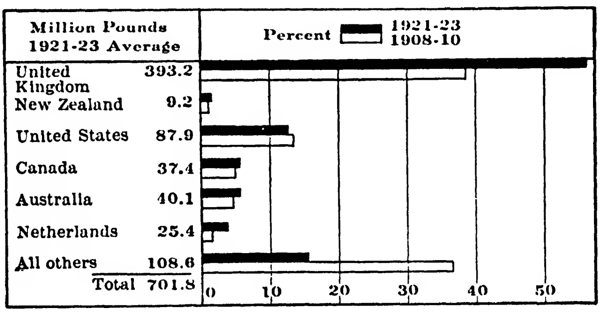


FIG. 130.—World's tea import, three-year average.

of Russia in 1917 stopped the tea import, making financial embarrassment in central China, checking their power to buy cotton yarn in England, making depression in England, reducing import of pork from the United States, depressing American pork market and value of farm lands in central United States.

JAPAN. Tea requires fertile but well-drained soil along with much moisture, a combination of conditions usually furnished best upon hillsides. This fact, in combination with the large amount of labor required, makes it a crop admirably suited for Japan, where the vast demands for food cause the level land to be prized for rice and grain crops, and makes tea growing in terraces upon the steep hillsides fit in admirably with the Japanese economy. For home use they still prepare it by hand in the old-fashioned way, but for export it is almost entirely cured by machinery, the standard Japanese teas being green teas and the United States their principal market. Thousands of boxes are sent directly to Chicago, St. Louis and other interior points by way of the trans-Pacific steamers which sail from Yokohama to Vancouver, Seattle, Portland, and San Francisco, at which points they connect with the transcontinental American railway lines.

FORMOSA. The best tea in the world, the famous Oolong, is grown by Chinese people in the island of Formosa, which was ceded to Japan in 1895 as a result of the Chino-Japanese War. The eastern half of this tropic island is still possessed by head-hunting natives, and tea growing is confined largely to the northern and northwestern parts. The plantations, formerly owned by Americans, British and Chinese, are now largely in Japanese hands, although the bulk of the Formosan Oolong tea is still exported to the United States. The inferior grades go to China.

INTRODUCTION OF TEA IN BRITISH COLONIES. Chinese teas were practically the only teas in commerce up to 1840. Since that time the world's tea trade has been revolutionized as a result of activities of the British government in introducing tea growing into India and Ceylon. In the year 1888 the British import of this commodity from China fell below that from the British Colonies of India and Ceylon. Between 1881 and 1922 the Chinese export fell from 300 million to 76 million pounds. In the year 1905 we had the remarkable spectacle of a commission of Chinese experts sent out from the tea-growing province of Nanking to study conditions of tea growing in British India. China had fallen so far behind because her unprogressive tea growers clung to the old hand methods of their remote ancestors, while the rivals under the British flag and the British teacher had attacked the problem in the scientific spirit and with unbiased minds and had been using many labor-saving machines.

Tea growing in India is carried on chiefly in the northeastern part of east Bengal and Assam, regions tributary to the port of Calcutta. There are at present about 700,000 acres under cultivation in more than 5,000 plantations. The tea crop is grown upon the hills sloping down from the great plateau of Tibet and to some extent in many other places along the southern slopes of the Himalaya Mountains, a district receiving tremendous summer rains. In southern India on the Nilgiri hills is the most important tea district outside of Assam and Bengal. Owing to its low latitude this district produces best at an elevation of from 4,800 to 5,600 feet above sea level, while upon the slopes of the Himalayas the plantations find the temperature that best suits tea at 3,500 feet or less.

British India has become the world's most important tea exporter, with 305 million pounds in 1922, valued at $62,000,000, nearly twice as much as Ceylon, her nearest competitor. Nearly all of India's export consists of black tea, of which 90 percent goes to the United Kingdom.

European tea industry of Ceylon. In contrast to the three large pickings of the temperate zone, the tea of India is gathered every ten days during the period of the monsoon rains in summer, and orchards of Assam like those of Japan average 450 to 500 pounds of tea per acre. On the still more humid hills of Ceylon we find probably the best tea-growing region of the world. There it can be plucked every two weeks throughout the year and has yielded 1,000 pounds of dry tea per acre, a quantity 20 percent greater in actual weight than the average wheat yield of the United States.

Tea growing is a new industry in Ceylon, having been taken up very suddenly by the coffee planters after the blights had destroyed the coffee trees. In 1867 there were 10 acres of tea, in 1887, 2,700; in 1897, 170,000; in 1904 there were 338,000, but the prices were so low that no new tea orchards were then being set out. The export of tea from this island reached a million pounds in 1883, 148 million pounds in 1900, 182 million in 1910, and has remained at about that figure to the present date. The Ceylonese method of tea growing is typical of the most successful method of prosecuting tropical industries. More than half of the plantations are owned by corporations, and practically all are managed by English superintendents. By this means the average size of the plantation is raised to 300 acres, while in China it is probably a small fraction of an acre. The Ceylon tea plantation work is done by coolies, men, women and children, many of them being Tamils from southern India, and they usually return to their homes across the straits after a period of work gives them a little money. The intensity of the tea industry and its dependence upon a dense population is shown by the fact that less than 600 square miles of tea plantations employ about 400,000 coolies. This is one person to the acre, strong contrast to the American corn belt farm of 160 acres, on which the proprietor often has but one hired man to help him grow and harvest 40 acres of corn, 40 acres of hay, 40 acres of oats, and fatten 40 cattle and grow 60 to 100 hogs, besides raising enough horses for his own use with an occasional pair to sell.

NETHERLANDS EAST INDIES. Java has the tea combination of abundant rainfall and cheap native labor (population 683 per square mile). It is the fifth great tea-growing country, after India, China, Japan and Ceylon. The tea districts are from 2,000 to 5,000 feet above sea level, with most of the estates on the slopes of the volcanic mountains. It was found that Indian tea trees would produce a superior grade of leaf when grown under Javanese conditions and the European colonists have turned most of these slopes into beautiful tea gardens. Exports of Java tea have grown from 16 million pounds in 1900 to 100 million in 1920 (76 million pounds, 1922), but as practically all the available soil in Java is now under cultivation, there is little room for future increase except through better cultivation methods.

The success of tea in Java has led to experiments on the island of Sumatra, which is now growing fine tea in several districts. One authority predicts that eventually Sumatra, with her more abundant land, will pass Java in tea-growing.

THE LABOR FACTOR AND UNITED STATES TEA GROWING. The vast amount of hand labor in pruning and caring for tea trees and picking and curing the tea explains why the industry has not been developed in the United States, although it has long been known that the tea tree thrives well over an area 100 times greater than all the tea plantations in India and Ceylon. A little tea of good quality has for some years been produced near Charleston, chiefly by the labor of negro children, but naturally the industry does not expand in this region of relatively high wages. While the tea picker in Formosa works for a few cents a day, it costs fifteen cents a pound to pick tea in South Carolina and the laborers there have been unable to learn a certain dexterous move that pulls a leaf without destroying the bud in the axis of its stem. To avoid this they pinch it off leaving about one-third of the weight of the leaf.

TEA DISTRICTS OF MINOR IMPORTANCE. Tea growing has been carried on to a small extent in a number of places throughout a rather large part of the world in which the tree would naturally thrive. Among them may be mentioned Johore in the Straits Settlements upon the Malay Peninsula, French Tonkin, Southern Burma, Jamaica, the Fiji Islands, Madagascar and Brazil. South Africa is growing about 1,800 acres of tea, principally in the province of Natal, with its fertile slopes facing the Indian Ocean moistened by the southeastern trade winds. In none of these regions has it been an important success, chiefly for labor reasons.

OTHER TEAS. The leaves of a number of other plants are locally used as tea in various places throughout the world. In southeastern United States the Cherokees and other Indians dried the leaves of a holly plant from which they made yupon, or "black drink." In Australia the eucalyptus leaf is used. South Africa has a so-called Bushman tea, a grass called lemon grass is used in India, while in the Island of Bourbon or Reunion in the Indian Ocean, the so-called "bourbon tea" is made from a dry orchid.

Of all the minor teas the yerba maté or Paraguay tea is the nearest to being a rival of the ordinary tea of commerce. This plant, which is a member of the holly family, grows wild in southern Brazil, Paraguay and Argentina, and is now being successfully grown in plantations. The summer rains of the yerba belt favor the rapid leaf growth necessary for such a crop. Unlike tea, the bright green yerba leaves are not picked by hand, but the branches are lopped off the bushy trees and rudely smoked over fires until the leaves are dry enough to crumble into powder. The beverage is widely used by the people of South America,[5] Paraguay and Brazil exporting the powdered leaves in addition to using large quantities at home, while Argentina, Bolivia and Chile are the chief importers. In 1922 Brazil exported 62,547 metric tons of this South American tea, valued at nearly $6,000,000. France is the European country importing the most yerba, and its use in Europe is rapidly increasing.

3. CACAO

THE CONFUSION OF NAMES. The chocolate and cocoa of commerce are prepared from the seeds of the cacao tree which, because of its name, often gets confused with the coco palm which gives us the large, hard-shelled cocoanut (often spelled coconut). It is also confused with the coca tree, the leaves of which are sent to market from the east slopes of the Andes in Peru and Bolivia by way of the Amazon River or the Pacific ports for the preparation of the drug, cocaine. The word cacao here refers to the dried bean.

[5] "A reasonable and quite impartial estimate places the number of drinkers of Paraguay tea at about 10,000,000 persons in South America, and it is stated, moreover, that the supply frequently falls short of the demand."—"Paraguay," *Bulletin of the Pan-American Union*, 1923.

ORIGIN AND INTRODUCTION. The cacao tree is a native of tropical America, growing wild in Mexico and in the Amazon and Orinoco River Valley forests up to an elevation of 400 feet. At the time of the discovery of America, it was grown from Panama to Guatemala and Yucatan, and to some extent in the lowlands of Mexico, in which country it was so prized that the dry seeds passed as money among the Aztecs of the plateau. The Spaniards carried it from Acapulco to the Philippines and the early exportation of the beans to Spain and Portugal has caused its use to become more general in these countries than among any other European people. The use of cacao is spreading rapidly, as it is a table drink, a much prized material for candy, and an acceptable, very nutritious food for travelers and explorers.

EXACTING CLIMATIC REQUIREMENTS. The climatic requirements of cacao are exacting. The tree, which is 15 to 40 feet high, requires more heat than coffee and yet cannot stand the full blaze of the tropic sun, and so is grown under the shade of taller trees, the young plantation being sometimes shaded by corn or bananas. It requires much moisture with soil rich and deep so that it is almost always grown upon low plains. The valuable seeds or beans, to the number of 30 to 60, are produced in a greenish or reddish pod, 3 or 4 inches in diameter and 6 to 10 inches long. As this heavy, cucumber-shaped fruit is attached in clusters to the trunk and larger branches of the tree, and since a strong wind beats the immature pods about until they fall useless to the earth, the area over which cacao can be a profitable crop is greatly limited. In regions of tropic typhoons (hurricanes), or even where strong winds blow the cacao tree cannot be depended upon as a source of financial income. This affects most of the West Indies where cacao can be grown only in sheltered valleys protected from the wind, as in rugged parts of Trinidad, Jamaica, Grenada, St. Lucia, and Santo Domingo. A level island, like Barbados, exposed to the steady trade winds, cannot produce it. The tree begins to bear at the age of three years, but does not reach its maturity until it is ten or twelve and may bear for thirty or forty years more.

IMPORTANCE OF THE DOLDRUMS OR ZONE OF CALMS. Near the equator in all continents is a zone of calms, called doldrums, lying between the two trade wind zones and drenched with frequent and heavy rains. In this belt, at no place more than 13° north or south of the equator, are found the most important cacao districts.

ECUADOR. Ecuador was long the greatest cacao-shipping country. The low plain upon the western coast of that country is crossed by the equator, where the doldrum rains and evergreen

FIG. 131.—The heavy fruits of the cacao tree cannot mature in windy location. (Photo Walter Baker & Co.)

forests make it a striking contrast to the trade wind deserts upon the same coastal plain in the adjacent country of Peru. The trees here find every condition suited to them and the jungle easily becomes the cacao orchard. As with the banana, plowing is not necessary, the only care being enough chopping to prevent the smothering of the young trees.

Ecuador and Brazil compared. Ecuador alone boasts of having several thousand square miles of good cacao land, but this is as nothing in comparison to the hundreds of thousands of square miles of equally good cacao land in the Amazon valley of Brazil and neighboring countries. But cacao growing is not a comfortable business and it takes large profits to tempt men to do it. The Ecuadorean growers all desire to live elsewhere. The climate of the cacao forest is unwholesome to the white man, the jungles swarm with dangerous animals, poisonous serpents and pestiferous insects. Fevers are common, and labor naturally is scarce. Although sparsely settled, the low plain of Ecuador is populous in comparison to the empty jungles of the Amazon Valley of which Ecuador, Peru, Colombia, and Bolivia each own an area greater than the Pacific Plain of Ecuador. However, the scattered settlements along the Amazon have recently produced more cacao than Ecuador, and the cacao export of Brazil has recently exceeded that of her great forest product, rubber. While the total cacao crop of Ecuador does not equal that of Brazil or the Gold Coast, it is the chief money crop of the country, and Ecuadorean prosperity is even more dependent upon it than that of Brazil is upon coffee.

The West Indies and Caribbean countries. The British colony of Trinidad, lying below the hurricane belt and with many protected hollows, and the tropical island of San Domingo are rivals of Ecuador for second rank in western hemisphere cacao production. This valuable bean is also important in Venezuela, where it is grown in valleys in northern and northeastern mountains.

A little cacao is grown in many West Indian Islands and throughout Central America,[6] but it is chiefly for local use, although Guatemala and the adjacent parts of Mexico claim to produce the best cacao in the world.

Old world cacao growing. Cacao, being a native of America and only recently of importance in commerce, has not been grown long in the Old World, but the greater labor supply of the Old World tropics already bids fair to make those regions outstrip America in the export of the precious bean. Thus, the Gold Coast

[6] Export of cacao from Costa Rica has increased almost 200 percent in the last five years, while the estimated acreage in bearing has increased 75 percent. The soil and climate of the Atlantic slope of Costa Rica are especially favorable to the growing of this crop. In 1922 approximately 6 million pounds were exported.—*Commerce Reports*, May 14, 1923.

(British West Africa), which stretches for 334 miles along the Gulf of Guinea, has developed this new and valuable tree crop agriculture as its leading industry. From less than 6,000 tons in 1905, the output of the plantations, under the management of white men but worked by negroes, increased to 160,000 tons in 1922, with an export value of $28,000,000. The Gold Coast now produces from one-third to one-half of the world's cacao crop. The spasmodic labor of cacao growing suits the tropic denizen.

The tropic islands of São Thome (or St. Thomas) and Principe (or Prince's Island) lie under the equator in the Gulf of Guinea, and while they have less than 60,000 people (of whom 97 percent are negroes), and have an area of but 360 square miles, they have the cacao climate and a fertile volcanic soil. In some years this tiny Portuguese colony outstrips Ecuador and most of the other cacao-producing countries. This is not a measure of superiority of resources. It is because virtual slavery exists there and the task-master can make the native work.

Cacao growing in Ceylon has also been successful, although the 31,000 acres devoted to it is only one-fifteenth as great as the area under tea. In Java also the climate and the labor supply are suitable and cacao cultivation has been established in a small way. Its growth has been begun in Samoa and other Pacific Isles, but the population there is insufficient for the production of a large surplus.

Method of preparation and use as food. After the cacao pods have been severed from the tree by means of a knife on a long pole, they are carefully cut open, and the seeds, which are covered with a slimy pulp, are taken to the sweating house for fermentation. This process in the course of a week disposes of the pulpy seed covering, and they are then ready for drying in the sun or by hot air furnaces. When carefully fermented the seeds are twice as valuable as when carelessly done.

Cacao differs from tea and coffee in the manner of its use. The latter are used as decoctions made by steeping or boiling the tea leaf and coffee berry in water, after which the leaf and berry are thrown away. Cacao, containing the same stimulating principles as tea and coffee, has in addition many food elements and is, therefore, a food as well as a drink. All processes of manufacture merely grind up the red-colored beans, which we eat as solid chocolate, as candy, or drink as a thick, brown liquid when mixed with milk or water. This grinding may be done in the kitchen as do the

Chinese cooks in the Philippines who pound the beans in mortars and flavor them with spices to suit individual tastes. In the western world the beans are taken to the great factories of Holland, England, France, Germany, Switzerland, or the United States, where expensive machinery pulverizes the beans to great fineness, mixes the powder with sugar and sometimes also with milk. This use of milk requires many chocolate factories to be near dairy centers and it even causes the location of some plants in the country towns of dairy districts, as in eastern United States and Switzerland.

The so-called breakfast cocoa differs from chocolate by having the nourishing fat, or cocoa butter, removed to make it more easily digestible. This fat comprises about 50 percent of the bean, whose great richness helps to explain the necessity of fertile soil for the growth of the tree. The fat is valuable in medicine and has the peculiarity of never becoming rancid no matter how long it is kept. Examination of the table of food values and the comparison of chocolate with our staple articles of diet will show its great value as food. It is several times as nutritious as eggs and about two and one-half times as nutritious as beef. These are significant facts when taken in connection with the relatively declining quantity of beef, and its increasing price. The cost of cacao production is estimated as low as 4 cents a pound, and the fecund tropics can increase the supply indefinitely to meet the demand—quite different from the meat situation.

The growing fondness of Americans for chocolate and cocoa in its various forms is shown by an eightfold increase in the import or the cacao bean, which has grown in the last twenty years from 50 million pounds to over 400 million.

4. SPICES

Despite their non-nutritious character spices are so generally prized as an article of diet as to be of nearly world-wide interest. In the history of commerce they are of especial interest because the trade in spices long dominated the commerce between the East and the West. They were for centuries the only food products that could be transported far and they were of greater relative importance in the diet of ancient and medieval peoples because the small variety and poor flavor of their food made a greater necessity for something to improve its palatability.

Spices the product of tropic garden spots and hives of population. Practically all the spices with the exception of mustard are limited in their production to the tropics. The trees and fruits from which they are produced have been widely disseminated throughout the hot countries, their growth is usually common, but the commercial production of the spice rarely follows the mere introduction of the plant for local use. This is due to the fact that nearly all the spices are like tea in requiring tedious and painstaking labor in their production. As a result their export is limited to centers of dense population and good labor supply. It was the spice trade that Columbus sought, and spice trees were among the early introductions to the New World. While the New World gave the Old World grains and cattle and now dominates in the export of these products of sparse populations, our export of spices yet remains insignificant.

Pepper. This is the most important of all spices. It is prized alike by rich and poor in both tropic and temperate latitudes. In quantity it equals all of the others combined. Singapore is the greatest pepper-exporting port. Most of this export is assembled from Malacca, Java, Sumatra, Borneo and Siam, but much is also grown about Singapore. It is significent to note in this connection that the population of the pepper-growing Straits Settlements, 850,000 people, includes 432,000 Chinese coolies, the best laborers in all the tropical world. With them are many Europeans—a combination providing both workers and supervisors. The Chinese coolies are also responsible for most of the pepper and other exports of Sumatra. The Malabar coast of India is another pepper country and a little is also produced in the West Indies. Over one-half of the pepper used in the United States comes from Java.

Black pepper is the dried, unripe seed of a climbing vine and the white pepper is the same seed riper and with the skin peeled off. The common method of growing this plant is to sow the seeds in fields of rice, castor beans and other temporary crops. At the same time the seeds of rapidly growing trees are sown. In two years these trees are cut and stuck in the ground as poles, making a permanent support for the climbing pepper vine, which yields its crop in about two years.

Cayenne pepper or chillies is an entirely different plant, yielding a small fruit something like the peppers commonly seen in temperate-zone markets. It is widely grown for local use throughout tropic Asia and Africa and in South America, and properly takes its name from the city in French Guiana.

GINGER. This, the second spice in the order of demand in the market, is the underground stem of a reed-like plant growing wild in the warm parts of Asia. It is one of the most widely cultivated spices. It is planted like any common crop, dug in ten months, and like most spices, dried in the sun. The best preserved ginger is exported from South America, west Africa, China, Bengal, Cochin China, and to a small extent, from north Queensland.

CINNAMON AND CASSIA. Cinnamon is the bark from young shoots of a small evergreen tree native to Ceylon and the adjacent coasts of India. It was a government monopoly in Ceylon until 1833. Since that time it has been introduced in Java, Cape Verde, Brazil, West Indies and east Africa, but almost the entire supply is still produced in certain districts of southeastern Ceylon where 35,000 acres are under cultivation. This island has the necessary warmth, moisture and light sandy soil, and over most of its territory a population ranging in density from 200 to 600 per square mile, thus furnishing the labor necessary to keep the cinnamon trees trimmed to a low bush-like form, to gather the long shoots, peel the bark from them and dry it ready for market. The flavor of cinnamon, like most of the spices, is due to an essential oil. Cassia, the bark of a somewhat similar plant, is much like cinnamon, is gathered in the same way but is of inferior quality, and is largely used to adulterate the Ceylon article. Most of the cassia is produced in the tropic part of south China and the exports, sometimes amounting to a million dollars a year, are sent out through Hong-kong.

NUTMEGS AND MACE. Mace is the husk around the nutmeg, the fruit of a tree growing wild in the Banda Islands in the East Indies. This spice tree, with the clove, was long a monopoly of the Dutch government in the Moluccas or Spice Islands, where the Dutch traders in the days of their commercial supremacy preserved their spice monopoly by sailing the eastern archipelagoes and cutting down spice trees wherever they found them. Nutmegs are now chiefly grown for export in Singapore and the islands of Penang, East Indies (108 square miles, 906 people per square mile), and Granada, West Indies (133 square miles, 498 people per square mile). The population of Penang is largely Chinese, which conduces to production. In addition to nutmegs, the little West Indian isle of Granada exports cacao and some minor spices.

CLOVES. This hot spice is the dried, unopened flower bud of a tree grown to some extent in Penang but most largely in the islands of Zanzibar (640 square miles) and Pemba (380 square miles) on the eastern coast of Africa. (Population, 193 per square mile.) The large plantations are owned mainly by Arabs of which there are about 10,000. These islands, with about 48,000 acres planted to clove trees and over 3 million trees in bearing, export the bulk of the world's cloves, having produced on the average 17 million pounds yearly for the past ten years. The oil of cloves is often extracted from the spice and sold as a separate product.

VANILLA. Vanilla differs from the other important spices in being a native of America, Mexico. It is cultivated to a small extent on the eastern coast of that country, but this cultivation is practically captured by the Oriental labor supply, situated in the Indian Ocean islands of Madagascar, Reunion, Mauritius and Seychelles.[7] These islands resemble other spice districts in population. Reunion (179 people per square mile) has a considerable sprinkling of Hindoo, while Mauritius (523 per square mile) has an important element of Chinese. The growth of vanilla is very exacting. It is an orchid-like vine and must grow in the shady and humid forests. Owing to a peculiarity of the blossom, each one must be fertilized by means of a small splinter of wood in the hand of the attendant. After the beans are ripe, they must be most carefully dried to maintain the perfect flavor. It is estimated that the United States takes about one-third of the world's vanilla.

PIMENTO OR ALLSPICE. This fragrant spice is the small dried and wrinkled fruit of a beautiful tree which grows to 30 feet in height, is a native of tropical America, and cultivated chiefly in the island of Jamaica (population over 150 per square mile in a mountainous territory). The pimento trees commonly grow in pastures and at picking time small boys climb the tree and break off the fruiting twigs. Women pick them up from the ground and attend to the work of drying and preparing the fruits for market.

[7] The official estimates of the vanilla production of 1922 in the islands of the south Indian Ocean were as follows: Madagascar and dependencies, 563,937 pounds; Mauritius, 1,543 pounds; Reunion, 110,230 pounds; and Seychelles, 3,210 pounds, making a total production of 678,920 pounds.—*Commerce Reports*, April 2, 1923.

MUSTARD. Mustard is the most popular and extensively used spice in Great Britain, and is quite generally used in other countries. It is the finely powdered seed of a plant belonging to the same family as the turnip and beet. The production of this seed is quite widely scattered, and seems to be centered in localities possessing the necessary foggy climate that favors its best development; thus certain foggy districts in Essex and Cambridgeshire, England, and in Holland have developed a mustard industry.[8] The United States has one successful mustard district in Santa Barbara County, California, in a valley opening directly to the Pacific, whence come the necessary fogs at the ripening time. The attempt to develop mustard production in sunny districts east of the California Coast Range has resulted in lamentable failure, although the crop was promising to within two weeks of harvest.

An inferior quality of mustard is also exported from Bombay, India, where the climate renders the seed too hot to be generally acceptable.

5. TOBACCO

THE USE, SPREAD, AND CONSUMPTION OF TOBACCO. No textbook for use in Europe or America need tell of the uses of tobacco, except to refer to some of the newer ones, such as the utilization of tobacco waste as fertilizer and insecticide. The dust made of stems is a fertilizer rich in potash and is also used to kill the aphis on the roots of fruit trees. The nicotine, which is the cause of opposition to it, has of late given rise to the manufacture of poisonous fluids for use as sprays in exterminating insects. Columbus and his fellow discoverers found tobacco in use among the American Indians. When carried back to Europe, its use was opposed by priest, pope, king, and emperor, and the czar of Russia once laid even the death penalty upon its use. Medical and athletic professors oppose it, but none the less its use has spread faster than any language or religion, and is found throughout the realms of civilization and barbarism. The Dutch and Belgians, with respectively 6.5 and 6.7 pounds per year per capita, are leading consumers, probably because of their early acquaintance with it as traders. The Germans use 4.3 pounds and the English 3.8. It is in the

[8] Baltic lowlands near Königsberg were important centers of production before the World War.

United States, however, that the most surprising amount is consumed, 10.3 pounds for each person annually, an amount which is nearly double that of fifteen years ago.* The steady increase of smoking in the United States during and since the World War has driven the sale of cigarettes alone from 15 billion in 1913 to the the appalling total of 63 billion in 1923. Even the numerous enemies of tobacco, either on moral or on economic grounds, cannot ignore the tremendous part it plays in our national production and industry.

Few commercial plants grow over so wide a range of the earth's surface. It is injured by frost, but it grows in a comparatively short season, so that profitable crops ripen as far north as Wisconsin, southern Canada and England, while it is at home throughout the tropics. Probably no other commercial product possesses more grades and commercial varieties. One field of Sumatra tobacco may be classified into as many as seventy-two different market kinds. The quality of the soil affects it in a remarkable degree, as does temperature, humidity, and especially the fermentation and chemical changes that take place in the process of curing the leaf. The resulting strength or weakness of flavor, the kind of flavor, the thickness, brittleness, elasticity, texture, color, size, perfection and relative weight of leaf, its specks, its dustiness, gumminess and ripeness are some of the factors that decide whether the tobacco will bring two cents or $2 per pound.

TOBACCO'S COMMERCIAL SERVICE. The commercial service of tobacco has been great. The Jamestown Colony in Virginia was about to fail in its early days because the settlers could find no money crop, nothing to sell to the mother country in return for the imports that they must have. England, being then essentially an agricultural land, had an abundance of wheat, oats, barley, rye, and all agricultural staples as well as manufactures. The company that founded Jamestown imported Italian experts and tried to grow silk, but

* PER CAPITA CONSUMPTION OF TOBACCO, POUNDS

	United States	Germany	France	Great Britain
1861–65	1.6	2.8	1.7	1.2
1886–90	4.6	3.3	2.0	1.4
1906–10	5.1	3.6	2.4	2.1
1923	10.3	4.3	3.0	3.8

failed. The grape also failed, and with it went their hopes of a wine industry and the colonists had been depending on those two luxuries, for which there was a good market in England. Despair ruled in Jamestown and talk of returning to England was rife. Then a trial shipment of tobacco which the Indians had shown the colonists how to grow brought a good price in England and spread industrial hope in Virginia where there was unlimited land suitable for tobacco. It promptly became the great staple of trade, remained so throughout the whole Colonial period and to a very considerable extent down to the present time. It was so important

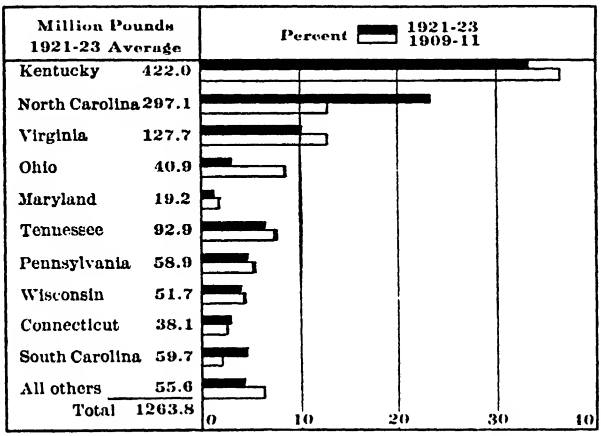


FIG. 132.—United States tobacco production, three-year average.

as to become a standard of currency in the Colony of Maryland in 1722 and the clergy and all other public officials received their pay in tobacco. As late as 1810 it was one of the few crops that could be sold by the people of Kentucky and Tennessee, whose export market was New Orleans, reached by flatboats down the Ohio and Mississippi Rivers. At the founding of our government its export of over 100 million pounds was one-fifth as great as it is now.

TOBACCO INJURY TO AMERICAN SOILS. The ready market for tobacco in Europe has resulted in great injury to the soil resources of most American tobacco-growing districts. For centuries it had been the custom of European planters to raise wheat or other winter grain, such as rye, one year, followed the next year by spring-sown grain, like oats or barley, and the third year the land was plowed and let lie idle or fallow, before entering again on the three-year rotation. But in America the crop of tobacco took the place of the fallow year and, because of the good profits, tobacco was even grown year after year until its great demands for potash exhausted the soil for a time and the field was often abandoned because land was so cheap that more could be had by cutting down and burning the forest. Then the heavy downpours of the summer thunder showers reduced the abandoned tobacco field to useless gulleys before the old field pine could again make a forest there. This wasteful policy brought great poverty to southern Maryland and middle Virginia, and from these sections the people emigrated in such large numbers shortly after the Civil War when western farm lands were opened up, that there was a general loss of population throughout the old Colonial tobacco district, which to-day has less land in cultivation than it had a century ago. As regards potash, tobacco is the worst of soil-robbers, although the destruction of soil fertility does not necessarily follow if proper crop rotation is practiced. This has been proved in many places, notably by the farmers of Lancaster County, Pa.,[9] and other parts of that state, where splendid crops of tobacco are grown on small farms producing corn, wheat, clover, and cattle, the tobacco being grown on the same land only once in a period of six or seven years. For the three years 1921–23 the average yield per acre in Pennsylvania was 1,360 pounds; in Virginia but 680 pounds.[10] But the report of a former Secretary of Agriculture states that "In Virginia . . . by the proper handling of the soil through modern methods of culture and of fertilization, the lands have been left in so much better condition after the tobacco crop has been removed, that without further special treatment the yield of subsequent crops of wheat has been increased threefold and the lands have produced heavy crops of hay where formerly this crop was not even considered a possibility." This unfortunately was the description of a few scientifically operated farms, not the description of a state.

[9] "Lancaster, Pa., is the leading county of the United States in (tobacco) acreage and production, and in 1919 produced 49,335,000 pounds on 37,301 acres. Hartford, Conn., the second county in production, leads in the value of her crop, which in 1919 was worth $13,000,000, or more than two-thirds of the value of all crops produced."—*Yearbook*, United States Department of Agriculture, 1922.

[10] As a result of the use of fertilizers and the development of better varieties, the U. S. Department of Agriculture states that the average yield of tobacco per acre in the United States has been increased during the past 25 years from 700 pounds to over 800 pounds.

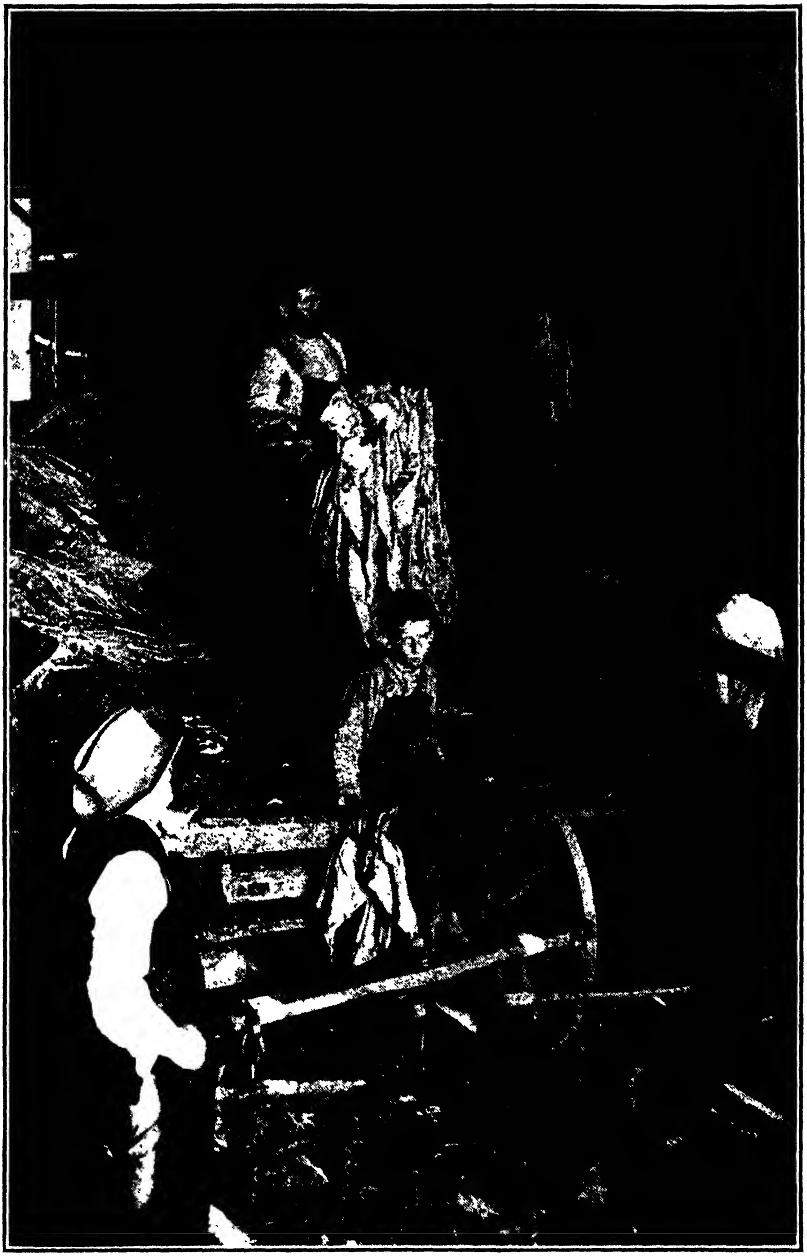


FIG. 133.—Tobacco leaves are plucked from the stems in the field, speared through with sticks upon which they are hung up in the barn to cure, one of the many laborious processes in the preparation of this land-destroying and man-destroying product. (Copyright Underwood & Underwood, courtesy *Country Gentleman.*)

TOBACCO AN INTENSIVE CROP. Because of the great labor in its production and the small yield, a pound of tobacco is worth many times as much as a pound of hay or grain. It belongs to intensive agriculture. The tiny black seeds, three or four hundred thousand to the ounce, are sown in seed beds, and the little plants were, until the recent introduction of a new machine, transplanted by hand to their place in the field, where constant attention and hand labor are necessary to protect them from the cut worm which cuts off the young plant, the leaf worm which eats holes in the leaves, the stalk worm which destroys the central stalk of the plant. The blooms must be picked off, so that the energy may go to leaf rather than seed. For the same reason, the suckers or side shoots must be pulled off, while the process of picking, curing, sorting, grading, and packing, is laborious and requires skill. The farm value per acre in 1923 was $164.25, that of wheat $12.44, and that of hay $20.83. The United States crop of 1923 was worth $300,000,000—not quite half the value of the wheat crop but grown on one-thirty-second the area. The entire American crop of approximately a billion and a quarter pounds in 1922, five-sixths of the world's crop, is grown on 1.8 million acres (2,850 square miles)—slightly less than 2 percent of the corn area. As much of the labor of tobacco growing requires watchfulness and care rather than strength, it can be done by women and children as well as by men, and as a result it is rarely grown on an extensive scale and is usually grown by the members of the farmer's family (often tenants), who care for a small field. The tobacco farmer of Virginia and Kentucky usually raises enough corn to feed the horses that work his lands, the pigs that make his meat, and the cow and chickens that help feed the family. He sometimes also raises some other supply crops, but all his money he usually expects to get through the sale of tobacco.

THE LEADING TOBACCO BELTS OF THE UNITED STATES. For a long time the Virginia-Carolina tobacco belt running from southern Maryland through the middle part of Virginia and North Carolina was the leading tobacco belt of the United States, but Kentucky has now become the first state, producing in 1923 over two-thirds as much as all of the states east of the Appalachians.

The limestone lands of Kentucky are the chief seats of tobacco production, and Louisville, their natural commercial center, is the greatest tobacco market in the world. Much Kentucky tobacco is exported to European countries, for the United States is by far the greatest exporter as well as the greatest tobacco grower in the world. Large amounts of tobacco are also manufactured in Louisville. In the eastern field, Richmond is the greatest center, while Petersburg and the Carolina towns of Winston-Salem and Durham have enormous tobacco factories where, by very complicated machinery, cigarettes, smoking and chewing tobacco, and snuff are manufactured for shipment to all parts of the United States and for export.

THE MINOR TOBACCO BELTS OF THE UNITED STATES. The growing of tobacco is widely scattered in this country, small but important tobacco-growing districts being found in the Connecticut River Valley of Connecticut and Massachusetts, in southern Wisconsin, in Louisiana where the famous "perique" is grown, and since 1884 in Florida. Experiments with the seed of the high-priced Sumatra tobacco showed that with shade it would grow well, so fields are so planted that thin cotton sheets can be placed over them to soften the rays of the sun and make a more even temperature and more uniform humidity. Despite this great expense the business has proved profitable in Connecticut and Florida. Cuban tobacco as well as the Sumatra has been grown in Florida and the artificial shade method has been copied in Cuba and Porto Rico. The effect of these innovations is shown in an acreage value in Connecticut of $648 in 1923, while the great crop of Kentucky averaged but $142 per acre.

OUR IMPORT NEEDS. The fact that the United States is the world's largest producer and exporter of tobacco does not mean that we supply all the requirements of our own people. We are large importers of three distinct classes—cigar tobacco coming mainly from Cuba and Porto Rico; wrapper tobacco from the Dutch East Indies; and certain types of cigarette tobacco chiefly from southern Europe and Asia Minor.

TOBACCO IN CUBA AND THE WEST INDIES. Cuban tobacco is famed throughout the world for its fine flavor, being much prized for cigars, and chiefly used in the manufacture of the famous Havana cigars. The amount produced is about half as great as that of Virginia. The Havana tobacco is the peculiar product of the south slope of the Sierra de Los Organos, a mountain range running from east to west throughout the whole length of the province of Pinar del Rio in the west end of Cuba. Tobacco is the one means by which the people of this district, called the Vuelta Abajo, are now able to buy products of the entire world. Innumerable attempts to grow the same tobacco in other parts of Cuba and other countries have resulted in failure, the nearest approach to success having been the shade-grown Florida product. The secret of its high quality is not known. It may be the protection from northern winds or some quality of soil or some effect of fermentation in curing. Most of the Cuban tobacco is used for cigars and Havana is a great cigar-manufacturing center.

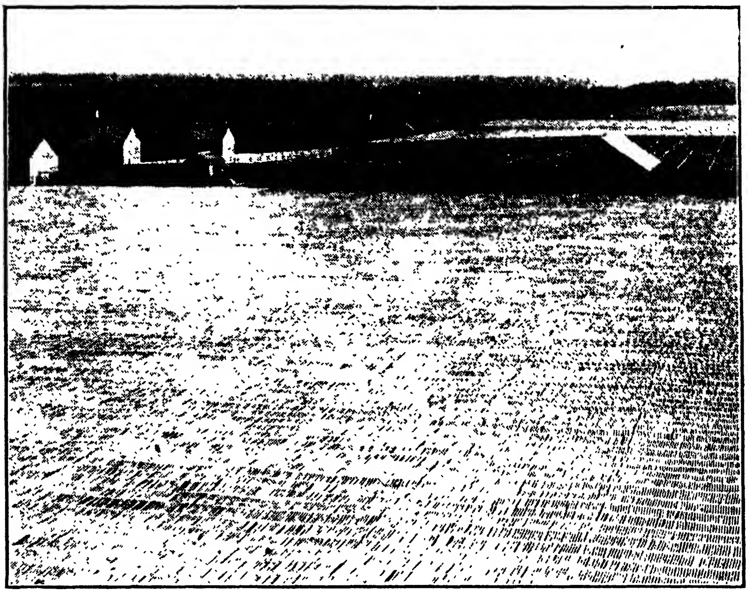


Fig. 134.—Plantation of cigar wrapper tobacco grown under artificial shade in Norfolk, fine sandy loam, Florida. (United States Dept. Agr.)

The American tariff on imported cigars and tobacco has caused the building, largely by Cubans, of the cigar-manufacturing city of Key West on a little coral reef, 90 miles from Havana, the nearest spot in the United States to which the Cubans could move to take advantage of the high price created by our tariff. From Key West the industry has spread to Tampa, which now makes more clear Havana cigars than any other city in the world, the production in 1923 being 582,000,000.

Tobacco is also exported from Porto Rico, and from Santo Domingo on the east half of Haiti.

TOBACCO IN SUMATRA AND THE ORIENT. Sumatra tobacco is like the Cuban in being of high value. Its thinness and elasticity give it great excellence as cigar wrappers, while the Cuban excels as cigar filler. The growth of Sumatra wrapper tobacco is comparatively new, being due entirely to the enterprise of Dutch financiers and managers, a single company of Dutch capitalists having employed in the island of Sumatra as many as 16,000 Chinese with 200 skilled European overseers.[11] This Sumatra tobacco belt lies on the eastern plain extending 5 or 10 miles inland from the Straits of Malacca. Practically all the labor is done by Chinese, who, under the supervision of the Dutch managers, have cleared the virgin forests and have taken such splendid crops of tobacco from the rich volcanic soil that some of the companies have paid as much as 75 percent dividends per year. Considerable tobacco is also grown upon the plains of Java, and the Dutch East Indies is second only to the United States as a tobacco exporter.

British India produces about half as much tobacco as the United States but it only amounts to 1.5 pounds per capita and but little of it is exported. Japan grows about 140 million pounds, 2.5 pounds per capita, but it is all kept at home and some is imported. Its growth for local use is quite general throughout western and southern Asia.

The Philippine tobacco bears the same reputation in the eastern world that the Cuban tobacco does in the western world and the export (40 million pounds) is about half again as great. The best of it is grown in the northern Province of Luzon in the valley of the Cagayan River, which keeps the tobacco lands perpetually fertile by the layer of mud deposited in the annual overflow. This tobacco is shipped from the port of Aparri to Manila, where many persons are employed in making it into the well-known Manila cigars. The poorer tobacco from the southern Philippines is sent to Spain.

EUROPEAN TOBACCO PRODUCTION. Tobacco is grown in many parts of the continent of Europe, but on account of large population the quantity is insufficient for local use. Even Russia (pre-war crop 233 million pounds), the leading tobacco-growing country of Europe before the war, had an insignificant export. Germany, the largest grower at present with 65 million pounds a year, imports three times as much, while France and Italy grow 50 million pounds

[11] The mortality among some of these poor workers (10–20, even 40 percent per year) can only be classed as a crime.

each and import far more than they grow. Careful fertilization and cultivation give the French growers the highest return per acre of any of the important tobacco producing countries—about 1,500 pounds.

Nearly all of the Danube Basin and Balkan countries are tobacco growers; it is an important crop in Hungary, Bulgaria, Rumania, Yugoslavia and Greece. Some of the choicest grades of Turkish tobacco are raised in the provinces of Bosnia and Herzegovina in Yugoslavia; wherever a small patch of level ground can be found among the limestone sinks, soil is collected and protected from erosion by stone barriers. Greece is the only important European exporter, her mild-flavored Turkish tobacco, grown largely on the plains of Thessaly, going to Germany, to the United States, and to Egypt to use in cigarette-making. The so-called Egyptian cigarettes, one of the principal manufactures of Cairo, are made entirely of imported tobacco. The growing of tobacco is prohibited in Egypt, and she must depend on Greece, Russia and Asia Minor for her raw material.

France is fostering tobacco growing in her African colony of Algeria and the export of Algerian tobacco is increasing.

TOBACCO MONOPOLIES. Of all the well-known agricultural products tobacco has probably been the most subject to government regulation and control. Considered as more or less of a luxury it has long been taxed heavily, particularly in Europe. Twelve countries, Austria, Hungary, Yugoslavia, Spain, Italy, France, Poland, Czechoslovakia, Sweden, Morocco, Ecuador and Korea have full government monopolies. In some of these countries as much as 10 percent of the total revenue comes from the tobacco monopoly.

The plan of operation is usually the same. Farmers must secure production permits before they are allowed to plant tobacco, and when the crop is harvested and cured the government purchases it at a fixed price. The factories are government owned and the manufactured cigars and cigarettes are sold for the account of the government. In some cases the government sells the monopoly to a single company. Many other countries, such as Great Britain, which do not have a monopoly still tax it heavily for purposes of revenue. To aid this revenue collection England long prohibited its growth.

SOUTH AMERICAN TOBACCO. Brazil grows enough tobacco along her eastern coasts for her own large home consumption, and an export (80 million pounds) that makes her the third tobacco exporter of the world. Ninety-five percent of the export is shipped from Bahia, where the foreign commission houses advance the money to the growers, who are always in debt, and take the crop in payment for the loans. It is not grown on plantations, as in Sumatra, but by the families of small farmers who get but 300 pounds per acre—a very low yield (Pennsylvania 1,360 pounds). Before the war 85 percent of the Brazilian tobacco export went to Germany, but at present she takes less than one-third of it, while considerable quantities go to France, Argentina and the Netherlands.

Colombia has a small tobacco export which is an interesting illustration of the commercial service of the plant. In some dis-

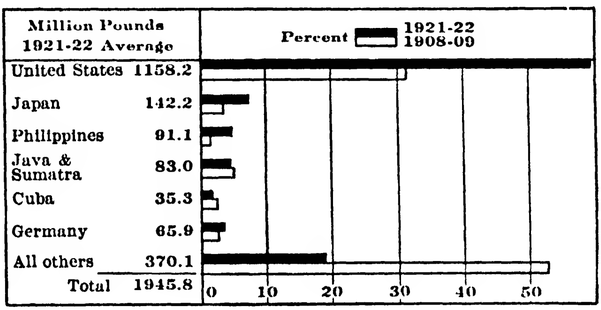


Fig. 135.—World's tobacco production, two-year average.

tricts in Colombia, tobacco, wrapped in bales covered by one or two layers of raw ox hide, survives the humidity of the climate, the downpours of frequent rains and the hardships and costs incident to weeks of ox-cart and mule-back transportation. Such hide-covered bales are a common sight in the tobacco markets of Europe. The people of Paraguay, men and women alike, are among the greatest smokers in the world; the rich soil of this subtropical country is supplying not only the local demand but providing an export crop of growing significance. From Argentina to Central America and Mexico tobacco growing for local use is common.

World trade in tobacco. Bremen is one of the great tobacco markets, distributing it throughout Germany and many of the other countries of Europe. Amsterdam is the headquarters for the companies owning the tobacco plantations in Sumatra and Java, and practically all the export of the Dutch East Indies (total, 113 million pounds, 1922) goes to Amsterdam for distribution. Over 40 percent of the tobacco entering into world trade comes from the United States, while the Dutch East Indies and Brazil together supply about 20 percent. The United Kingdom and Germany are the heaviest importers, with 174 and 146 million pounds respectively in 1923. The British tobacco market is supplied almost entirely from the United States. Germany gets 40 percent of hers from the Dutch East Indies, 20 percent from the United States and 10 percent each from South America and Greece.

TOBACCO MANUFACTURING. Plug tobacco, cigarettes and smoking tobaccos tend to be prepared by the use of much machinery in large factories near the centers of production.[12] Cigar making, on the contrary, is a hand industry and is peculiarly dependent upon skilled labor. The trained cigar maker, using little besides nimble fingers and a sharp knife, rolls and shapes the filler, binder and wrapper into a fragrant Havana cigar. Machines have not succeeded in replacing this hand labor except in the cheaper cigars. The cigar factories in Tampa and Key West draw upon a labor reservoir of Cuban and Spanish cigar makers. All the great cities like New York, Philadelphia and Chicago have their supply of skilled labor and the additional advantage of a market close at hand, so that cigar manufacture can become an important industry.

REFERENCES

See General References

UKERS, W. H. "All About Coffee." *The Tea and Coffee Trade Journal,* New York, 1922.

HOLMES, G. K. "Three Centuries of Tobacco." *Yearbook,* United States Department of Agriculture, 1919.

GARNER, W. W., and others. "History and Status of Tobacco Culture." *Yearbook,* United States Department of Agriculture, 1922.

[12] Tobacco manufacturing as carried on in Durham, Winston-Salem, North Carolina, Richmond, Virginia, and other cities in the American tobacco belt, is an impressive industry. As the tobacco is allowed to cure a year or two before manufacture, one sees warehouses 1,000 feet long, 120 feet wide, two stories high, each floor piled with three tiers of hogsheads holding 900 pounds each. These monuments, taken in conjunction with the rooms full of cigarette machines, each about as big as an automobile, running off cigarettes by the mile and chopping them off into smoking lengths at the rate of 500 a minute, make one wonder how the human system will ever get rid of so much nicotine.

CHAPTER IX

FISHERIES

THE CONSERVATION IDEA. A cow walks upon the hay eating a little and spoiling the rest. We call her a dumb beast. But how do *we* fare when we think of ourselves as a race, and consider our care of our resources, which are the possession and the only possession of our race outside of ourselves? Take, for example, our fish (unfortunately there are many other examples). Mr. Herbert C. Hoover, Secretary of Commerce, says:

"River herring, striped bass and sea-run trout 'are decreasing with great rapidity.' Crabs, lobsters, and oysters 'are on the same road to destruction.' The oyster fisheries of Chesapeake Bay 'have decreased to 50 percent in twenty years. Our lobster catch is less than one-third that of thirty years ago. Our great supplies of salmon on the Atlantic coast have totally disappeared. They have been diminishing over one-half on the Pacific coast, and only recently have measures been taken there to halt their destruction; and it is only within the last few months that we have sought to save the last great salmon fishery in the world—Alaska—where reckless exploitation threatened their complete destruction within half a generation. The sturgeon fisheries of the Great Lakes have declined 98 percent in forty years. . . .

" 'Blindly, without regard to the stability of the industry in our generation, without sense of responsibility to future generations, we are recklessly destroying our littoral fisheries—that is, the species of sea-food in our bays and adjacent to our coast, at a rate which promises the end in a generation unless we accomplish further reform.' (How can we prove our superiority to the cow?)

"One great enemy of our fisheries is pollution of the water. 'Pollution comes from a hundred different sources. Ships, factories, coal-mines, chemical works, cities and towns—to mention only a few—all make their contributions of waste and refuse in the waters. Most of these forms of pollution damage fish. Some of them are enormous in their damage.' "[1]

[1] *The Literary Digest*, Sept. 27, 1924.

The fish are like many of the other resources upon which our mechanical civilization depends, limited in amount and rapidly declining. They are unlike many in that they offer hope of restoration, the cycle being as follows: natural plenty, destruction by man, study of the situation, restoration by the application of science and the control of this generation in the interest of the future. Unfortunately the latter two stages require intelligence and the concept of racial welfare, the former of which is but slightly visible in larger human affairs and the latter almost completely invisible.

FISH AND MARINE PLANTS. The sea is a great resource, but little used as yet. It covers three-fourths of the world's surface. Even the clear water of the sea has countless millions of minute plant organisms which are eaten by many small animal organisms, they in turn are eaten by each other and by the smaller fish, and they in turn by the larger fish, but the support of the whole pyramid of marine animal life, like the life of land animals, is based upon vegetation.

The word fishery is applied to the catching of practically any animal that is taken in the water, as oysters, lobsters, whales, and even seals, which are often taken on shore.

RELATION OF FISHERIES TO SEAFARING. Sea fishery is considered the cause that first led man to sail upon the ocean,[2] and from this beginning, all maritime nations have had their rise. Such was the origin of the fleets of the Phœnicians and the Greeks who laid the foundations of Italian cities. The Norsemen on the inhospitable shores of Scandinavia developed fleets where man must fish or starve. The Dutchmen who wrested the commercial supremacy of the world seas from the Portuguese had had centuries of maritime training on the herring banks of the North Sea. In recognition of the importance of fisheries to Dutch welfare there was each year for centuries a national celebration in which one of the most important ceremonies was the public eating of a salt herring by the Dutch ruler. The fleets of England had their origin on these same fishing banks of the North Sea, and later the New Englanders became the pioneer seamen of America because good fishing banks were near them. The schooner, the fastest of all sailing vessels, was invented

[2] "Fishing is probably our most ancient industry, for men were hunters before they were farmers, and fishing is the only form of hunting that survives with us as a commercial industry."—*London Times Trade Supplement,* April 14, 1923.

and is yet used by the fishermen of Gloucester, Mass., and in recognition of the importance of the sea industry to the state, a dried codfish has, since colonial days, hung over the desk now occupied by the speaker of the Massachusetts Senate.

The fishing industry, through its connection with sea power and the romance and charm of the ocean, tends to be overestimated in its real importance. All the fish that are caught by Americans annually (worth about 80 millions of dollars to the fishermen) are only one-half as valuable as the tobacco crop, and not one-twelfth as valuable as the poultry and eggs produced in the United States. The annual fish catch of all the world is only three-fourths as valuable as the poultry and eggs of the United States.

THE LOCATING FACTOR OF FISHERIES. Most of the world's fishing industry depends upon two habits of fish which enable us to catch near the land those that may have passed most of their lives hundreds of miles away at sea. The first is the spawning habit of many species which lay their eggs only in rivers or in the shallow waters near the shore. The second is the congregation of fish to feed upon the bottoms, in shallow waters, commonly called "banks." The occurrence of such banks near the shores of northeastern Asia, northeastern North America and northwestern Europe is responsible for the three greatest fishing regions.

NORTH ATLANTIC FISHERIES OF AMERICA. The fisheries of northeastern North America are based on a rich combination of rivers, bays and shallow off-shore banks. Especially important are the Grand Banks of Newfoundland and smaller banks off Labrador, New England and New Jersey. The Newfoundland banks were known to the fishermen of the French provinces of Normandy and Brittany within a dozen years after Columbus had returned to Spain from his first voyage. Unquestionably the knowledge of these fishing banks made a greater sensation in Europe than the mere fact of the discovery of the new continent, because at that date Europe was poorer than now, and a new food supply was important. In that day the fishing industry was relatively more important than at the present time. Practically the whole of Europe was Catholic, and even to those who could afford meat there were many fast days upon which fish must be eaten in place of meat. Scores of vessels sailed back and forth from France to these Newfoundland banks each year for a century before the French made settlements in the St. Lawrence valley.

THE COD FISHERIES. The most important fish on these and other northern banks is the cod, although the haddock is becoming of nearly equal importance. The cod feeds along the bottom and is commonly caught on a "trawl" which consists of baited hooks attached to short lines that are fastened at intervals of 4 feet to a longer line sometimes 3,000 feet in length. These trawls are attended to by fishermen in rowboats called dories that put out from the schooners. The men in the dory take up one end of the trawl, which is anchored and marked by a float, pass the boat along under

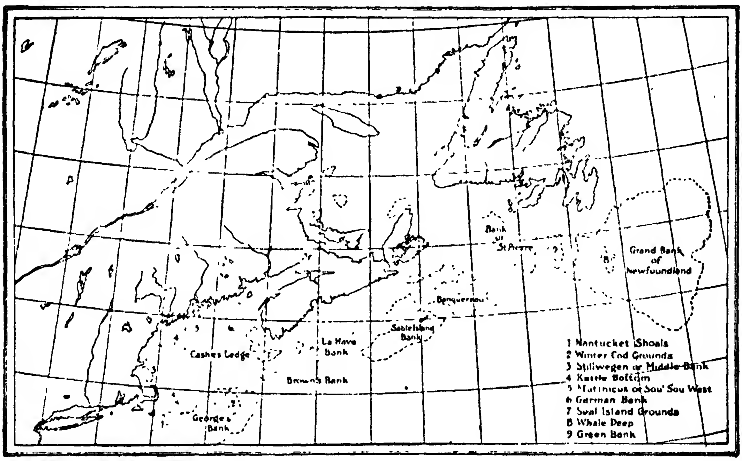


FIG. 136.—Map showing (by broken lines) principal fishing grounds off the coasts of New England, Nova Scotia, and Newfoundland. (After MacFarland.) (From Salisbury, Barrows and Tower.)

it, and let it down in the water again after the fish have been taken off and the bait replenished. Fishing on the Grand Banks is an exceedingly dangerous calling, as the banks are one of the foggiest places in the world and the schooners often collide with each other and with the icebergs, the men in the dories often lose their bearings and drift away to death, while a single fearful storm sometimes drowns scores or even hundreds of fishermen. To complete the chapter of dangers the fishing banks are in the path of transatlantic vessels which run down the small fishing craft in the fogs.

Proximity to the banks has made fishing a leading New England industry since Colonial times. Massachusetts and Maine have the most important fisheries, and Gloucester, Mass., was for a long time the greatest fish port in America, nearly the whole population being engaged in preparing to catch, catching, curing, buying and selling of fish. Boston with its better marketing facilities[3] has recently surpassed Gloucester, and Portland, Maine, is now second in importance in New England fishing.

The cod fisherman also catches halibut and hake. The American catch of these fish is actually equal in value to the catch of cod. The cod is at its best in cold waters and is taken in greater quantity by the Canadians than by the New Englanders, and the people of Newfoundland and Labrador catch more codfish than all the rest of the people of America. Dried cod makes nearly two-thirds of the exports of this northern dependency of Great Britain.

Newfoundland and Labrador offer one of the best modern examples of a people living from one resource—so great is their dependence upon fish. There is a little iron mining, a little lumbering, and paper making, but two-thirds of the exports are fish products and three-fourths of the workers are busy with fish.

The climate is so cold and damp that there is practically no agriculture, a garden even being a rarity in Newfoundland. The people who are not at sea catching cod, or herring, are busy curing them. Some of the cod are sold fresh, but most of them are cleaned and salted as soon as they are brought to the schooner by the dories, but when the schooner reaches its port they are dried in the sun upon sheds which stretch conspicuously along the coasts. The herring is salted or cured by smoking over a slow fire after being salted.

The Nova Scotia fishing industry with a catch of $10,000,000 per year, equals that of Massachusetts, the leading state of the United States, and the total Canadian catch ($35,000,000, 1921) is nearly double that of New England. Nova Scotia with her many good harbors partakes somewhat of the character of Newfoundland but, though she catches nearly one-third of the fish of Canada, the warmer climate of this province enables her people to engage, to a considerable extent, in agriculture, and they ship sheep, cattle and horses across the straits to the people of Newfoundland.

[3] The Boston Chamber of Commerce says that Boston is the most up-to-date fish port in the world and in production is exceeded only by Grimsby, England. It has one of the largest fish piers in the world, built at the cost of $3,000,000, is 537 square feet in area, with a capacity for simultaneous discharge of eighty vessels. On and adjacent to it is the largest fish-freezing, cold storage plant in the world.

European fishing fleets in American waters. Fishing fleets from Europe still visit the Grand Banks, and although Newfoundland belongs to Great Britain, the French fishermen may by treaty right fish along the shore of the greater part of Newfoundland. They may also land and dry their fish, although no permanent French settlements may be made. France also owns two islands, Miquelon and St. Pierre, situated just south of Newfoundland, with a population of a few thousand dependent entirely upon the fishing industry. This single product serves to give these islanders a per

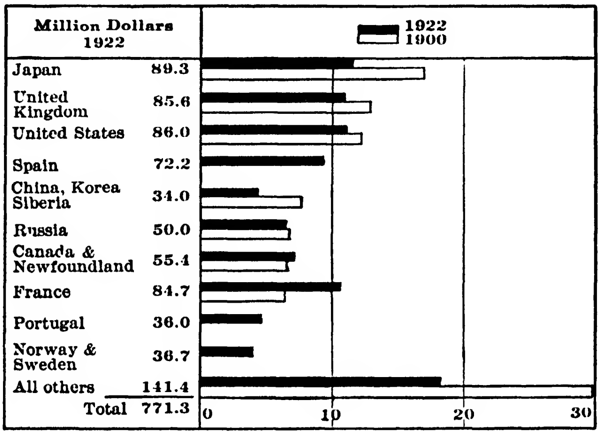


Fig. 137.—World's fishery products.

capita trade exceedingly heavy, many times as heavy as that of the United States.

North European fisheries. The North Sea is the greatest fishing ground in the world. It is very shallow and abounds in fishing banks. It is surrounded by populous lands, being within easy reach of the British, French, Belgian, Dutch, German, Danish, Swedish, and Norwegian fishermen, and belongs alike to all of them, since by the custom of nations, the sea three miles and more from shore is free to all mankind. These peoples having access to the North Sea catch about $250,000,000 worth of fish per year, and the greater part of them come from the North Sea.

Great Britain, with a catch of over $100,000,000 annually, has become the undisputed leader of the fishing industry. In addition to a wide variety of motor-driven and sailing craft, Britain employs more than 3,000 steam fishing vessels, greater than the combined steam fishing fleets of all the other nations. Eighty thousand men are engaged. The industry is centralized in a few large ports such as Aberdeen, Hull, Lowestoft, Yarmouth, London, and especially at Grimsby, which is the greatest fish market in the world. The thousands of tons of fish brought into Grimsby by the trawlers are handled at a special harbor built for the fish trade, and equipped with a covered pier two stories high and nearly a mile and a half long.

The Dutch, by their location more dependent upon the North Sea than are the British, fish nearly as much per capita as the British and have a fishing fleet with 20,000 men. The French, having no fishing banks along their coast, sail as far away as Newfoundland and Iceland.

NORWEGIAN COAST FISHERIES. Norway is of all the nations the most dependent upon fish. That the hardy Norse have been able to people their bleak and rocky coast all the way up to the Arctic has been due largely to this harvest of the ocean. In past ages the glaciers on their way to the sea cut deep furrows in the mountain mass of Norway, so that her present coast line resembles a huge jagged saw. These protected fjords, some of them over 100 miles long, form excellent harbors and fine fishing grounds. There is a small town or a tiny village in nearly every one of them. Fishing in this northland is not managed by large companies with expensive boats and equipment, but is largely in territorial waters and in the hands of the small independent fishermen. It is also a part-time industry. At the season when the cod and herring swarm into Norwegian waters to spawn, the small farmers and village tradesmen get out their boats and become fishermen for a spell.[4] While the bulk of the British catch is eaten fresh by the Britons themselves, Norway with her scanty population has an insignificant home consumption, and cures most of her catch for outside markets. Of her 600,000 tons of fish products, 400,000 goes into the export trade. Norwegian salted herring, codfish and cod liver oil have become standard products in many distant lands.

FISHERIES OF JAPAN. The third fishing region of importance is on the coasts of northeastern Asia, where again we have a cool

[4] "Of 109,000 fishermen in Norway, 27,000 have no other means of livelihood, 44,000 are mainly fishermen, and 38,000 have other more important sources of income. The majority of the two latter classes are also small farmers."—*London Times Trade Supplement*, April 14, 1923.

climate and rough shores, such as prevail in the same latitudes in eastern North America. The Japanese are credited with eating more fish than any other people in the world. Two reasons account for this. One is the almost entire absence of the meat animals in Japan, and the other is the abundance of fish in the waters surrounding the country, which happens to be composed entirely of islands, thus tempting its people to go to sea. Hokkaido, the northernmost of the four large islands of Japan, has a little coal mining and a little lumbering, and some agriculture of the northern Wisconsin type, but is too cold for rice growing. Much of it is too rough for any other kind of agriculture. Its people, like those of Norway and Newfoundland, must depend almost entirely upon the catch of cod, herring, and other fish of north temperate latitudes.

Japanese fishermen scour the coasts of Asia, especially those of Korea, the Kurile Islands to the north, and the cold island of Sakhalin. Fishing is one of the principal industries of Sakhalin, the main varieties taken being salmon, herring and plaice. Treaties with Russia have given the Japanese fishing rights along the entire Siberian coast,[5] with nearly 12,000 miles of shore line. Thus they have guaranteed their fisheries, which furnish not only the chief animal food of 56 million people, but also an important fertilizer, made of dried fish refuse and non-edible fish, and extensively used in the well-tilled garden-like farms of Japan.

THE FISHERIES OF THE OPEN SEA. Mackerel, unlike the cod, are surface swimmers, and are caught in nets swinging in the open sea. They are caught off the coasts of Europe and the United States, and immediately preserved in salt brine.

The sardine, deriving its name from Sardinia, is a small pilchard, dried, packed in oil, and sold in sealed cans. It is exported largely from France, the sardines of the Mediterranean being packed for shipment at Beauclaire on the Rhone, while Bordeaux upon the Bay of Biscay is a great center. Sardines are also caught along the coasts of Spain, Portugal, and Italy, but a kind of sprat is often sold under the name of sardine and many other kinds of small fish

[5] Under the Fishing Convention of 1916, amended in 1918, Japan was given liberal fishing rights in Siberian waters from the Korean border to Bering Strait. By the terms of this convention fishing concessions, including a small tract of land on the adjacent shore where fish may be cured, canned or salted, are auctioned off every year. The bidding is limited to Russians and Japanese, the seacoast stations going almost entirely to the Japanese fishermen, while the bay stations are in the hands of the Russians.

masquerade as sardines. Sardine fisheries reach their greatest importance in Brittany, the northwest province of France, where the failure of the sardines to appear in the neighboring seas for a season has caused as many as 80,000 persons to be in a starving condition, dependent for their lives upon the donations of the French government. Along the coast of New England, especially in Maine, there has long been an important industry in the so-called "American sardines" which are really small sea herring, a fish closely allied to the pilchard. Although the Maine sardine canners have to dry their herring with artificial heat while the Frenchmen can do it in the sun, the American product is much cheaper, and is shipped all over the world. Of late years the canners of both Europe and America have discovered that the cheaper cottonseed oil can be used in the place of olive oil in fish canning.

THE MENHADEN INDUSTRY. The early American colonists were taught by the Indians to place a fish in each hill of corn for fertilizer. The menhaden, a coarse and bony fish which swarms the waters of the Atlantic coast from Florida to Newfoundland, is now caught by millions every year for the same purpose. Small fishing steamers carry on the fishing in the open sea, using nets many hundred feet long. When a school of menhaden, swimming near the surface, is sighted by the look-out, the net is drawn around the fish, pursed at the bottom, and the fish ladled into the hold. The shiploads of menhaden are taken to fish factories, mainly along the Virginia and North Carolina coasts, where they are cooked by steam and pressed, emerging as fertilizer (rich in nitrogen and phosphoric acid) for the farmer's corn, fish oil for soap-making, and fish meal for the fattening of livestock.

WHALING. Of all fishing enterprises whaling is the least dependent on home ports of ships and particular shores. It is also essentially an industry of the past. It was of very great importance in the first half of the nineteenth century, when whale oil supplied the family lamp. In those days New Bedford and Nantucket in Massachusetts and New London, Connecticut, were the great outfitting centers of an industry that was prosecuted in all oceans of the world so persistently that the whale was nearly exterminated by 1860, when the discovery of petroleum lessened the demand for whale oil and gave the monsters of the deep a little reprieve. Some whale fishing is still carried on, but the whalers of Nantucket have changed their base to San Francisco, so that they may be nearer the home of the whale, now caught chiefly in the Arctic Ocean near Bering Straits. There is still some fishing in tropic waters for the sperm whale which has in his head a white mass called spermaceti, useful in the preparation of sperm candles and certain ointments. Whaling is still carried on in the Indian Ocean, two companies with headquarters at Durban, Natal, catching 809 whales in 1923. (*London Times Trade Supplement,* Jan. 12, 1924.)

SEALING. The seal gets its living (fish) in the sea, rears its young upon the rocky shores and is the prey of man on both sea and land. It is such a valuable and easy quarry that extinction seems to be its fate where not protected by strictly enforced legislation.

The great center of fur seal fishing is the Pribilof Islands, an American possession in the Bering Sea. Here each year many thousands of seals gather from distant seas, and remain for a few weeks during which time the seal pups are born and grow large enough to swim away with their mothers. Unfortunately for the seals no country has in past years had any jurisdiction more than three miles from its coasts, and the seal at sea was like the whale, beyond the protection of government. While the United States could and did protect the seals during their stay on the rocks of the Pribilof Islands, the mother seals daily swim to the open sea for fish, and during many months the whole herd is scattered widely over the Pacific Ocean. When more than three miles from shore they fell a prey to the rifles of the pelagic sealers from Canada, Japan or the United States, who sailed the seas in search of them. As a result the mothers of many little seals were shot while gathering food, leaving the young to starve on the rocks. Thus the number of seals in the Pribilof herds rapidly declined and extinction seemed only a matter of years.

Such an economic insanity was averted by a sealing treaty (1911) drawn up between the United States, Japan and Canada. This treaty protects the seals because the three nations agree to stop pelagic sealing and the United States agrees to divide the proceeds of the monopoly which she holds because she owns the seal rookeries. As the seals are polygamous, a certain proportion of the young males can be captured each year without in any way lessening the rate of increase of the herd. The seals are killed under government supervision, the number of pelts taken in 1923 being 16,000. Most of the skins are sold at the great St. Louis fur auctions. Under the careful management of the government the Pribilof seal herd increased from 215,000 in 1912 to 653,000 in 1923.

A less valuable seal (hair seal) sought for its oil and leathery skin is common in Labrador and Arctic America, and a fleet of steam sealers sails from St. Johns, N. F., on an annual fishing voyage. Single vessels have been known to bring back 30,000 skins.

SHORE AND RIVER FISHERIES. A number of marine animals such as the oyster, clam, lobster, and sponge live in shallow waters

FIG. 138.—Scooping up salmon, the cattle of the sea, near the mouth of an Oregon stream. (Courtesy Portland Chamber of Commerce.) (From *North America;* published by Harcourt, Brace and Company.)

where they can easily be caught. Many rivers and bays have a fishing value out of proportion to their area because of the sea fish that annually enter the stream for spawning and become the rich harvest of the fishermen.

The sturgeon, the largest of these visitors, is a fish that grows as much as 10 feet long and is found to some extent in the American Great Lakes [6] and the rivers of the Atlantic, but in greatest quantity in the Caspian Sea, whence years ago it ran up the Volga River in such quantities that at times they crowded each other out of the water in narrow places. The fish are caught in part for their

[6] This marine fish, like the seals of the Caspian Sea, seems to have survived from the time when the Lakes were connected with the ocean.

eggs, which are sold as Russian caviar, and the industry has been prosecuted so vigorously that this valuable fish is about to become extinct. The industry has practically disappeared from the Atlantic rivers of America and has greatly diminished throughout the world, but the rising price of caviar makes sturgeon containing eggs more and more valuable, and the quest more fierce—another example of our idiotic practice of letting a man for his own small gain wreck the resources of mankind.

The salmon, of which there are several species, is easily the king of all river-running fish. Living most of their life in the ocean, the salmon return again to the fresh water streams where they were originally hatched in order that the females may deposit their eggs. Salmon are found to some extent in northwestern Europe, New England and Canada, but the rivers of the north Pacific, between San Francisco and Japan, are the chief source of world's supply. It is estimated that 150,000,000 salmon are caught yearly in the rivers and off the coast of Eastern Siberia, about three-fourths of which are from the Amur River. In Alaska they have for an unknown period been almost the only food supply of the natives, who at the time of the annual run put away the year's supply of smoked salmon in little houses on high poles, out of the reach of wolves and dogs.

The Pacific Coast salmon industry is our most important commercial fishery, with a catch of over 400 million pounds annually. Salmon canning was first established in California, Oregon and Washington, then in British Columbia and finally in Alaska, where in almost every river, especially the great Yukon, salmon are exceedingly abundant. They run in great numbers and a common method of catching them for the cannery is by the fish wheel, a large water wheel revolving in the swift current and having wire buckets which catch the salmon and throw them into a boat below the wheel. Large salmon canneries have been built at the mouths of various streams in Alaska along coasts so rocky and cold as to be undesirable for human habitation throughout most of the year. As the season for the salmon running approaches, vessels loaded with empty cans and carrying many workmen, usually Chinese, leave San Francisco, Portland or Seattle for the cannery. In a few weeks hundreds of thousands of pounds of salmon are canned, loaded into the vessels, and brought back to the home port. The annual pack, valued at $30,000,000 or more ($39,000,000 in 1924), is distributed throughout the United States and exported to all parts of the world.

Seattle is the most important fishing center on the Pacific coast largely because of the salmon fisheries, and, in the United States, is exceeded only by Boston, Portland, Maine, and Gloucester.

The shad, probably the most highly prized of American food fish, ascends each spring the rivers from Florida to the St. Lawrence. North of the Delaware this fish is unimportant and the estuaries of the Chesapeake furnish about one-half of the total catch. The river herring also ascends these same streams in such numbers that

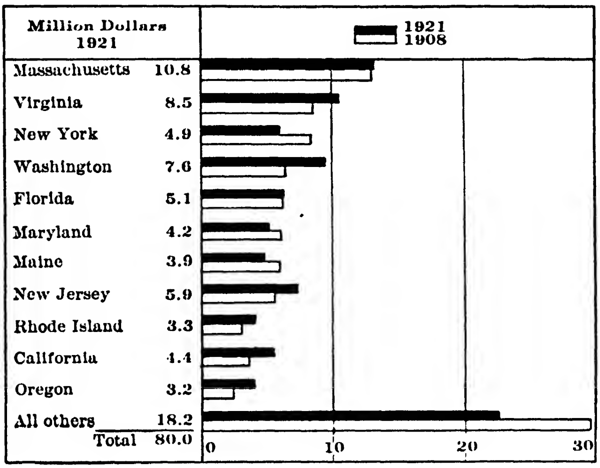


FIG. 139.—United States fishery products by states.

at times their scaly backs make the surface of the water to shine almost like a mirror.

SHELLFISH. The oyster, of which the United States has from five-sixths to nine-tenths of the world's catch, is exceeded in value only by the salmon. This delicious shellfish, which furnishes about one-sixth of the total value of all fisheries of the United States, lives on the sandy and gravelly bottom of shallow bays and estuaries. It is found to some extent in the English Channel and the Bay of Biscay and on the Pacific coast of the United States, but the numerous bays between Cape Cod and Galveston, with their large expanses of shallow water of suitable temperature seem to be the best place in the world for oysters. The oysters of best repute are produced between Cape Cod and Cape Hatteras, and the Chesapeake Bay, an old river valley into which the sea has flowed, is the most important oystering district of all, while Long Island Sound is second. The middle Atlantic states have two-thirds of the total American oyster product. The oyster, after being hatched from the egg, swims around for a time and then attaches itself to some firm substance, such as gravel, an old oyster shell or sunken wood. For two or three years he eats whatever the tide brings him, and is then scooped up with long-handled tongs in the hands of an oysterman or by a steam-drawn dredge. During the seven or eight months of the oyster season they are shipped in barrels and sacks and iced containers all over the United States and even to Europe, while at Baltimore there is a large canning industry. The shells are ground and used as grit for poultry, or as lime for the soil to counteract acidity. The natural supply having been found inadequate, oyster culture has been established. Beds of young oysters are sometimes planted, that is, put down to grow large; another method is to lay old oyster shells and the bushy tops of trees upon the bottoms of the bay so that there may be something to which the floating spawn may attach themselves and grow. Although the oyster fisheries have decreased by 50 percent in the past twenty years, the possibilities of extension by artificial culture in Long Island Sound, and in Delaware, Chesapeake and other bays are very great.

Clams and lobsters yield greater cash return to the American fisherman than the codfish. The clam is a cousin of the oyster but possesses power of locomotion and is caught by being dug out of the mud. It is especially important along the New England and middle Atlantic coast.[7]

The much-prized lobster, a great crayfish and cousin to the crab, lives along the seashore and, from the mouth of the St. Lawrence River to the mouth of the Delaware, is caught in a baited box trap

[7] "The bottoms of millions of acres of shallow waters are studded with albuminous jewels called clams. There are parts of the northern coast from Maine to Labrador where these are so abundant that they actually constitute a considerable proportion of the floor of the bays, and yet they are for the most part unused. A thousand years from now many of the neglected mollusks and still lower forms of animal life in the sea will be served in the form of delicious tempting repast upon our tables. . . . The relative value between sea foods, which cost man little or nothing to raise, and land meat which costs man a great deal to raise, show no considerable differences excepting in the large fat content of land meat."—*A Surgeon's Philosophy,* by Robert T. Morris, M.D. Pages 239 and 240.

called a lobster pot. The high esteem of the lobster causes it to bring about four times as much per pound as the codfish. The consequent keen prosecution of the lobster fishing has caused the passage of severe laws (rarely enforced) to prevent its extermination along the shores of the United States. Most of the present supply comes from Canada, the Newfoundland export of canned lobster being important.

THE SPONGE. The sponge of commerce is the fibrous skeleton of a marine animal whose jelly-like body is washed out before the sponge is dried for shipment. The sponge grows at the bottom of warm shallow waters, the finest sponges coming from the Mediter-

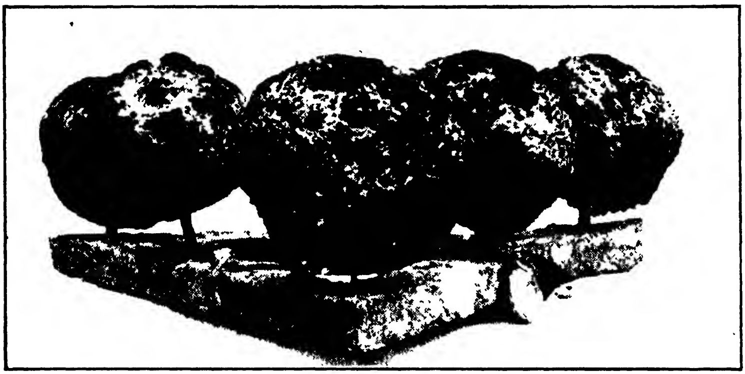


FIG. 140.—A new conquest of science. Bits of sponge wired fast to cement frames have grown nicely in Florida waters.

ranean coast of north Africa between Morocco and Tunis, and the Adriatic Sea. They are commonly found here to a depth of 150 to 200 feet and are brought up by divers. In the still, shallow water around the coral Bahama Islands and off the southwest coast of Florida near Key West they are torn from the bottom by a hook attached to a pole 10 to 30 feet long. Nassau in the Bahamas is an important sponge-fishing center. Tarpon Springs, Florida, the center of the American sponge industry, is the headquarters for the Greek divers[8] who bring from their beds on the rocky bottom of the Gulf of Mexico the sponges that are regularly auctioned in bunches at the local sponge exchange. The growing scarcity and

[8] The head of the Greek church in America blesses the industry in the elaborate ceremony of its annual opening. For similar cod fishing event, see Smith, J. Russell, *North America*, p. 38.

high price of free sponges has led to experimentation with sponge-farming, seed sponges being fastened to weights and put upon the sea bottom to grow.

PEARL FISHING is a shore fishery not possessed by the United States, since the pearl is found in the shell of certain inedible oysters that inhabit tropic waters. The pearl is a product of accident, being deposited around some foreign substance that gets inside the oyster shell. The output of pearls is, therefore, uncertain and often the fisheries are non-productive. The finest pearls and most important fisheries are upon the southern shore of Persia in the Persian Gulf, where for ages this industry has been important. The shores of Ceylon also have a pearl fishery. America has two pearl fishing centers, one in some small islands along the coast of Venezuela, the other in the Gulf of California. In addition to pearls, the pearl-like covering of the inside of the shells of these oysters is sold as mother-of-pearl. A similar pearly shell used for button making is yielded to the extent of 30,000 tons per year, by certain mussels inhabiting the upper Mississippi River and some of its tributaries.

THE IMPORTANCE OF FISH TO THE ATLANTIC PLAIN OF THE UNITED STATES. In the central part of the Atlantic Plain of the United States, unusual fish resources combine with many other resources, to make the peninsula between the Chesapeake Bay and the Atlantic Ocean one of the most favored places in the United States or the world for the easy support of the human race under physical conditions that place no serious handicap on man. The climate is wholesome, the varied soil, abundant, well-distributed rainfall and satisfactory temperature permit the commercial production of an unusual variety of grains, fruits, and vegetables, while wild game and fish products reach their maximum of abundance. It is the greatest oyster, shad and herring locality and many minor fish are caught. Herring are so abundant that the laboring man may in the springtime buy a thousand for a few dollars, and with a sack of salt and a barrel they can be preserved for the entire year. As herring and corn bread make a sustaining meal (materials costing three cents) for a working man, living is exceeding cheap.

The advantages of this peninsula are in the main typical of the whole Atlantic coastal plain that extends from the fall line on the Atlantic rivers, to the ocean, and includes Long Island and Florida.

Fish in southern waters. It is a fact that southern waters contain more species of fish but fewer fish than the colder waters of the north. The heat causes fish to spoil quickly, rendering difficult the marketing of the product. Recent improvements in means of artificial refrigeration make it possible to catch fish in the waters of Florida or the West Indies, freeze them at once, and market them weeks later in New York and Europe, in the same way that fish are now marketed in the winter season in those markets from the waters off Vancouver Island and other distant places. We may, therefore, anticipate a development of the fishing industry in southern waters.

Fish culture. Many centuries ago the Chinese and Japanese found out that fish growing in ponds and rivers is one of the easiest ways of getting meat in a densely peopled country. Oyster culture was an art among the Japanese a century before the Declaration of American Independence. The German people are also systematic fish growers, devoting themselves chiefly to the carp, a fish that can be fed in a pond like poultry in a yard. There are many fish growers' associations in Germany and the total area of fish ponds approaches 200,000 acres. In Saxony one-half of 1 percent of the area is covered with fish ponds. (Compare with the 3 percent under cultivation in Cuba.) The fish are fed upon corn, vetches, potatoes, malt, snails, slaughter-house refuse and many other foods. The average yield is about 100 pounds of fish per acre per year and much higher yields are sometimes made.[9]

The threatened extermination of many valuable species of fish has led to systematic fish culture which has thus far been chiefly devoted to collecting the eggs, hatching them and caring for the fry for a short time. The United States government has a fish commission which hatches billions of fish eggs and releases the fry in streams and lakes to replenish the supply. There are several salmon hatcheries in Oregon, Washington and Alaska, shad hatcheries in the eastern rivers, lobster hatcheries upon the New Eng-

[9] Experiments in pond culture of the buffalo fish have been conducted by the Fairport (Iowa) station of the Bureau of Fisheries for several years. In a pond used in the experiments the progeny of eight fish at the end of the season numbered 98,000 fingerlings from 2 to 5 inches long, a product equivalent to a yield of about one ton of fish to the acre.—*Annual Report of the Commissioner of Fisheries*, June 30, 1922.

Four hundred and fifty pounds live weight is meat limit per cultivated acre in corn and alfalfa in Illinois.

land coast, and hatcheries upon the Great Lakes for whitefish, lake trout and other fresh water varieties. The governments of Canada, Norway, Switzerland and Germany are also aiding the industry by the same means.

FISH IN COMMERCE. Foreign commerce in fish is not important in the countries having the greatest industry. The United States and Great Britain consume about as many fish as they catch, Ca-

FIG. 141.—The codfish, dry as a bone, hard as wood, and keeping indefinitely, is admirably fitted for the tropic market. A Porto Rico grocery. (Photo by Miss Helen Fogg.)

nadian fish coming into the United States to replace the salmon and sardines exported. The United Kingdom exports herring to continental Europe and imports American salmon and French sardines in their stead. Labrador, Newfoundland, Nova Scotia and Norway, lands of small population, export the greater part of the fish they catch, chiefly cod, with herring second in importance. The great fish-importing countries are Italy, Spain and Portugal, where the Catholic church lays certain restrictions upon the use of meat and the poverty of the masses of the people limits them to a food that is cheaper than meat. The Latin-American countries and Brazil are also important fish importers for the same reasons that exist in south Europe and the added one that in such hot climates fresh meat and fresh fish spoil very quickly while the dried cod, resembling a piece of wood in hardness, appearance and durability, keeps indefinitely even in hot climates. The dried cod or stock fish is, in combination with corn bread or corn-meal mush, a staple article of diet alike in Venice and Valparaiso, Lisbon and Yucatan.

POSSIBLE FUTURE OF FISHERIES. Oceanography is an undeveloped science. The sea is an unknown resource. Perhaps its fisheries offer our greatest possibility of easy extension of the human food supply. When we consider that three-fourths of the earth's surface is sea and that it teems with microscopic plant life and animal life, nearly all of which has food value, we begin to see how great may be the possibilities of its full utilization.

Our ignorance of it is well illustrated by the fact that Europeans made revolutionary discoveries in the art of càtching sardines in the year 1900 and again in 1915.

We see the limiting influence of prejudice in observing the way we have thrown away the flesh of thousands of whales per year when it is about as good and nutritious as beef.

The chief bulk of marine life is not in the whales or the fish we now eat but in the smaller forms, mollusks the size of a grain of corn or grain of wheat or a lead pencil point that move about the sea in masses containing innumerable millions. These small fry, the food of the present food fish and of whales, are nutritious for us also, and the art of food preparation and preservation can make them good to eat and keep them till wanted. The airplane is already coming into service to discover these and other schools of marine life which men may catch.

Most suggestive of all, however, for prompt results, is the discovery, now well established, that fish meal in combination with the existing rations, reduces the cost of producing both beef and pork. While we are slowly, through the generations, learning to eat semimicroscopic mollusca, the sea may be quickly patrolled with airplanes, guiding the floating factories to the masses of mollusca which are scooped up and turned into cargoes of cow feed and pig feed for the indirect nutrition of humans.

REFERENCES

See General References

Publications of United States Bureau of Fisheries, Washington, D. C., give much valuable information as to the conditions of the industry and the attempts now being made to improve it.

CHURCHILL, E. P. "The Oyster and Oyster Industry of the Atlantic and Gulf Coasts." Bureau of Fisheries, *Document* No. 830, 1920.
COBB. J. N. "Pacific Salmon Fisheries." Bureau of Fisheries, *Document* No. 902, 1920.
BOWER, W. T. "Alaska Fishing and Fur Seal Industries in 1923." Bureau of Fisheries, *Document* No. 951, 1923.
TOWER, W. S. *History of American Whale Fishery.* Ginn, Boston.
SETTE, O. E. "Fishery Industries of the United States." Bureau of Fisheries, *Document* No. 976, 1923.

CHAPTER X

THE FUNDAMENTALS OF MANUFACTURE

This universe in which man lives is one continuous carnival of power, a veritable saturnalia of power—physical power, energy.

If some supercyclopean hand should grasp this spinning ball, the earth, with force enough to stop its 25,000 miles per day momentum, the thing would split up into myriad pieces, a great dump of rock, with a little water and loose dirt far down out of sight in the mass.

This earth speeds forward on its yearly journey around the sun at a rate of over a thousand miles a minute. If it should bump into a solid, unmovable object the force of impact would fuse the earth into molten lava in the first instant, and turn it into white hot gas in the second instant. The final conflagration pictured by the author of Revelation would be but a burnt match in comparison to this celestial flare—a new sun, gaseous, white hot and radiating heat rapidly into space.

Yet more. The earth rotating, revolving, is but a part of our solar system, the whole of which is flying headlong through space. Let us hope it doesn't bump into anything big. Every meteor is a little bump.

This solar system, rushing, revolving, rotating, with forces of inconceivable origin, carries with it an automatic power plant, the sun, which continuously hurls energy off into space. Of this heat and light the earth receives but a $\frac{1}{1,200,000,000}$ part, but see what it does for us! It supports all earthly life. By unequal heating of the different parts of the earth's surface it makes all the winds. The winds in turn blow the ocean into currents, make the waves to eat up continents, and continually pick up the waters of the sea, lift them high into the air, carry them away over the continents, and wearying of them drop them down as rain. We see a tiny scrimption of this wind power as the water runs back to the sea, and we talk about tens of millions of horse power of water power.

What is man in this universe, with its saturnalia of power, endless, unmeasured, unmeasurable? Despite his splendid self-assurance, man is a very small creeper who lives in a narrow crack between the bottom of the air and the top of the earth. Narrow indeed is the crack in which the creeper must stay. He cannot go high into the air or deep into the earth—the earth where nature has wrenched and twisted, blown and beaten, piled up, worn down and spread out her leavings. After all it is only one of the lesser cosmic scrap heaps.

Here on this scrap heap the creeper is a kind of salvage man, continuously culling over the tailings of the universe, looking for scraps that he can use in his little games. For a long time, as he counts time, he got nothing but a few small third-hand products of energy—the plants and animals. Of late the implements of the hunt have improved and the catch has picked up greatly. Frequently now he finds a new scrap of power that he can use—a bit of breeze for his windmill, a bit of falling water, a few bits of dead moss (coal), some remains of dead fish (petroleum and natural gas).

He is wonderfully pleased with himself when he finds these things and he has a right to be, for they have entirely changed the conditions of life among the creepers in the crack. But the creeper has thus far been able to pick up only the tiniest of tiny crumbs that fall from the table of the universe—with its endless feast of limitless power. The big finds are yet to come—perhaps.

Every one of our manufacturing industries is directly dependent in the first instance on some form of power. In addition to power man must have raw materials, human labor, and capital. The ease of financial and commercial transfer make capital so mobile that it can go wherever the other conditions demand it, but the location of raw materials, power, and labor is more fixed because of factors most of which are geographic.

The discussion of particular manufacturing industries should follow the presentation of some elements common to all manufacturing industries. The first of these is the human element, labor, and especially the relative abundance of labor and natural resources, a relationship exercising strong control over manufacturing.

I. RELATION OF LAND AND POPULATION TO MANUFACTURE

CHEAP LAND OPPOSES MANUFACTURING.. Where the population is scanty there is much land for every inhabitant, but where the population is dense there is little land for each individual. We all get our living directly or indirectly from the land. Land is, therefore, man's great opportunity, and where there is little of it per person, there is less opportunity to work; therefore, other things being equal, less return for labor, lower wages, and a necessarily lower standard of life. This is usually the most important fact in explaining the industrial history and industrial condition of any nation.

Manufacturing is chiefly carried on by people who work for others, but in America, from the date of earliest settlement to the present, there has been, because of our scanty population and abundant land (cheap land), much greater opportunity to work for one's self and less necessity to work for others than there has been in Europe.

CHEAP LAND MAKES INDUSTRIAL PROBLEMS AND ALSO SOCIAL PROBLEMS. When the first English settlers established themselves at Jamestown in Virginia, and discovered the profit of tobacco growing, enterprising and capable men, seeing the abundant land, said to themselves, "Here is a fine chance to grow tobacco to export to England and make money." The one remaining requisite was labor. But each settler had the same opportunity to take up free land and each preferred to work for himself rather than to work for his neighbor. If newcomers were brought from England they too could work for themselves, and thus every energetic man wanted many laborers and could get few or none. Out of this labor scarcity, slavery arose, whereby the Englishman could control his labor. Similar situations produce somewhat similar problems wherever they arise. At the present time in Queensland, the northern state of Australia, there is a large extent of country where it is too hot for white laborers to work in the fields and there are few colored men there. Therefore labor is as scarce as it was in the Virginia Colony. Similarly the white men who own the lands could superintend large numbers of East Indian, Polynesian, or Chinese laborers if they could get them. But this would result in Queensland becoming essentially an African or Chinese or Polynesian community, with but a small percentage of white people. This the other Australians do not wish, and, therefore, they will not permit the Queenslanders to import a single coolie, although the population is only one person per square mile. The North and South problem is there also a bitter one, as it was in America in 1861 when the South wanted slaves and the North did not.

In South Africa the great gold mines of Johannesburg and the diamond mines of Kimberley, require large amounts of labor in a country where nine-tenths of the native population are Kafirs. These natives are too lazy and too few to do the work regularly, and the white men who make a small minority of the total population are also too few. The difficulty has been met by importations of large numbers of Chinese workmen. These coolies were brought by the mining companies at their own expense under government supervision, and they will be deported at the expiration of their terms of service, because the British government does not want an Asiatic population permanently in the colonies.

CHEAP LAND CHECKED MANUFACTURING IN AMERICAN COLONIES. All through the eighteenth century and down to the year 1815, while manufactures were developing in England and manufacturing towns were arising, the young man of America could choose between manufacturing or taking a pair of oxen, a wagon and a few implements and going into the forests of western Massachusetts, New York, Pennsylvania, Virginia, or across the Alleghenies. Here by felling trees, building a log house and clearing a field, he could make a farm. The forest was to be had for the taking, and the young men built frontier settlements rather than go to factories and cities.

THE FREE LAND OF THE NINETEENTH CENTURY. With the means of transportation then in use, our resources were relatively used up by 1810. Good farming depended upon good transportation and good transportation in the United States depended on natural waterways. Since farm products could only be shipped from near the banks of navigable streams such desirable land was comparatively limited in amount, and very valuable and profitable during the period of high-priced grain produced by the European import during the Napoleonic Wars. The cessation of these wars lessened the demand for American grain and meat. This lowered the profits of farming, the value of farms, the amount of employment, and the rate of wages, which became lower in the eastern United States than they have ever been since. The low wages were produced by the removal of the European market, but they quickly vanished with the coming of the steamboat and the railroad, which placed new resources within the reach of the people along the Atlantic seaboard. The American people who had been clustered along the seaboard and navigable rivers suddenly found themselves able to take possession of the whole continent, and the vast flat prairies of the Mississippi Valley at once became available for settlement. For decades the land was given away by the government to the homesteaders and three generations of Americans triumphantly and truthfully said that "Uncle Sam has a farm for every one of us." From 1816 to 1890 people went from the east to the new west by tens of thousands each year. The records of this population movement exceed anything that has previously occurred in the history of the world. The population of Indiana went from 157,000 in 1820 to 476,000 in 1840, to 851,000 in 1850, to 1,711,000 in 1860. Illinois went from 53,000 (1820) to 155,000 (1830), to 472,000 (1840)to 846,000 (1850), to 1,704,000 (1860) and to 2,511,000 (1870). The tide of emigration crossed the upper Mississippi about the middle of the century and the population of Iowa increased from 192,000 to 674,000 in the decade 1850 to 1860. The population wave reached Kansas the next decade and a population of 107,000 in 1860 reached 364,000 (1870), 996,000 (1880), 1,428,000 (1890), and then the increase suddenly ceased, 1,470,000 (1900). As our facility in land conquest increased the filling of states became more sudden. Nebraska rose from 122,000 (1870) to 452,000 (1880) and 1,062,000 (1890), and in the next ten years it remained practically stationary because droughts checked the farmers' prosperity and the waves of emigration rolled on to another new and empty frontier. Oklahoma, for example, newly opened to settlement, increased from 258,000 (1890) to 790,000 in 1900 and 2,000,000 people in 1920. So excellent were the opportunities to go west and get fine land for nothing that in many parts of the east people actually abandoned their farms. Because of this western emigration the population of Virginia was practically stationary between 1820 and 1840, that of Maine and New Hampshire actually declined between 1860 and 1870, while the practically stationary figures for Vermont 314,000 (1850), 315,000 (1860), 330,000 (1870), 332,200 (1880), 332,400 (1890), 343,000 (1900), 355,000 (1910), 352,000 (1920) are typical of what has happened in many agricultural districts throughout the east in the same period.

Eastern farm lands, often as productive as ever, declined in selling value because of the competition of the western land, and the man who wished to farm could begin easily either east or west. Owing to the influence of these forces it is plain that the factory that succeeded in getting workmen had to pay high wages to make them stay, and for that reason American wages became high and remain high. Immigrants came from Europe often by hundreds of

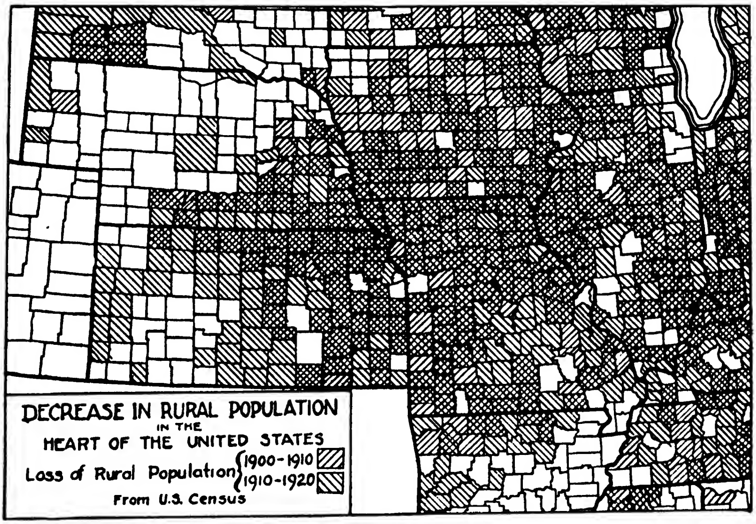


FIG. 142.—Map showing the counties in five Corn Belt states that lost population between 1900 and 1920. This is in part a tribute to the efficiency of agricultural machinery and part to the cheap land of the farther West.

thousands a year and although they landed at New York and other eastern ports many of them went to the west where land was free and wages high. Thus the Germans, the Swedes, the Norwegians and the Danes settled county after county in the states of Wisconsin, Minnesota, and the Dakotas.

Since 1895 the irrigation settlements in the region beyond the 100th meridian have kept before the American people the opportunity to go west and since 1900 there has been an enormous opening up of Canada, where new railroads have been built across the open level plains and where, in the attempt to attract settlers, the Canadian government has advertised in Europe and even in the

United States the fact that it was giving good land away. History has quickly repeated itself. The Mississippi Valley that was filling so rapidly in 1850 has for a time begun to empty itself into other frontiers. So rapid has been the emigration to Canada that the young man of the corn belt has been able to choose between taking up a free farm in Canada or working for high wages in Iowa. So many went to Canada between 1900 and 1910, that the population of the splendid fertile state of Iowa declined as it also did in other parts of the corn belt.[1] During the decade laborers were very scarce in the corn belt, and crops were sometimes ruined because there were no men to harvest them. Thus farm laborers in the northern Mississippi Valley near to free land get nearly twice as much wages as those in the valley of the Potomac, who are far from free land. Free lands in Canada, through their influence of possible employment on Iowa and other parts of the United States have actually made higher wages for the street sweeper or factory worker in New York City, for only by increase in wages could the laborers be kept in the east.[2]

New resources have same effect as new land. The effect of abundant natural resources and especially of newly discovered or newly utilized resources upon wages and industry has been sharply illustrated many times in the settlement of this continent. When gold was first discovered in California, there was an enormous rush of miners from every state of the Union and every country of the world to dig up this gold from the sands of the California rivers. These thousands in a frontier devoid of farms and food producers had to be fed, and enterprising persons loaded sailing vessels with flour and provisions and sailed to San Francisco to sell at fabulous prices. But as any man could go out to the hills and dig for gold, the rate of wages rose to $10 or $15 per day. This was too strong a temptation for the sailors on the flour ships and they, like the soldiers of the United States garrison at San

[1] Sixty carloads of emigrant goods left one Iowa town in one day in March, 1911.

[2] The period 1921-22 showed the same philosophy, making an interesting reversal of facts. The dependence of the spring wheat country of Dakota upon the European market which was depressed caused the exact reversal of frontier conditions, namely, depressed prices, declining acreage along with the low prices and therefore agricultural depression. Therefore farm wages made a greater post-war shrinkage in this section than in any other part of the United States.

Francisco, regularly deserted until at one time there were 100 idle ships lying in San Francisco bay because the crews had been tempted away by the higher returns of working for themselves.

At Cape Nome, Alaska, on the shore of the Arctic Sea, report of gold discovery some years ago brought a rush of thousands of men who when they got there strove for the chance to work for $3 a day in the few claims that made up the one gold-yielding creek. Suddenly it was discovered that the sands of the seashore were full of gold where each man could wash out $10 worth per day, and that sum promptly became the rate of wages in all the settlement.

The opposite influence has been lately shown in southern California, whither thousands of people have gone from the east to benefit their health in the gentle climate of the south Pacific coast with its warm and even-tempered winters and dry summers. The sudden influx of persons attracted by health rather than resources has caused an overcrowding of many occupations and the compensation has, therefore, become surprisingly low in comparison with the general level of wages in the western country.

THE EASE OF LIVING IN A SPARSELY PEOPLED COUNTRY. Where population is scarce and the climate favors vegetation, many things grow naturally and are to be had for the taking—free goods. These conditions prevail to a greater or less extent throughout many parts of the United States, but especially south of Pennsylvania and the Ohio and Missouri Rivers and west to the limit of the eastern forest area. This whole region was originally forest covered, and more than half of it is yet covered by some kind of forest growth. Logs and timber are still abundant for the building of houses and the winter, milder than that of the north, permits a cheap house to suffice. The same climatic conditions make less demand for fuel and this the abundant woods still furnish in most rural communities.

While natural conditions, therefore, make houses and fuel cheap, custom permits cheap clothing. A large part of the expenditure of city people for clothes is for style rather than for protection, and the inexpensive cotton suit is about as durable as a woolen suit costing several times as much.

FREE FOOD IN SOUTHERN STATES AND ITS INFLUENCE ON MANUFACTURE. It is in the matter of foods that the free goods are most abundant and most helpful in cheap living. From the Rio Grande to the Delaware Bay the first bright days of spring bring a run of fish upward from the sea in thousands of creeks and rivers, and in these regions a family can eat fish as surely by sitting on the stream bank and catching them as can the family that sends to a city market and pays money for them. The herring which can at this season be caught in nets by the millions is sold so cheaply that a few dollars will buy enough to fill a barrel and supply a family

FIG. 143.—Mazzard cherry tree on campus of Swarthmore College. This variety, often very productive, grows wild in much of the East and South, and the fruit is so abundant that anyone may pick all he desires—free goods.

with salt fish for the rest of the year. Before the frosts are over the spinach and lettuce of the city market are duplicated by various spring greens which are to be had for the cutting throughout the fields of the southland. In parts of the south a law permits every man to pasture one cow along the roadsides, and in other districts pasture for a cow can be had at from $1 to $2 per month. This family cow, giving from 4 to 12 quarts of milk per day, is a cheaper source of supply than the city milkman, charging from ten to twenty cents per quart. In May and June, wild strawberries are to be had for the picking, as are also the black heart and red heart cherries. These cherry trees grow naturally along the fences and open woods on thousands of roomy farms from Pennsylvania southward, yields of 10 bushels per tree are not uncommon, and the fruit is often wasted because there is no one to use it. After the strawberries and cherries come raspberries and the raspberry season merges into the blackberry season. These two productive briars are regarded as weeds over a territory covering a million square miles in the United States and in most of this region it is common custom for any one to pick the wild berries wherever they may be found away from the immediate vicinity of a farm house. The blackberry season merges into that of the huckleberry which grows in such abundance in swamps and on mountain sides that they usually have no sale value whatever until they are picked, and they are commonly regarded as free property which any one may pick. Once picked they are often a considerable source of rural income. After huckleberries come peaches, which grow wild like the cherries along the fence rows in some localities. In autumn comes the persimmon, sweetened by freezing, to hang upon the trees all winter waiting to be eaten. Throughout the lowlands and upon the moist hillsides the black walnut, which is nearly as nutritious as the high-priced English walnut (Persian walnut) is so common that it often lies ungathered on the ground. Before the first frost the chestnut burrs are opened and this sweet nut has long been an important food supply, a money crop of no mean importance and the people roam at will through the woods picking them up for shipment to all the great cities of the northern and central part of the country.[3]

The generosities of nature do not end here. The natural meat supply does not stop with fish. In late August and September the young squirrels are full grown and a good hunter can at times get five or ten before breakfast. With frost the opossum is fat and colored men in the south sometimes report the catching of sixty opossums in a single season, thus getting a meat supply which was quite as abundant as could have been bought with the wages earned by arduously working on a trolley track on a noisy street. More-

[3] Unfortunately the ravage of the chestnut blight which started in Brooklyn in 1904 is now sweeping through the chestnut forests of Appalachia and ending this nut as a source of food for this generation.

over, opossum hunting is generally considered more fun. With the falling leaves the oak trees shower down their acorns, the natural food of the hog. Often allowed to run at large in the forests, by December these hogs are fat enough to slaughter for the year's supply of ham and bacon.

In addition to these free offerings of nature there is a garden to almost every house in the country districts and small towns of this part of the United States where, if a man desires, tobacco can be grown, while the sweet potato and a few hills of peanuts supply his needs in these directions and the "roasting ear," the partly ripened ear of corn, is a great standby of summer diet.

The working man in this region has two alternatives. He may work regularly, get wages and buy food, or he may work occasionally at the spasmodic labor of the farm and get an equal amount of food by going hunting, fishing or berrying—facts of profound influence in checking the developing of manufacture.

THE EXACTING DEMANDS OF MANUFACTURING. Manufactured goods are produced in a factory that should start Monday morning at the blow of the whistle and work on a schedule until Saturday afternoon. This is an exacting demand upon labor. Throughout the sparsely peopled district, with the abundant free goods above mentioned, most of the laboring population think they are just as well off if they occasionally stop work and go fishing or berrying or hunting, and they go. If they want to go to farming, land is cheap in comparison to the prices in the North Central States or Europe.

There are some counties in the tide water region of the Atlantic Plain where almost the entire laboring population is negro and when August comes most of the crops have been cultivated, the plowing of corn is over, wages are in hand, and roasting ears, garden produce and blackberries are to be had, and it is the unwritten custom that nobody works in August. These conditions help to explain the absence of large manufacture in these territories, which are the superiors of busy New England in the manufacturing resources of raw materials, power, and natural ease of transport.

In the colder north nature demands more of man. On the treeless prairies of the Mississippi Valley, there is no free house material, no free fuel,[4] the fertile level prairie is all cultivated, so that

[4] Therefore the early settlers of Illinois and adjacent areas made their homes not in the open prairie but in the broken wooded lands along the

the fence corner crops of fruits and berries are not so abundant. While the returns of industry are probably greater the temptations of free goods are distinctly less and manufactures are therefore a greater dependence of the people in the north central and northeastern states, where man must depend more upon his own efforts than is necessary in the south. This is one of the reasons why manufacture has developed more in northern districts.

THE EUROPEAN LABOR SUPPLY. The chief difference between the life of the people in America and in Europe is explained by the factors already mentioned in this chapter. In Europe the result of density of population is clearly brought out. While the average

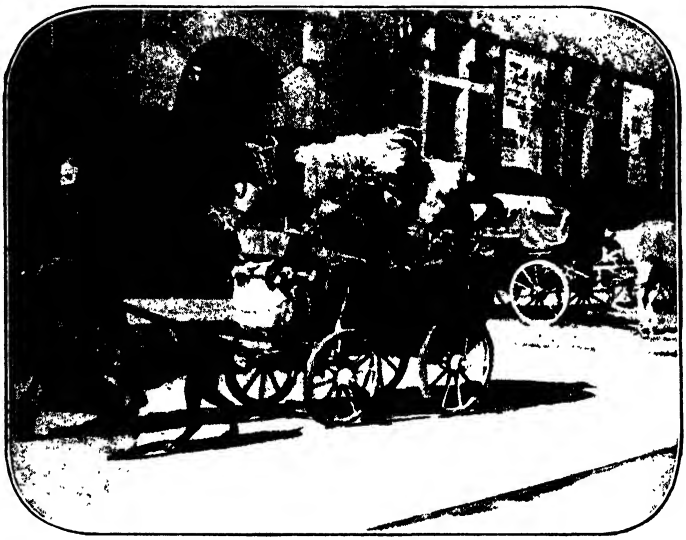


FIG. 144.—In densely peopled Saxony the peasant woman and the dog are draft animals. Factory labor is abundant.

population of the United States is 36 per square mile, that of Germany is 311; in Holland it is 536; and in Belgium it is 658, or more than one person to each acre. This denser population makes great demands for food, which in turn makes necessary the careful cultivation of land and the consequent high yields give the land a high price, often several hundred dollars an acre. It often costs as much to rent a field for a single year as it does to buy land in the

streams. Thus the Ozarks were for the frontier generation better than the rich and treeless prairies of Iowa.

southern or eastern part of the United States. Over large parts of the territory there are no fence rows with berry bushes, fruit and nut trees because there are no fences. All the land is tilled, and one man's grain field touches his neighbor's as do two connecting lawns that have no fence between. The roadsides are often lined with fruit trees, but they are not the free gifts of nature to be taken by any one in the neighborhood, but a crop grown by the farmer or even by the local government and sold like any other crop. It is a region of little land per man. He who eats the product of the land must either produce it with much labor or buy it. Food prices are high, and wages are low. Under these conditions people must work, and work regularly, and a great difficulty is to get a chance to labor. Thus the factories can get laborers and northwestern Europe with its dense population is a veritable hive of manufacturing industries.

The emigration of many million people from the crowded section of Europe to the cheap lands of America, Argentina, South Africa, and Australia has to some extent raised European wages in the same way that higher wages resulted from the similar emigration of people from the eastern to the western states.

THE INDUSTRY OF THE CHINESE. In the more densely peopled Orient these relations of mere resources and wages are still more pronounced. China proper, which does not differ greatly in size and resources from that part of the United States east of the Mississippi River, has five or six times as many people. For many generations their numbers have been so great that they could support themselves only by diligent labor, in agriculture and in household industries. As a result the work habit is so thoroughly established among them that they are among the most industrious people of the world and the best of laborers. By their thrift and energy and ability to live on little they are able to crowd out the white races in economic competition. As a result mere self-protection has compelled Chinese exclusion by all white nations to whose lands they have attempted to emigrate in large numbers.

2. IRON AND STEEL

So great is the dependence of our modern civilization on iron that an abundance of this metal is generally considered an essential part of a nation's wealth. The present is often spoken of as an age of steel and steel is merely a kind of iron. Iron and steel are especially important in the manufacturing industries. Without their extensive use no nation can develop great manufactures. This dependence of manufacture upon iron causes this chapter to be a proper place for the discussion of this fundamental metal, although its use is by no means restricted to manufacturing industries.

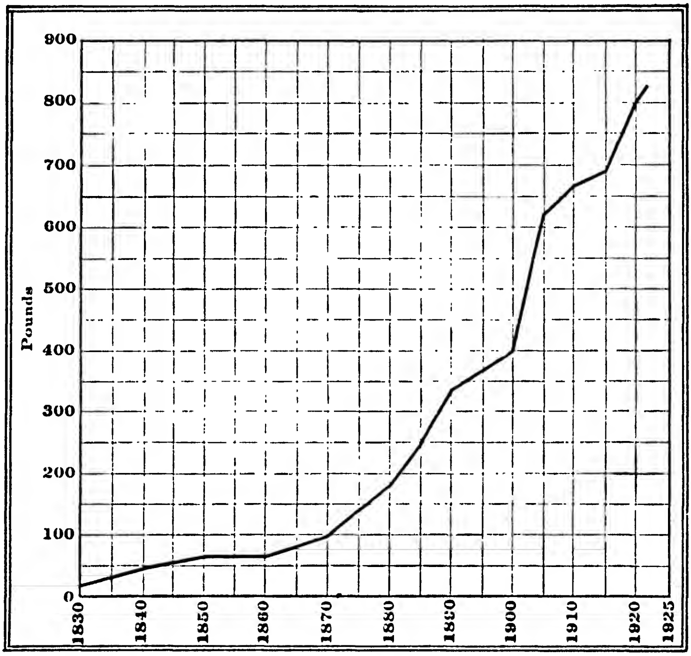


FIG. 145.—Per capita production of pig iron in United States, 1830-1922.

DISTRIBUTION AND USES OF IRON. Iron, the most useful, is also one of the most universal of metals. It exists practically everywhere throughout the earth's crust and is responsible for the red color of clay banks and even of our own blood. Man has found it in many parts of the world and used it since before the dawn of history, but we have of late turned to the earth's stores of iron with renewed eagerness and within a few decades increased our use of it by manyfold. Iron is a twin of coal in the production of the new world commerce, because this commerce is carried in vehicles made of iron, driven by power derived from coal. Our ever-increasing list of manufactures is almost universally produced by machines of iron and steel, while the same material is entering in increasing quantities as a raw material for the equipment of factories, farms, and homes, and all kinds of industrial equipment.

Iron was an industrial luxury a century ago. Now it is an industrial commonplace, since recent improvements in production have reduced the cost and permitted a great increase in production. A century ago the chief users were the blacksmith and the machinist, now it is the construction engineer. The demand used to be for nails, now it is for beams.

THE FORMATION OF IRON ORES. Iron ores are plentiful, but the metal is never found even in a reasonably pure state except in recently fallen meteorites. It is dissolved from almost every hillside by the leaching rain waters, and where a stream of water with iron in solution enters a stream of water with lime in solution, iron ore is deposited. For this reason we have a string of iron deposits in the United States from northern Vermont to central Alabama. They are scattered along the edges of the limestones which are so common throughout this whole region, especially in the Great Valley from Lebanon, Pennsylvania, to Chattanooga, Tennessee, which has many deposits of limestone throughout its extent. Sometimes iron streams flow into small lakes, where lime or certain organisms cause the deposit of the ore in a powder upon the bottom, the so-called bog ore which has at times been quite an important source of the world's iron industry. Bog ore is sometimes collected at intervals as a kind of harvest on lake bottoms in Sweden, but the yield from such sources is insignificant. Where the conditions suitable for the deposit of iron ore continue undisturbed for great periods of time, we have large deposits, veritable mountains of ore, such as exist in the rough country south and west of Lake Superior, in the iron mountains of Mexico, the mountains near Santiago, Cuba, near the Cantabrians of northern Spain, in northern Sweden, and in many other parts of the world.

SHORT LIFE OF MINING INDUSTRIES. The iron industry is typical of the mining industries, which, in contrast to agriculture, are always temporary. At best, the digging of a mineral is the removal of the accumulation of ages, which when once removed is gone forever. The Germans call it "The Robber Industry." The life of a mining town is therefore temporary and uncertain. Such towns rise and fall, or change the source of their support, while an agricultural community may live on undisturbed, tilling the same fields for three or four thousand years, as in parts of China, and the field may even be the better for it. The iron industry especially has roamed from place to place as changed conditions in manufacture, industry, and commerce have made it profitable or unprofitable. It does not depend on ore alone. There must be fuel, labor, and markets, a combination of factors. A change in any one factor may upset this industry as it does so many other industries.

HISTORY OF IRON MAKING. Iron is extracted from the ores by burning off the impurities, the chief of which is oxygen. No ordinary fire will make sufficient heat, but prehistoric man learned how to make a super-heated fire probably by the means still in use very recently in so many parts of the world by peoples with primitive industry, as in interior China or central Africa. A hearth or forge was made with an artificial draught worked by bellows driven by hand or foot or occasionally by the force of a prevailing wind focussed through a funnel so that the fire got hot enough to reduce the iron to a sticky mass in the bottom of the fire. This was purified by pounding and it made a metal the *quality* of which has never been excelled. These forges, like the hand loom, were pretty much alike the world over, and commonly bear the name of Catalan forge, after the Spanish province of Catalonia. The universal fuel for this forge was wood charcoal. Only the best ores could be used and this industry was naturally dependent upon the combination of ore and forest in the same place. This type of apparatus made the world's iron for at least 2,000 years and probably much longer. While good, it was costly, so costly that medieval builders climbed up and dug out of the solid rock of the Coliseum at Rome, the links of iron with which the Romans had fastened the stones together. The refuse of medieval and Roman iron makers was long ago used up as good ore by later British manufacturers.

Toward the end of the medieval period the forges were made taller, and the draught was made stronger, until finally it was given the name of blast and we had the blast furnace, first used in Belgium about 1340. This new device melted the iron into a liquid which absorbed impurities and was poorer iron than the more expensive product of the old forges, but it could be run off into molds for cooling in convenient forms. This "cast iron" has to be purified before it has qualities other than weight and brittle strength. The blast furnace, like many modern inventions, sacrifices quality for quantity and cheapness.

IRON MAKING IN ENGLAND. The fuel of the early blast furnace, like that of the forge it succeeded, was charcoal, and the iron industry in England came into disrepute in Queen Elizabeth's time and was subjected to restrictive legislation because it devoured so much wood that, to keep itself going, it followed the vanishing forests of England from place to place. In the eighteenth century English iron output declined, and it seemed that the English iron industry was doomed because of the limitation of the fuel. There was large iron import from the pine forest districts of Germany, imports from the new American colonies across the Atlantic had begun, and the basis for a great trade was visible between the forested colonies with abundant charcoal material and the bare mother country. But this trade was shattered and even reversed by a single invention, when in 1740 an Englishman named Darby learned how to make iron by use of coal in the form of coke. This gave the English iron industry a new lease of life and it prospered greatly through the period of the establishment of the factory system and the early nineteenth century when no other country had industrial access to such resources of fuel, ore, and labor.

In the middle of the nineteenth century, the railroad, the steamship, the modern factory with its great use of machinery, caused a rapid increase in the demand for iron, and Britain with her good resources of coal and iron ore lying side by side became the leading iron-making country in the world. The location of the iron and coal fields on the west coast of England, southwest coasts of Scotland and of Wales and the east coast of England gave easy access to the sea for export, and later, when the ore supplies ran low in England, it was easy for the English iron industry to turn to a supply of imported ore from the mountains near the north coasts of Spain and from northern Sweden, where in recent years large developments of the iron industry have taken place.

IRON MAKING IN AMERICA. The United States is the twentieth-century leader in iron making, as was England during the nineteenth century. This leadership has come as the result of a number of rapid transformations of the industry in this country. In George Washington's time the little forges or small blast furnaces with a draft forced by a water wheel were scattered from New England to Georgia and from the sea coast to Appalachian valleys in what now seem to be remote and isolated locations. Iron was made wherever the local blacksmiths needed iron, and a good ore bank, waterfall, and the American forest, almost universal in the East, furnished the necessary raw materials. While England was at that time using coke, American coal lay far back in the forests of Pennsylvania and West Virginia, remote from all the paths of easy commerce.

Fortunately for the American iron industry, the first coal field to be developed was the anthracite, which, by its purity and hardness, served well for smelting purposes without being made into coke. Here was a factor that gave one region a heavy advantage over all others and after 1840 we had a rapid concentration of the iron industry in the Schuylkill Valley and other regions adjacent to the anthracite coal mines of eastern Pennsylvania. The old

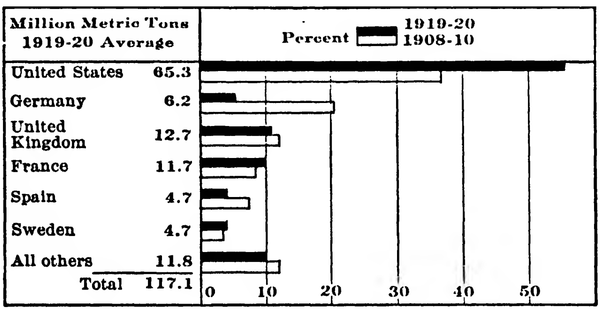


FIG. 146.—World iron-ore production, two-year average.

charcoal forges survived longest in locations remote from the places of superior manufacture and in the isolated mountains of western North Carolina and other parts of the southern Appalachians, where some of them were running for purely local supply as late as the year 1900.

PITTSBURG AND THE UPPER OHIO VALLEY. The supremacy of the eastern iron districts was short because the building of railroads through the soft coal regions of western Pennsylvania caused the introduction there of coke making, for which the coals of the Connellsville Basin were particularly adapted. The iron industry promptly rose in that region and in the year 1875, the 900,000 tons of coke-made iron in that region exceeded in quantity that made with the much more expensive anthracite coal. The enormous development of railroad building after the Civil War made rapid increase in the demand for iron. Pittsburg, with good local ores and abundant coke and coal, was a natural point for the assembling of the raw materials. Being at the head of the Ohio Valley, and the junction of the navigable streams, it was an excellent point for the shipment of both raw and finished products and rose rapidly to be the center, first of the American and then of the world's iron industry. The importation of richer iron ore from the Lake Superior district began in 1884, but in America, as in England, the old English adage holds true in most cases that the ore goes to the fuel, so that Pittsburg held the leadership, although the source of ore supply suddenly shifted from the valleys of Appalachia to the pine woods along the shores of Lake Superior. To bring these ores from the distant mine there have been evolved wonderful mechanisms which load, unload, and carry the ore with astonishing cheapness.

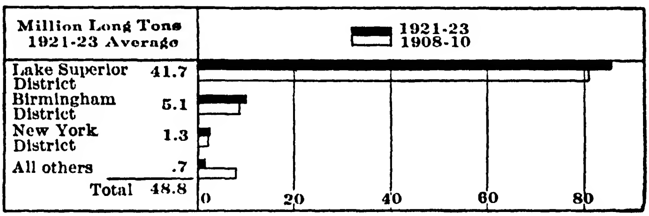


FIG. 147.—United States iron ore production, three-year average.

CHANGES IN THE LOCATION OF THE INDUSTRY. Fuel has been the dynamo that moved the iron industry, as from England to the forests of Germany for charcoal, and back to England for coke; from the forests of New Jersey, Carolina and Maryland to the anthracite of the Schuylkill Valley and thence to the upper Ohio basin for Connellsville coke. The efficient railroad now carries this coke to very considerable distances, but a more potent decentralizing force is now in operation. It is the new processes of coke making which enables the iron maker to get good coke in many coal fields, thus destroying the regional monopoly that existed when all coke was made in the old bee hive oven (see section on coal) and that from Connellsville coal was without a rival. The making of iron is again spreading territorially in response to this widened fuel supply.

There is, at present, a tendency to shift the iron and steel industry using Lake Superior ores from Pittsburg to lake shore points, such as Buffalo, Cleveland, Chicago and Gary. The whole of the triangular region between Pittsburg, Chicago and Buffalo is dotted with towns having some of the iron industries, such as bridge plants, nail mills, wire fence works, steel car plants, and other varieties of iron work. The tendency of the industry to shift to the lake shore points is due to the economy that results from having the blast furnace located beside the ore dock where the lake

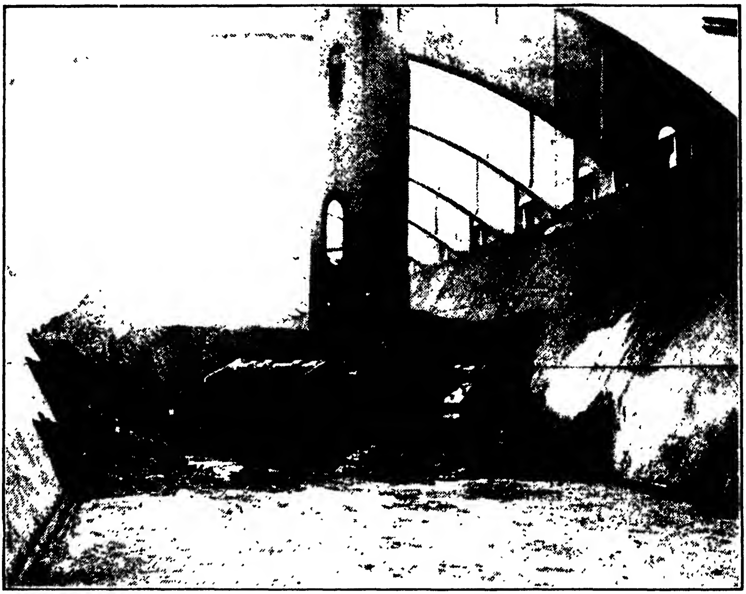


Fig. 148.—Grab buckets of Hewlett automatic ore unloader lifting cargo from the hold of one of the Great Lake boats with its continuously open decks. (Wellman Seaver Morgan Co., Cleveland.)

steamer unloads, as they may at any point on the shores of the lakes from Buffalo to Chicago. Manufacture under such conditions requires one less handling of the ore than is necessary at an inland point like Pittsburg, or Youngstown, Ohio. This economy has been instrumental in causing the removal of the Lackawanna Steel Company's main plant from Scranton, Pa., to Buffalo, and it was also an important factor in causing the United States Steel Corporation to locate at Gary, Ind., on the lake shore near Chicago, the largest and most complete steel plant in the world. This plant is also close to Chicago which is in itself a large iron market.

In northern Alabama, Birmingham, named from the iron city of England, possesses iron-making facilities that probably permit iron production with less effort than at any other place in the world. No other locality has such a natural assemblage of raw materials. On one side of the valley is an open ledge of iron ore, on the other side is the limestone necessary for fluxing the furnaces, while shallow coal mines are but a few miles away. (See Fig. 149. Map of Birmingham District.)

Fairly good transportation facilities place the district within easy reach of the rapidly developing southern markets for iron and steel

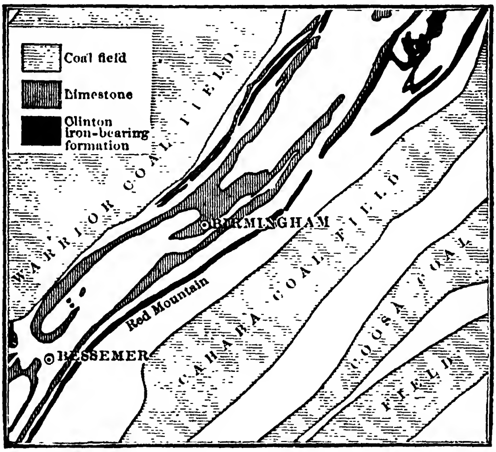


FIG. 149.—Birmingham District, Alabama, showing a relation of iron ore, coal, and limestone which permits the cheapest iron manufacture in the world. (Map after Brigham.)

products. For these reasons the Birmingham district ranks high in the value and importance of its output, and is a leading factor in the industrial development of the South.

Several minor producing districts exist in the United States. At the head of Lake Superior, near Duluth, iron plants have arisen to supply the northwestern market. They use the local ores and coal brought chiefly from Pennsylvania, because the vessels that have carried ore eastward to the Pennsylvania furnaces would otherwise usually have to return to the ore docks empty. Some iron is made of local ores and western Pennsylvania coke on the shores of Lake Champlain, in northern New Jersey, and in eastern Pennsylvania, as at Bethlehem, Lebanon, and Steelton. The eastern Pennsylvania plants are mixing local ores with some from Lake Superior and from foreign countries. The importation of ores into Atlantic ports indicates a revival of eastern iron making. Despite our great riches in iron ore there is an advantage in iron quality resulting from mixing ores. There are many qualities desired in iron, and various mixtures of ore make it possible to produce them easily. Our chief ore import is from the district of Santiago, Cuba, controlled by American interests, to the ports of Baltimore, New York, and Philadelphia, while lesser quantities are brought from Newfoundland, from Sweden, from Spain, from the island of Elba in the Mediterranean, and scattering cargoes from the coasts of the Black Sea, South Africa, and South America. Americans have even purchased and begun to develop valuable ore lands in Chile.

In Colorado, which has local coal and ore, is another new iron center, and, being a thousand miles from any other iron-producing district, is of great importance in the Rocky Mountian region, but the output is as yet only about 1 percent of the total product of the country.

The Pacific Coast, with its scarcity of fuel, high wages, and convenient access to water-borne cargoes of structural iron from eastern plants, has developed only a very small iron-smelting industry. Its shipyards and foundries import most of their material from the eastern States and from Europe, a process that is made easier since the opening of the Panama Canal in 1914.

The Lake Superior fields produce far more iron ore than any other because of the great size of the deposits, their richness, and the ease with which they can be mined. Many of the ore beds are so near the surface that they can be taken from open pits, and so pure that they can be scooped up with steam shovels and loaded on freight cars according to the method followed in digging railroad cuts. It is never lifted by human muscle or touched by human hand until it is finished iron or steel. "Up by steam and down by gravity" is the motto. The ore car runs out onto a high dock, drops the ore through its bottom into ore pockets, thence it drops into the steamer alongside to be lifted out by clam-shell buckets working like human hands but lifting tons at a grab.

STEEL MAKING. Steel is merely a kind of iron which is hardened by an admixture of definite amounts of alloys, mostly carbon. There are several processes of making it. The oldest process called cementation begins by taking cast iron, putting it into a puddling furnace, which is a sort of basin with flames beating over it. The puddler stirs the molten iron in the basin with a rake while the flames burn the carbon out of the iron. When the coarse carbon of the cast iron is nearly all burned out, the iron, then called wrought iron, is very tough, malleable, and ductile. In the cementation process the wrought iron bars are packed in air-tight boxes with charcoal (carbon) and the whole box kept red hot for a few days, during which the carbon is slowly absorbed by the iron. The product, called "blister" steel, has great hardness but lacks uniformity, as the amount of carbon varies from the surface of a bar to the center.

Fine steel was first made by a watchmaker of Sheffield, England, in search of better material for his watch springs. By melting the bars of blister steel in clay pots he obtained the desired uniformity. This method developed into the crucible process, where wrought iron is melted in a clay pot and powdered charcoal or some other form of carbon is put directly in the molten iron. The famous Sheffield tool steel is still made by the crucible process, and is used for fine cutlery, firearms, and instruments of precision.

But the railway and the steamship require a cheaper metal. The great development of world commerce could not begin until after the invention, in 1860, by an Englishman, Sir Henry Bessemer, of the so-called Bessemer process. By this process 20 tons of steel are made in a few minutes by putting molten iron into a large retort through which a current of air is blown violently. The oxygen of the air unites with the carbon in the iron and burns it out. The product is then virtually wrought iron, which is changed to steel by the addition of the proper amount of carbon in the form of high carbon iron called "spiegel-eisen." This quick method makes the cost of Bessemer steel but a small fraction of that of making crucible steel; and so for the 60 years since its invention, Bessemer steel has been of great service in making rails for railway tracks, and steel girders for bridges, elevated railways, and the skeletons of tall office buildings.

Bessemer steel, however, sometimes breaks without warning and the great weight of the present-day locomotive requires a better rail than can be made by the Bessemer process. This new demand is met by a newer, slightly more expensive metal called open-hearth steel. This is made by putting molten iron in a basin over which flames from a gas-fed fire beat for 8 or 10 hours or until the carbon content is reduced to just the right amount, which can be determined by testing. This stronger, more uniform, and more reliable open-hearth steel is used for boiler plates, ship plates, and the best steel rails now used, and is rapidly displacing Bessemer steel. This open-hearth process, enabling the removal of the phosphorus impurity which occurs in many of the Birmingham ores, has greatly aided that district in taking a prominent place in the American steel

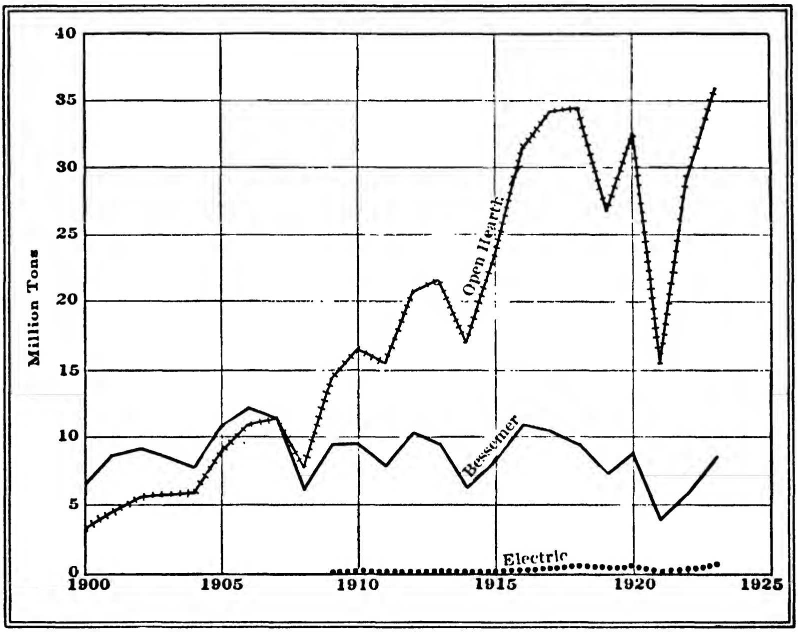


FIG. 150.—United States steel output. Open hearth has proven superior to Bessemer, while electric steel is just beginning.

industry. Open-hearth steel gained the ascendency over Bessemer because the furnaces can be accurately controlled, to meet the scientific needs of modern industry.

THE NEW STEELS. Finally electric steel appeared, first manufactured in Europe where hydro-electric power is abundant, then made in America in 1908. The electric furnace can be regulated even more minutely than the open hearth. Because of that fact electric steel is in a fair way to displace crucible and, although still higher in price, is beginning to compete with open-hearth and Bessemer.

Electric furnaces in the United States have increased from 19 in 1913 to 406 in 1923. The electric furnace is especially adapted to the making of various steels using alloys other than carbon. Their importance is not measured by their quantity but by their high usefulness for special purposes, such as the very hard nickel steel for armor plate for battle ships and industrial uses where great hardness is important. Chrome steel and tungsten steel have the quality of holding their cutting power better than carbon steel does in a metal-working lathe. Through this superior cutting quality a few hundred tons of tool steel have multiplied severalfold the efficiency of thousands of machines and machinists.[5] Indeed they have made man a giant, as he likes to do with himself in fairy tales. Vanadium steel is far superior to carbon steel in its lessened tendency to break without warning—a quality of especial value in automobiles and other vehicles where the continuous jarring of motion causes crystallization with its result—fracture without warning.

IRON AS A WORLD INDUSTRY. Extensive iron making is an industry of countries advanced in manufacturing. It requires excellent transportation facilities, many laborers, much capital to build and operate the enormous plants, and the large market which only a vast population can give. It very distinctly is *not* a frontier industry, and this is just as true in the new states of the United States as it is in Australasia or South America. As a result, three rich and populous countries, the United States, Germany and Great Britain, have long dominated the iron manufacture of the world, making over three-fourths of the total supply. In 1890 the output in million tons of pig iron was: United States, 9; Great Britain, 7.8; Germany, 4.5; in 1913, United States, 31; Germany, 16.5; Great Britain, 10.2. The World War increased iron making, especially in the United States, but the post-war stagnation of industry caused a slump far below the 1913 production. In 1922 the figures were: United States, 27.2; Germany, 8.2; Great Britain, 4.9. France, Belgium, Sweden, Spain, are each producing a little. South America, Africa, Asia, Australia, the East Indies, all the islands of the sea, and all the countries of the Mediterranean do

[5] "The use of tungsten steel for machine tools permits five times the output of work per man and machine possible with the old-style carbon-steel tool. Ninety to ninety-five percent of the tungsten produced goes into tool steel."—From "Certain Mineral Industries," Tariff Information Series No. 21, United States Tariff Commission. (1920.)

not together make as much iron as a single Pittsburg company, though nearly all of them have large quantities of ore.

For instance, the most promising mining enterprise in Brazil is that of iron ore, of which she is estimated to have the largest deposits in the world (*Bureau of Commerce Trade and Economic Review,* 1922). But Brazil has little coal for smelting, and that of inferior quality, still uses charcoal and has only a few furnaces. Lack of both fuel and labor hampers the industry throughout South America, though Chile has a few charcoal furnaces, as has Mexico. With the exception of a few small plants in the Union of South Africa, all of Africa is without iron making in the commercial sense. Even in Australia, where the year 1915 saw the beginning of iron and steel making with abundant raw material near at hand, the industry is not growing because of the lack of an adequate labor supply. All these countries are still in the pioneer stage where the high-paid workers of a sparsely peopled land exchange raw materials for the manufactures made by low-paid workers in more crowded countries.

THE GERMAN-FRENCH IRON INDUSTRY. A bitterly contested coal field extends from the north of France through Belgium into the lower Rhine Valley where it underlies the basin of the historic Ruhr, a branch of the Rhine. Near by are the still more bitterly contested iron fields of Lorraine, one of the great ore fields of the earth. These were seized by Germany at the conclusion of the Franco-Prussian war and the great German industry of the twenty-five years preceding 1914 was based in large part upon Rhenish coal and Lorraine ores which are near together. Then came the World War and the recession of the ore fields to France. Then came some years of jangling, France having the ore and Germany the coal, both of which were necessary for the satisfactory making of iron, but the people could not agree.

In 1925 common sense made advances through industrial negotiation that it could not make through political negotiation. The French and the German iron and coal interests joined by making plans for the exchange of iron and coal so that each group can make iron as its conditions require.

This whole situation is an excellent illustration of the follies of bullet war and the almost equal follies of tariff war which so often provokes the blood-letting variety.

The restoration of iron and coal peace along the Rhine promises renewed international competition in which pre-war Germany was playing such havoc with the foreign trade of both England and the United States.

The navigable Rhine, with cheap transportation by barge, makes possible the import of Swedish and Spanish ores through Rotterdam, Amsterdam and via canal from Antwerp, and the export through these same ports whose steamship lines take the finished products at cheap rates to all the world. The town of Essen on the navigable Ruhr, a river reaching the Rhine below Cologne, is the center of the world-famous German iron industry owned by the Krupps. Some iron is made on the coal fields of central and eastern Germany, but the Rhine valley district (Westphalia) is to Germany what the Chicago-Pittsburg-Buffalo triangle is to the United States. Westphalia with its Rhine boat connection with the world shipping lines has a location from which export is easier than from Pittsburg.

Germany has not exceeded Great Britain as an iron maker because of superior advantages. Germany's natural advantages are slightly inferior, but government aid, science, and energy, and a large population have fostered the industry.

Iron in sweden. Sweden has large iron ore deposits from which she mines more per capita than the United States. These ores, mined near the Gulf of Bothnia, beyond the Arctic circle, are the richest in Europe. A railroad has recently been built from north Sweden across the Arctic mountains to the Norwegian coast, so that the ore may be exported in the winter when the Baltic is frozen over. Sweden has no coal, and like our own Lake Superior ore district, she exports most of her ore. Some of it comes to the United States; most of it goes to England and Germany. With a large percentage (54.8) of her area in forests, Sweden had the wood to keep on making charcoal iron, which is superior in quality to that of the coke-fed furnace, and is much sought by blacksmiths and machinists in many countries. For example, Sheffield (England) cutlery is made of Swedish iron, and the Swedish production of charcoal iron is now giving rise to the manufacture of high-grade machinery in Sweden.

Other european iron production. Bohemia in Czecho-slovakia has nearly all the coal of old Austria-Hungary and also some iron ore. While her ore and coal fields are separated and the land transport necessary to assemble material of only moderate richness is costly, the great iron works at Skoda keep busy and Czechoslovakia has been an exporter of iron since the World War.

The whole Mediterranean Basin is barren alike of coal and consequently of iron making until the Azoff basin of south Russia is reached. There the demands of a population greater than that of the United States were causing a rapid increase of iron making before the war, the Russian production in 1913 (4.8 million tons) being 15 percent as great as that of the United States. Following the war Russia ceased manufacture for a time and is yet far from her pre-war production.

At Bilbao, a Spanish port on the Bay of Biscay, there is arising an iron industry (less than half a million tons) with an explanation similar to that of the Duluth furnaces. Bilbao exports several million tons of iron ore annually to England and the returning ore vessels carry fuel to Bilbao for the operation of furnaces built there by British capital.

Iron in Asia. Japan, the last of the nations to gain recognition as a world power and to enter diligently among the world's manufacturers, is a country comparatively poor in coal and much poorer in good iron ore. Her first modern shipyards used European iron. It is only within a few years that iron works have been established, using ore brought down the Yangtze River from central China. Japan has increased her production greatly in the last ten years but does not as yet make sufficient for her own needs.

China is as conspicuous for her iron riches as is Japan for their poverty. In addition to possessing, next to the United States, probably the most abundant supply of coal in the world, there is much evidence to show that iron ore exists in great quantities and good quality. A little iron has been manufactured in the primitive way for ages, and now that China is adopting modern methods the possibilities of the future iron industry are a matter of interesting speculation. Both iron ore and coal, the great raw materials, are there and also a labor supply exceeding in amount that of any three western countries. Already in a period of great prosperity and temporary shortage in the American iron market, the product of a modern blast furnace located at Hankow at the junction of the Han and Yangtze Rivers has sent its product to the port of New York, where it could pay a heavy tariff in addition to a freight charge for transportation half way round the world and yet compete with the American product.

Three companies have been producing good iron and steel in India from ores of high iron content. It is claimed that India with her huge undeveloped ore beds, her good coal and limestone, and her unlimited supply of cheap labor can make the cheapest steel in the world, and even become a competitor of the United States and Great Britain in iron and steel manufacture. (*Mineral Industry*, 1921.)

The next century will probably witness a most astonishing competition in iron making between the Orient and the western world.

World commerce in iron. While the large production of iron is localized in a few districts of eastern America and western Europe, its commerce is world wide. All peoples who trade use it in many forms, so that from England, Germany, France, the United States, and Japan, the manufactured products go to every country. The European countries with their older industries and their cheaper labor produce the more highly manufactured forms such as cutlery, tools, instruments, and the finest machinery. From the United States, which excels in raw materials and labor-saving machinery, the heavier products are shipped, such as railroad rails, bridges, girders, plates and pipe. Pittsburg rails and bridges are to be found upon the railways of Mexico and Manchuria, on the upper Nile at Khartum, upon the African lakes in Uganda, in Australia, in China, and in Ecuador. The steel mills of Europe and America will continue for many decades to equip with steel the new countries of the world.

The future of the iron industry. Despite the many shiftings of the iron industry it has as yet used but a small fraction of the total ore supply. The amount of ore throughout the world is very great, some of it being of good quality, but much the greater quantity is of relatively low grade such as we have not as yet learned to use because we have not as yet been compelled to do so. The iron industry, being comparatively young, has thus far drawn only upon the best ores. The distance of carriage has rarely exceeded 500 miles, except where the ores have been so located that they could be water borne nearly all the way from the mine to the furnace, as for example, between the iron port of Bilbao in northern Spain and the furnaces on the west coast of England. The Swedish ore is water borne to England and to the German plants upon the navigable Rhine, while the great American movement of iron ores is made possible only because of the astonishing cheapness of steamer transportation (in summer only) on the American Great Lakes, which leaves but short distances for the railroads to carry the great weight of the ore.

Ocean steamers now render such cheap service that the ores near the coast of distant lands such as Mexico, Central America, Brazil, South Africa, and Sweden are in terms of freight rate much nearer to the furnaces of Pittsburg, Glasgow, and Essen than the ores of Colorado or central Russia. Thus the Sparrows Point smelters of Baltimore bring most of their ore from Cuba, although the Lake Superior mines are only two-thirds as far away, but over a more costly transportation route. The increasing American import of Swedish, Spanish, Cuban, Chilean, or Brazilian ores is not an exception but part of a world movement.[6] Within a few decades 6,000 or 8,000 miles by steamer and 1,000 miles by rail will probably become a regular haul for iron ore, one that will make nearly all the earth accessible to one or the other of the great manufacturing regions of the future—the North Atlantic or the Orient.

Better and cheaper methods of smelting are also a future probability. The electric smelting of iron ore has long been experimented with and has reached a profitable stage in Scandinavia where abundant water-power is available for cheaply generating the powerful current. It is calculated that ores of only 40 percent purity can be utilized by the electric method. This possible emancipation of iron making from a fuel supply is a matter of great significance. The Norwegians make a ton of iron per year for one horse-power of electric energy.

Successful iron making in the future is likely to depend more on superior equipment and machinery than on natural advantages. While the best Lake Superior ores are richer than those of Europe, the average quality is already declining, the cost of mining is increasing, and the distance of the ore from fuel and from blast furnace is often greater than in Europe. The lead of the United States in iron making has been maintained largely through the use of wonderful ore-handling equipment and modern furnaces, many of them the best in the world. This lead may be overcome in the future when other countries begin to substitute modern machinery

[6] The United States Steel Corporation owns the famous iron mountain of Durango, Mexico, said to contain 300 million tons of iron, and American companies have built expensive equipment in Chile to dig and load ore for export to this country.

for man labor in every stage of iron making from digging the ore to turning out the finished steel.

MANGANESE. The mining of manganese ore, like much quarrying of limestone, is an adjunct of the iron industry which would, if it stood alone, command considerable attention. We manufacture no metallic manganese, the entire supply being used in steel making, each ton using about 15 pounds of manganese. The world's production of about one million tons is practically all used in the steel industry, and is supplied chiefly by India and Brazil. About forty percent of the world's pre-war manganese supply came from

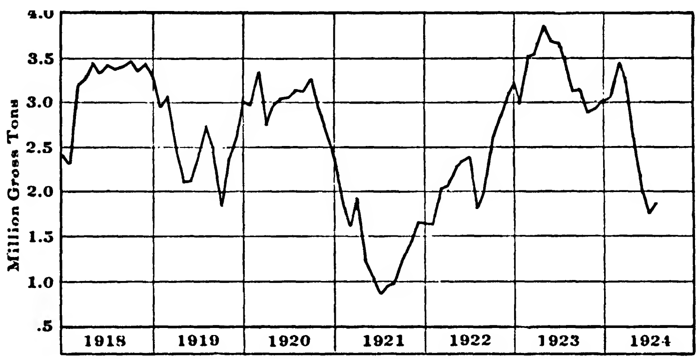


FIG. 151.—Production of pig iron in the United States. The iron industry is called the Industrial Barometer. What is the percentage of variation?

the Russian Caucasus by way of the Black Sea ports, but Russia is now out of the market.

3. COAL

In the development of manufactures iron is important, but the possession of some source of mechanical power is a much more potent factor in deciding a nation's rôle in manufacturing and in civilization.[7] We depend upon mechanical power in a way not unlike the dependence of young children upon their parents. For this generation the chief dependence is coal.

[7] "That fuel is the backbone of the present titanic struggle for world supremacy was completely driven home by the recent collapse in Italy. 'For the want of coal her industries stopped; for the want of shells her guns were spiked; for the want of guns her armies were powerless.'" (R. H. Fernald, in *Philadelphia Public Ledger,* Jan. 31, 1918.)

THE DEPENDENCE OF OUR CIVILIZATION UPON COAL. If some wizard should, upon the first moment of some incoming year, banish all coal from the world, instant darkness would settle over the streets in most of the world's great cities and their inhabitants would rise the next morning to find their houses cold and nearly all their factory wheels motionless. The starvation that immediately faced them could kill millions of people before another January first had come. Witness the plight of Belgium in the war, winter of 1914-15. England would be the worst sufferer, because coal-driven steamships and railroads bring to that country much of the food and raw materials upon which her people depend for sustenance and industry. There would be no escape from the panic-stricken island because the coal-driven steamships of the world would lie helpless, sailing vessels and oil burners would be grossly inadequate, and to build more vessels would require iron and wood, neither of which could be had without the use of coal. The people of Germany, Holland, and Belgium, New England, and New York City (this city alone uses over 15 million tons of coal a year) would be in nearly as bad a plight as those of England. The only possible escape would be through the conversion of coal-burning steamships and locomotives into petroleum-using ones, and even if we had enough petroleum, this change probably could not come fast enough to avert the catastrophe, for world commerce is now coal-driven commerce, and world manufacture is chiefly in the steam-driven factory. Coal is thus back of both factors which have enabled man in the nineteenth and twentieth centuries to separate so widely his home space from his sustenance space.

All the modern nations have at their disposal mechanical power, chiefly coal driven, which far outranks the combined muscular force of all the men and all their beasts and the increase in its use is very rapid (see table, page 403. This table merits study.) If all the coal used in the United States were used to generate power in moderately efficient plants of large size in which 2 pounds of coal generate 1 horse-power for one hour, the resultant energy for 300 working days in the year would be at the rate of about 750 man-power for each living man in the United States. This is on the basis of ten men per engine horse-power, which is actually lower than the facts would be.

EARLY USE OF POWER IN HOLLAND AND ENGLAND. Holland with her windmills was the first extensive user of artificial power. She used wind because she had no waterfalls such as have long been used to some extent in other countries. For the same reason windmills were used to grind the breadstuffs in the early days in Rhode Island, eastern Long Island and on the flat prairies of Illinois. England, already a coal user when the steam engine was invented, quickly took from Holland the leadership in power development, and then in manufactures, because she has enormous[8] good coal fields near to the sea and near to the iron, which is necessary for the harnessing of power derived from coal. England had, in addition to power, an adequate labor supply, a stable government, and peace. With these advantages the modern factory system quickly originated. It came after a number of mechanical inventions in the latter part of the eighteenth century made it possible to assemble many workers in one building where their machines could be run by a common engine. Previously, the English manufacturing had been done by hand machines in the cottages of people who lived in populous country districts and tilled some land. But coal and steam made easy the establishment of the factory system, and condensed these people into cities usually to their physical injury, changed Britain from an agricultural to a manufacturing country and transferred

POWER CONSUMPTION OF U. S., 1870-1905-1919

Power used for manufacturing	Total Horse-power			Horse-power per wage earner			Horse-power used per $1,000 of output		
	1870	1905	1919	1870	1905	1919	1870	1905	1919
	Thousands	Thousands	Thousands						
Agricultural implements ...	26	106	128	1.0	2.2	2.4	0.5	1.0	0.42
Boots and shoes	3	62	120	0.1	0.4	0.57	0.1	2.0	1.03
Cotton goods	146	1,040	1,863	1.1	3.3	4.1	0.8	2.3	0.85
Flour and grist mill products	576	780	876	9.9	19.9	19.4	1.3	1.1	0.427
Hosiery and knit goods....	6	84	152	0.4	0.8	0.87	0.4	0.6	0.21
Iron and steel	170	2,725	5,403	2.2	11.2	13.2	0.6	3.0	1.49
Lumber and timber	641	1,500	2,922	4.3	3.7	6.08	3.1	2.6	2.11
Paper and pulp	54	1,125	1,851	3.0	17.0	16.6	1.1	5.9	2.35
Silk goods	2	79	177	0.3	1.0	1.39	0.2	0.6	0.25
Woolen goods	85	164	172	1.1	2.3	2.77	0.5	1.2	0.47
Worsted goods	8	130	296	1.6	1.9	2.4	0.4	0.8	0.401

[8] Estimated to last six centuries at present rate of consumption.

the center of population and power from the agricultural southeastern plains to the rougher, more mountainous north-northwest and west with their coal and iron. Here people live in towns and get almost all agricultural products by trading, and the many manufacturing cities that have been developed give England a higher proportion of city population than any other country in the world.

THE BRITISH COAL FIELDS. The location of British coal fields favored this early development. The coal is good, although it is all bituminous, and the fields are well distributed, some on the east coast at Newcastle, some on the west coast in Cumberland, some in Scotland near Glasgow, some in Wales near Cardiff, and some inland near Sheffield and Birmingham and Manchester, making possible a varied development of industry. Each coal field has developed an industrial district. The southern inland coal fields support the great iron and steel manufactories of Sheffield and Birmingham, the northern give power for the cotton mills of Manchester and the other towns of Lancashire and the wool manufactures of Bradford, Leeds and Huddersfield in Yorkshire. The Cumberland field in northwest England has an iron center at Barrow-in-Furness, and the fields of southwest Scotland make Glasgow a great port and iron center and the Clyde a great shipbuilding river. The coals of Newcastle near good harbors have for three centuries been carried in ships to London and across the North Sea to continental points, while the neighboring cities of Shields, Middleborough and Sunderland have of late become great shipbuilding and iron-manufacturing centers. The southwestern fields in Wales have led to a great smelting industry and export of coal, a branch of the foreign trade in which England exceeds all other countries of the world combined. Some of her publicists have urged the stopping of the coal export because she is thereby hastening the day when she will have none for her own use.

BRITISH COAL EXPORTS. The grain ship brings bread for the British people to eat, the refrigerator ship the meat, the lumber ship the planks from which they build their houses, the cotton and wool ships the fibers with which to clothe themselves and other ships yet other materials for their factories. The exports of manufactures are much less bulky than these imports, and the ships that would otherwise go away empty carry the coal of Britain into every sea and to most of the world's coalless lands. It is from England that the coalless Dutch, Danes, Norwegians, and Portuguese get their supply, while empty steamships outward bound to the Danube and Black Sea ports carry the coal burned by the Italians, Greeks, Spaniards, and Arabs upon the shores of the coal-barren Mediterranean. For the same reason British coal goes in hundreds of thousands of tons to Argentina, to Uruguay and to South Africa.[9] A steamship out of fuel gets British coal when she drops into such coaling stations as Madeira, the Azores, Rio Janeiro, Malta, or Port Said at the Suez Canal.

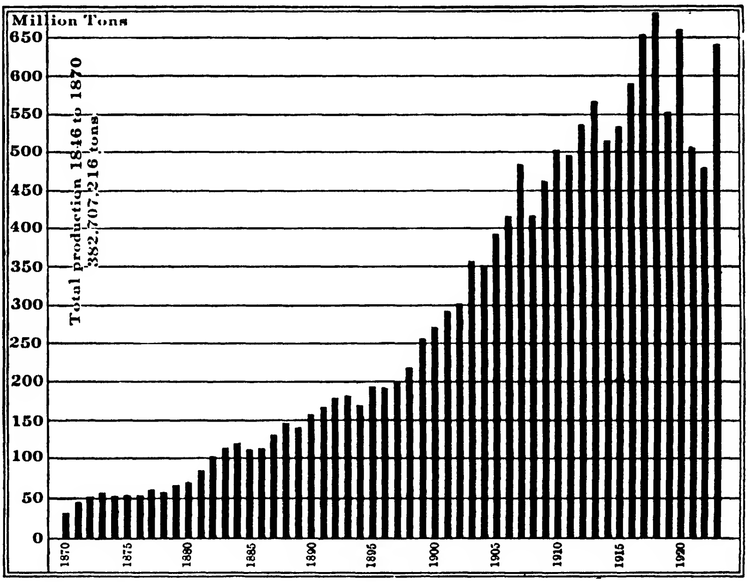


FIG. 152.—Production of coal in United States, 1846-1923, a rate of increase that cannot and should not be maintained.

LATE AND RAPID DEVELOPMENT OF AMERICAN COAL MINING. During the first two-thirds of the nineteenth century, while England was busy manufacturing with coal, the people of the United States were chiefly employed in farming and settling the free lands of the Mississippi Valley which the United States Government was giving away to settlers, who rarely needed coal for the family stove. Our manufacturing industries started, before the improvement of the steam engine, in New England, where many streams tumbling down

[9] In 1913 the United Kingdom imported 54 million tons of freight and exported 16 million tons of freight, plus 76 million tons of coal.

from the highlands made abundant waterfalls and good water power, as evidenced in the names of old New England mill towns, such as Fall River, Chicopee Falls, Rumford Falls, Bellows Falls, and many others. For domestic fuel the American people for two centuries burned wood, while England, old and relatively populous, had been short of forests in Queen Elizabeth's time and was using coal. In 1660 the British consumption was two-fifths of a ton per capita, a quantity not equalled in the United States until after 1850.

A small coal field near Richmond, Virginia, was but a few miles from tide water at that city and because of that fact was, in the days

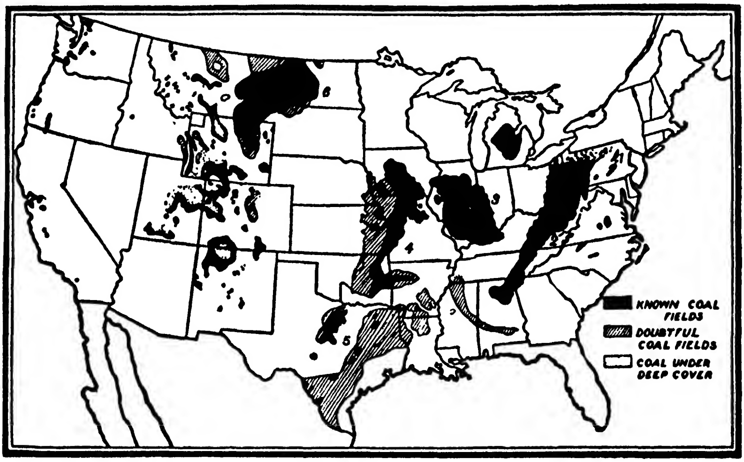


FIG. 153.—Map showing general distribution of coal fields in the United States. (United States Geol. Surv.) (From Salisbury, Barrows, and Tower.)

before railroads and canals, the most accessible to eastern markets, because it could be carried to them over the natural waterways. The northward movement of the coal began in 1789, and this trade was used as an argument for the building of the Chesapeake-Delaware canal. This Richmond coal field, now entirely abandoned because of the competition of its superiors, was yielding 54,000 tons a year in 1822, while the Pennsylvania anthracite, of which the first shipments were made by wagon in 1807, had reached a production of a ton a day by 1820. The Pennsylvania anthracite deposits served as a magnet to attract the pioneers at both canal and railroad building, a highway of each type being built up the Schuylkill River from Philadelphia to the southern edge of the coal fields.

Owing to the improvement in transportation facilities our coal consumption increased rapidly after 1850. The per capita consumption in 1850 was 0.287 ton; in 1870, 0.960 ton; in 1900, 3.530 tons; in 1910, 5.100 tons; in 1920, 6.1 tons, or over 33 pounds per day for every man, woman, and child in the United States. The continuance of such a rate of increase is unthinkable.

THE INFLUENCE OF COAL ON SETTLEMENT OF AMERICA. It was coal and steam that enabled the American people to finish the con-

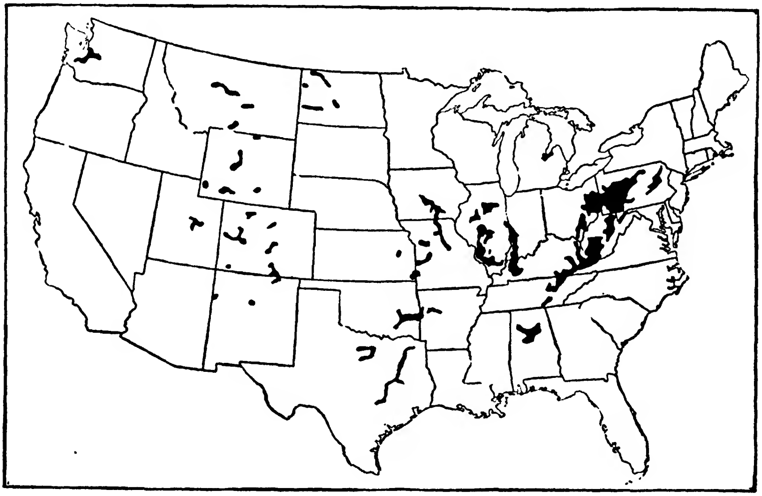


FIG. 154.—This map of actual coal *producing* areas should be compared with the map of coal areas. One represents the present and the other perhaps represents the future. (Courtesy Mr. McKenney, U. S. G. S.)

quest of the American continent. In the two centuries between the founding of Jamestown and the marketing of coal in Pennsylvania, the colonists had slowly struggled westward through the forests and mountains and settled the river districts of western Pennsylvania, Kentucky, and Ohio, but the conditions of transportation in the west were such that no populous commonwealth could arise. Exports of grain and meat and a little lumber went to New Orleans down the Ohio and Mississippi Rivers in flatboats which were knocked to pieces because they could not be pushed up stream against the swift current. Imports were brought in wagons over the Allegheny mountains to Pittsburg and thence down stream to points where they were consumed. Economic and social progress was difficult under such conditions. In 1812 the steamboat changed all this by ascending the Mississippi River and making a two-sided commerce. It enabled American people emigrating by the power of steam to attack the heart of the continent in a hundred places on the great navigable system of the Mississippi between Pittsburg, Kansas City, Minneapolis, and up-stream points on many smaller rivers. Two decades later the steam-driven locomotive broke the shackles that had for ages held civilized man by the river bank and seashore, so that in half a century the American people spread five times as far as they had in the two preceding centuries.

PENNSYLVANIA ANTHRACITE. The first coal field to be extensively developed in response to the steam demand was the anthracite field of eastern Pennsylvania, which has the best coal in America and is also nearest to the cities of the Atlantic Seaboard. The canal built up the Schuylkill from Philadelphia to this field was followed by some of the earliest railroads in America. Every railroad system anywhere near the district has reached out for a share of the coal freight until now a dozen railroads carry this coal in all directions, to Philadelphia, New York, and New England, on the east, to the Great Lakes on the north, and to the west, and the south. This coal, being the nearest to New England, is very important there, but is a luxury on the Great Lakes and in the west, because there is so much bituminous coal near at hand in Ohio, Indiana, and Illinois. The United States has a production of nearly 1 ton of this valuable coal per capita per year, all produced in the small coal region of eastern Pennsylvania, and the supply is being rapidly reduced. The scattering remnants of a deposit once of much greater area are divided into three fields covering an area of but 475 square miles with the cities of Scranton, Wilkesbarre, Pottsville, and Shamokin as the chief mining centers.

The improvements in methods of burning small sizes of anthracite coal have caused the closer utilization of the output and led to the re-working of the culm banks left by the mining operators of past decades. These reclaiming plants, called washeries, sent 5.3 million tons of coal to the markets in 1917.

THE APPALACHIAN BITUMINOUS COAL FIELD. The Appalachian coal field, reaching almost without a break from northern Pennsylvania into northern Alabama, contains the finest bituminous coal lands in the world. The coal area in western Pennsylvania alone is larger than Massachusetts, Rhode Island, and Delaware combined. Ohio River navigation opened this rich fuel deposit to the world and caused many new towns to spring up in the wilderness to shelter the miners. Pittsburg, the so-called smoky city, standing where the navigable Ohio was formed by two navigable branches, was the most convenient point of access to this coal field and the natural place for its earliest development. Each year acres and acres of barges of Pennsylvania coal float down the Allegheny, the Monongahela, the Ohio, and the Mississippi, carrying millions of tons to Pittsburg, Cincinnati, New Orleans and other cities along the great waterway.

The central part of this Appalachian coal field in West Virginia, eastern Kentucky, Tennessee and part of Virginia was not developed so early because it was more difficult of access, but many mines were opened there in the decade after 1915. At the present time there are in eastern Kentucky 10,000 square miles of this Allegheny plateau underlaid with coal. But this plateau has been carved by its many streams into a succession of steep mountains and sharp gorges, which are so difficult to travel that there is no railroad, and therefore no commercial coal mining. The people of some localities thus isolated are living the life of the pioneers and backwoodsmen of the Revolutionary period.

No more striking illustration of the dependence of economic welfare upon transportation facilities can well be found than the contrast between the poverty and ignorance of these isolated mountain people and the prosperity and commerce of their kinsmen and neighbors upon the lowlands beyond the mountains.

West Virginia, not so inaccessible as Kentucky, but far less accessible than the Pittsburg district, has now become a great coal producer. The West Virginia coal fields are difficult for railroads to cross and the valleys are so narrow that the houses of the mining towns are perched row after row upon the steep slopes that rise directly from the streams.

The southernmost of these eastern coal fields is in Alabama near Birmingham. It is very accessible to adjacent markets and hence has greater development than any field south of West Virginia. The recent building of locks and dams in the Warrior River, which permits the carriage of this coal in boats to Mobile and New Orleans for the supply of steamships and for export to Gulf and Caribbean ports, greatly increases the opportunity of this district for profitable development.

Pennsylvania bituminous coal was worth about $5.00 per ton at New York harbor in 1924, and Virginia Pocahontas (used by the United States Navy because it is one of the best steam coals in the world) was $4.25 per ton at Hampton Roads. Atlantic coast cities thus have a relatively cheap fuel supply in the Virginia coal brought to tidewater by the Virginia railway and taken to New England by boat from Hampton Roads for eighty cents per ton in competition with coal taken by boat from Philadelphia and New York or taken by all-rail shipments.

THE INTERIOR COAL FIELDS OF AMERICA. The eastern interior field, southern Illinois, southern Indiana and western Kentucky, is

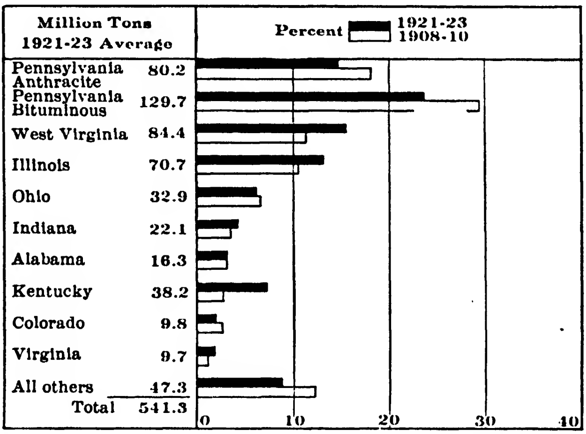


FIG. 155.—United States coal production by states, three-year average.

second in importance only to that at the headwaters of the Ohio. The coal, bituminous, is not of as good quality as that of the Appalachian fields, but it is better than most of the coal of Europe, and its nearness to Chicago, St. Louis and the manufacturing centers of Illinois and Indiana makes it the chief dependence of those regions and the output is greater than that of Pennsylvania anthracite.

It is an interesting fact that the quality of American coal declines as we go west until the Rocky Mountains are reached. The large western interior and southwestern fields extending from central Iowa to central Texas are inferior to those of Illinois and Indiana and are not so extensively mined. Beyond these the yet inferior coal that underlies vast areas of the plains of Dakota, Montana and Wyoming is mined only for local use. Most of it is lignite like the coal of Germany.

In taking any long view of our resources we should count the low-grade coals at a higher valuation than to-day's market gives them. *They have energy in them* and we can depend upon science to get it out when needed, provided we can maintain science and civilization. The Rocky Mountains, which with their adjacent plateaus embrace almost one-fourth of the United States, are a region of such sparse population and vast extent that their coal resources are not fully explored. Each year the scientists of the Geological Survey find thousands of square miles of additional coal and it is already known to exist in every state from New Mexico to the Canadian boundary. The total quantity is doubtless very great and some of it is anthracite of good quality. Much of this western coal land still belongs to the United States Government and is being held as a reserve for the future needs of the nation. It is hoped that it will make comfort for all people rather than colossal fortunes for a few and misery for many. It can be leased to mining companies by the government quite as easily and more satisfactorily than the present practice of leasing coal lands by individuals to mining companies.

PACIFIC COAST AND ALASKA. The Pacific coast is the only part of the United States which suffers from lack of coal, the total product being less than 1 percent of that produced in this country, and the resources are meager. Oregon and Washington mine a little high priced coal and California is even worse off because her available coal is practically negligible.

For this reason the development of manufactures was greatly hampered in California and the railroads even had to pay $11 and $12 per ton for coal for their locomotives. The discovery of petroleum in large quantities in 1901 ended this fuel scarcity for a time.

Our incomplete knowledge of Alaska is being rapidly extended, and one of the surprises of this erstwhile little esteemed region is its valuable deposits of coal and copper. The coal veins are of astonishing thickness and estimated to be worth millions of dollars. This source of supply, opened up by a new government railroad and first extensively mined in 1918 with an initial output of 76,000 tons, is too inaccessible to be used rapidly, but is likely to prove a boon to future generations.

CANADIAN COAL. Canada, with one-sixth of the world's reserve, is richer in coal than all of Europe, but her production at the present time is small. In Nova Scotia there is a coal field near the sea (and extending under it) and water transportation which enables it to be marketed in New England. Thus it happens that New England desires free trade in coal and Pennsylvania desires a tariff on coal. The most populous parts of Canada in Ontario and Quebec are without coal and import several million tons across the Great Lakes and the St. Lawrence from the nearby fields of Pennsylvania and Ohio.

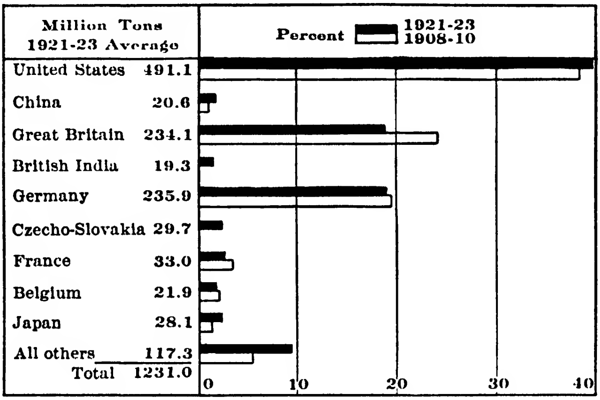


FIG. 156.—World's coal production, three-year average.

The coal fields of Montana and the Rocky Mountain region are continued in Canada where parts of the western plain are underlaid by large deposits of coal, already of great service in driving the locomotives on the long railroads that connect the new wheat lands with the steamers on the Great Lakes. In drilling a recent artesian well near Macoun, Saskatchewan, 100 feet of coal were found within 1,000 feet of the surface. The remoteness of this coal from large population makes it an interesting reserve for the future.

British Columbia also has some coal in the immediate coast district whence it was exported to California in considerable quantity before the California oil discoveries.

AMERICAN COMMERCE IN COAL. Despite our enormous coal sources and world-surpassing production, the coal export of the United States is relatively insignificant, because the coal-carrying vessels can get no return cargoes. Nearly all of it goes to Canada, but small amounts are sent to Italy, Mexico, Argentina, Brazil, Cuba, and the West Indies. Regular lines of vessels have long carried coal from Norfolk to Tampico for the supply of the Mexican railroads and mines. In times of European war and coal strikes we have temporary coal exports of large volume, but in normal times our export is but a fraction of the British.

The small export should not for an instant cause one to lose sight of the enormous part that coal plays in American railroad traffic. The entire wheat crop of the United States does not weigh half as much as the coal produced in Illinois or West Virginia. The entire cotton crop of the United States only weighs a quarter as much as the coal product of Alabama and only an eighth as much as the coal imports of New England.

Most of this coal carriage is entirely unnecessary. Central power plants at the mine mouth could generate power quite as cheaply as in more expensive town locations. Experience has shown that power can be transmitted over 200 miles in the form of electricity at a very low cost. Most of the people and most of the cities of the United States are now within that distance of coal mines. We need transmission wires and gas mains to replace freight trains, thus saving much unnecessary and expensive handling, as well as the fuel used by the engines now hauling the needless coal trains. The chief barrier is conservatism. Technique has been ready for years. A single German power plant sends up to Berlin by wire the energy that would be produced by 500 coal cars working constantly.

Of coal lands the United States has about 500,000 square miles now being mined in thirty states and with an estimated available supply of over 3,200,000,000,000 tons, two-thirds of which is easily accessible and one-third accessible with difficulty. We have still on hand about 99 percent of the total original supply, but we are wasting, in the process of mining, one ton for every two we get.

Coal in europe. Europe does not possess the coal riches of the United States. While we have 500,000 square miles, one-sixth the area of the country, underlaid with coal, Russia has only 20,000 square miles and the United Kingdom but 11,900. Germany, with less than 2,000 square miles, is, next to England, the greatest European producer, because Germany has within the last forty years had an enormous development of manufacturing that depends upon and

WORLD COAL PRODUCTION AND RESERVES [10]

(In metric tons of 2,204.6 lbs.)

Country	1921 millions	1922 millions	1923 millions (Preliminary)	Estimated Coal Reserves millions
North America				
Canada: Coal	10.7	10.6	11.3	285,596
Lignite	3.0	3.2	3.2	948,450
United States: Anthracite	82.0	50.0	86.6	17,645
Lignite and bituminous	377.3	383.0	494.8	3,205,288
Other countries	.7	.9	(a)	505
South America	2.0	2.0	(a)	32,070
Europe				
Belgium	21.7	21.2	22.9	10,730
Czechoslovakia: Coal	11.6	10.0	11.6	7,251
Lignite	21.0	19.0	16.2	11,491
France: Coal	28.2	31.0	37.7	15,645
Lignite	.7	.8	.9	1,623
Germany: Coal	136.2	130.0	62.2	242,643
Lignite	123.0	137.2	118.2	12,498
Saar Basin	9.8	11.2	9.1	16,394
Poland: Coal	7.8	24.2	36.1	157,465
Lignite	....	....	....	9,138
Russia	7.6	7.8	11.7	57,254
United Kingdom: Great Britain	165.8	253.6	283.0	185,567
Ireland	.9	(a)	(a)	291
Other countries	28.5	29.0(a)	(a)	36,877
Asia				
British India	19.6	19.3	19.0	58,723
China	19.9	21.3	(a)	995,000
Japan (including Taiwan and Karafuto)	27.4	29.0	27.8	7,644
Other countries	4.3	2.9	(a)	198,308
Africa				
Union of South Africa	10.3	8.8	10.8	56,083
Other countries	.8	.6	.7	1,634
Oceanica				
Australia	13.0	12.5	12.9	165,431
Other countries	3.1	2.9	3.0	3,883
	1,134.0	1,223.0	1,337.0	6,741,127

[10] Statistics of output from Weekly News Release of U. S. Geological Survey for June 14, 1924. Reserves are estimates of John E. Orchard, based on "The Coal Resources of the World," XII, International Geological Congress. (a) Estimate included in total.

demands coal. Part of the former German coal reserve has now passed into the possession of France and Poland.[11] France is very poor in coal, her chief fields being near the northern boundary and extending across into Belgium, which country, like France, is an importer of British coal. This inadequacy of the French coal supply is probably a chief explanation of the small number of factories in comparison to England, Germany or the United States. France can scarcely be called a manufacturing nation and unlike her neighbors still virtually feeds herself. The Russian coal fields are largely undeveloped.

Europe likewise fails to produce as many tons of coal per man[12] as do the United States and other countries of the western world where the mines are equipped with modern machinery and the deposits are more accessible. England and France have coal mines 4,000 feet deep.

[11] "The War has made important changes in the political distribution of coal resources. From Germany, France has obtained the coal in Alsace-Lorraine and the Saar Basin—the former unconditionally, the latter for 15 years, with a possibility (subject to a plebiscite) of repurchase by Germany at the end of that period. The extensive coal field lying at the juncture of the former German, Austrian and Russian empires has also been redistributed. Those parts lying within German and Russian Poland and Austrian Galicia have gone to Poland. The remainder of the Austrian portion is now within the Czechoslovakian boundary. The ownership of the richest portion of the field, which lies in Upper Silesia, is, divided between Germany and Poland, the bulk of the reserves being assigned to the latter country. The Austrian Empire has also lost the deposits in Dalmatia, Bosnia and Herzegovina to Yugoslavia."—From "Some Great Commodities" (1922); Statistical Dept., National Bank of Commerce.

[12] COAL OUTPUT PER MINER (IN TONS)

	Annual output per man employed underground			Daily output per man employed underground		
	1901	1910	1918	1901	1910	1918
United States	729	832	1,134	3.37	3.78	4.40
New South Wales	689	684	814	....	3.70	4.07
Nova Scotia	719	708	718	2.74	2.46	2.50
Prussia	357	367	409	1.22	1.26	....
Great Britain	400	368	337	1.50	1.35	1.19
France	304	296	....	1.05	1.04	.91
Belgium	248	255	207	.84	.84	.72
Japan	176	168	155 *	.73	.73	.72 *

Source: United States Bureau of Mines.

* For 1917.

Coal in the tropics. Throughout most of the tropics there is a great scarcity of coal. The whole of South America is quite insufficiently supplied with it, the annual production being about 2 million tons, while an additional 3 million tons are imported. Chile is the leading producer followed by Brazil and Peru; Colombia is estimated to have the largest coal reserves on the South American continent but they are at present untouched. There is practically no coal in Central America and but little in Mexico.

The continent of Africa seems to be poor in coal, with the exception of South Africa where the Transvaal and Natal have a combined production of over 10 million tons annually. The Natal deposits consist of excellent steam coal and Durban has become a port of call for ships wishing to bunker.

India has a reserve of coal estimated at nearly one-third as large as the reserve in Great Britain, but the Indian coal is mostly of poor quality. India is producing nearly as much as Belgium. There are coal beds scattered throughout the East Indies from Sumatra and Java to the Philippines, some of it good steam coal, but the total output is insufficient to supply even the local demand. The production of all the hot countries of the world is insignificant in comparison with the 500 million tons mined some years in the United States.

Australasia, Japan, and China. Both Australia and New Zealand have enough coal for their own needs. Coal is found in all six states of Australia and the beds in New South Wales and Queensland are believed to be sufficient for a long time. The mines near Sydney have a considerable export of coal across the Pacific to Chile and California.

Coal mining in Japan is a very ancient industry, certain beds having been worked for over 400 years. Although the Japanese coal beds are scattered widely throughout the islands, and at present the annual Japanese production of 27 million tons is the largest in Asia, the reserves are limited. It is of very great importance, however, to a country which is rapidly developing manufactures.

China is our nearest rival in coal riches, having in addition to large areas of bituminous, the largest known anthracite reserve in the world. Our Pennsylvania anthracite underlies less than 500 square miles, the veins are twisted and broken, but a German geologist reports that the province of Shansi in the valley of the Hwang River, west of Pekin, contains a single deposit of 18,000 square miles of coal like Pennsylvania anthracite, lying in thick seams, level and undisturbed, and outcropping on hillsides so that trains can run right into them. Extensive deposits of good bituminous coal are reported in practically every one of the eighteen provinces of China proper and reach far into the interior as well, the millions of China having left their coal untouched during the forty centuries of their activity in that country.[13] Large scale mining financed by foreign capital has recently begun; as yet the

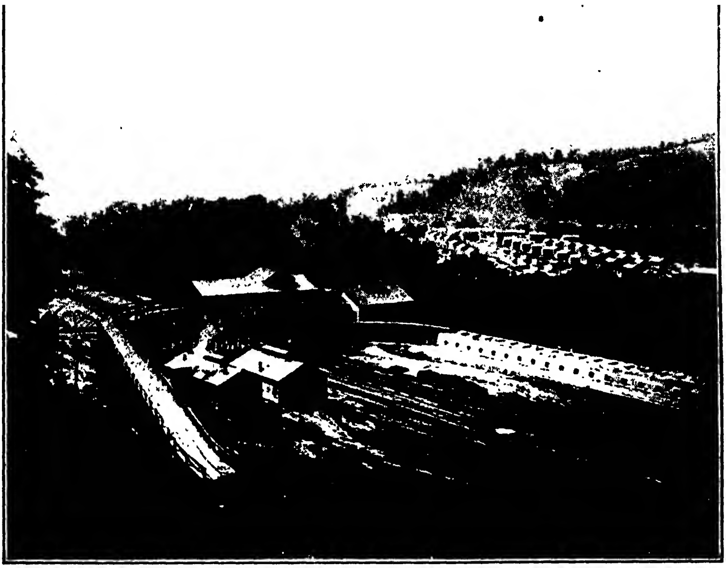


FIG. 157.—Coal tipple, bee hive coke ovens (right center), and miners' village in bituminous field, West Virginia. (Philadelphia Museum.)

output of about 20 million tons a year is not sufficient to meet China's own needs and she is still importing coal from Japan, a country much poorer in coal. Railroad building is now in progress, and in twenty-five years of peace and free foreign investment China might build more railroads than the rest of the world combined. Her coal resources will unquestionably be utilized shortly for modernization is on in China despite the political chaos. The coal resources are very accessible as well as rich and vast. The possi-

[13] Mr. O. K. Davis of the Foreign Trade Council, New York, reports having seen children pulling up bean stubble to use for fuel while there was a coal out-crop on the other side of the road. Yet many parts of China have burned coal for a long time.

bilities of manufacturing in such a nation with such resources of fuel and labor are enormous.

METHODS OF MINING COAL. The methods of mining coal vary greatly. In western Pennsylvania and West Virginia the coal lies in a high plateau through which the streams have cut valleys so that the coal outcrops on the hillsides, making the entrance to the mines exceedingly easy. Near Pittsburg the railroads must climb up two or three hundred feet from the rivers to get to the mine mouth. In many parts of the Rocky Mountains and the Great Plains the coal outcrops are so abundant that the scanty population

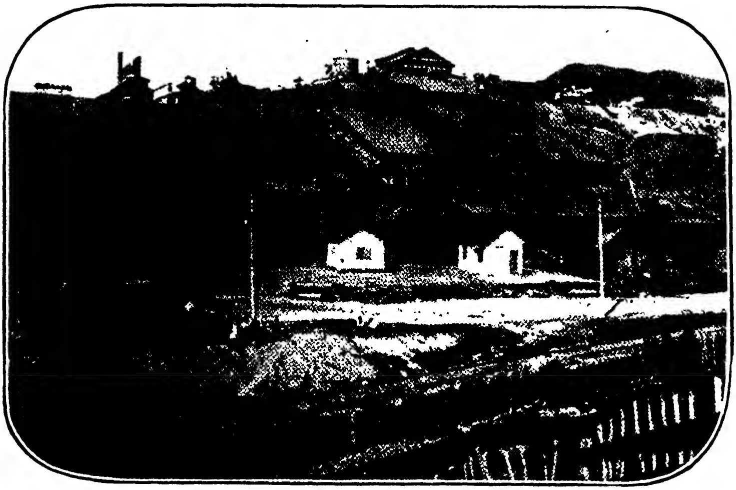


FIG. 158.—A large building is required to prepare anthracite coal for market and the earth is encumbered with refuse. Eastern Pennsylvania.

can be supplied by going to the cliffs, bluffs, or river banks and digging it down with the pick and shovel and hauling it away in the farm wagons. These conditions of easy access are very different from those existing in Europe and in the anthracite fields of Pennsylvania. Pennsylvania anthracite lies in the folded and bent strata of mountains, the pressure of mountain-making having turned the coal to anthracite. It may outcrop in some places, as at Hazleton, so that it can be quarried from the surface. Near by it is buried 3,000 feet in the ground, requiring deep shafts which go below the level of the sea and involve much moving of rock, pumping of water and lifting of coal. Then the anthracite requires much sorting, cleaning, and preparing to get it clear of the shale so that 10 percent of the coal is used in the mining, while in bituminous mining in United States but 2 to 3 percent is so used.

The mines west of the Appalachians are mainly shaft mines of no great depth; the mines of Europe are almost universally deep, some of the shafts descending nearly a mile into the earth.

NEW METHODS IN THE UTILIZATION OF COAL. The greatest uses of coal are for engines—factory, locomotive, or steamship—for the

FIG. 159.—Man standing in front of coal seam outcrop in banks of Yellowstone River, Montana. Blocks of fallen coal in foreground. In some parts of the West, farmers go to such banks and load their wagons. (Campbell, United States Geol. Surv.)

domestic fire, for the smelter that extracts metals from ores, for the electric power house and gas works. The railway locomotive is a tremendous user of coal—also a tremendous waster of it, since it is estimated that only half of the locomotive fuel is utilized for effective work.

In the ordinary methods of using coal as fuel in grates and furnaces much of the heat value of the coal goes off up the smokestack, unused, in the form of gas and smoke. In gas making much waste often occurs in similar ways, and many valuable by-products are often allowed to run to waste for lack of suitable means for their recovery. Recent improvements in furnaces, smoke consumers, and especially in gas engines, the most economical form of power generation, and a new process of making the gas called producer gas, promise to be revolutionary in increasing the usefulness and life of our coal deposits. The producer gas plant can get the combustible carbon in the form of gas from any of our coals, even from Texas lignite, or from peat itself, from wood, from tan bark refuse, and even from dried sewage, although these latter have not yet been used on a commercial scale. This process of using

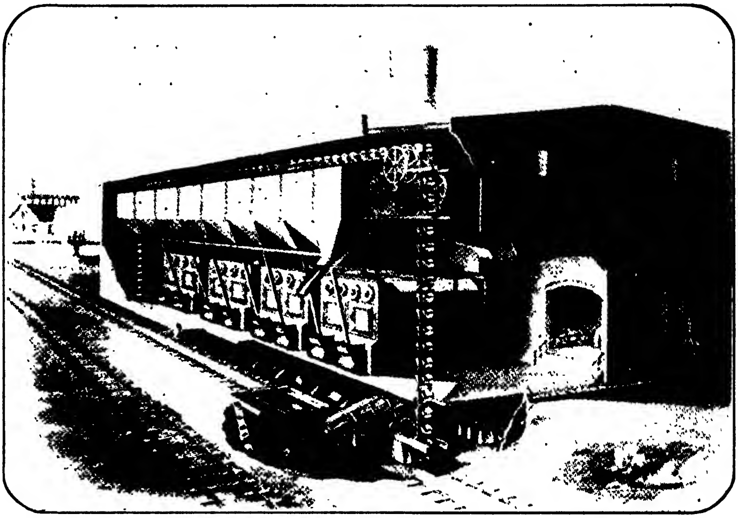


Fig. 160.—Power plant where mechanical devices carry coal from car to furnace, feed the furnace, and load the ashes on the cars.

low-grade fuel offers great power possibilities to many lands poor in coal but rich in peat, such as Ireland, where one-fifth of the surface is covered with peat bogs. Peat also covers large areas in Scotland, Sweden, Denmark, Russia, Canada, and New England. A promising new method is the burning of low grade coals in the form of dust driven by an air blast, the whole shooting forth into the furnace in a great tongue of flame. The Dismal Swamp, south of the mouth of the Chesapeake, is a peat bog 20 to 25 feet in depth covering several hundred square miles and having material which would make millions of tons of coal in some millions of years or can make millions of horse-power of energy right now if put through the producer gas plant and the gas engine.

The recently perfected process of briquetting enables the use, as fuel, of coal dust and fine fragments which would otherwise have to be discarded as mine refuse. Briquettes are compressed lumps of coal made by mixing small particles of coal with some adhesive material and pressing it in molds so that it holds its shape until burned. In Germany 35 million tons of briquettes were made in 1922, while the industry is only getting started in the United States after many years of trial. It should enable us to save millions of tons of coal now wasted. Its greatest promise may be in connection with coke. Coke breeze possesses high fuel efficiency, but because of its small size, cannot be used as such either for domestic or other fuel. The quantity of this coke breeze produced in the United States each year and practically wasted at the present time is from 2 million to 3 million tons.

COKE, GAS, AND GAS BY-PRODUCTS. Iron making requires the use of coke. Coke is made by heating coal in closed retorts where the gas and liquid matter are driven off as vapor and the coke is left in big lumps that are harder than the coal itself and therefore hold up the burden of the ore so that the fire in the blast furnace does not smother. By the old coke methods, the coal was roasted in simple "beehives" or conical kilns of brick, and the gas and liquids were burned or allowed to escape as undesirable refuse. The modern "by-product plants" for distilling coal are elaborate and expensive but they quickly pay for themselves by converting this refuse matter into a great variety of useful and valuable products. In coke making sometimes as much as 10,000 cubic feet of gas per ton of coal may be entirely wasted by the old-fashioned beehive oven, or saved by an improved by-product coke oven. The purification of the gas from the by-product coke oven and also from the producer plant gives several pounds of crystallized ammonia and several gallons of tar per ton of coal. The ammonia is a valuable fertilizer; the tar is used for roofs and roads besides furnishing a host of chemicals and dyes. The distillation of coal can also be made to yield automobile fuel. We should be putting scores of millions of tons of soft coal through this process and getting dustless coke to burn instead of anthracite coal. England is doing it. Here again technique is ready; only conservatism blocks the way.

The Germans, scientific, thrifty, and poor in coal, led the world before the World War in the manufacture of by-product coke, coal-tar by-products and gas engines. The by-product oven gained ground more slowly in America, and we are still wasting much fuel in the old-fashioned beehive coke plant, in wasteful steam engines and in wasteful mining.[14] These facts in combination with the rapid increase of manufacture and commerce are causing some concern for fear of the exhaustion of our coal resources at a much earlier time than we previously thought possible. The price of coal is rising and must continue to rise. This turns our attention again toward substitutes, of which the chief are water-power and petroleum, now both in active competition with coal. Of these, the oil may have an advantage of cheapness while it lasts, but all the minerals are at best an accumulation soon robbed and are but ephemeral in comparison to water-power which, depending upon the sun, the sea, and the highlands, remains an enduring source of power while climate and land endure.

An example of this competition between the coal mine and the waterfall comes from the Rocky Mountains.

On the extension of the Chicago, Milwaukee, and St. Paul railroad to Puget Sound, the many waterfalls combined with the long and heavy haul necessary to provide coal for locomotives, led to the great undertaking of installing electric power on the entire system over the mountains. This work is successful and may revolutionize railroad engineering wherever water-power is available and grades and traffic are heavy.[15] The initial cost of such equipment is enormous, but there can be no doubt of its final advantage over coal.

[14] COKE PRODUCTION IN U. S. (NET TONS)

	Beehive	By-Product
1900	19,457,000	1,075,000
1910	34,570,000	7,138,000
1920	20,511,000	30,833,000
1921	5,561,000	19,918,000
1923	17,960,000	37,527,000

In 1921, in a period of industrial depression, the beehive plants had to shut down.

During the coal troubles and prospective coal famine that harassed Germany in the early period after the end of the World War, improvements were made in handling peat so that it was taken up by steam dredges, dried quickly and artificially distilled in by-product coke ovens, gas and tar and other by-products being saved. The whole thing is analogous on its consumption side to the previously achieved German methods of handling coal, and on its engineeering side quite like the general mechanical handling of dirt in drainage and excavation operations.

[15] This particular enterprise in electrification replaced 162 steam locomotives, saving 265,000 tons of coal and 35 million gallons of fuel oil.

4. WATER POWER

It has been estimated that in this country as a whole there runs to waste every day the hydro-electric equivalent of one million tons of coal. This lost energy could run most of the factories, operate most of the mines, and drive most of the railway engines within

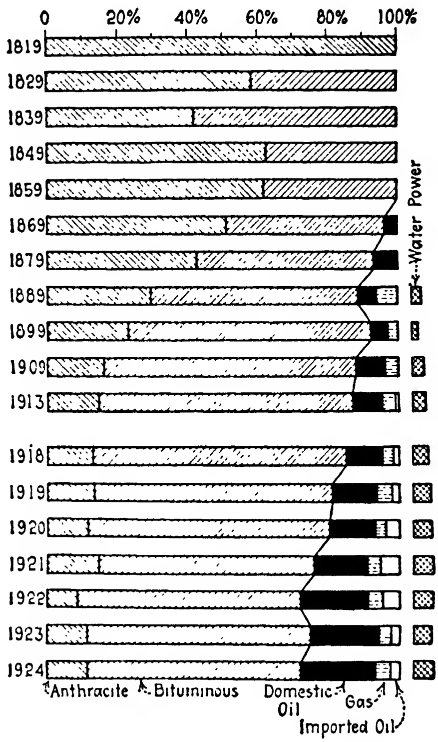


FIG. 161.—Percent total heat value of the mineral fuels, showing the competition of the various materials that give us power. (Courtesy *Coal Age*.)

the nation's bounds, besides lighting thousands of homes in cities and countrysides. Despite this fact, the overestimate of water-power resources is one of the many common errors of a people (the Americans), most of whom are economic illiterates.

WATER-POWER RESOURCES. The water-power resources of a country are affected by many circumstances. If the land is high like Norway it may be rich in power from waterfalls which are so absent from flat lands like Holland, Denmark, and Delaware. The seasonal distribution of the rainfall may give three months' flood and six months' drought in which torrents become dry stream beds, a condition found in monsoon countries and where the Mediterranean type of climate prevails. Here water-power plants may be idle a large part of the year unless there is some kind of water storage.

The water runs away more quickly from hilly than from level land. Even where the rainfall is well distributed throughout the year, there is, in small short streams, a great variation because of

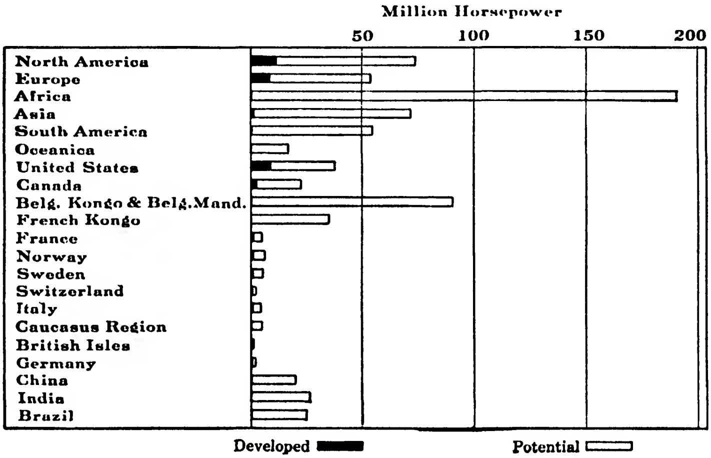


FIG. 162.—Man has scarcely touched even his water power resources.

the quick running off of the water after rain. A large river system tends to even up these inequalities.

The most important factor affecting water-power is some form of natural water storage. The spongy leaf mass of the forest floor holds water and makes more even stream flow and better water power on the forest stream than on one draining tilled lands or hard tramped pastures. Porous volcanic soils like our Cascade Mountains are splendid. So are swamps and marshes, and lakes are best of all. Man improves streams by building dams to serve as reservoirs and hold the water, but the natural reservoirs of lakes are manyfold better, and hold waters that would otherwise be wasted in freshets, and let it out in time of drought. As most of the world's lakes are due to the action of glaciers, the fact that an elevated region has been glaciated is, granted rainfall, a most im-

TABLE SHOWING ESTIMATE OF STREAM FLOW AND WATER-POWER IN THE UNITED STATES*

Principal drainages	Drainage area, square miles	Flow per annum, billion cubic feet	Horse-power available	
			Primary or minimum	Minimum of six highest months
Northern Atlantic to Cape Henry, Va.	159,879	8,942	1,702,000	3,186,600
Southern Atlantic to Cape Sable, Fla.	123,920	5,560	1,253,000	1,957,800
Eastern Gulf of Mexico to Mississippi River	142,220	6,867	559,000	963,000
Western Gulf of Mexico west of Vermilion River	433,700 †	2,232 †	433,760	829,650
Mississippi River main stream	1,238,800	21,940	147,000	335,000
Mississippi River tributaries from east	333,600	12,360	2,472,590	4,940,300
Mississippi River tributaries from west including Vermilion River	905,200	9,580	3,948,970	7,085,000
St. Lawrence River to Canadian line	299,720 ‡	8,583 ‡	6,682,480	8,090,060
Colorado River, above Yuma, Arizona	225,000	521	2,918,500	5,546,000
Southern Pacific to Point Bonita, Cal.	70,700	2,193	3,215,400	7,808,300
Northern Pacific	290,400	15,220	12,979,700	24,701,000
Great Basin	223,000	....	518,000	801,000
Hudson Bay	62,150	614	75,800	212,600
Total	4,508,289	94,612	36,906,200	66,449,310

* "The Conservation of Natural Resources in the United States," by Van Hise, Charles R., pp. 119, 120.
† Includes Rio Grande in Mexico.
‡ Includes drainage in Canada.

[By primary horse-power is meant the amount which can be developed upon the basis of the flowage of the streams for a period of two weeks in which the flow is the least. According to the table, if all the installations in the United States were made to use as much of the water as is available the lowest two weeks of the year, and allow all the rest to escape without use, there would be developed 36,906,200 horse-power; that is, approximately seven times the amount now produced.]

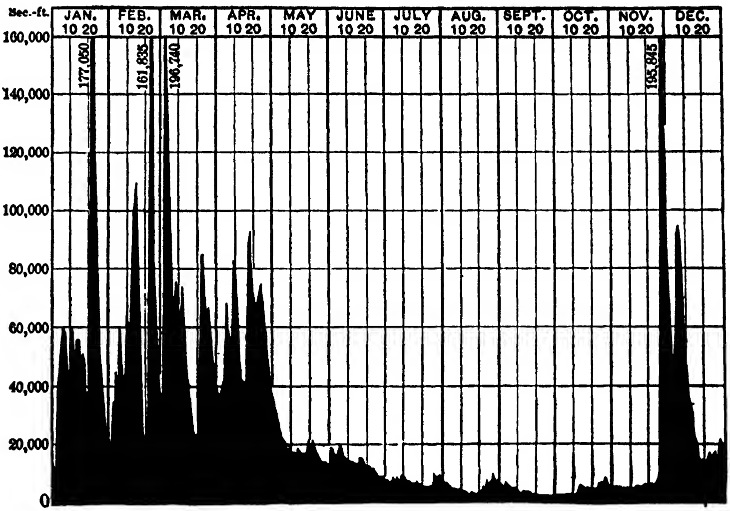


FIG. 163.—Discharge of water in 1900 from the Susquehanna at Harrisburg, a river with a practically lakeless basin with much steep land. (United States Geol. Surv.)

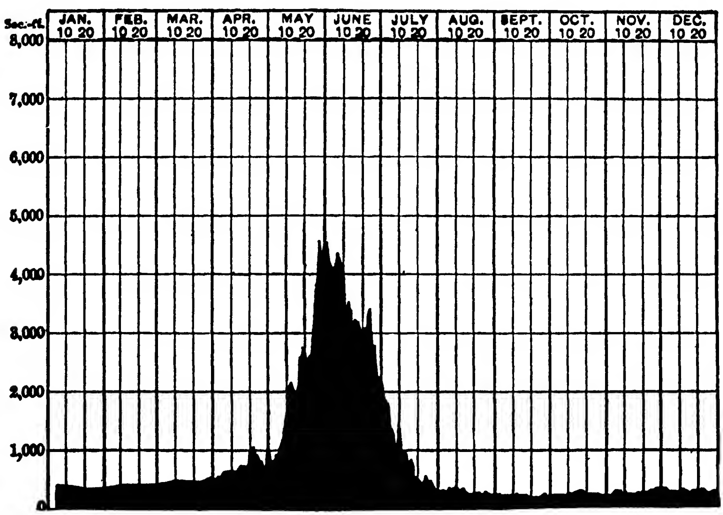


FIG. 164.—Discharge of water in 1900 from the Arkansas River, a stream fed by Rocky Mountain snow, near Canyon, Colo. (United States Geol. Surv.) The maximum of water in the growing season is very valuable in raising alfalfa and other irrigated crops which are so important in supporting our animal industry.

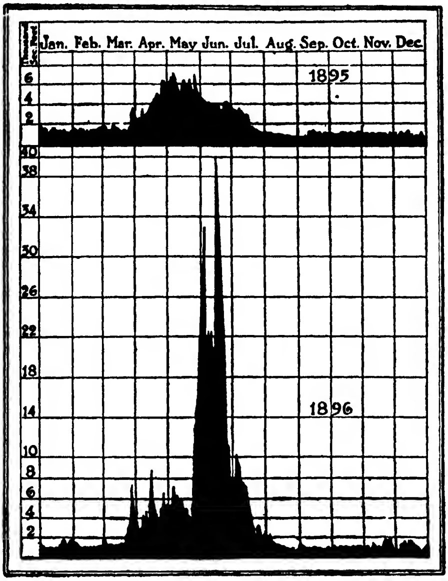


FIG. 165.—Diagram showing discharge of the Boise River above Boise, Idaho, in 1895 and 1896. (Newell, United States Geol. Surv.) (From Salisbury, Barrows, and Tower.)

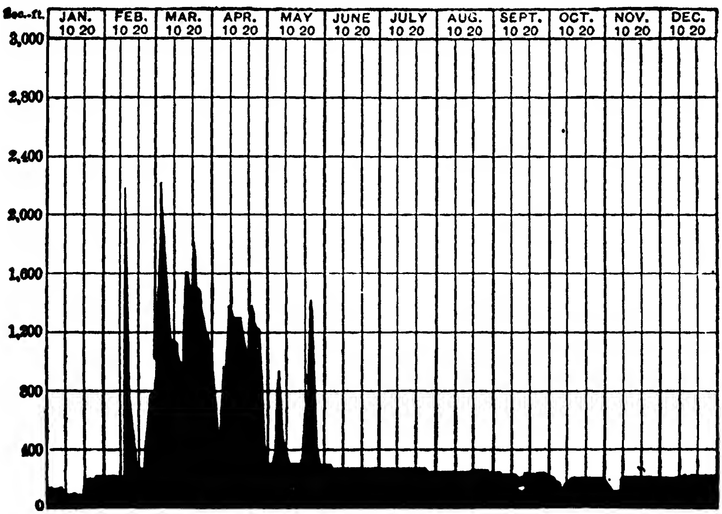


FIG. 166.—Discharge of water in 1909 from the Cobosseecontee, a river draining many lakes in the Maine woods. (United States Geol. Surv.) The attempt to make a river discharge a uniform stream is one of man's supreme combats with the uncertainty of deadly nature. Compare the percent of variation of this stream with that of the Susquehanna (Fig. 163).

portant thing in deciding its water-power resources. The St. Lawrence River system is the crowning example of this. The Niagara River with its wonderful natural reservoirs varies but little in volume, while the lakeless Potomac varies according to the amount of rainfall from 1,000 to 250,000 cubic feet per second.

Snow fields and glaciers are second to lakes as natural reservoirs and they have the particular advantage of releasing the water in time of summer drought, and holding it tight in a period of exces-

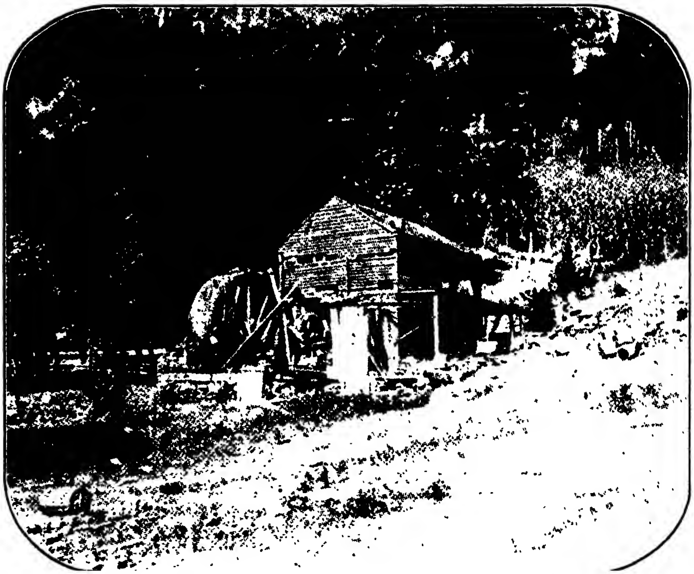


FIG. 167.—Abandoned grist mill in Tennessee. Old-fashioned overshot water-wheel, cornfield in background.

sive winter precipitation. These factors, combining with a heavy rainfall and the high Coast Range, Cascades, and Sierra Mountains, give the Pacific Coast states nearly half the water-power resources of the United States.

If flood waters were stored so that the streams were more fully utilized it is estimated that it would be practicable to develop in the United States from 100 to 200 million horse-power.

THE USE OF WATER-POWER. The use of water-power has had its ups and downs depending on industrial conditions and inventions. It was a factor of great importance in the American Colonies, furnishing as it did a means to grind their flour and saw their logs. The old-fashioned overshot water wheels so common from 1800 to 1850 were largely displaced in the latter half of the nineteenth century by improved engines and cheap coal.[16] Water-power is again coming into use since the invention of the new turbine and Pelton water wheels and the ability to transmit power in form of electricity many miles to a convenient place of consumption. The easy construction, effectiveness and permanence of well-built cement dams are factors which have greatly influenced water-power installation. This alone

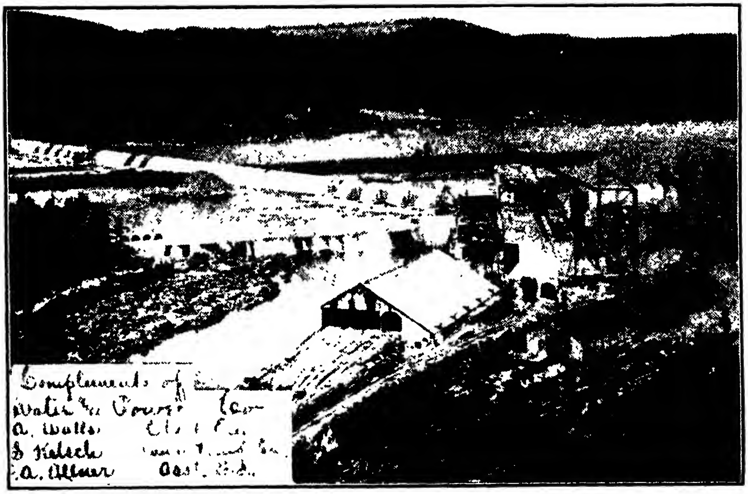


FIG. 168.—Concrete dam built in sections across Susquehanna River, McCalls Ferry, Pa. Power-house and forebayette right. Tail race sheltered behind island to left. 120,000 horse-power within reach of Baltimore, Philadelphia and Washington. (Penna. Water & Power Co.)

is enough to give us a new epoch. Since 1890 the use of water-power has increased both in absolute amount and in proportion to coal-derived power. An excellent example of this new competition of water-power with coal is to be found in Pennsylvania, the greatest coal-producing state in the world. The Susquehanna River, whose tributaries drain two great and active coal fields, is harnessed by an enormous dam at McCalls Ferry, near the Maryland boundary, where by water wheels 120,000 horse-power of electric energy has been developed. The power can easily be sold as far away as Philadelphia and Baltimore, in which latter city it runs

[16] Small country mills were abandoned and ruined by the thousands as a result of this change.

the street cars. This dam is merely one of many that might be built on this river. Plans for a second were under way in 1925. Even the navigable Mississippi has been dammed at Keokuk, Iowa, where 170,000 horse-power has been developed while boats pass up through locks beside the dam.

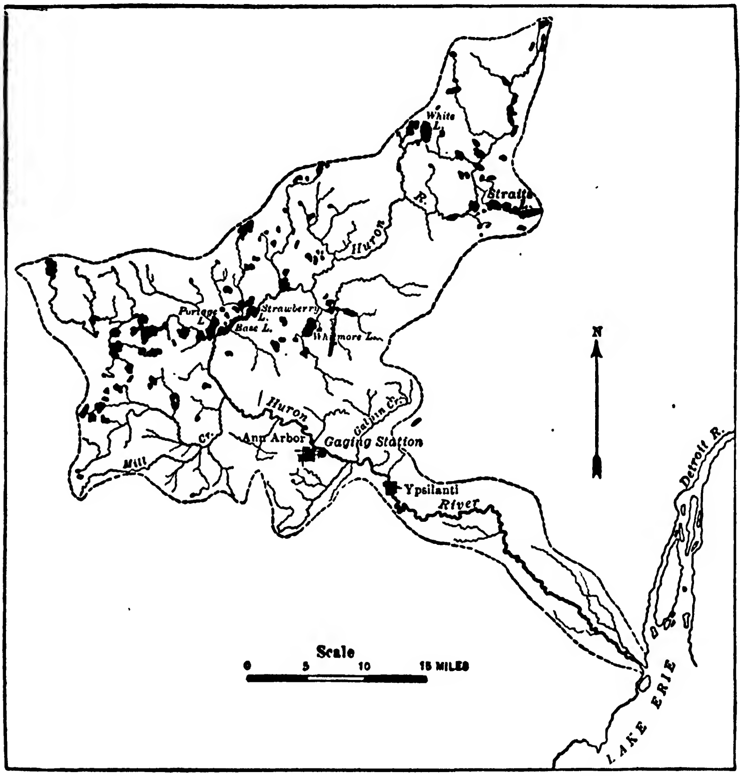


FIG. 169.—Basin of Huron River showing the natural reservoirs afforded by glacial lakes. (Newell.)

If we take a long point of view, the water-power of the glaciated region of northeastern United States is likely to have a much greater value than all the coal of Pennsylvania. The lakes and swamps and waterfalls of the glacial region produce power enough to run enormous industries. Coal will go and the water-power will stay. The best example of this is to be seen at Niagara Falls, where the glaciers diverted a single stream across a cliff of rock, forming the Falls which will develop about 6 million horse-power day and night if they are fully utilized.[17] Hundreds of smaller falls combined have a greater power than even Niagara and many of them are already in use, as in the wood pulp and paper industry which is scattered from Niagara Falls to eastern Maine. It was this glacial water-power which started New England manufacturing. The state of Maine itself has waterfalls that will yield a possible total of nearly 1 million horse-power. In addition to this we are just learning how to utilize the energy of tides from which it is estimated that a half million horse-power may be developed on the coast of Maine.

There is extensive but as yet almost unused water-power on the many streams flowing from the lakes and swamps upon the large glaciated plateau between the St. Lawrence River system,[18] the Atlantic Ocean and Hudson Bay. The province of Quebec alone had, according to the estimate of the Dominion Water Power Branch, 910,000 horse-power installed in 1920, and 6 million undeveloped.

New York state is about to begin making a series of state-owned reservoirs at the headquarters of some streams from which stored water will be released to be used many times as it passes through a succession of water wheels on its way down to navigable water levels.

Norway and Sweden have unusual water-power resources in their mountains, glacial lakes, glaciers, and snow fields. They have poor coal supply and in their forests a resource demanding power. It is but natural that they, like the Swiss who have similar conditions, should be leaders in water-power development, as shown by the fact that the Swiss are leading water-power engineers and that water-power furnishes two-thirds of all the power used in Sweden and three-fourths of it in Norway.

Dry summer lands like the Mediterranean countries and California are greatly handicapped for water-power unless they happen to possess mountains where snow fields and glaciers melt in summer and furnish a flow when the rains do not come. Thus, the snow-fed waterfalls of the Alps are being rapidly put to use by the Italians who have no coal and the waterfalls of the Sierra Nevada mountains

[17] A plan whereby 60 percent of total flow of river can be diverted for developing power is being considered.

[18] On the St. Lawrence from 4,000,000 to 5,000,000 horse power can be produced.—From "Super Power," by J. C. Welliver, *Rev. of Reviews*, Sept., 1922.

in California are already harnessed, power being carried by one company 241 miles to Los Angeles.[19]

Lands of monsoon rain, like India and other countries of southeastern Asia, have even a worse handicap than the Mediterranean lands, because the dry season comes in winter when snow fields are less effective. No wonder that India should primarily be described as a land of tanks. Therefore, despite its heavy rainfall, its water-power resources are limited.[20]

WATER-POWER RESOURCES OF TROPICS. The tropics, nearly devoid of coal, have large areas devoid of water-power, and here and there resources of stupendous size. The grand prize in water power creation seems to be the combination of conditions which prevail on the Congo. (See resources of French and Belgian Congo.) This river runs east and west along the equator in such a position that the doldrum rains fall continually on its northern branches, its sources, or its southern branches, thereby causing it to miss the great seasonal fluctuation common to all great rivers but the Niagara and the Congo's twin, the Amazon. But, unlike the Amazon, the Congo kindly tumbles some 3,000 feet in a series of cataracts near its mouth, making water-power resources so stupendous as to be severalfold those of any other continent.

Stanley Falls on the middle Congo with its seven cataracts is

[19] The stupendous nature of this new basis of modern industry is well shown by the units of a single enterprise. One California power company completed in 1925 the longest tunnel of its bore in the world—over thirteen miles. It was built to carry water from one branch of the San Joaquin River to another, which had a lake whose level could be raised and used for storage purposes. This combination of two streams also focused the water at a place where the fall was great—4,700 feet within five miles. Here four power plants can produce 1,407,000 horse power to push and pull, lift and pump, carry and turn, and heat and cool and light wherever the need arises anywhere within a radius of three or four hundred miles.

This enterprise becomes insignificant in comparison to the plans for harnessing the Colorado River with dams and cyclopean power plants, producing millions of horse power in its picturesque canyons. The greatest of these sites, in Boulder Canyon, is 299 miles from Los Angeles, which yearns for the prosperity this plant could bring to her life and industries.

[20] About 43 miles from Bombay (Western Ghats) is the largest hydroelectric plant in Asia, outside of Japan. Rainfall from middle of June to middle of September in this region averages 175 inches, and this water is stored in two small streams to provide power for the plant which has capacity of about 60,000 horse-power. Demand exceeded supply from the start, and as capacity of the site is established at 110,000 h.p. for 300 days of twelve hours each per year, considerable extensions are planned.

estimated to have ten to fifteen million horse-power, but the problem of developing it involves much difficult engineering. The whole of Africa has only 11,000 horse-power developed. It is not a land that uses power.

WORLD WATER-POWER RESOURCES

A summary by continents and by selected countries, in 1920. (U. S. Geol. Survey.) (000 omitted.)

	Developed horse power	Potential horse power
North America	12,210	62,000
South America	424	54,000
Europe	8,877	45,000
Asia	1,160	71,000
Africa	11	190,000
Oceanica	147	17,000
Approximate Total	23,000	439,000
United States	9,243	28,000
Canada	2,418	20,000
France	1,400	4,700
Norway	1,350	5,500
Sweden	1,200	4,500
Italy	1,150	3,800
Switzerland	1,070	1,400
Germany	1,000	1,350
Japan	1,000	6,000
Spain	600	4,000
Mexico	400	6,000
Brazil	250	25,000
British Isles	210	585
Austria	205	3,000
Finland	185	1,500
India	150	27,000
Yugoslavia	125	2,600
Russia	100	2,000
Belgian Congo and Belgian mandate	....	90,000
French Congo	....	35,000
China	2	20,000
French mandate in Cameroon	....	13,000
Nigeria and British mandate in Cameroon	....	9,000
Siberia	....	8,000
Argentina	25	5,000
Region of the Caucasus	5	5,000
Madagascar	....	5,000
New Guinea	....	5,000
British East Africa	1	4,700
Peru	36	4,500

From the plateaus of Central America, streams fed by the trade wind rains develop many fine waterfalls, while from the Andean plateaus streams go down to the interior of South America from

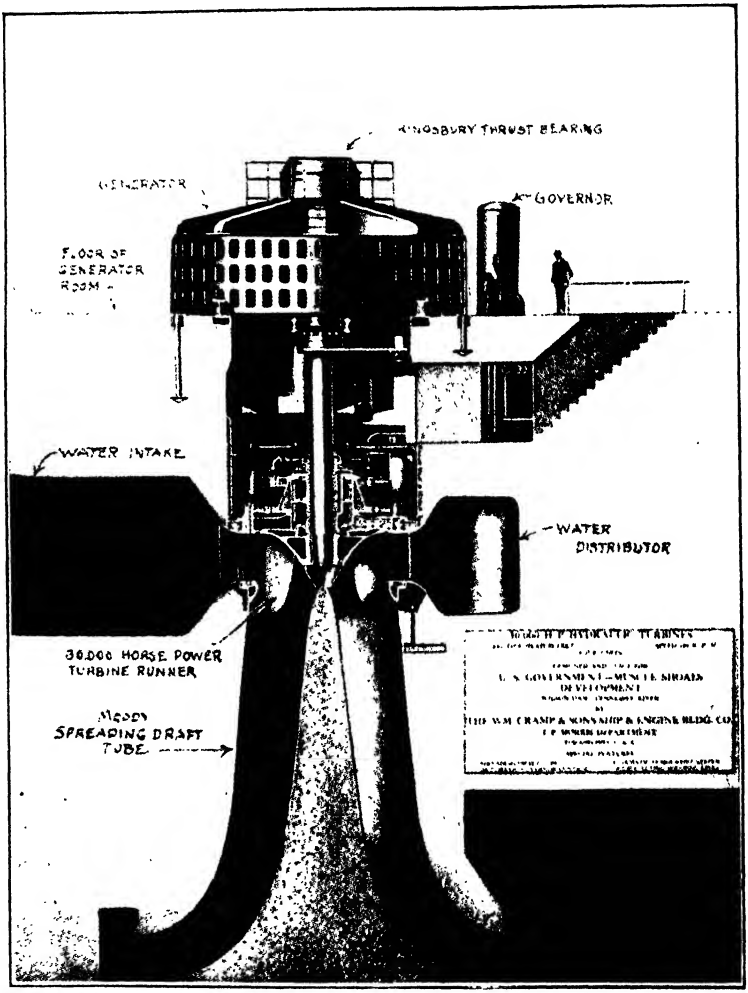


FIG. 170.—Cross section of a power unit developing 30,000 horse power. The size of it is shown by the figure of a man on the platform.

the plateaus, which give an unrivaled descent of from 6,000 to 10,000 feet. The plateaus of southern Brazil also result in many extensive waterfalls. Some of these along the coast are being used, but the arrangement of streams causes most of the falls to be in the interior, as the great fall of Iguazu on the Paraná.

5. PETROLEUM

The use of coal and water-power has been momentarily checked in some places, as in southern California, by the sudden gush of the oil well.

THE USE OF PETROLEUM. Petroleum has helped greatly in spreading civilization over the world. All the world loves light, which is so necessary for the reading habit and the spread of book culture, and so damaging to the age-old practice of story telling. Kerosene made from petroleum is, in every continent, the most common illuminant for the family lamp. For ages mankind had been depending upon vegetable and animal oils. Since remote times the lamps of south Europe have been lighted with refined olive oil. In northern Europe and America, whale oil was more popular, but by the middle of the nineteenth century the demand for this oil had become so great that the whales were well nigh exterminated, and the discovery of abundant petroleum and the art of using it came just in time to prevent a return to the gloom of the tallow candle. The process of refining crude petroleum breaks it up into a surprising number of products, the best known of which are kerosene for lighting, gasoline for the development of power, and lubricating oil for the wheels of the world's machinery.

THE ORIGIN OF PETROLEUM. Petroleum probably originates from animal remains buried in rocks, although theories differ. It collects, especially in porous sandstones, with water and natural gas, the gas, being lightest, on the top, the oil next, and the water at the bottom. Small quantities come to the surface in springs of water, and these oily springs have been known for many centuries in the Russian oil fields. In western Pennsylvania they were known for a century before the petroleum industry began, in some cases farmers being compelled to put a board across their springs to turn the oil aside so that their cattle might drink. In 1853, a company began collecting the oil by absorbing it in blankets spread upon the ground, but the real beginning of the industry dates from 1859, when an oil well was dug in the Allegheny Valley and 2,000 barrels were produced. When the artesian bores broke the impervious caps that sealed the oil sands the oil gushed from the earth, due to the great pressure of the gas imprisoned with it. This sends the oil forth as soda water blows itself from a bottle. This force, common in petroleum fields, sometimes makes a well yield 600 or more barrels per hour.

THE AMERICAN OIL FIELDS. American prominence in oil production has been due in part to the fact that it was first discovered and developed here, but more especially to the discovery of field after field, a process which has caused our annual output to increase nearly 500 percent in the past decade and a half, so that America has two-thirds of the world's production. The oldest American oil field, known as the Appalachian, runs from southeastern New York, southwest through western Pennsylvania, southeastern Ohio, and the adjacent parts of West Virginia, a territory 160 miles long and from 25 to 40 miles in width. Within 40 years after the discovery of the first well, this field had 20,000 deep wells and 4,000 miles of pipe line to collect the oil in storage tanks and carry it to refineries. Large towns bearing such suggestive names as Oil City, Olean, Petrolia, from small beginnings grew large, rich, and prosperous.

The second discovery of importance in the United States was the Ohio-Indiana field, which crosses the northern part of the boundary between these two states with its center in Lima, Ohio. Then the twentieth century witnessed a number of discoveries; in 1901 the Gulf field in Texas and Louisiana; [21] then came California, which in a short time surpassed in production all older states, to be in turn suddenly rivaled by the new Mid-Continent field in Kansas and Oklahoma, while in northern Mexico a still more spectacular field was almost immediately discovered. The first California oil field, located in the southwestern part of the state, partly underlies the city of Los Angeles where backyards bristled with wells and derricks. Some wells were even sunk in the Pacific to strike the oil-bearing rocks beneath the waters. The chief fields of California are in the southern part of the Great Valley. California oil is of especial value to the state because it is a heavy oil good for fuel purposes in a region surprisingly devoid of other forms of fuel.

[21] In the year 1901 the Beaumont oil district in southeastern Texas, only 18 miles from the Gulf of Mexico at Port Arthur, produced so largely that well owners made tens of thousands of dollars a day. Unfortunately the digging of many wells finally revealed the fact that the district (Spindletop) covered only about one-half of a square mile. This bottle was soon emptied.

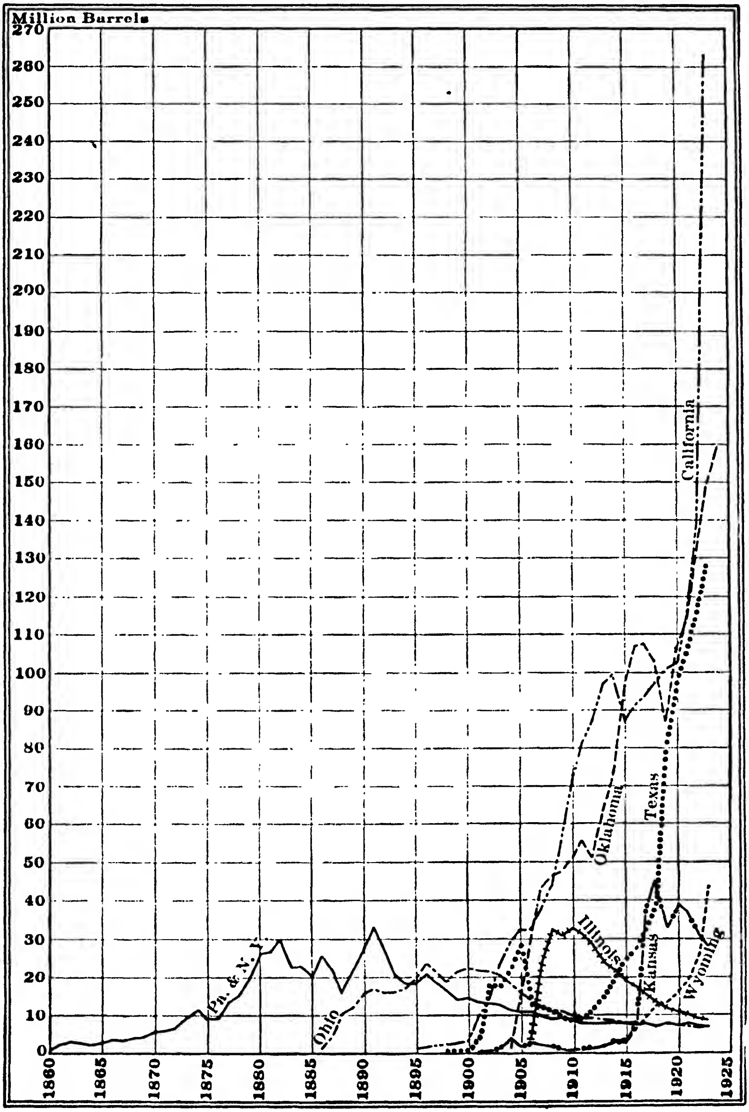


Fig. 171.—Petroleum production in the United States (barrels of 42 gallons). (United States Geol. Surv.) Petroleum is a meteoric industry. Notice the changes in state leadership.

THE FUTURE OF THE INDUSTRY. Oil production is like a mushroom, so uncertain is the life of the fields. The bringing in of numerous gushers will cause an oil boom and a sharp rise in production, followed by an equally sharp fall and then a long steady decline, in which oil must be pumped from wells instead of flowing out. Pennsylvania reached an output of 33 million barrels in 1891, followed by a gradual decline to 7 million in 1923. Ohio attained peak production in 1896, West Virginia in 1900, Illinois in 1908; the present output of each is about the same as Pennsylvania. As fields gave out, oil prospectors and promoters flocked westward to the newer strikes. The oil fields of Texas and Louisiana, Kansas, and Oklahoma, and some of the far western states are still in their zenith, the west producing 92 percent of the United States output in 1922. New discoveries in that year caused Oklahoma to break all previous records with an output of 150 million barrels, while California did nearly as well.

The ephemeral nature of the oil industry is well shown in the case of Texas, which produced 4 million barrels in 1901, 28 million in 1905, 9 million in 1909, and 118 million in 1922 after the discovery of new fields. Different states succeed each other rapidly in the position of first place, and, following the decline of output, comes the emigration of population, and the dilapidation and decay of temporary structures which mark the worn-out oil fields with desolation. For many reasons oil may be called economic strong drink (fire water).

The Rocky Mountain field, centered in Wyoming where thousands of acres of public oil-bearing lands have lately been leased for private development, has its life largely ahead of it. How long the supply will last, another decade or several, no one knows, but a period of decline and eventual exhaustion will face the western fields, as it has the eastern. The demand for gasoline, fuel, and lubricating oils has fully kept pace with the tremendous expansion in petroleum. The United States is already importing petroleum from Mexico and the future user of its products may be obliged to turn to other sources.

OIL FROM SHALE. Two reserves, however, stand between the exhaustion of our present oil fields and the necessity of using alcohol. One is oil shale. It exists in great quantities in the Rocky Mountain region and oil from it can be obtained at somewhat greater cost than we now get it from wells. The best shale areas are in the Rocky Mountains of the United States and Canada, and in New Brunswick, Europe, and probably all continents. Distillation of the shale, however, is both difficult and expensive, as the crude oil is obtained by heating (distilling) the shale in great retorts, and the process has not been reduced to a basis where it can compete extensively with oil wells. The average grade of shale in this country will produce one barrel (42 gallons) of crude oil to the ton. At our present rate of consumption the shale deposits of America have locked up in them sufficient oil to last us a century.

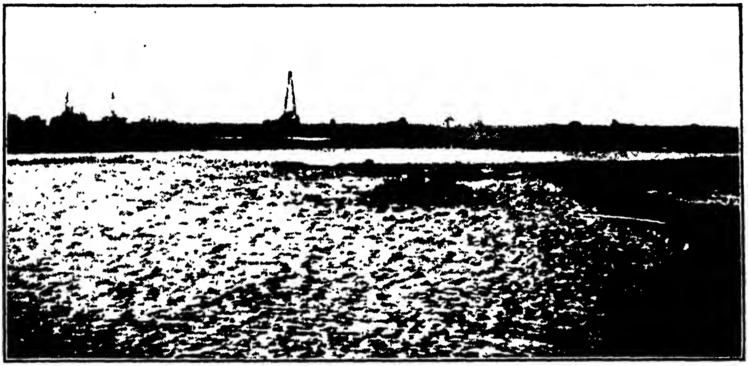


Fig. 172.—Oil well, derricks and pipes discharging crude petroleum into a pool containing many thousand barrels, Muskogee, Okla. (Standard Oil Co.) This wasteful method is often necessary where every landowner works wildly to dig wells on his land, and the wells gush (20,000 to 60,000 barrels per day), so much that even pipes cannot carry it away.

Scotland and some of the other European countries have been using shale oil for years. Little Esthonia leads the world in the utilization of oil shale. The fact that the country has no coal and only a limited supply of wood led to experiment with the abundant shale. In retorts it is made to yield oil, paraffine, and coke. The crude shale itself in Esthonia is used as fuel in grates, stoves, lime kilns, cement plants, cotton mills, locomotives, and steamships. Oil shale is most handy for the cement plant as it furnishes both raw material and fuel.

Our other reserve is benzol, of which every ton of soft coal can be made to produce several gallons, along with ammonia and gas, by the previously mentioned process of heating it before it is finally burned as soft coke or coke briquettes.

PETROLEUM IN MEXICO. Mexico rose like a meteor in the oil firmament. The busiest part of all Mexico, the most modern and progressive part, is the coastal plain in the vicinity of Tampico which contains the oil fields. The development of Mexican petroleum, a heavy oil containing a large percentage of asphalt, is produced in fields following the usual trend of immense initial flow and then a gradual decline. Some of the Mexican wells have been the most sensational gushers in the history of the industry.[22] The output has steadily increased through the constant bringing in of new wells, rising from 16 million barrels of crude oil in 1912 to a peak of 193 million barrels in 1921. In 1922 and 1923 production fell off rapidly and the experts are predicting a decline of Mexican oil output unless more new fields are discovered.

The exploitation of the oil riches of Mexico has produced great rivalry between English and American companies, and nine-tenths of the industry is in the hands of foreigners.[23] Petroleum is not refined in Mexico, but is mostly carried by fleets of tankers to the refineries of the North Atlantic ports of Europe and the United States, about two-thirds of it going to the latter. In 1923 Tampico was the greatest oil-shipping port in the world.

THE RUSSIAN AND PERSIAN FIELDS. All the American fields together were at times distanced (before 1900) by the single great field

[22] On the fourth of July, 1908, the greatest oil well of the world, up to that time, was struck at San Geronimo, on the Gulf of Mexico, 67 miles north of Tampico. When struck, the oil gushed so rapidly that before the fire in the boiler of the engine running the drilling machinery could be extinguished, the flowing oil reached it and burst into a mass of flame which for two months burned 60,000 to 75,000 barrels of oil per day with a flame from 800 to 1,400 feet in height, and 40 to 75 feet in width, making light enough to be seen by ships 100 miles at sea, and to permit a newspaper to be read 17 miles away. After the loss of $3,000,000 the fire was put out, but the oil flowed so rapidly that it could not be carried away or put in tanks, and the English owners saved their oil only by confining it in a reservoir one-fourth of a mile long made by heaping up earth embankments to keep the oil from flowing away like water. Even this well was later surpassed by the Potrero del Lano No. 4 well near Tuxpan, Mexico, which yielded 160,000 barrels a day for some time.

[23] The political aspects of this industry are one of the sad phases of international relations. The scene could hardly be better set for trouble. The prize is vast wealth, which in all ages tends to turn men's minds. This prize is controlled by a corrupt and graft-ridden local government, where elections are commonly carried by the rifle. The prize must be operated by the multi-millionaire who must have concessions, privileges and special favors. What is more natural than that the foreigner (whose desire for gain is strong) should finance a revolution or a government?

of Russia. Evidences of petroleum exist from the Crimea in the Black Sea eastward along both slopes of the Caucasus Mountains and along the Persian frontier to the city of Merv, but until 1913 nearly all the oil produced in this large region came from the small field around the town of Baku on the Apsheron Peninsula which projects into the Caspian Sea near the end of the Caucasus Mountain range. This has had a greater proportion of naturally flowing wells than any other field, and several wells have yielded as much as a million gallons of oil per day for several days in succession, a record that was unexcelled until the discoveries of the Beaumont, Tex., field.

A Persian oil field on the Mesopotamian lowland and easily accessible to ships by way of the Persian Gulf commenced production in 1913 and has steadily risen in output. New oil fields near Mosul have recently been discovered and Mesopotamia, including western Persia, is one of the most promising future oil sources, and it is often said that this is the real reason why England holds Mesopotamia—a difficult and very costly process.

Other foreign fields. Oil fields exist in widely scattered locations. On the outer slopes of the Carpathian Mountains is the second oil field of Europe. It lies in the Polish province of Galicia, and in Rumania. In Burma is one of the older oil fields which has given a steady yield but far inferior in quality to Russia and the United States. The Dutch East Indies produce some oil in northern Sumatra, in eastern Java, and in Borneo.[24] Peru has, upon the shore of the Pacific adjoining Ecuador, a field yielding a heavy black oil of some value for illumination, but of great value as railroad and engine fuel for the industries and railroads of Peru, a country having very meager supplies of coal. Venezuela has also commenced production and seems to have the best oil prospects in South America. Many geologists think there is great promise of oil along the eastern slope of the Andes, an area of great length.

Transportation of petroleum. The fact that petroleum products are used in almost all countries and exported from so few necessitates large transportation. The problem of handling this inflammable fuel has been difficult. At first, barrels were used, then

[24] Unofficial rumor of the year 1925 reported that the great oil field of the world was being kept hidden from statistical record and foreign eyes by the British in the interior of wild, dangerous and unhealthy New Guinea. Sixty tank steamers in Brisbane harbor lent credence to the rumor.

came iron tank railway cars, and lastly pipe lines where the traffic is great. Iron pipes 3 to 6 inches in diameter are laid over long distances to connect oil fields with great markets and ports of shipment. Thus Oklahoma oil is now piped to the Gulf Coast or to St. Louis, Chicago, Philadelphia, and New York. The recent large production of the California fields has resulted in several pipe lines from the wells to the Pacific Coast. The natural accompaniment of the pipe line is the tank steamer, holding hundreds of thousands of gallons and loaded by merely letting the liquid flow in from the pipes. Such vessels connect with the pipe line at the ports of Mexico and Texas, and carry crude petroleum to the refiners of Europe, as well as New York and Philadelphia.

The Russians long used tank cars to transport their product over the 600 miles of railway between the Caspian Sea and the Black Sea ports of Batum and Poti. A pipe line was finally established to handle a part of this traffic. Tank steamers plying to western Europe connected with the pipe lines and tank cars at the Black Sea ports, while interior Russia was supplied by steamers upon the Caspian and up the navigable Volga River.

Petroleum as a source of power. The first great use of petroleum was for illuminating oil and then for lubrication, but with the opening of the twentieth century it has rapidly increased in use as a

ESTIMATED PETROLEUM RESERVES OF THE WORLD, 1921

	Percentage	Millions of Barrels
United States	14.0	9,150
Southeastern Russia, Southwestern Siberia and the Caucasus	9.0	5,830
Persia and Mesopotamia	9.0	5,820
Northern South America, including Peru	8.8	5,730
Mexico	7.0	4,525
Southern South America, including Bolivia	5.4	3,550
East Indies	4.6	3,015
China	2.1	1,375
Japan and Formosa	1.9	1,235
Rumania, Galicia and West Europe	1.7	1,135
Canada	1.5	995
India	1.5	995
Algeria and Egypt	1.4	925
Northern Russia and Sakhalin	1.4	925
Additional Deposits Probable	30.7	20,000
Total	100.0	65,205

From "Some Great Commodities."

source of power. First came the engine run by gasoline, one of the petroleum products, now so important to the automobile. Then came the use of crude petroleum as ordinary boiler fuel. This has had its chief use in ships where oil tanks take up less space than coal bunkers and the crew can be reduced because the flowing of the liquid replaces the labor of coal passers.

Oil is also a good locomotive fuel, and as the great oil fields of Oklahoma and California are at the ends of a region where coal is scarce, the cheap oil of the new fields was quickly utilized by the railroads. It now drives the locomotives on 17,000 miles of railway between the Gulf of Mexico, Oklahoma, Utah, and California.

The third and newest use of petroleum as a source of power is in the German invention of the Diesel engine, an internal combustion gas engine which has the great advantage (in cost) of being able to use the crude petroleum as it comes from the earth. It is so efficient that a gallon of oil costing from 3 to 8 cents will develop 15 horse-power hours. This invention promises to make oil a great power fuel while the present cheap oil lasts. In Germany this engine is also being used to develop power from tar oil derived from the tar produced by the by-product coke ovens and the producer gas plants.

NATURAL GAS. Natural gas, the most volatile of the petroleum products, is the best and most convenient of all fuels, the cheapest and most convenient of all sources of power. It separates itself from the oil as cream separates from milk but it accompanies the oil in practically all fields. It has for many centuries burned at the crevices of the rocks on the Russian oil fields where for ages the fire-worshipers of Persia have made pilgrimages. The greater part of this gas, which is richer in heat than that manufactured at so much expense in most cities, has been largely wasted, owing to the heedlessness of man in failing to provide proper means for preventing its escape. The conservation of petroleum and natural gas has been a peculiarly difficult problem where every one owning as much as a backyard is free to dig a deep hole in the earth and let them run out. Thus the desire to get some oil causes every landowner to dig a well. Thus twenty wells (at $15,000 to $40,000 each) may be dug where one would get all the oil.[25] For many

[25] This waste of resource in getting oil is a strong argument for the idea that it should belong to the Government rather than to the persons who by chance own the land. Another argument may be seen in the effect of the oil riches on the owner.

years the gas thus going to waste from oil wells in the United States was probably worth at city prices over a half a million dollars a day. In the American oil fields this gas has been of very great industrial importance in the iron and glass industries as boiler fuel and as city gas. It has been piped to many towns and cities outside the regions of its production. Most unfortunately the life of the gas well is short and the supply is exhausted in a few decades, but it furnishes an astonishingly cheap fuel while it lasts. In 1913 the average price per thousand cubic feet of gas was 5 cents; in 1921 this had risen to 26 cents—an indication that the era of cheap natural gas, like the era of free land and of abundant timber, is drawing to a close. With high prices the present gas supply is being more carefully conserved but that cannot bring back the amount wasted in the past or increase the future supply.

This resource has been the fourth element in making western Pennsylvania more liberally supplied with fuel than any other place in the world. In that region a thick forest covered hills which were underlaid with the magnificent coal deposits of the Appalachian field, while further down was crude petroleum, and the natural gas that drove it spurting from the orifices in the rocks. The gas from this field is now about exhausted, the forest is practically gone, the oil output has greatly declined, the coal is being rapidly used up, and scenes of desolation face the traveler. No wonder the American people are beginning to consider the question of the conservation of natural resources—now that the richest of them are gone and the time of need begins.

Refining of petroleum. Crude petroleum is very complex chemically and every year more and more commercial products are being separated from it. The process of refining consists of distillation. The thick, black crude oil is put in a large tank and heated so that one product after another becomes volatilized and passes off, like steam from a kettle, to be caught and condensed. Among them are many kinds of oil from light naphtha to heavy paraffine oils, wax, paraffine, tar, and finally coke. Each product is capable of separation into others by redistillation, some of the products being vaseline and other ointments and drugs, so that altogether the modern petroleum refinery sells, in addition to kerosene, several hundred by-products, including tar which may be made into thousands of aniline dyes. Thus we see why the refinery must be a large plant.

The great demand upon the oil chemist is to get more gasoline out of a given oil.

OUR FOREIGN TRADE IN PETROLEUM. The American trade in petroleum products is as wide as the world. Our oil makes better illuminating oil than that of Russia, and is sent, in the crude form, to some of the more important countries, while in the form of kerosene or refined petroleum for lamps it is distributed more universally to the nations of the world than any other product of American export. It goes alike to Greenland and New Zealand, Norway and Madagascar, to the tribesmen in Italian East Africa, and to the Italian in the home country, to the Spaniard in Spain, and the Spanish-speaking mestizos or half-breeds of the Philippines. The Chinese, who regard light as a most prized luxury, buy large quantities of American refined oil. The ordinary 5-gallon cans of American kerosene are distributed throughout the interior of China in places where the face of the white man has never been seen. And the empty oil can, what services does it not render, from house roof to city water supply (by way of vendors)! In 1923 the United States export of illuminating oil was 850 million gallons and that of gasoline and naphtha combined practically equaled it. Yet it should not be forgotten that we are now *importers of crude oil.*

ASPHALT AND WAX. These products are not fundamentals of manufacture like coal, iron, petroleum, and natural gas, but their occurrence with petroleum is the reason for presenting them here. Asphalt, supposed to be an oxidized form of crude petroleum, is a common accompaniment of oil fields, its presence at the surface often pointing out the existence of oil. While used in the manufacture of many products, the chief use of asphalt is in the paving and roofing industries. For many years it has been mined commercially in France, Italy and other European countries, but the best natural asphalt deposits are near the mouth of the Orinoco River in Venezuela and on the adjacent British island of Trinidad. The famous asphalt lake of Trinidad has furnished thousands of tons of this much prized paving material annually during the last 40 years without lowering its surface more than a few feet. The lake is apparently inexhaustible and the viscous material after being dug up, slowly replaces itself within a few hours. The lake is less than a mile from the seashore and cable ways with traveling buckets transfer the asphalt easily from the lake to the holds of the ships, which carry it to the world's commercial ports.

Because of the ease with which Trinidad asphalt can be gathered and shipped, it led in the markets until the enormous production of petroleum in the United States and Mexico furnished a new source. Most of our asphalt is now recovered directly from petroleum in the refining process, by which the more volatile parts are distilled off. In 1923 the United States produced 974,000 tons of asphalt from native petroleum, 1,400,000 tons from imported Mexican petroleum refined in this country, and imported only 100,000 tons from Trinidad.

Ozokerite, or mineral wax, a material somewhat resembling paraffine, is found in several oil fields and makes the brightest of all candles. It exists in great quantities in the Russian oil regions, but practically all the world's supply is gathered in Galicia, Poland, where there are even richer deposits along with a labor supply more abundant than in any other existing oil field.

6. OTHER SOURCES OF POWER

Fortunately man does not have to depend for power upon wood, coal, oil, natural gas, or waterfalls. These are but a very small fraction of a veritable fury of power manifestations in the midst of which man lives. We have already made suggested beginnings for the utilization of other sources. (See opening of this chapter.) The most promising next rival is probably the wind. New types of generators just being perfected in 1925 are about ten times as efficient as the old windmill which distributed water on the farms. It is a fact that if the propeller of the ocean steamer goes too fast it kicks the water out of the way, makes a hole and then runs fruitlessly in the hole. Something of the same sort seems to occur with the widely distributed multi-vaned windmill, with many rays filling its complete circle. An airplane propeller has just two, which apparently always find air to kick when they get to a certain point in their revolution. The new windmill is of this type. Hundreds of European engineers have been working upon it fiercely since the World War.[26] In the year 1925 it gave great promise. The promise seemed to be like this: fields of great mills, each with arms per-

[26] The announcement of the rotor is significant—wind power by an entirely new theory—the theory of the curving baseball. The steamship's present triumph may be temporary, for coal and oil are getting scarce, and wind?—where is it not found?

haps fifty feet or more in length, each with a dynamo directly attached to its shaft, these fields in windy places such as the top of the southern Appalachians, the top of the White Mountains, the shores of the Great Lakes, windy Cape Cod, all harnessed into one system. When the wind balked in one or two places it would most likely be blowing in others, thus reducing power storage to a minimum.

The cosmic force of gravitation and planetary momentum gives us the tides. This we have thus far used but little, although methods for its utilization have recently been perfected.

The English have a pretty plan to impound several square miles of high tide, twenty feet high, in the estuary of the Severn, south of Wales, and the same in the estuary of the Dee, north of Wales. As these high tides are three hours apart, and as the water is to be made to work as it goes into tidal basins and out of them, the prospect of almost continuous power is an important aspect of the enterprise. But the tide cannot be expected to solve any major part of man's power needs.

Another cosmic power source of considerable promise is earth heat, especially around areas of volcanic energy, active or latent, as evidenced by hot springs. This source of heat is being used tc run steam engines, electric generators and do industrial service, in Tuscany, Italy, and in California.

The heat of deep earth is worthy of consideration in this connection.

Probably the chief source of all our power is the sun, whose energy is stored in wood and fossil fuels, but whose chief manifestation is in the wind. This result of the unequal heating of the earth's surface develops such tremendous energy that in the work of carrying the earth's waters it uses power of which the water-power resources as man sees them are but a small fraction of 1 percent. In passing over the surface of the sea the wind raises the waves which have eaten away continents. In the mere rising and falling 2 feet three times per minute the waves exert on a strip 100 feet wide 6,000 horse-power per mile. This power man has not yet utilized.

We can boil ether and probably other cheap chemicals by subjecting them to the heat of ocean water at a temperature of 80°. We can condense it by subjecting it to cold water at a temperature of 40°. It so happens that there are millions of square miles of ocean surface with the above high temperature, while a half mile below are limitless cubic miles of water with the low temperature—the one fed by tropic sunshine and the other by Arctic chill whose cold waters fill all deep seas and are continuously replenished by both Polar zones.

This offers interesting power castles to the engineer who observes that many West Indian islands have both kinds of water within a mile of the surf.

All other sources of power pale beside the great source—the direct rays of the sun which are calculated to hurl into 9,000 square miles of Egypt enough power to replace all the engines and waterwheels in the world. Three different types of mechanism have utilized this power to a small extent. The success of such power development to the point of superiority to existing power sources offers interesting speculation as to where would be natural seats of empire when the best sources of power were within the zone of 200- or 400-mile power transmission from cloudless deserts.

Alcohol is, however, nearer to us from the mechanical standpoint. It can be produced from henequen pulp, corn stalks, potatoes, and a great variety of vegetable materials. We already know how to use it as a rival of gasoline and kerosene and it is extensively used for those purposes in Germany, which has no petroleum and much potato land. Alcohol as a source of power permits us to go on indefinitely, because it depends upon agriculture, the enduring industry. The alcohol tank steamer coming from a distillery on a trade wind shore beside tropic yam or cane fields tilled by Chinese emigrants could probably give us a surprisingly close duplicate for many of the products of petroleum.

New chemical discoveries may give us any day cheap liquid fuel that will turn the whole power world topsy turvy.

Water power has loomed large in the last thirty years because of two major inventions. The solid cement dam enables us to harness the great stream. Water power used to be usable only at the end of the shaft or belt that hooked directly to the wheel. Now the engineers can build a power plant in the California mountains, where the tents of the workers cling almost like birds' nests to the face of cliffs, and use it in seashore cities three hundred miles away.

This brings us to the project of super-power, a word applied to long distance power transmission by which many plants are hooked together.[27] The plan promoted by the government contemplates hooking together everything from Washington, D. C., to Portland, Maine, receiving power from a few enormous plants of great size and economy of production. Equalization of peak loads is one of its great advantages. When one town wants its maximum another may not, and the power can be shifted from one to another.

The rapid advance of the hooking up of power enterprises indicates that in a few years we may have Quebec, New Orleans and Chicago on the same wire, with power capable of being diverted from one to others or to any place in between.

Here is one of the great problems in the relation of industry to government. As F. R. Lowe, President of the American Society of Mechanical Engineers, said: "Control of national power resources would give to the possessor mastery over his fellows and the opportunity for tyranny and extortion possessed by no autocrat of previous empire."

The prediction that our coal will never all be mined is therefore not altogether fantastic.

REFERENCES

See General References

Persons interested in mineral and power resources can find additional information in the following publications.

The United States Geological Survey, two-volume annual, *Mineral Resources of the United States*, gives comprehensive, detailed, new information and statistics upon the mineral industries of the country and to some extent of foreign countries.

The Mineral Industry, annual, The McGraw-Hill Company, edited by G. A. Roush, does the same thing for the entire world.

The Engineering Magazine, New York, publishes each month and annually an index of periodic literature in the whole field of Engineering, including power and power resources, and mining enterprises.

The World Atlas of Commercial Geology, 1921, published by the United States Geological Survey. Part One deals with the Distribution of Mineral Production in the United States and throughout the world. Part Two makes a survey of the Water Power of the World. Both have many maps of the producing and reserve areas. Very valuable.

The Story of Iron and Steel, by J. Russell Smith, nontechnical account of the development of the industry and of the condition in different countries. Appleton, 1908. Old, but not bad.

[27] See reports on this subject by the U. S. Geological Survey.

CHAPTER XI

THE FOREST INDUSTRIES AND PAPER

THE USES OF WOOD. Man cannot get along without wood. It has been useful in all stages of civilization and the more civilization advances the greater is the service it renders. It serves as fuel for the savage's camp fire, it makes the wagon in which the roving tribesman carries his family and goods, and when he settles down to agriculture he uses wood for his plow, for his house, for the barns for his cattle, and for the fences that limit his land and keep his animals from wandering away. It rendered the same services in the making of house, barn, fence, and household fuel throughout Colonial America, and to-day its use even as fuel is as great in the United States as ever before. World commerce is served by the millions of trees that go each year into the bed of the railway as ties, while the lordly conifer has for centuries been the mast of the ship. In this day of great movement of goods, surprising quantities of wood are used for barrels and packing boxes, a single Philadelphia soap factory using for this purpose five carloads per week. Each day some inventor finds a substitute for wood in one of its uses, but other inventors find corresponding new uses for it, so that our dependence upon it is increasing day by day. It has even become essential to the spreading of knowledge, for practically all our books and magazines are printed on paper made of wood pulp.

THE AMERICAN FORESTS AND THEIR DESTRUCTION. America is the richest of all continents in useful wood. Through much of our history our people have had to fight the forests, which came down to the shore of the Atlantic so that the first settlers landed beneath its shade. The first effort of the new colonist was directed against the forest, which he worked laboriously to clear away before he could plant a crop. He then had to struggle for years with the stumps before he could have a smooth field to grow his food. Decade after decade, through the seventeenth, eighteenth, and the middle part of the nineteenth centuries, the occupation of the country east of the Mississippi went steadily forward, accompanied by the destruction of the forest to make room for the plow. In this process millions of fine oaks have been rolled into piles and burned to get rid of them. Throughout this period of most active forest clearing the necessary lumber was usually made in little sawmills on local streams where the water wheel drove a big upright saw up and down and ripped off the boards one at a time for the man who brought his logs to the mill. Recently, great improvements have been made in the manufacture of logs into useful lumber, the circular saw has replaced the upright saw, and in some cases the rapid double-cutting band saw has replaced the circular saw, especially for the large logs in the western mills.

THE RISE IN THE PRICE OF LUMBER. For fifty years the price of lumber has been gradually rising while we in America have been cutting down the forests, wasting the wood, using lumber prodigally and letting the forest fire run almost unheeded, to the great destruction of the young trees that should be making the lumber of the future. The pine areas, first of New England, and then of the Great Lakes long supplied part of the lumber for the treeless northern Mississippi Valley with its thousands of towns and hundreds of thousands of farms. Suddenly there came an end to this lumber supply and the middle west began to import heavily from distant places. At the same time eastern lumber regions began to show signs of exhaustion, and lumber operators from New England, New York, Pennsylvania, and Wisconsin began to buy timber lands in the South, the longer railway haul driving up the price of lumber suddenly with the opening of this century. Now four-fifths of the original southern pine is gone and the lumber center is shifting to the Pacific Coast. In addition to the growing scarcity each of these moves increased the distance between the centers of production and the centers of consumption, with a resulting increase in lumber price.[1]

THE LOCATION OF THE LUMBER INDUSTRY. Lumber is a product depending upon forests and favorable conditions of transportation to market. A log must be carried sometimes for miles from the stump upon which it grew to the saw mill, and the heavy boards carried thence to market and sold. In the past the price of lumber has

[1] New York and Pennsylvania, formerly leading lumber states, now import from 80 to 90 percent of the forest products they consume and pay over $20,000,000 each for lumber freight bills.

usually been much less than a cent a pound, so that lumber making for the market has always been dependent upon very favorable conditions of transportation, often depending in part at least upon water transportation. The big log is more difficult to transport than the smaller boards, so the sawmills are situated as near as possible to the place where the trees grow. The mill is often portable, moving about the woods sawing the logs of a few acres in each place, thus minimizing the log hauling. A large sawmill is usually found

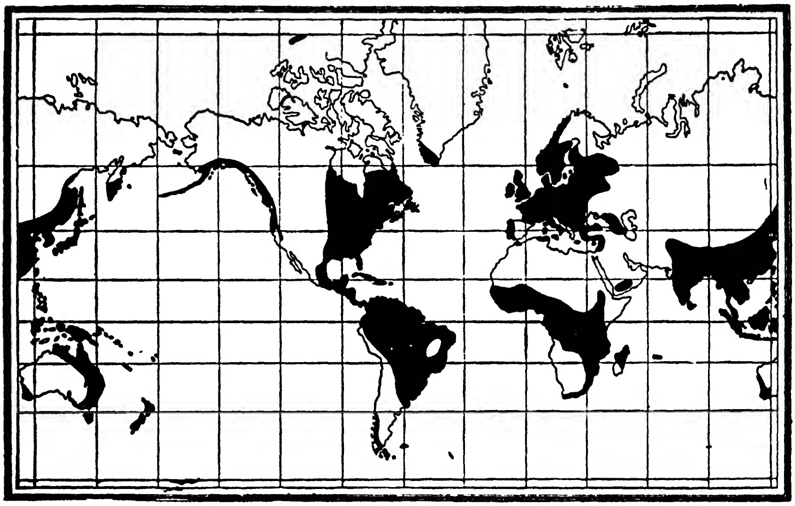


FIG. 173.—Arid regions of world (rainfall less than 20 inches per year) shown in white. Forests grow on the mountains of arid regions and on plains at about lat. 55°. (U. S. Geol. Surv.)

only where the logs can be floated down a river or brought in by rail, so that it can draw its supply for many years from a large territory.

As to the forest, it will grow from the heart of the tropics to the edge of the Arctic far beyond the grain line, if there is a moderate rainfall, evenly distributed throughout the year. Granted moisture, no soil is too poor, too sandy, or too rocky if the tree can once catch hold with its roots. So great is this power of tree life that a good timber tree often stands on the face of a cliff fastened by roots that have wedged themselves in rock crevices which they have penetrated in the search for food.

Within the forest the trees vary greatly in their suitability for lumber, most of which is made from a few species that are especially adapted for lumber uses by form and quality. The shade trees commonly used along city streets of America and Europe are the broad-leaved deciduous trees. These handsome species are poor timber trees because their trunks are apt to be crooked and a great proportion of their wood is in the branches. The cone bearers are better timber trees because they have a large, straight trunk with small branches and their woods are softer and better adapted for easy use by man. They can also thrive in lower temperatures and poorer soils. As a result our familiar broad-leaved trees do not furnish over a quarter of the lumber used in the United States or in Europe.

THE FOREST REGIONS AND LUMBER DISTRICTS OF THE UNITED STATES. The natural forest region of the United States comprises almost all the country between the Atlantic Coast and an irregular line extending from the mouth of the Rio Grande, to the Canadian border near the western boundary of Minnesota; a large area in the higher regions of the Rocky Mountains; and the Pacific forests on the Sierra Nevada and Coast ranges. It is too dry for tree growth on the lower lands of California, of the Rocky Mountain region, the Great Basin, and also on the Great Plains. The prairie fires set by Indians to remove old grass from the pastures are supposed to have kept down the forest in large areas of the Mississippi Valley where trees now thrive, when man gives them a chance. Parts of the Shenandoah Valley of Virginia and West Virginia are for the same reason said to have been devoid of forest at the time of settlement.

There are seven important lumber districts in the United States, although the forestry map based on varieties of trees gives six forest regions and there are various other ways of dividing them.

NORTHEASTERN DISTRICT. The first of these seven districts is the northeastern, comprising the upper New England and Adirondack forests, occupying a highland with a climate rather too cold for satisfactory agriculture of nineteenth-century type. Much of this cold country is impossible of tillage because of its steep and rocky surface. It was made rocky and also swampy and sandy by the work of the overriding ice in the glacial epoch. But its rocky, swampy, and sandy soils can, if properly cared for, give us crops of wood indefinitely. This lumber district, being easy of logging and near to cities, was the first in the United States to be largely de-

FIG. 174.—This map of the natural forest areas of North America should be examined carefully. (Courtesy Baum's Atlas of U. S. A. Electric Power Industry.) (From *North America*, published by Harcourt, Brace and Company.)

veloped. The cold winter and heavy snow of this northeastern highland are essential factors in the lumber industry because the swamps and rocks, impassable by wagons in summer, are frozen firmly and covered by the deep snows of winter so that teams and tractors are able to sled the logs out to the stream bank where the melting of the snow in spring furnishes the freshets which carry the logs downward to the mills. Thus Bangor, Maine, on the Penobscot, became a sawmill center.

Fig. 175.—Snow is almost as good as railroads for the northern lumber industry. Thief River Falls, Minn. (United States Forest Service.)

The most important timber tree of this forest region was originally the white pine, which yields one of the very best of woods. It is prized for its lightness, strength, durability, freedom from warping, cracking, or shrinking, and the ease with which it can be worked.[2] The spruce is second, and the hemlock third in importance. The broad-leafed trees, including the maples, beeches, birches, and oak are often scattered through these forests, forming a rather large part of the forest growth in this and the next lumber district. They have so far been neglected in favor of the more easily worked and salable soft woods.

[2] "God made pine," says the carpenter, and, as he pulls a splinter from his thumb, "the Devil made hemlock."

THE FORESTS OF THE GREAT LAKES. The second lumber district is that around the upper Great Lakes, which is climatically and industrially a sort of separated western half of the New York and New England field. Similar glaciers overrode the states of Michigan, Wisconsin, and Minnesota, leaving in their northern parts similar sandy, rocky, and swampy areas. The likeness to the east is completed by the predominance of the white pine, the spruce and the hemlock, while the lumbering operations are carried on with the assistance of the snow, which in the region between Lakes Superior and Michigan attains a greater depth than in any other part of the United States and enables the most astonishing loads to be taken out over a land which is in the summer utterly impassable for any kind of terrestrial vehicle. The lumber industry of this district shows the westward development that has accompanied the advance of the American people across the continent.

Lumbering in this district began in the lower peninsula of Michigan, then went to the upper peninsula. Then Wisconsin succeeded Michigan as the leading state, but as her forests diminished she was in turn succeeded by Minnesota. Minnesota has now been surpassed by the rapidly rising lumber districts in the South and on the Pacific Coast. The exhaustion of the white pine especially has been the impetus to make the lumbermen emigrate to new fields, and so thorough was the destruction of the forests that all the Lake states had become lumber importers by 1920.

APPALACHIAN HIGHLANDS FOREST. The third lumber district is that of the Appalachian Highlands, reaching from southern New York to the northern parts of Georgia and Alabama. This plateau, becoming higher as it goes south and reaching its maximum elevation in North Carolina, extends the temperature of New England far into the south and with it the trees of New England. Some hemlock is found in western Carolina, West Virginia has 5,400 square miles of hemlock and spruce, with some yellow pine and some white pine, while hemlock has long been a standard timber from the Pennsylvania mountains. In this Appalachian district the steepness of the mountains and the small amount of snow makes impossible the extended use of sleds as in the New England, Adirondack and Great Lake forests, and the logs are moved to the mills on wagons or, in some cases, on chutes of logs or steel down which the logs slide from precipitous hills to a temporary railway in the valley below. The timber has been almost entirely exhausted from the more accessible parts of this region. By 1910 carloads of lumber were regularly shipped into Pennsylvania districts from which twenty-five years ago it was sent out by the trainload.

HARDWOOD FORESTS. The fourth lumber district is the middle region of hard woods extending from New York to Alabama, from Louisiana to the lower Great Lakes, and from Tennessee to the western edge of the Ozarks near the boundary of Kansas. The evergreens, spruce, pines, and hemlocks hold the top of the Appalachians, and pine trees grow naturally upon the sandy Atlantic plain, but between these two on the lower slopes of the Appalachians and the hilly country leading up to them on both the eastern and western slopes is a large area where the forest is made up of the broad-leaved trees, oak, hickory, chestnut, tulip, black walnut, and to a lesser degree ash and basswood, classed as hard woods by the Forest Service.[3] This is the region from which the American supply of these hardwood timbers has chiefly come, although they are produced to a lesser extent in both northern and southern forests. Lumbering on a large scale was done earlier in the eastern part of this hardwood district than in the western; at the present time Arkansas, Tennessee, West Virginia, Michigan, and Wisconsin are the states of greatest production. Chattanooga and Evansville, Indiana, are important markets and Memphis is the greatest hardwood market in the world. Oak, maple and red gum are the leading woods, and it is the district producing the greatest amounts of chestnut, beech and yellow poplar.

SOUTHERN PINE FORESTS. The fifth lumber district is that of the southern pines, extending in an almost continuous forest along the Atlantic coast plain from Long Branch, New Jersey, to Austin, Texas. The most important tree in this district is the yellow or hard pine. The strength and hardness of this wood make it much prized for flooring, interior woodwork, and many other uses. In 1922 it furnished 38 percent of all the lumber cut in the United

[3] *Commercial Woods as Classified by the Forest Service*

Soft Woods		Hard Woods		
Pines	Redwood	Oak	Beech	Ash
Firs	Cedar	Maple	Birch	Hickory
Hemlock	Larch	Poplar	Basswood	Walnut
Spruce	Tamarack	Gum	Elm	Sycamore
Cypress		Chestnut	Cottonwood	Cherry

States. Various other pines growing in this belt, particularly the short-leaf, loblolly, and slash pines grow very rapidly. Between 1860 and 1900 they covered many abandoned corn and tobacco fields in Maryland, eastern Virginia, and North Carolina with a growth large enough for the sawmill.

Much of this southern country is sandy and level, some of it gently rolling, but none of it is rugged. Lumbering is much easier than in New England or the Appalachian district. Much of it is done on temporary railroads which are put through the woods about 2,000 feet apart so that a donkey engine winding a cable

Fig. 176.—A Louisiana lumber mill with a pond for log storage. (United States Forest Service.)

1,000 feet long can draw logs from any part of the woods to the side of the railroad track.

The ease of lumbering has made for reckless cutting, so that the passing of the piney woods is imminent. By 1920 four-fifths of the original southern pine was gone. The cut-over pine lands of the South, estimated at nearly 80 million acres in 1924, are increasing at a rate of 2 million acres each year. The warm moist climate makes this one of the best sections for the trees to replace themselves if properly cared for. Under the practice of forestry the South can be one of the main sources of the nation's softwoods, but the South, like the rest of the country, is still backward in protecting its forests so as to insure regrowth.

The combined coastwise and export trade in this southern lumber makes large shipments from the ports of Mobile, Alabama; Pensacola, Florida; Brunswick and Savannah, Georgia; Charleston, S. C.; New Berne, N. C.; and Norfolk, Va.; while the small town of Gulfport, Miss., is one of the greatest lumber-shipping points in the world. Vast quantities of southern pine are also sent by rail into the Ohio and Mississippi Valleys.

Another important timber tree in the southern field is the cypress, used for shingles and interior work. It is one of the few trees that will grow in a swamp, where its roots must be under water. The shifting source of cypress well illustrates the growing shortage of lumber, and the reasons for its rise in price. Norfolk used to be the great cypress market, but the comparative exhaustion of the Dismal Swamp supply caused Florida to succeed Norfolk, whereas scarcity in Florida has been followed by the rise of New Orleans as the chief market for the product of this swamp forest tree from the swamps of the Mississippi bottoms. Of increasing importance, too, are the gumtrees and a few other varieties formerly considered worthless for lumber and left standing while cypress was being taken out.

THE WESTERN MISSISSIPPI VALLEY AND THE ROCKY MOUNTAIN FORESTS. The central part of the Mississippi Valley north of the Ozark Mountains was partly covered with mixed hardwoods when occupied by the homesteaders in the second and third quarters of the nineteenth century. Ohio and Indiana had magnificent forests of oak, hickory, maple, ash and elm. Illinois was transition ground where fine hardwood timber alternated with large patches of open prairie. Only along the streams of Iowa, Kansas and Nebraska was there forest. The scattered growth of broad-leafed trees was of great value to the early settlers, furnishing them with wood for buildings and fuel. Most of this timber has been gone for many years.

At the North the humidity in the glacial swamps and the lakes had preserved forests west of the source of the Mississippi (see Great Lakes district above) and at the south, the Gulf rains had extended the southern forests over east Texas and the hardwood forests over the Ozarks. From the Missouri River to the Rocky Mountains, from Canada to the Rio Grande was a timberless area with one oasis of forest on the small highland, where the Black Hills of South Dakota and Wyoming, with a greater rainfall, supported a rather inferior tree growth.

Owing to the slight rainfall at low elevations, the Rocky Mountain forests grow only in high elevations, particularly in the South, but the lessened heat and evaporation make the area of the forest increase in Idaho and Montana. These Rocky Mountain forests, because of their dependence upon elevation, occur in scattered patches which increase in and toward the North. The percentage of forest area is comparatively small in New Mexico, but it has many more square miles of forest than has New Hampshire. There are even several thousand square miles of fine open forest upon the

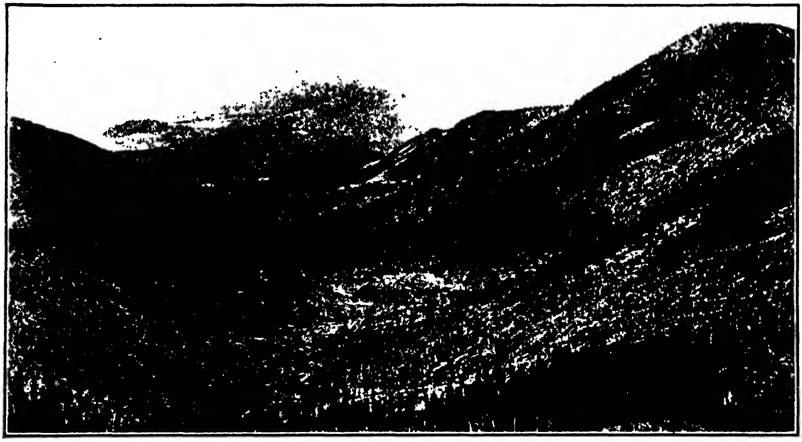


Fig. 177.—All the middle ground of this picture is a fire-killed forest. Only patches here and there remain alive. San Francisco Mountains, high above the Arizona plateau.

plateaus of northeastern and central Arizona, and there are large extensions of this same plateau forest in the mountains of northern Mexico to which no railroads have yet been built.

Owing to the prevailing coolness resulting from elevation, the Rocky Mountain forests are mainly coniferous; they include chiefly the western yellow and lodge-pole pine, spruce, Douglas fir, and western red cedar. Seventy-five percent of this area remains uncut but it is often hard to get out and it has been sadly injured by fires.

Sometimes the Rocky Mountain forests are upon plateaus and slopes at the head of steep walled canyons through which logs will not float, and where the prospect of permanent settlement and traffic are too small to warrant the building of railroads. From these seemingly inaccessible places lumber and logs are brought out by flumes or troughs through which a stream of water flows and pushes the lumber down a gentle incline often miles in length over territory utterly impassable by any other means of transportation.

FORESTS OF THE PACIFIC SLOPE. The seventh forest district of the United States and the finest in the world is that near the Pacific coast. This forest belt begins about latitude 35° in California, where it occupies the Sierra Nevada and Coast ranges, but low rainfall causes the great valley of that state lying between these mountains to be treeless, save along streams, as are the lowlands farther south and east. In northern California, parts of Oregon, and central Washington the forests cover not only both mountain ranges, but most of the valleys between. The second system of mountains, as we go inland (Sierras and Cascades), sharply limits the rainfall so that, except upon the higher ranges, there is no forest in the Great Basin between the east front of the Sierras and the Wasatch Mountains of Utah, nor between the Cascade Mountains of west central Washington and Oregon and the mountains of Idaho, except where the Blue Mountains of northeastern Oregon lift their lands up into the altitudes of moisture and hence of trees.

The even climate, a good rainfall, freedom from windstorms, and a dry summer, checking fungous action, permit the trees of the Pacific forests to grow for ages and attain great size, as is shown by the well-known big trees of California.[4] But commercially more important than these forest giants is the thick stand of California redwood, and the Douglas fir in all three of the Pacific states. This tree grows from 4 to 8 or even 10 feet in diameter with straight trunks 100 feet and even more in length. It is difficult work to get these huge logs to the sawmill. Because of this difficulty much fine timber is wasted.[5] As it is utterly impossible to haul them

[4] The wood of the big trees is almost unburnable and the thick bark holds water in a most unusual way—a great pair of fire-protective qualities.

[5] Lumber is wasted on the Pacific coast more than in the East and South because the haul to Eastern markets is too long to pay for making up cheaper stuff—boxing, crates, etc. Only the best of the lumber can be profitably worked up and shipped. Thus does natural law enforce double penalty upon us for the neglect and waste of our Eastern forest.

on an ordinary wagon, they are sometimes dragged by donkey engines or long teams of oxen over a roadbed paved with small logs. Oftener they are taken on temporary railways, and sometimes they are allowed to slide by gravity down log chutes. The largest must often be split by blasting before they can be moved at all. The lumber is manufactured in the largest and most perfect lumber

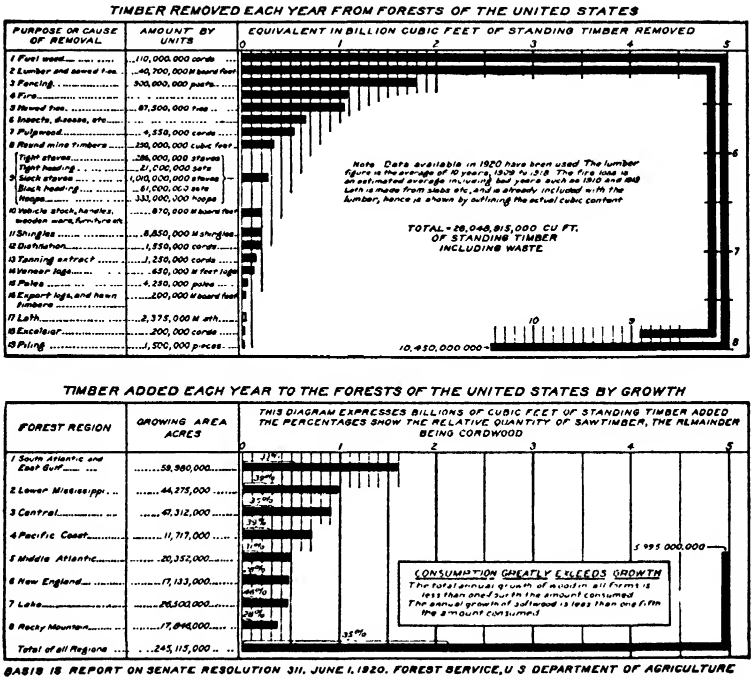


FIG. 178.—Each year we use four times as much timber as we grow. What will be the end of this process of destruction?

mills in the United States, some of them using every particle of the log that is brought to their wonderful machinery. A typical mill may produce shingles, lumber, and match-sticks from the finest portions of the logs, while the sawdust and bark feed the engine fires. Usually, however, there is an extra fire burning unused waste. Sailing vessels have for years loaded at Seattle and Tacoma, Wash., Vancouver, B. C., Eureka and Humbolt, Cal., to carry this most excellent timber to markets of South America, Australia, Japan, South Africa, and even to England, France, and Germany, a voyage much longer than half the distance around the world.

The increased price of lumber in the United States permits the Pacific Coast lumber to be carried across the continent to Chicago and even to New York, and it has become an important article of freight eastward upon the transcontinental railways. The three Pacific Coast states now contain more than half of our remaining saw timber.

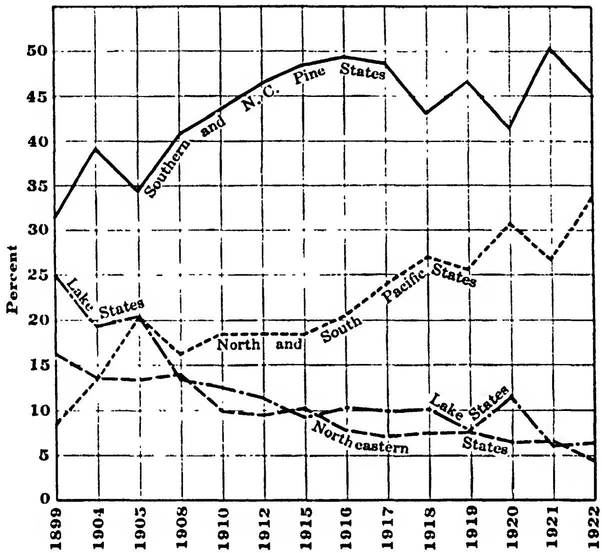


FIG. 179.—Percentage of total lumber production supplied by different sections of the United States.

THE SHIFTING LUMBER SUPPLY. The changes in price, the exhaustion of local supplies and the competition of the different lumber fields gives a great variety of lumber to the eastern United States. The joists (floor supports), which used to be of hemlock, are now partly supplied by old field pine grown on abandoned corn and tobacco fields in eastern Virginia. If the outside is of wood it may be made of fir from the Pacific coast in place of white pine from northern forests. For interior finishing, cypress, Georgia pine and West Virginia chestnut have replaced Maine pine. The flooring is the hard pine of the South, the shingles are fir from the state of Washington, which has replaced the almost extinct cedar from the swamps of New Jersey, or cypress from the Dismal Swamp of Virginia. Nearly all American cities have an equally wide supply and have had equal shifts in its source.

With one-half of all our remaining saw timber located in the three Pacific Coast states, while about 50 percent of the lumber is consumed east of the Mississippi and north of the Ohio River, an interesting problem in transportation has arisen. The National Lumber Manufacturers' Association boldly advertised the fact that

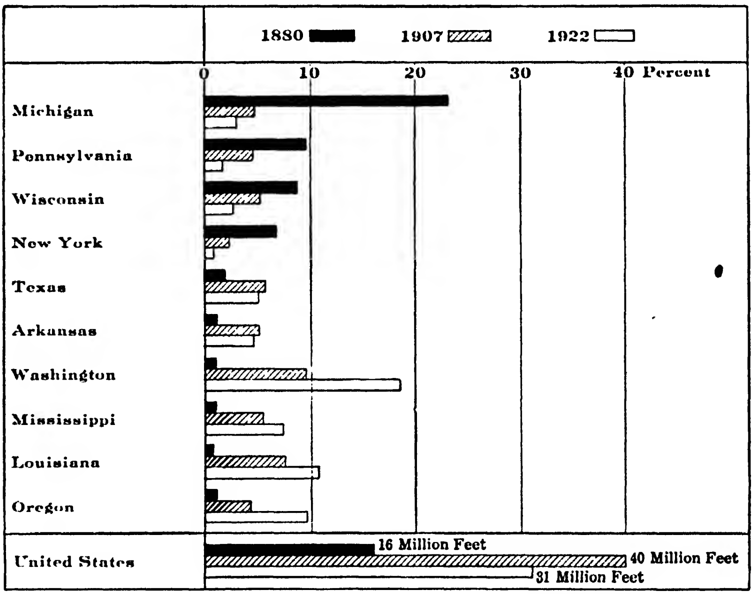


FIG. 180.—The shifting lumber supply as shown by percentage of output by states in 1880, 1907 and 1922. (United States Forest Service.)

it required nearly 3 million freight cars to move the lumber used in 1923, and that the country paid a freight bill to the railroads of $300,000,000. In another decade when southern pine has practically dropped out of the large central and eastern lumber markets,[6] leaving the far West as the chief source, the lumber will be still more costly and the freight bill higher yet. And this for lumber

[6] The Chief of the Forest Service says, "Every year sees 30 to 40 lumber mills in the southern pine belt close down. Every year sees the same number added in the west. The soft woods of the West are about all we have left."

that should be growing near the market on the hills of New England, the slopes of Appalachia, and the cut-over lands of the Atlantic Coast Plain, the South and Michigan. But the real rub will come some years hence, when the Pacific coast supply is exhausted and there is no other.

CANADIAN FORESTS. Four of the forest belts of the United States touch and extend across the Canadian boundary. The Pacific and Rocky Mountain forests combine in Canada, extend northward through British Columbia and on to the Yukon, a vast region crossed as yet by but two railroads, the Canadian Pacific near the United States boundary and the Canadian National farther north, so that most of it is unsettled and much of it is even unexplored by any but the unscientific trapper and prospector. It contains, along with some land good for agriculture, many forests that have excellent prospect of being burned before we can get their product upon the world's market. The treeless belt of the Mississippi Valley goes northward through Canada until between latitude 50° and 53° the moisture conditions for forest growth are again found and there is a connection between the Rocky Mountain forests and the forest region north of the Great Lakes in a subarctic forest belt 400 to 500 miles in width.

The whole of the country from near Winnipeg to the Atlantic was originally a forest of which but a fraction has been cleared for settlement in the region between Lakes Erie, Ontario, and Lower Huron, and in the St. Lawrence Valley. North of this small inhabited belt is one of the great forest reserves of the future reaching from near Lake Winnipeg to the mouth of the St. Lawrence and from Hudson Bay to Georgian Bay, the Ottawa River and almost to the banks of the St. Lawrence itself. Much of it is upland, it is well sprinkled with lakes and marshes, and is practically unsettled, except by a few Indians, fur trappers, and summer fishermen. A railroad has been built across it from the south end of Lake Winnipeg to Quebec, and branch lines have been built northward from the Canadian Pacific to reach silver and nickel mines in the Algoma district north of Lake Superior, otherwise this great forest is yet without industry save lumbering on its southern edge. For this the Ottawa River gives a good outlet and the city of Ottawa is an important lumber market.

In its northern part this forest thins out through a wide area of scrubby forest and bush to the Arctic tundra, home of the caribou and reindeer. Unfortunately these forests have suffered terribly from fire and the rate of growth of the trees is very slow. As acquaintance with Canadian forests advances estimates of their resources dwindle. Explorers traveling by canoe, the only way to travel through this country, have seen stream bank forests which they could with difficulty penetrate because of the thick undergrowth of juniper and other scrub stuff. They made the mistake of inferring that the inter-stream spaces were equally good, whereas many of them are without timber.

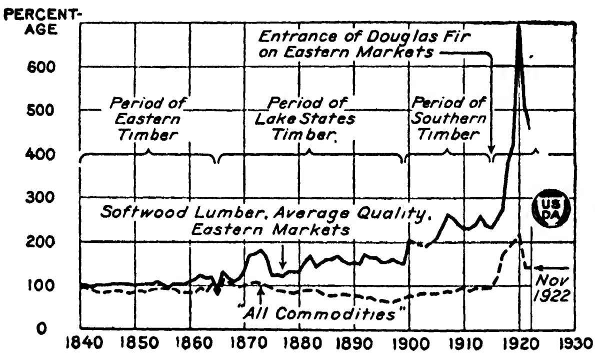


FIG. 181.—The person who still feels that our resources are boundless should study this graph of the relative price of "all commodities" and soft wood lumber, average quality, on eastern markets.

A continuation of the New England forests occupies most of the Canadian territory between the St. Lawrence and the Atlantic, and lumber is an important export from both Quebec and New Brunswick, which latter greatly resemble the state of Maine in climate, topography, agriculture and in the importance which lumber and fishing assume.

Forests cover much of interior Newfoundland, and wood products are the only plant products exported from that cold, foggy, and sparsely peopled island.

ALASKAN FORESTS. The forests of Alaska are a continuation of those of British Columbia and those of British Columbia are a continuation of those of adjacent parts of the United States. In the southern part of Alaska, especially on the rather narrow Pacific Slope, there is a heavy rainfall and a considerable area of dense forests of the Pacific Coast type.[7] In the interior of Alaska there is also timber along most of the streams, with a lesser growth in the dry interior, and the wood thus supplied has been of great aid in the operation of steamboats and for cabins and fuel for men hunting gold along those streams. But little of this timber of interior Alaska is large enough for the sawmill; it is suitable for pulpwood but its rate of growth is slow and it has had serious fire injury.

COMPARISON OF EUROPEAN AND AMERICAN TIMBER CONDITIONS. Europe, having four times as many people as the United States and Canada, and having been much longer occupied by a large population, has very different forest conditions. The American settlers found a continent covered with the forest growth of centuries which they have cleared to get at the earth in desirable localities and have elsewhere cut recklessly and with no regard to the future. While a scarcity threatens the United States, Europe has long felt it in the form of high prices, and is raising timber as carefully as she raises breadstuff. European timber consumption per capita is about one-fifth or one-sixth that of the United States, which is over 300 feet board measure per year. It declined from 520 feet per capita in 1906 to 320 in 1920. That is a simple fact but it cuts deep. Indeed it is one of the most significant economic occurrences of the century.

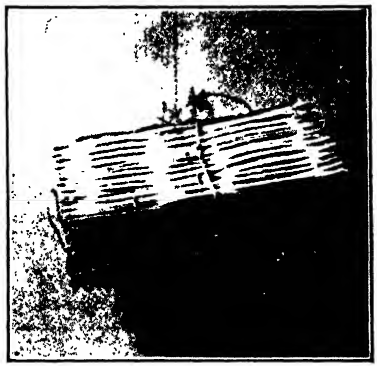


FIG. 182.—An example of French economy. An 11-pound cut flower basket for parcel post shipment made of split cane and requiring but a fraction of the material necessary for a wooden box. (U. S. Consular Bureau.)

This European economy involves many practices unknown in new forested countries. The American people annually destroy tens

[7] The Tongass National Forest covers most of the heavily timbered panhandle of Alaska. The salable timber of this forest includes at least 100 million cords of western hemlock and Sitka spruce, over 90 percent of it well adapted for the making of wood pulp and paper, for which small trees are as suitable as large ones.

of millions of barrels and packing boxes, after they have been used but once. These barrels and boxes are made of sawed lumber with all the waste this involves. In Europe packages are often used repeatedly and are very often baskets made of round or split twigs of willow which is grown for the purpose. The trees are planted in wet ground and repeatedly cut off when 5 or 6 feet high so that the stubby trunk with its great load of long twigs yields repeated harvests of basket material, being many times as productive in this respect as American trees that are once cut to have boards made of the trunk only, utilizing less than 40 percent of the wood and that of century-old growth. Reeds resembling bamboos are also planted

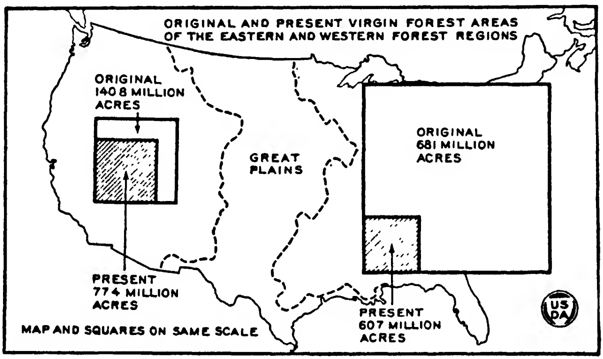


FIG. 183.—We have used all but a remnant of our original eastern timber and half of our western supply.

in the south of France and other European localities for package material. Frame houses have been built by hundreds of thousands all over the United States and Canada, while many people in central Germany never in all their lives saw a frame house. It is decidedly cheaper there to build one of brick, stone, or plastering put upon a wooden framework. This framework is often of unsawed poles made from small trees, rather than the sawed material from large trees as in America. Reeds from the stream bank often replace in Germany the plastering lath used in America. This house made of reeds, poles, and plaster illustrates Europe's economy of wood. In forested mountain districts the European often uses wood as shown by the well-known Swiss chalet. This form of house seems to be a mountain institution, as it exists also in southern Asia Minor and on the southern slope of the Himalayas.

European timber markets and exporters. All Europe north of the Mediterranean slopes is naturally a forest country. In England, however, only 4 percent of the land remains in forest. The needs of tillage have not caused such complete clearance of the North Central Plain which reaches from northwestern France through north Germany and central Russia to the Urals. There are considerable areas of sand suited to little but pine forest. Holland 8 percent forest, Belgium 18 percent forest, and well-tilled little Denmark 8.2 percent forest have put their arable land to the plow and must import nearly all their timber of which but five countries in Europe have a surplus, namely, Finland, Norway, Sweden, Russia and Austria. Norway and Sweden are, like New England and Canada, glaciated, mountainous, and unpopulous, with a comparatively small proportion of their land good for anything but the growth of trees or forests, which assume a very important place in the foreign trade of these countries. In Norway 75 percent of the land is unproductive, 21.4 percent is in forest and but 3.5 percent is under cultivation, and forest products make up over 25 percent of the exports. In Sweden 50.2 percent of the area is in forest and the proportion of the population engaged in the manufacture of wood products is nearly as great as that engaged in railroad work in the United States. As in America north of latitude 53, the forests of Canada extend east and west across the continent, so in Europe in the same latitude the forests of Norway, Sweden and the Baltic States are continued eastward across Finland and north Russia to the Urals and onward across Siberia to the Pacific.

Thrifty Finland, with 14.7 acres of timber for every inhabitant, now rivals Sweden as the great commercial wood source for all Europe. More than half her surface is covered with forest, chiefly spruce and pine, but in the seventeenth century, forests of larch were planted. Now each spring, with the melting of the snow, the Finnish and Swedish streams carry down their burden of logs as do the streams of New England and Canada, and upon the melting of the fields of ice in the Baltic fleets of west European steamers hasten to the Gulfs of Bothnia and Finland to load cargoes of lumber, mine props, pulp, and paper from the many sawmills, paper mills, and log drives. Wood furnishes 70–80 percent of the exports of Finland and promises to hold this leadership.

Forestry and timber supply in central and northern Europe. The scarcity of wood, that has caused the European na-

FORESTS BY CONTINENTS AND SELECTED COUNTRIES

Country	Forest areas million acres	Ratio of forest to total land area %	Forest area per 100 inhabitants, acres
Asia	2,096	21.6	240
South America	2,093	44.0	3,245
North America	1,444	26.8	998
Africa	797	10.7	560
Europe	774	31.1	170
Australia and Oceania	283	15.1	3,470
United States	550,000	28.9	520
Canada	596,746	25.0	8,230
United Kingdom	3,315	4.3	10
Russia (European)	440,000	38.7	440
Siberia	1,083,500	30.5	7,530
France	24,420	18.4	60
Germany	30,905	23.8	50
Czechoslovakia	12,354	34.3	90
Rumania	21,758	27.8	120
Poland	21,881	22.8	90
Italy	14,252	18.1	40
Spain	16,886	13.9	80
Denmark	872	8.2	30
Norway	17,037	21.4	650
Sweden	55,550	54.8	960
Finland	49,410	60.0	1,470
Hungary	3,148	14.0	40
Yugoslavia	17,258	25.2	120
Netherlands	640	8.0	10
Portugal	5,000	22.0	80
Switzerland	2,320	22.7	60
Japan (proper)	46,602	47.9	80
British East Indies	40,504	82.8	4,550
China	190,000	6.9	60
Brazil	1,000,000	47.5	3,280
Uruguay	1,070	2.3	70
French Guiana	21,000	98.0	42,000
Union of South Africa	1,511	0.5	25
Egypt and the Sudan	7,000	0.8	40
New Hampshire	3,602	62.3	813
California	33,000	33.1	962

Source: *Forest Resources of the World,* Sparhawk and Zon.

tions to preserve their timber and practice forestry, has often driven the central governments themselves into the lumber business.[8] Nearly all the governments own forests and care for them as part of their administration. As a result France has 19 percent of her area covered with forests, Germany 26 percent and Switzerland 29 percent, and in populous Saxony the forest area rises to 25 percent. During the disturbances of the French Revolution, forests were cut from some of the mountains of France so that the earth, exposed to the erosion of rainfall, was washed away to the destruction both of the mountain soils and the valleys below, upon which the rocky

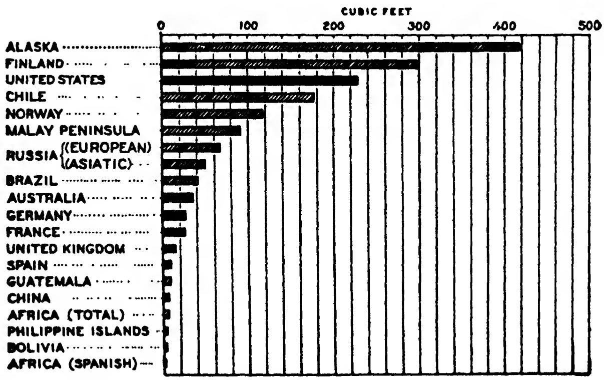


FIG. 184.—Annual per capita consumption of wood, United States compared with various countries and regions. The use of wood is closely related to the abundance or scarcity of it. (United States Dept. Agr.)

earth was piled. After the end of the Napoleonic Wars, steps were promptly taken to replant these areas wherever possible.

The French government now owns and operates over one-fourth the forests of France. Within a century an area of shifting sand dunes and marshes in the southwest of France twice as large as the state of Delaware has been turned into a profitable pine forest yielding rosin, tar, pitch, turpentine, and other products. These are made from small trees which are bled to death in the process, and the trunks sent to England to serve as mine props. This thinning promotes the growth into sawlogs of the trees that remain.

[8] Poor or expensive transportation facilities of the 18th Century forced Europe to governmental and municipal timber operations. Europe was then in the same scarcity that we now face, and since they could not haul it they started to grow it—luckily for their grandchildren.

SCIENTIFIC FORESTRY IN EUROPE. It is to Europe that we must go to see forests well managed and producing their maximum output. There we can learn to make our own forests permanently meet our needs. In densely peopled localities the trees are often planted as thickly as hills of corn in the United States, which is about 4 feet apart. When the trees are 1½ to 2½ inches in diameter they are cut for use as bean poles, hop poles, fence palings, etc., while the later thinnings furnish poles for firewood and many other uses, including part of the framework of the plaster house. At the

FIG. 185.—German fence made of forest thinnings. Uprights are first thinning 1½–2½ inches in diameter, round. Cross pieces are second thinning, split. Posts are larger round pieces. No sawdust or slab waste. The forest was planted with trees about as far apart as hills of corn in American fields. (Photo, J. Russell Smith.)

end of one hundred years or more, after many thinnings, the forest contains only big trees that can be sawn into boards and building timber, after which the forest is replanted, to go through the same cycle of harvests. Many German and Swedish towns own adjacent forests which are carefully managed and furnish the towns with a large part of their revenues. There are several different systems of handling forests in Europe each suiting some particular kind of forest or condition of marketing the product. But even under scientific forestry France, Germany, and Switzerland with their relatively large percentage of well-managed forests are not able to supply their own needs even with their small consumption.

The importance of forests and forestry is shown in the mountains of Switzerland and the Black Forest district of south Germany, where wood carving is an important industry of the peasants in the winter season, and their wooden toys and curios are exported throughout the western world.

THE FOREST POLICY OF THE UNITED STATES. The European experience of deforesting, timber scarcity and the resulting soil loss, tree planting, and forestry has at last been heeded to a slight extent by the United States, especially since the rising price of lumber,

FIG. 186.—Cornfield made by the Indians' method of deadening the trees and letting them stand. Rail fence in foreground. Slopes of Blue Ridge, Mitchell Co., N. C. This process still goes on. (United States Forest Service.)

beginning about 1900, has called the attention of all classes to the impending scarcity of timber. Careful estimates by forestry experts indicate that at the present rate of use our timber supply will last possibly forty years, and that the rate of use is not likely to increase because of price limitations. Therefore, our national government has set apart as national forests those parts of the government land which are unfit for agriculture but which have trees upon them. The map of national forests shows that they comprise large areas, mainly west of the Mississippi River, being nearly four times as large as New England, and comprising about one-fifth of the standing timber of the United States. The national forests of California alone cover 29,000 square miles, an area one-half as great as New England. Many of our states also own timber lands, but these are chiefly cut-over and burned-over tracts which have reverted to the state because no one will pay the taxes.

The United States Forest Service, besides the all-important function of fire protection,[9] manages the cutting and reforestation of the national forests in a scientific manner. We may expect a steadily increasing output of lumber from this source, chiefly by the sale of full-grown trees to sawmill owners under conditions of cutting that will not destroy the growing trees. The Forest Service recently opened up for sale and development a tract of 550,000 acres in eastern Oregon, estimated to contain 7 billion feet of mature saw timber. The cutting of this timber is so hedged about by thrifty rules that instead of wholesale destruction of old and young trees alike, the timber trees will be removed carefully and the saplings safeguarded, so there will be a permanent yearly supply of 50 to 60 million board feet from that forest. Our timber needs will compel us, as our population advances, to take better and better care of our forests, and to eliminate waste in lumbering.[10]

We have thus far been chiefly in the hunter stage as regards lumber production. Just as the hunter goes out and shoots a wild rabbit, so the woodsman cuts a wild tree which nature similarly has provided. The time may not be far distant when we will be obliged to pay as much attention to lumber growing as we do to wheat production or cattle raising. At present we are cutting timber four times as fast as we are growing it, which is indeed the handwriting on the wall. Do we care enough about the coming decades to read it?

Numerous forces are promoting forestry in the United States—the high price of lumber, the sentiment for conservation of natural resources and lastly the irrigators of land and those interested in

[9] The chief work of forestry is fire protection, although strange to say some foresters do not like to feel that such is the case.

The problem is one of profound difficulty. It takes a tree a hundred years to make a sawlog; a fire can kill it in a minute. A fire often gets to a forest one or two generations ahead of market need. Witness the huge desolations in the Rocky Mountains in the 60's, in Northern Canada in the last twenty-five years, and similarly in Siberia.

This is one of the most difficult and major problems on the economical side of our civilization.

[10] The Forest Service estimates that careless cutting and milling loses 13 percent of our lumber cut.

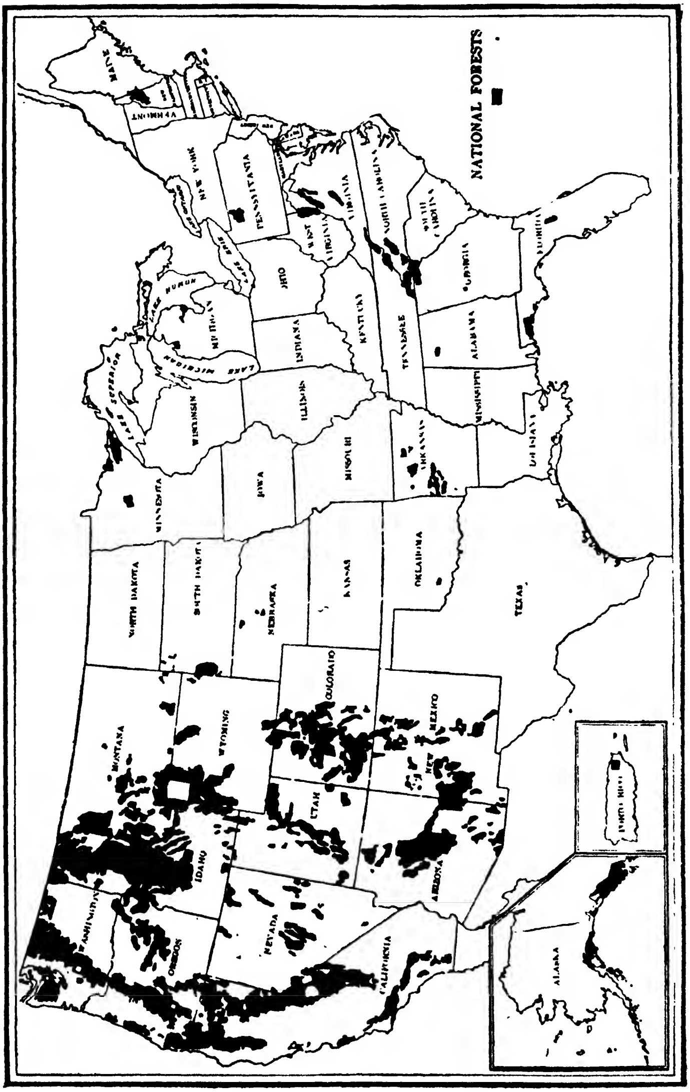


FIG. 187.—Map showing distribution of the National Forests, 1924. Compare this with a physical map (showing mountains) and Fig. 17 showing unappropriated, unreserved government land. (United States Forest Service.)

river and water navigation. Both the irrigator and the navigator want floods suppressed and the water held for gradual use. This is promoted by the natural storage in the leaf mold beneath the mountain forest and by the earth which the gripping roots preserve upon the mountain's rocky framework.[11] This lack of the protection to the earth, our greatest resource, has wrought fearful destruction in old lands. Deforestation and desolation is the accomplished tragedy of south Europe. China is swept by disastrous

FIG. 188.—"After Man the Desert." These rocks were covered with trees, roots and black soil before the forest fire. Mt. Tabor, Rutland Co., Vt. (United States Forest Service.)

floods almost yearly because the Chinese for ages have been stripping their land of every tree and shrub. The bare soil that is left will not absorb heavy rainfall and give the waters forth grad-

[11] The following letter from a rancher in northern Wyoming throws light on what the protection afforded by the Bighorn National Forest means to the water user in that part of the country: "I have resided on Rock Creek for 28 years. During all this time I was owner of a ranch and was dependent on a good supply of water for all my crops; the welfare of my stock and my own financial standing depended, therefore, more or less, on a good flow of water in Rock Creek. All these reasons make a man observant and thoughtful about any causes that may prevent a normal flow of water in any stream the headwaters of which are in the mountains. We all know that if a forest fire runs through the biggest portion of the watershed of a stream the water supply of such a stream is greatly diminished, if not entirely cut off, during the latter part of July and August, and untold damage is done to all ranchmen who are dependent on such a burned-off area for their irrigation water."—United States Forest Service.

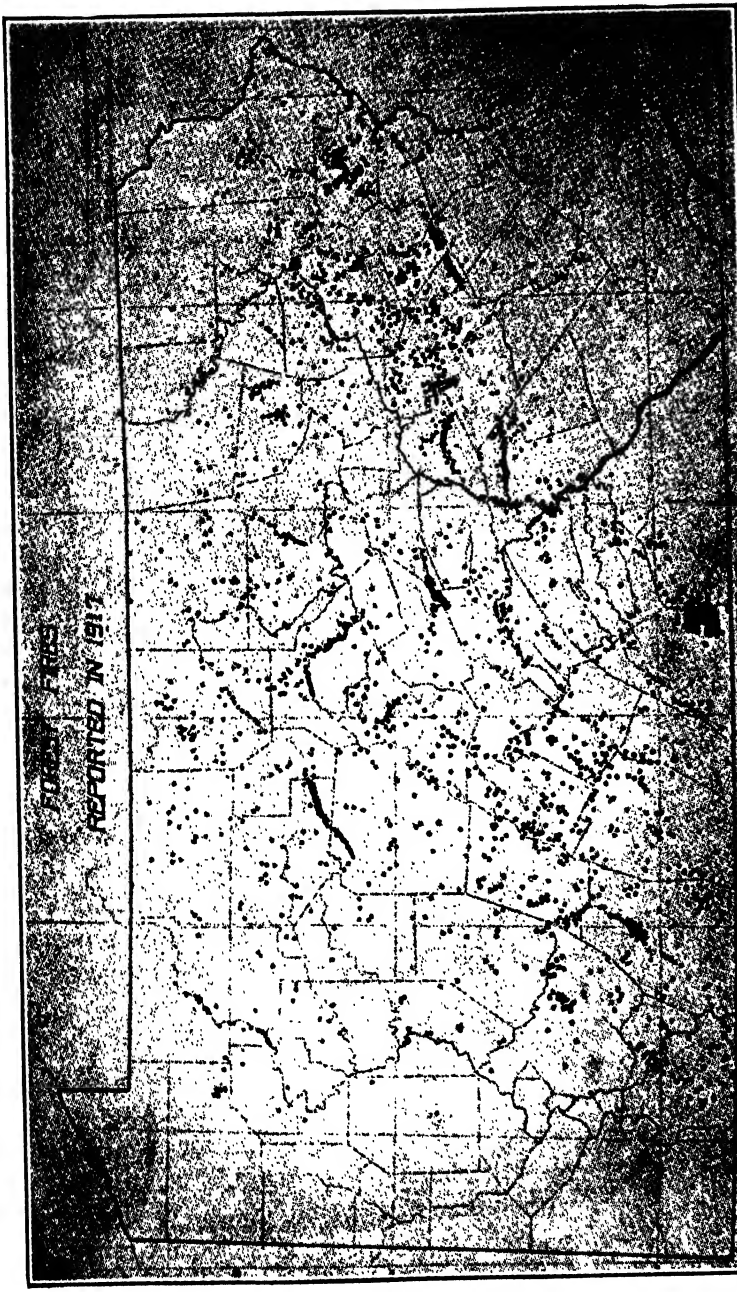


FIG. 189.—This Pennsylvania map, dotted with the battlefields of a single year, shows how hard is the fight civilized man with his pockets full of matches must make to keep a forest.

ually, for the rivers to carry away in safety to the sea. The whole downpour rolls off at once, sweeping the good soil from the hillsides, and covering cities, people and crops. Dr. Otis Caldwell says, "The basis of life is washing away."

THE FORESTS OF MEDITERRANEAN COUNTRIES. In Europe, as in America, the coniferous trees comprise the northern forests while the oak comes from lower latitudes, growing in Spain, Italy, Hungary, and the Balkan Peninsula. In Yugoslavia, the oak trees on the high lands comprising most of that country furnish in their acorns one of the leading crops—harvested by swine.

There are practically no forest resources of importance along the southern or western shores of the Mediterranean and the dry summer of Spain, Portugal, Italy, Greece, and Turkey limits tree growth to the mountains with their greater rainfall, and leaves all these countries with an insufficient supply of lumber. The houses are almost invariably built of earth materials, mostly stone and plaster and, as these countries are barren of coal, and populous with poor people, many of the inhabitants suffer keenly from cold in the winter season.

Italy, having, like France, lost good lands from unwise deforestation, has also been planting forests. The soil destruction in these European countries is as nothing in comparison to that which has occurred in north Africa, Palestine, Syria, and Asia Minor, where many districts that were fertile and populous in Roman times have been reduced to deserts through neglect, forest fires, overpasturing, and reckless tree cutting by ill-governed peoples. It is said that there are more Roman ruins west of the Jordan than in all the rest of the world together, and where there were once populous cities, there is now no support for tillage and a very considerable territory east of Antioch which was populous when conquered by Pompey and ruled by Cæsar is said to have the soil so thoroughly washed away that there is nothing but bare rocks. Some of this desolation has probably been caused by the changes in the rainfall but forest denudation has been a more certain factor.

CORK. Cork, the most important forest export of south Europe, is the tough outer bark of a kind of oak growing upon the highlands of Portugal, Spain, southern France, and the mountain ranges of north Africa running through Morocco, Tunis, and Algeria. The bark can be stripped repeatedly from the trees at intervals of a few years. The chief export comes from Spain and Portugal and a smaller amount from Algiers and Morocco. The cork oak grows without cultivation on rough mountainous land and it covers large areas in the northeastern part of Spain near and upon the Pyrenees Mountains in Catalonia where the best quality of cork is produced. It is also largely grown in the province of Andalusia and Estremaduro in southwestern Spain and in the adjacent parts of Portugal. The Spanish cork exports exceed 45,000 tons and are the chief export of this country. The cork forests cover 1,300 square miles (840,000 acres) in Spain and also much of Portugal. In Algeria the area is 50 percent greater and the output is 50 percent less. Some cork is also grown in the south of France and the introduction of the tree into the United States shows that we have large areas suited to it if we choose to so use our land. Because of its high value and easy transport by pack animals this is an ideal crop for isolated and almost inaccessible locations.

Japan's forest industries. Japan is a country which from necessity takes excellent care of its forests. Because of the rocky nature of the country and heavy rainfall, forests cover a large portion of the country, much larger than in mountainous Switzerland. Having a meager coal supply, the forests have up to a recent time furnished all the fuel as well as building material of a dense population, now 55 million people on 112,000 square miles.[12] The United Kingdom with 47 million people on 121,000 square miles has used up practically all her forests and has long been importing from the United States, Canada, Norway, Sweden, and Russia. Since her industrial revolution Japan has opened up previously unused oak forests in her little used north island, Hokkaido, but this does not seem to meet her growing needs, for in recent years lumber import into Japan from the United States has begun. It is probable, however, that Asia will supply most of Japan's timber. The immediate cause of the Russo-Japanese War was a dispute over certain timber concessions along the Yalu River between Manchuria and Korea. Manchuria and Korea have extensive forests under Japanese control, but most of them will be inaccessible until American methods of lumbering shall be introduced and new railroads built. In bamboo, lacquer, and camphor Japan has three forest products that well illustrate the genius of oriental people. The bamboo is probably the most important Japanese tree. It is

[12] Excluding cold Hokkaido and the Kurile Islands. Total Japan 148,756 square miles. Total Empire 260,738.

planted and cared for like a field crop and fills a multitude of uses. It is said that the ingenious Japanese can build with it an entire house—framework, floor, walls, and roof—while its large joints serve as buckets and other utensils in great variety, and the

Fig. 190.—Forestry. Bamboo grove in central China where temperature falls to 20° F. (Photo F. N. Meyer, explorer, United States Dept. Agr.)

young shoots serve as food. The lacquer, that beautiful varnish which we see on the glossy lacquer ware, is made from the sap of the lacquer tree. The camphor is a kind of resin distilled from the wood of a tree which grows throughout most of the Japanese Empire, but the trees have been so vigorously cut that the greater part of the world's supply now comes from the Japanese colony of

Formosa. The Fukien province of China, the islands of Shikoku and Kiushiu in Japan, Cochin China, Sumatra, Java and Borneo also contribute one or more kinds of camphor to the world's market. (*London Times Trade Supplement*, April 10, 1920.)

It has now been found that there is more camphor in the leaves and twigs than in the trunk, so that the practice of chopping up the whole tree is unnecessary. In Florida where the camphor tree grows well, specimens attaining a diameter of four feet in thirty years, clippings of leaves and twigs are made once a year, and the crude gum is produced (on an experimental scale) from them by distillation. Thus does man change from a hunter and destroyer of wild products to a cultivator of crops.

In like manner the bamboo has been transplanted to our own South Atlantic and Gulf States, where small groves are thriving as well as in their native Japan and China. In time we may have the basis for a commercial industry to supply the several million dollars' worth of bamboo now imported from the Orient.

FORESTS IN CHINA. The Chinese forest situation is far inferior to that of Japan. In some districts her dense population long ago used all the forests and often dug up the roots with frightful results in floods and denudation. In many sections of the country, her people raise a small amount of fuel for domestic use in the form of the stalks of a coarse millet, while considerable parts of the Empire have been irreparably injured by the cutting off of the forests and washing of rocky mountain earth over the fields in the erstwhile fertile valleys. A scientific forest policy is undoubtedly one of the most pressing needs of the new government, and one of the most difficult for it to bring about. Meanwhile the new era of railways will bring much lumber from the less populous parts of the Chinese highlands, especially to the south of the Yangtze. At the present time there is a considerable import of lumber from the United States.

THE SIBERIAN FOREST. As Canada holds a great forest reserve for America, so the corresponding parts of east Asia promise to serve that continent. Much of the Amur River basin is useless for agriculture as we now know it, but, like upper New England, Newfoundland, and Quebec, good for forests. A recent estimate places the forest area of Siberia at 30 percent, or over 1 billion acres, an area much larger than all the forests of Europe. The Siberian forest is the real hope of Asiatic peoples for a near-by timber supply, and constitutes the world's largest untouched (but not unburnt) reserve. In Siberia west of Lake Baikal the forest belt narrows but it reaches clear over to the Urals, an area of vast but unknown extent situated in admirable relationship to the agricultural belt to the south of it.

THE TROPIC FOREST AND ITS PRODUCTS. The torrid zone contains a larger area of forest than does the temperate zone. Tropic woods are in great variety and many are of surprising beauty and hardness, but the forests upon the whole are very much less valuable than those of the cooler north with its less favorable conditions for the growth of vegetation. The relative uselessness of the tropical forests is due to poor quality and inaccessibility. Many trees of the tropic forests are crooked and useless for lumber. They are often worthlessly soft and weak, and the good ones are almost always mingled with many other species. This mixture of species is a striking and important contrast to the practically solid stand that exists in the pine or spruce forests of Maine, the fir of Washington, the cypress of Louisiana, or the oak of West Virginia. Those who gather tropic logs usually find but one tree of a kind in a place, surrounded by hundreds of useless specimens of other varieties.[13] To make matters worse, the heavy rainfall and the heat produce such a wealth of bushes, small trees, and vines that a man can only force his way through by first cutting a path. Thus the machete, a long-handled knife, is the most universal tool possessed by the inhabitants of many tropical countries. With it they cut paths through the forest in which each tree is often bound by creepers to a dozen others so that the felling of one tree is a most difficult process. As the jungle is often swampy, it is evident that a wagon can rarely enter to carry logs because the wheels would sink into the soft earth even if roadways could be cut. The nearest approach to the northern blessing of snow with its sled transportation is the annual floods of the rainy season, which permit the floating out of those logs which grow on overflowed land and are light enough to float. Those that are heavier than water, and most of the tropical cabinet woods with their great strength and beauty are heavier than water, must rot where they grow, or be dragged out at great expense. Consequently, the chief timbers exported from

[13] The mahogany tree lives by itself, two trees to an acre being a liberal estimate. More frequently only one tree will be found in a larger stretch of territory.

the tropics are the buoyant mahogany and cedar, of which the United States imported $5,000,000 worth in 1923, while all other cabinet woods imported were not one-sixth as valuable. One vast belt of solid green girdles the earth wherever the land emerges from the equatorial sea, yet this equatorial forest has thus far been of less use to our world trade than if it were a desert with an occasional oasis.[14]

THE PHILIPPINE FORESTS, AN EXAMPLE. The botanists tell us that more than a hundred species of useful woods are to be found in the Philippine Islands, which are largely covered with forests belonging to the United States Government. It is not the number of species, but the goodness and cheapness which make them valuable. Nine species of trees, namely, yellow pine, Douglas fir, white pine, hemlock, western pine, spruce, cypress, the oak, and maple, have furnished 95 percent of American timber and made the United States the greatest timber producer and exporter in the world. Despite their riches in forest area and number of varieties the Philippine Islands have only recently begun a small export of cabinet woods.

THE WOODS EXPORTED FROM THE TROPICS. Mahogany, the most important wood exported from the tropics, is hard,[15] strong, taking a beautiful finish, and is much prized for furniture and interior work. It is light enough to float and valuable enough to be hauled out of some locations where there are no floods to float it. The best mahogany is shipped from Haiti and Santo Domingo, while other mahoganies come from Mexico, Honduras and Cuba. The

[14] The tropic forest naturally runs through great variety of stand and condition in places where the rainfall varies from desert to 200 inches per year—open scrub, solid scrub, jungle (low forest tied together with creepers), and finally the rain forest, open beneath because the thick mat of the tops of tall trees smothers undergrowth.

The roving tropic agriculturist kills the rain forest, which is replaced by jungle and after some generations finally restores itself. W. N. Whitford, for years Professor of Tropic Forestry at Yale, avers that there is much good timber in the virgin tropic rain forests. The one little specimen of this that I have seen in Porto Rico leads me to agree with him, but he has difficulty in pointing to any lumber from this source. And the difficulties of tropic lumbering, particularly in places where the tropic agriculturist has left virgin forest, are likely to cause this dearth to continue until lumber scarcity has become much more acute. Any climate wet enough to make the rain forest makes also a good deal of mud.

[15] Mahogany is really an intermediate wood, being softer than oak, elm or even birch, but harder than yellow pine or Douglas fir. In strength and specific gravity tests it is almost identical with our red gum.

mahogany hunter, climbing one mahogany tree, looks across the forest to locate the next one towering above the level green, and then cuts his way to it. African mahogany, a slightly different species, is shipped in large quantities from coast ports between the Gold Coast and Cameroon in west Africa. The chief market for this wood is Liverpool, whither it is shipped in great logs and forwarded to the finer wood-working establishments of Europe and the United States. Cedar, the second tropical wood in commercial importance, exists in many varieties, exported chiefly from the West Indian Islands, and the Gulf coasts of Mexico and Central America. One of the chief uses for this soft light wood is the making of cigar boxes and pencils. The third of the tropic woods is the teak, a wood which resembles oak in its physical characteristics, but is much more valuable than oak for shipbuilding because, unlike oak, it contains an oily substance which acts as a preservative, and will not corrode iron as does the oak. It grows in the forests of southeastern Asia from India to China and has been planted for timber purposes in Java. The chief supply of commerce comes from Burma where it is floated down the Irawadi River to Rangoon, the Salween to Maulmain, and from Siam where the Menam River floats the valuable logs down to Bangkok for shipment. As Britain is the greatest shipbuilding nation in the world, she imports most of the teak.

Minor products of the tropic forest. The tropic forest is more important for its minor products such as rattans and gums than for its major product of wood. Of these minor products the greatest, rubber, greater in value than all the other products of the tropic forest combined, is left for another chapter. Closely allied to it from the botanical standpoint are many other gums which are produced from the dried sap of trees. The well-known "gum arabic" so commonly used as office paste has the useful quality of being soluble in water and is plucked from trees by natives throughout the half-forested belt that lies between the jungle and the desert reaches across Africa from Senegal to Abyssinia. It is also shipped from Somaliland, India, Australia, and South Africa.

Gums of another class known as copals are with difficulty soluble and therefore serve as the basis of varnish used for vehicles. They are produced by many trees, one, the kauri gum of New Zealand, is extra-tropical, being found in a fossil condition covered by the surface earth where it has dropped from kauri trees of past ages.

It has been diligently dug for the last sixty years and is still being found, and small quantities are produced by the living forest. Other copals are dug from the earth in Madagascar, Zanzibar, and adjacent Africa, but the greatest center of shipment for these gums is Singapore, the Malay metropolis. Here also is gathered for shipment a large proportion of the world's rattan, the jointed stem of a creeping vine that runs for hundreds of feet through the tropic tree tops and helps to bind them together in the jungle mass. Properly split it makes the cane seats of chairs.

Nuts make an entirely different class of forest product and one of indefinite expansion. From Para, Brazil, come the dark Brazil nuts with their triangle cross-section and rich white meat. They could apparently be produced (picked up) in indefinite quantities if desired. Other varieties of good nuts waste in the same forests. From Ecuador and Colombia several thousand tons of palm nuts (Corozo or ivory nuts) are annually exported to European and American button factories. This valuable nut, sometimes as large as a hen's egg, is the product of a palm that grows wild in most locations, sometimes yields thirty pounds of nuts and lives for fifty or one hundred years. The market has of late been partially supplied by somewhat similar nuts from Italian Eritrea (on the Red Sea), and the Sudan.

Tropic imports of temperate zone woods. It is true that some tropical timbers have great hardness, strength, durability, and beauty, but many of them are so hard that tools will scarcely work them. Furthermore, their inaccessibility makes them as useless as the millions of tons of excellent building stone which lie valueless in the heart of every mountain region far from growing cities. Despite the riches of millions of square miles of jungle and forest lands, American lumber is imported by practically every tropical country in America and Africa, and occasional shipments go even to Asia and the East Indies. The rubber merchants of Para or Manaos on the Amazon, desiring to build a warehouse, find it economical to buy the soft woods of the United States, into which they can easily drive a nail, instead of using the beautiful but hard cabinet woods in the forest that actually encroaches upon their building lots.[16] In Peru the commercial centers along the Pacific are located

[16] Tropic lumber trade was graphically illustrated by a ship unloading Texas pine lumber at San Domingo city on to the dock beside piles of mahogany logs ready to go north.

in a desert three or four hundred miles away from the Peruvian forests on the Amazonian low plains accessible only by the pack train across the snow-clad passes of the Andes. In Bolivia, the same mountains and desert shut off the possibility of native lumber. Chile, which is in the temperate zone, has coniferous forests in her rainy, cold, southern provinces, but facilities for getting out logs and sawing lumber are so much better in the states of Washington and Oregon that most of the lumber for treeless north Chile comes from that source rather than the south temperate forests. Argentina has large sub-tropical and tropic forests in her northeastern territories where the jungle conditions prevail. But her centers of population are in the temperate zone and she is the largest of all South American lumber importers.[17] Her extensive temperate-zone forests at the base of the Andes in Patagonia are too distant from ports and transport facilities to be developed as yet. The form of the two Americas makes great contrast in lumber resources. The large forests of the north temperate zone are in the high latitude where the areas are great. In these latitudes of good timber South America tapers to a point and suffers from aridity.

THE SOUTH TEMPERATE ZONE is largely in the latitude of Spain and New Mexico and is too dry for good forests, the only important exceptions being the small and rough points of South America (in part), of New Zealand, and the island of Tasmania and a small portion of Australia. This explains the fact that South Africa and Australia, like temperate South America, are importers of soft lumber from the United States and the Baltic countries of Europe, although certain small sections in southwestern Australia produce two species of export hardwood. They are members of the Eucalyptus family, the karri and jarrah, which, through their hardness and durability in the ground, are well suited for wooden pavements and are exported to European cities for that purpose. The northern island of New Zealand has some splendid forests of the well-known gum-yielding kauri, a tree furnishing logs 8 to 10 feet in diameter and 100 feet long, but New Zealand now has a law forbidding the export of timber.

NAVAL STORES AND TANBARK. Important among the many minor industries of the forest is the preparation of naval stores, the name applied to turpentine and rosin, products of the sap of certain pine

[17] Argentina imported our southern yellow pine to the value of over $9,000,000 in 1923.

trees. Rosin is the product remaining after turpentine has been distilled from pine sap. The chief center of production is in the long-leaf pine forests of the southeastern United States; Charleston, Savannah, Jacksonville, Pensacola, and Mobile, being important points of shipment. The manufacture of naval stores, as carried on in the southern United States, is very injurious to the forests. The sap gatherer makes great wounds in the base of the tree from which in a few years it bleeds to death. During the process it is exposed to easy destruction by fire, and is easily overturned by wind storms. A newer way of turpentining, known as the cup and gutter method, does not gash the tree so deeply, and greatly prolongs its life and yield. Inasmuch as the slabs which are burned or wasted around many southern sawmills also contain large quantities of sap, as do the small branches and tops which are left in the woods, it is likely that the near future will see more economic methods of gathering naval stores. Some processes already discovered take all this refuse wood, soak the sap from it for distillation and leave the pulp thus purified for making paper. The French gather turpentine much more effectively than we do. They use the method which our Forest Service is requiring in the national forests —"turpentine thinning." This means gradually bleeding to death the trees it is desired to remove, thus serving a dual purpose, and in addition using the wood of the exhausted tree. Such trees from France prop many a British mine.

Another industry which has caused great destruction of American forests is the gathering of bark for tanning. The chief bark trees are the hemlock and certain species of oak growing from Pennsylvania southward on both slopes of the Appalachians. Millions of good trees have been cut down for their tanbark alone, the trunks being allowed to rot. This shameful waste of logs goes on to some extent in the eastern country and also in California, where in the Coast Range there is considerable collection of tanbark from one of the western oaks that grows among the redwoods. The tanbark district of Wisconsin and Michigan (chiefly hemlock) is second to the Appalachian in output. More detailed information about this industry will be found in the chapter on leather.

Wood manufactures. The manufacture of the heavy log into rough lumber naturally clings to the forest, although special conditions cause some export of logs, especially of such high quality woods as mahogany and walnut. The further manufacture of lumber, usually carried on in planing mills where the rough boards are finished, tends to concentrate near the market in or near centers where building operations are largely carried on, since the rough lumber is more easily moved and stored than the easily injured dressed plank or the sash, doors, blinds, and special shapes that the planing mill turns out for the builder. There is a growing tendency, however, to attach the planing mill to the sawmill.

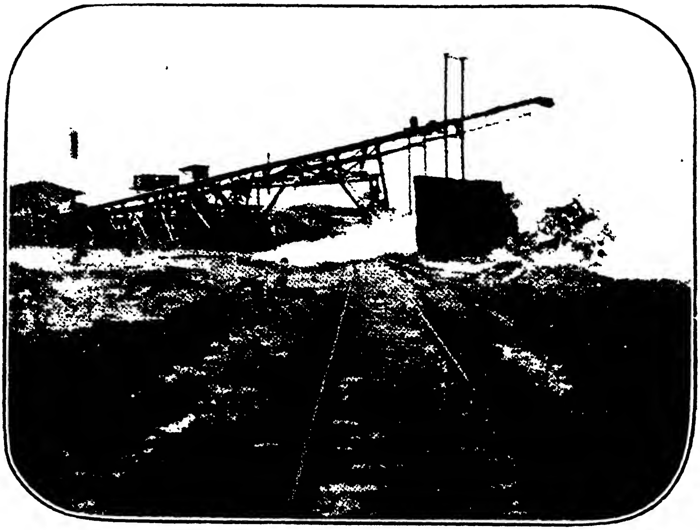


Fig. 191.—One of our crimes against posterity is this Georgia sawmill slab fire that burned for 25 years without stopping. (United States Forest Service.)

The same factors tend to locate furniture manufacture in great centers of consumption, especially in timber-importing countries. Thus London is both market for product and center for raw material because the imported wood is unloaded there from the ships. Owing to an early start when near-by timber supplies were abundant, and to very low freight rates since, we have had a great furniture industry developed near the former area of wood supply in Grand Rapids and other towns of the Lower Peninsula of Michigan, in Evansville, Indiana, and more recently the same industry is rapidly increasing in North Carolina.

The modern furniture factory in Grand Rapids or elsewhere uses quantity production methods similar to those in use in the Ford automobile plant. Hand work is at a minimum and machinery does every possible part of the cutting, shaping and assembling of parts. One may see ten thousand sewing tables going through the factory all at the same time, and all identical in wood, design, finish and workmanship. The recently perfected "knock-down" system of furniture making, which has been extended to boats and even houses, has helped many such cities to maintain their wood-working industry even after the near-by timber supply has been exhausted. The expense of importing the raw lumber is balanced by the saving in freight. Furniture is expensive to ship, not so much because of its weight, but because of its bulk. "Knock-down" furniture can be taken to pieces, permitting economy of space in shipping. In this way the parts of boxes and barrels (called shooks) are shipped ready to put up.

The constantly increasing price of hardwood lumber used for making furniture, fixtures, and cabinets has caused the substitution of much built-up lumber, usually made of three-ply veneer. Veneer is wood sliced into thin sheets like pasteboard or even like paper. Thus a fine hardwood log selected for beauty of grain can be used as the exterior finish for thousands of articles of furniture made of cheaper wood. In manufacturing this built-up material it is possible to utilize woods which heretofore have been practically valueless, owing to their tendency to twist and warp when sawed into lumber. The sudden increase in the manufacture of veneer and its use for cheap industrial purposes [18] is suggestive of the advancing economy of wood that scarcity and high prices are forcing upon us.

Paper. In 1870 when cotton, linen, and woolen rags were the chief dependence of the paper manufacturers, it would have seemed preposterous to place a discussion of the paper industry in a chapter dealing with forests and forest industries, but this is an industry which has been completely transformed by changes in technique since that time, resulting in changes in raw material.

Some material for the easy recording of thought is important alike in industry, commerce, and civilization. The inhabitants of Babylon, Nineveh and other cities of Mesopotamia wrote on clay tablets and baked them, making the clumsiest but most enduring of

[18] With the improvement of veneer machinery and methods of drying there has developed a large demand for veneers cut from cheap woods and used for packing boxes, berry cups, fruit baskets, veneer barrels, drawer bottoms, filling in three-ply lumber, glass backing, and novelties, such as butter dishes, wooden plates, and fancy confectionery packages.

all books. The Egyptians made papyrus closely resembling paper by carefully pasting together the pith of a sedge-like reed of the Nile bank, which was carefully cultivated on large areas where now corn, cotton, and rice are grown. The Chinese discovered how to make paper. The art spread thence through central Asia to the Arabs, was brought by them to Spain, and became established in England in 1588. Without it the printing press would have been of little value, for the only alternative was parchment, made of sheepskins, much more durable than paper, but too expensive.

WHAT PAPER IS AND HOW IT IS MADE. Paper was first invented by the wasps and hornets who still maintain the industry and defend the product. They use the same process now followed by man—macerating wet vegetable fiber and spreading it out thin to dry. Nearly all plants have cellulose fibers in them, and as indefinite numbers of vegetable materials will make paper, the actual choice of materials is decided by the relative quality and the cost. For two or three centuries cotton, linen, and woolen rags were the chief dependence for paper making. In 1857 an Englishman invented a process of making paper from a tough grass called esparto, which grows well on arid, sandy, and rocky land and is found wild over large areas in the Barbary States of north Africa and in Spain. In less than 30 years after its introduction it assumed an importance in English paper making greater than that of rags. By 1901 esparto was far outranked by the predominating wood pulp, which opened up to the paper industry a vast supply of materials at a relatively low cost. Various other fibers are used to a small extent, such as the bark of the baobab tree, which with long, strong fibers makes the exceedingly fine paper used for bank notes. The cotton stalk is full of fibers and some inventors are promising us that it will soon be an important material for paper.

Wood is pulped by mechanical processes of which the chief are simply grinding or cooking in chemical solutions, which eliminate all woody substances but the cellulose fibers, the chief basis for paper manufacture. The fibers float in water which is kept at a uniform soupy thickness by stirring. For centuries paper making was a handicraft carried on by the paper maker and his family, who dipped sieves into vats of floating fiber and carefully lifted out upon the wire gauze enough fiber to produce a sheet of paper when properly dried. Now machines turn out more than 500 feet per minute and send it away from the factory in sheets often miles in length wound upon spools into rolls 3 or 4 feet in diameter. If the paper is to be used for writing purposes, the spaces between the fibers are closed by a process called sizing, which fills up the pores with material chiefly composed of china-clay, rosin, alum, and talc, a process that greatly adds to the weight of the paper. While the expensive hand method of paper making prevailed, its price was high, and demand for it small. The discovery of wood pulp and the invention of machines to turn out paper in quantity has made it cheap enough for a wide variety of uses.

Paper from wood. The manufacture of paper from wood pulp was begun in the United States in 1866, and tree trunks[19] now make the greater part of the world's paper.

Before the pulp era, our paper mills, like our woolen mills, had been clustered along small streams in the vicinity of centers of population. The great increase in the use of wood pulp for paper in the United States since 1890 has caused the transfer of the center of the paper industry away from the market to the forest districts of the New England and Lake states. Spruce, originally so common in this region, furnishes nearly three-fifths of the pulp wood consumed in this country, and two-thirds of the pulp mills of the country use water-power because, when available, it is the cheapest source for the great amount of energy required to grind the wood into pulp. So important is this relationship of water-power to paper making that two-thirds of the water-power utilization in the United States is in the paper mills. The combination of water-power and spruce logs makes the states of northern New England and the Lake district the greatest paper-manufacturing district in the United States. Relatively pure water is a very important consideration because the dirt of the water can adhere to the floating fibers and thus pass into the paper.[20] Massachusetts leads in the

[19] The cheapness of this material greatly depressed the trade in, and reduced the price of esparto grass, which had been a staple export of many of the Arab tribes of north Africa. The resultant hard times produced discontent, which, as is commonly the case, was blamed upon the Government, and the French rulers of Algiers had serious trouble with the tribesmen who found themselves poverty-stricken through the loss that followed the decline in the esparto trade.

[20] In a country like England which imports its raw material and has many of its streams impure from sewage and factory refuse, the water supply is important in locating paper factories. For this reason British paper mills were chiefly located on the slopes of the central mountain range in Lancashire and Derbyshire, and in Scotland where the streams are clear.

making of rag and fine writing papers, for the manufacture of which Holyoke, on one of the falls of the Connecticut, with twenty paper mills, is the most specialized center in the United States. Pennsylvania, Ohio, and Michigan also rank high in the manufacture of this type of fine paper.

The cheapest wood pulp paper is simply ground wood which makes the flimsy and perishable newspaper. The better and more expensive kinds are made of chemical wood pulp to which rag pulp is added to give a superior surface. High-grade writing and book papers are largely made of spruce and poplar (aspen) wood and rags, the woods for these papers being pulped by a chemical process to give it longer and stronger fiber. Two-thirds of the newsprint paper, practically all made of spruce, comes from the Adirondack and New England highlands, while three-fourths of the remainder is made on the southern edge of the upper lake forests in Wisconsin.

Paper industry leads to forestry. A paper mill with its water-wheels and heavy machines is expensive, and the great cost or impossibility of moving it makes it necessary that a paper company shall be sure of its wood supply. To do this they must often own the land, and, since they cannot flit from tract to tract after the manner of lumber manufacturers, some of the paper companies owning large areas of spruce land became the earliest large timber owners in the United States to protect their forests and cut them rationally—forestry. As their enterprises are often located in the deep forest, the companies must sometimes even build and own the towns in which the people live who make their paper. A good example of this is afforded by the town of Millinocket, Maine, where a huge paper mill turning out 250 tons of paper per day, was located far in the forest beside a great waterfall. A special railroad was extended to it, and the town built around the mill. The plant cost \$25,000,000—an excellent evidence of the impossibility of moving and of the consequent necessity for conservation of wood supply, both by avoiding wasteful cutting and by replanting the burnt-over lands, but above all by the stopping of fires. This same company owns over a million acres of forest land from which to draw its pulpwood.

The paper industry is undergoing rapid change in the source of its raw material. For a time the pulp supply was limited to spruce, then poplar and hemlock came into use, and now it has been demonstrated that a large number of native woods can be used. Already twenty species, including southern pine, hemlock and miscellaneous hardwoods are in use. Slabs and mill waste are also being utilized and there will soon be no excuse for the frightful wood waste of the past.[21]

PAPER FROM STRAW. In the eastern part of the wheat belt in Ohio, Indiana, and Illinois, there is a considerable paper industry

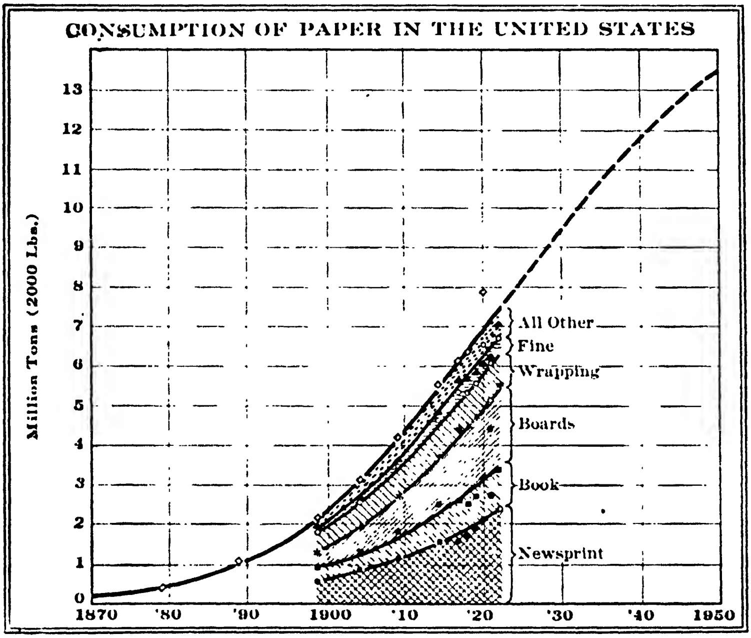


FIG. 192.—This age of mechanical power has made us much richer in useful things but much poorer in forest reserves. At present rate of increase our paper consumption will nearly double in another quarter century—if the pulp wood holds out. (After United States Dept. Agr.)

using straw, which makes cheap wrapping paper and strawboard, the so-called pasteboard of common use. Wheat, oats, and rye straw is used, rye being considered best. This is an industry which might easily move west and northwest with the moving wheat fields. Straw is used for making specialized paper products and is not competing with the use of wood. It is a pity that it does not make good paper, since so much of it is burned and wasted.

[21] The same company owning a pulp mill often operates a sawmill and all the sawmill waste from spruce and fir is used in the pulp mill.

Our huge consumption of paper. No other people in the world use so much paper as do the people of the United States with their large consumption of newspapers, magazines, books, wrapping paper, advertising and cartons. While 95 percent of all the paper made in the United States is made entirely or in part from wood pulp, we import rags from Europe by the hundreds of millions of pounds. From Canada we are getting over a million tons of pulp wood, half a million tons of pulp, and nearly a million tons of manufactured newsprint paper annually. One of the surprises of commerce is our import from Europe of nearly half a million tons of pulp wood, chiefly from Norway, Sweden, and Finland.

The print paper supply of the United States presents a serious problem, as our demands for paper have practically quadrupled since 1900. With an annual consumption of over 8 million tons of paper, one-third of it imported, with an embargo on pulp wood threatened in Canada, and with constantly decreasing domestic supplies, new sources for pulp are badly needed. Even if we continue to secure paper freely from Canada, the forests of the Dominion are no more limitless than our own have proven to be. Many of the paper mills in New England, New York and Wisconsin are facing the early exhaustion of their forests.[22] The solution for these mills seems to lie in reforestation, a process which will take years for the forests again to yield a crop. In the meanwhile new mills will probably be built in the far West and in Alaska. The United States Forest Service states that the two National Forests in Alaska can produce in perpetuity 2 million cords of pulp wood annually, or enough to equal more than half the present newsprint consumption in the United States.

Paper industry in Europe. England, one of the important paper-manufacturing countries, derives all of her wood pulp from foreign lands, principally from the three Scandinavian countries. Most of the other European countries manufacture paper and many of them export it. Germany, located in the center of Europe where 455 million people are daily converting clothing into rags, draws

[22] "More than 60,000,000 acres of potential forest lands accessible to the present established pulp and paper mills in the United States are now producing nothing. A production of one-third of a cord of pulp wood annually per acre on the waste areas would yield 20,000,000 cords, or three times the present consumption requirements in the United States."—United States Forest Service..

The inventor of matches rendered a questionable service to mankind.

on the best raw material supply in the world for the manufacture of fine rag paper, and sends her paper products all over the world. Even Spain, which formerly shipped thousands of tons of bulky esparto grass to be made into paper in England and Germany and then brought back again to Spain, is now manufacturing much of it at home.

In the production of wood pulp for paper the Scandinavian countries are in a position to supply the needs of all Europe and even

FIG. 193.—New Brunswick, Canada, has logs for pulp and water power to grind it. (Natural Resources Intelligence Service, Ottawa.)

ship large quantities to the paper-hungry United States. Sweden, with her large percentage of forests for raw material and mountain streams for water-power, exported pulp and paper valued at $85,000,000 in 1922. Norway with similar resources had an export of $62,000,000 and Finland's share was $29,000,000. (Compare these *per capita* with any element of American trade.) In both Sweden and Norway pulp (and paper) was the leading export, but in Finland, a younger country which has not had the time and the capital to develop as many mills although her resources are even better, lumber was a more valuable export.

PAPER IN CHINA AND JAPAN. The Mongolians, who (save for the hornets) first invented paper, still make an excellent quality and a large quantity of it. The cheap paper is made of rice straw, while the so-called fine "rice" paper of commerce the Chinese manufacture from the pith of a plant grown in Formosa. It is in Japan that we see paper rendering its greatest and most varied service. With a large forest area and a small arable area, they are compelled to make paper fill uses supplied in other countries by the products of agriculture. Thick, tough papers are substitutes for leathers, which they cannot produce at home owing to their lack of cattle. A very strong and durable paper is made from seaweed, and the Udo, a bush, also called paper mulberry, or paper plant, is grown on many Japanese hillsides for the very strong paper that can be made from its bark and used for grain sacks, for waterproof tarpaulins, and even for walls of houses. Paper is an excellent nonconductor of heat, and the native Japanese house, adjusted to the needs of a country that is often visited by earthquakes, is made earthquake proof by having a bamboo framework and paper walls. The Japanese paper umbrella and lantern are well known among us, and the Japanese have long used paper napkins and paper pocket handkerchiefs.

While we have not yet cared to establish a paper industry on the Japanese model, the Japanese have copied ours. A new $4,000,000 pulp paper mill was started several years ago at Tomakawai in the forested north island of Japan. It was the largest enterprise of the kind in the Orient, developing 15,000 horse-power from Lake Shikatsu 800 feet above, and its daily output of 70 tons supplied 50 percent of the consumption of the empire. All of the electric machinery and 97 percent of the paper machinery came from the United States, most of the paper machinery being made at Watertown, N. Y., in the midst of the Adirondack paper district. The Japanese method is shown in that one foreigner only was employed, an American to superintend the erection of the machinery.

THE PAPER INDUSTRY OF THE FUTURE. This Japanese paper mill in northern Japan, like that at Millinocket in the woods of Maine, recent new ones on the north shore of the Gulf of St. Lawrence, and especially a large mill owned by a London publishing syndicate in unagricultural Newfoundland—all these are suggestive of the ultimate service of the far northern country that will produce trees but not, under present conditions, any adequate food supply. In the meantime cheap vegetable fibers of all kinds and from all climes are likely to enter more and more into the making of paper for which there is every prospect of greatly increased use.

REFERENCES

See General References

The United States Forest Service publishes a vast amount of material under many titles, of which the constantly changing list may be had upon application. Some suggestive titles from this list are:

(a) "Timber Depletion, Lumber Prices, Lumber Export and Concentration of Timber Ownership." Senate Report, 1920.

(b) REYNOLDS, R. V., and PIERSON, A. H. *Pulpwood Consumption and Wood Pulp Production,* 1920.

(c) "Forest Products Laboratory, Madison, Wisconsin." 1922.

(d) REYNOLDS, R. V., and PIERSON, A. H. *Lumber Cut of the United States,* 1870-1920.

(e) National Forest Areas. (A table.)

Bureau of Plant Industry. Division of Foreign Seed and Plant Introduction has a suggestive list of bulletins.

American Forestry (Washington), a monthly, gives valuable current information.

SPARHAWK, W. N., and ZON, RAPHAEL. *Forest Resources of the World,* 2 volumes. McGraw-Hill. 1923.

"Timber—Mine or Crop." (Written by the Forest Service.) *Yearbook,* United States Dept. Agr., 1922.

CHAPTER XII

FIBERS, TEXTILES, AND CLOTHING

If we omit the story of Eden the first clothing worn by primeval man consisted of the skins taken from animals he killed for food. The discovery that fibers could be twisted into thread and the thread woven into fabric was a later development and marked a distinct advance in man's cultural growth. To-day the art of cloth making is known and practiced in some form by nearly all peoples from the nearly naked tribes of the equatorial forest to the skin-clad inhabitants of the tundra.

The clothing of mankind is the product of wide-reaching world industries, which, with the production of the raw materials, touch in varying degrees all countries. A multitude of fibers contribute, but cotton is by far the most important. In an average year the United States uses five or six times as much raw cotton as scoured wool, its closest rival. Because of its commanding lead in cotton growing, the United States is the greatest factor in the production of raw materials for the world's clothing. The United Kingdom has a similar leadership in textile manufactures, one-seventh of her workers being employed with textiles and clothing, while in the United States but one-sixteenth are so employed.

1. THE SUPPLY OF RAW COTTON

THE UNIVERSAL USE OF COTTON. It is probable that few readers of this book ever saw a person into whose clothing cotton did not enter in some part, for it is alike the raiment of princes and of primitive peoples who wear only a simple breech cloth.

Cotton was in extensive and general use in India as much as twenty-seven centuries ago. Unlike most other important plants, its distribution throughout the part of the world suited to it took place at a very early time, probably by natural means, for Columbus, Captain Cook and other early discoverers found it in general use in the West Indies, Brazil, Mexico, and the islands of the Pacific.

Until the end of the eighteenth century cotton was one of the most expensive of fibers, because hand labor was the only method of separating the fiber from the seed. The difficulty and slowness of this work made cotton more expensive than wool and linen, and caused it to be relatively more expensive than silk now is. In that day "cottons" was the name of a fabric made of wool in imitation of cotton—a process now so diligently reversed. The poor man of 1790 had to choose between wool, linen, and leather, and this last material, in the form of workmen's clothing, played a much more important part in man's raiment than now.

REVOLUTION THROUGH THE COTTON GIN. In the year 1793, the cotton gin started a revolution in the cotton industry and through it changed the course of American history.[1] Before this time cotton production required a most abundant supply of cheap labor to pick out the seeds from the fiber, a day's work resulting in from 1 to 2 pounds of cotton. The cotton gin separates the seeds by a very simple mechanical device in which slowly revolving saw teeth pull the fibers through a comb, leaving the seeds behind. This easy ginning so reduced the price of cotton that it changed from a luxury to a necessity and a great industry sprang up. Between 1790 and 1890 the import of raw cotton into Great Britain increased 7,000 fold. The greatly reduced price and increased demands shifted the deciding factor of production from cheap labor to cheap land. In 1790 three-fourths of the British import was from the West Indies and 8 percent was from Brazil, where populous coast settlements grew and seeded it by hand. By 1890 its production in the West Indies had changed but little and was therefore a negligible factor. Brazil's share had, while greatly increased, dropped from 8 to 2¾ percent, while the United States, with cheap and fertile land, was supplying over three-fourths of the entire world's supply. The gin and tillage machinery promptly transferred it from the class of garden and hand-labor crops, to the class of machine-grown field crops. The cheapened production and increased demand shifted the cotton-growing area from a region of cheap labor to one of cheap land, from the populous Indies to the broad fields of the almost empty South. The year before the invention of the cotton gin the

[1] The influence of cotton on slavery and of slavery on the history of the United States is an interesting bit of the economic explanation of history.

American crop was so insignificant that the United States had in a treaty willingly promised to export no cotton to Great Britain, but within less than forty years we were sending Britain over two-thirds of her imports. It was the leading article of American export for many decades, during which it was frequently declared that "cotton is King." While it is not now so relatively conspicuous or so politically dominant, it is still a towering export, and some years

Fig. 194.—The branching habit of the cotton plant and its uneven ripening has long baffled the inventors of picking machines. (United States Dept. Agr.)

both before and since the World War its export value has been double that of wheat, flour, and lard combined.[2]

During the century following the invention of the gin, cotton became the well-nigh universal clothing. It has almost entirely replaced linen, is competing with wool in the soft and warm flannelettes and canton flannel, and it is also very generally mixed with wool in the production of cloth to which it adds cheapness and in some cases durability. Other cotton fabrics such as sateen greatly

[2] The United States cotton export in 1924 was 950 million dollars. Wheat export was 237 million, lard 125 million, and wheat flour 91 million.

resemble silk, while mercerized cotton is often sold as silk, so that cotton is being used as a substitute for this more expensive fiber also.

NATURAL COTTON REGIONS. Cotton is a woolly fiber attached to the seeds of a shrubby plant and contained in a pod or boll, which at ripening time opens so that the white fiber protrudes in a mass about the size of a small apple. Naturally tropical and sub-tropical, the plant will grow almost everywhere throughout the world between 40° north and 30° south. The northward growth of cotton is limited by the requirement of about seven months of frost-free weather.[3] It also needs a good summer rainfall without too great an excess of rain, a uniformly warm summer without too excessive heat, and bright sunshine. A frost-free season from April 1 to November 1 is thus a necessity unless the plants are started under glass. Owing to combinations of geographical and industrial conditions, it is exported as yet from few and comparatively small areas and thus in its distribution throughout the entire world, it gives rise to a great commerce.

Cotton is like many other useful plants in that it tends to be more productive toward its northern limit. The unmitigated heat and moisture of some tropic locations cause the plant to flourish for years, but the gradual cooling of the early autumn or the drying of arid localities suggests death to the plant and drives it to seed and fiber production. It thus happens that this tropic plant yields most of its harvests under the threat of death by northern frost or arid thirst, while the vast reaches of green humid equatorial lands are almost invariably cotton importers. Thus Mexico, with several thousand miles of tropic coast lines, grows three-fourths of its small cotton crop by irrigation in the northern interior.

COTTON, SLAVERY AND CHEAP LAND. The invention of the cotton gin caused slavery, which had been a dying institution and unprofitable for all important industries other than rice growing in the swamps of South Carolina and Georgia, to assume a new importance in the South. The great abundance of cheap land made easy the growth of cotton by slaves under plantation methods. Under

[3] The outer boundaries of cotton production are determined almost entirely by climatic factors. The cotton belt has an average summer temperature of 77 degrees along the northern boundary. This temperature appears to be the limit, beyond which commercial production becomes unprofitable.—"The Cotton Situation," *Yearbook*, United States Department of Agriculture, 1921.

this system of one crop, extensive agriculture, it was the common practice to clear up a pine forest, raise a few crops of cotton and corn, abandon the field, and clear up more land, the ground being cleared in the winter time by slaves who cared for the crop in the summer and picked the fiber in the autumn. At the present time the agriculture of the South is greatly limited and our soil resources needlessly diminished by a too great continuance of this one-crop system.

THE POSSIBLE AREA IN UNITED STATES. It is estimated that 700,000 square miles of the southern part of the United States has the climate suitable for cotton. Owing to the ease of injury by too much rain and cloudy weather the coast districts of South Atlantic States are not so well fitted as the districts further inland where the greatest centers of cotton production are found. The small proportion of cotton states actually in cotton at one time shows how the one-crop system still finds room and also shows great possibilities of increased production. In 1879, 20,000 square miles were in cotton. This was practically doubled in 1898, but by 1924 it had not reached one-twelfth of the total 700,000 square miles of possible cotton land. It is thus evident that the cotton output can be increased severalfold while other crops can also be largely grown in the same belt.

METHOD OF GROWING. The cotton seeds, about the size of a small pea, are planted thickly in rows in March and April. As soon as the plants are established they are thinned with hoes, after which frequent cultivations with the plow or cultivator are needed to keep down the weeds and to break up the top soil to stop evaporation. During the growing season, the plant attains a height of from 4 to 5 feet, produces a beautiful blossom followed by a green pod, which later bursts open showing the bunch of white fiber.

The picking of the fiber, which has thus far baffled all machinery, is done by hand. Because the cotton does not all ripen at once, the field must be "picked over" several times before the crop is all harvested. The large amount of work involved makes picking the limiting factor in cotton growing. Owing to the light nature of the work, much of it is done by negro women and children.

THE BOLL WEEVIL AND DIVERSIFICATION. The ease with which the grower's cotton, indefinitely keeping, easily handled and the king of money crops, could be mortgaged and the great difficulty of mortgaging any other crop were factors in the establishment of the great crop-mortgage system in the South both before and after the Civil War. The cotton planter or small farmer obtained credit from his banker or merchant for all necessary supplies and provisions, generally giving a mortgage upon the crop and often upon his team and tools. At the end of the year the crop was turned over to the merchant or banker, who sold it, deducted the advances, and returned the balance, if any, to the grower. The man advancing the money did not encourage the growth of other crops, nor the development of a more rational agriculture, because no other crop was so easily mortgaged, so easily stored, or so readily salable as cotton. Thus one-cropping was fastened upon the South to an

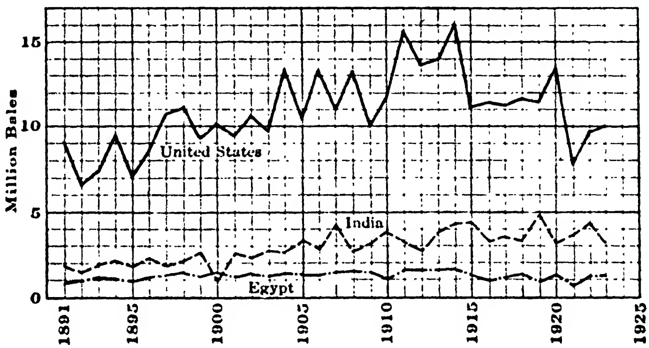


FIG. 195.—The United States has been for years the largest cotton producer with Egypt and India as the nearest rivals. (United States Dept. Agr.)

extent where few supply crops were grown and even the hay eaten by the mule was often imported in bales from north of the Ohio or west of the Mississippi.

The cotton boll weevil, one of the most destructive insect pests known to agriculture, made its appearance in Texas in 1892, coming from Mexico, but its full effect was not felt until after 1914, the year of our record 16 million-bale crop. The weevil lays its eggs in the young bolls, and when the larvæ are hatched they feed upon the unopened bolls, causing them to drop off, shrivel up or rot. Within two decades this pest spread throughout the cotton belt, costing the South scores of millions of dollars. Bankers and merchants refused to make advances, and the farmer found himself without credit, without food and without money. The result in many cases was financial and agricultural panic, with farms abandoned, stores closed and labor leaving the country.

Many of the erstwhile cotton farmers were forced to abandon their one-cropping, plant gardens, raise more corn, and keep a few pigs, cows and chickens in order to live (motto, "Cow-sow-hen"). The South has excellent natural facilities for the growth of forage crops and the development of livestock industries, and although she still continues to import some of her mules, hay and corn, butter, cheese and pork, an excellent start has been made in the direction of home production. The weevil still infests nearly the entire cotton area, in spite of vigorous eradication measures by state and nation, including the use of airplanes for dusting the fields with insecticides. In helping to break up the crop-mortgage system, however, and giving the South a diversified agriculture instead, the weevil has been a great blessing,[4] especially as it is still possible with care to grow considerable cotton.

IMPORTANT COTTON DISTRICTS. Cotton is grown in nearly every southern county from Norfolk, Va., to Austin, Texas, and up the Mississippi to Memphis. It thrives on nearly all well-drained soils within this area, but three localities with unusual soil stand out conspicuously. One is the rich, black prairie of Texas. Another is the so-called Mississippi "bottoms," a term chiefly applied to the alluvial land to the east of the Mississippi River between Memphis and Vicksburg, which is occasionally fertilized by the mud deposited when the river overflows its banks and floods the whole region. The third district in which the natural fertility of the soil suffices to give a crop considerably greater than the national average of about 130 pounds per acre is in Georgia and Carolina where two wide belts of fertile clays are separated by a strip of less fertile sand. The destruction caused by the boll weevil in the heart of the old cotton belt has had the tendency to push cotton growing west and north to the margins of the weevil territory where the winter is harder on the seed-weevils. Texas, the leading cotton state, is producing over four times as much as its nearest rival, North Carolina. These two states which produced 34 percent of the crop in 1914, had 53 percent of it in 1923.

SEA ISLAND AND MEADE COTTON. The fibers of the ordinary upland cotton, the chief product of the United States, vary in length

[4] One of the strangest monuments ever erected is in the little town of Enterprise, Alabama. The inscription on it is as follows: "In profound appreciation of the boll weevil and what it has done as the herald of prosperity this monument is erected."

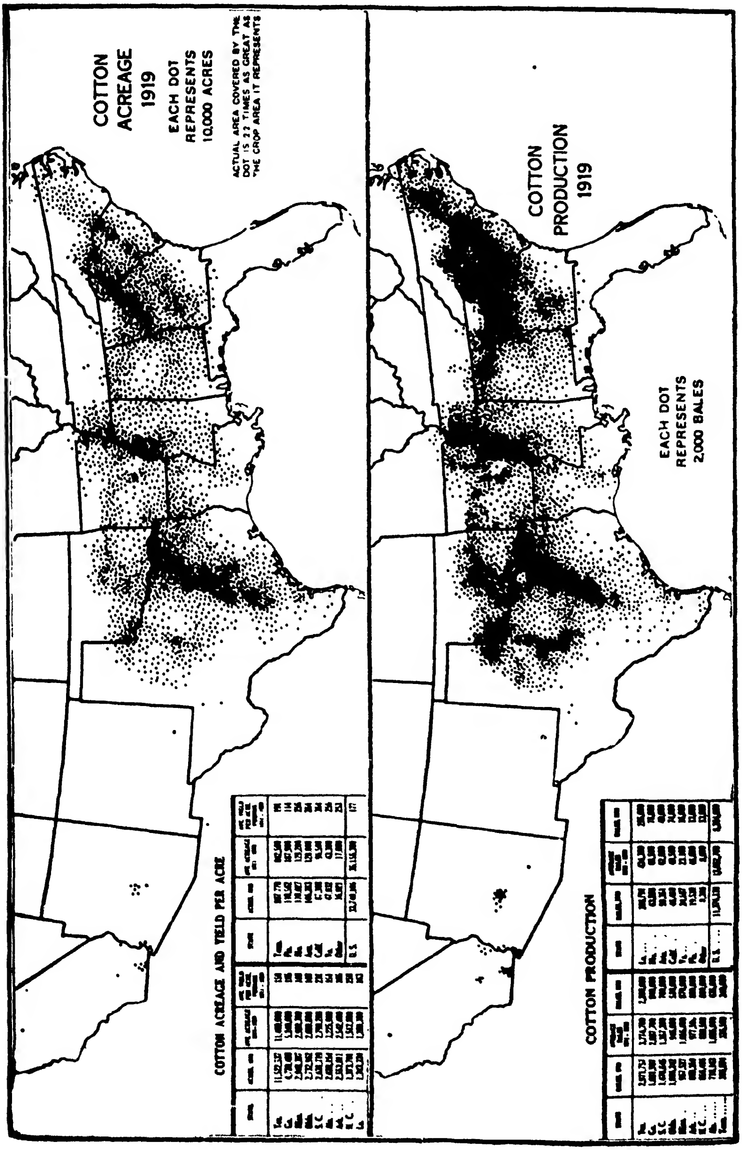


FIG. 196.—The densest areas on the map are where the richest soils are found. (United States Dept. Agr.)

from five-eighths to one inch, but a variety known as Sea Island cotton, considered the best in the world, has fibers nearly two inches in length, sometimes even longer. This fiber surpasses all other types in length, strength and fineness, and commands a high price for use in the manufacture of superior fabrics. Sea Island fiber was long grown on the low sandy islands (barrier beaches) and their adjacent mainlands in South Carolina and Georgia. It seems to require heavy rain, much moisture, and the slightly saline soil and air of shore districts. The West Indies Islands and Peru are the other important growers of this cotton.

Sea Island cotton in the United States has proved itself particu-

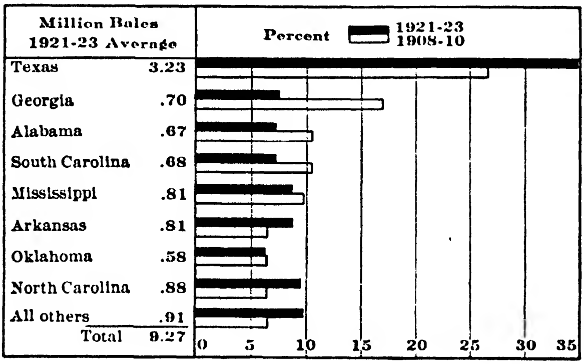


FIG. 197.—United States cotton production, three-year average.

larly susceptible to attack by the boll weevil, on account of its late-fruiting habits.[5] Production has declined from 116,000 bales in 1916 to almost nothing at present and the complete destruction of the Sea Island industry is threatened. To take its place a new variety of upland cotton called Meade has been developed. This cotton has a fiber as long and silky as that of Sea Island, and when properly ginned can only be distinguished from it by experts. Meade cotton has the desirable early-maturing feature of upland cotton, and as one boll of it yields as much as two bolls of Sea

[5] The peril of late varieties and the importance of early varieties in boll weevil infested territories arise from the fact that only a few boll weevils survive the winter. There are several generations of them through the summer, increasing with the terrible geometric ratio thus: 1, 10 (or 100), 100, 10,000, ten thousand times ten thousand, and so on. Therefore the diminishing chances for the late cotton plant are plain.

Island, much is hoped for this new variety in the southeastern United States.

COTTON IN INDIA. Asia is second to North America in cotton growing, and India with 4 million bales a year is second to the United States in production. The leading cotton area is located on the plateaus between one and two thousand feet above the level of the sea and lying east of the western Ghats Mountains in the region commercially tributary to Bombay. The crops depend upon the monsoon rains of summer,[6] which in this section are rather light, owing to the mountains which intercept the rain-bearing winds. Droughts follow rains and no cotton could be grown at all but for the very peculiar character of the so-called black cotton soil, which in the rainy season is often flooded, becomes a tenacious mud, and after the rains have ceased dries somewhat and is separated by countless cracks into hard lumps. This does not prevent the spongy soil from retaining sufficient water to mature the cotton, which is here sown broadcast like wheat, in a lava soil so enduring that some of it has been planted annually to cotton for centuries. The yield is a little over half of that of the United States and because of the short staple the quality is poorer. The influence of climate is shown by the improvement of Indian cotton when grown in America. Cotton can also survive standing in water in India, but in the United States it is fatal because of the smaller amount of evaporation by which the plants rid themselves of surplus moisture. In northern India, some cotton is grown in the irrigated districts along the Indus and Ganges. The Indian export goes largely to the mills of Japan and China to be made into cheap cotton cloth.

THE CHINESE COTTON BELT. China is the third largest cotton grower but her annual production of over 2 million bales is not sufficient to meet the needs of her enormous population whose chief clothing is cotton, so she must also import some from India. A large part of southern China has a climate which is essentially a duplicate of the climate in our own cotton belt, and China could

[6] "The arrival and continuance of the southwest monsoon with its accompanying general rains is an important factor in the planting and growth of the Indian cotton crop especially in central and northern India. The hot dry weather of the period March to May bakes the soil so that it is impossible to prepare the land for seeding before the coming of the monsoon rains. After the coming of the monsoon, seeding must be completed in the short interval between the first fall of rain and the tropical downpour of the mid-monsoon period." (*Foreign Crops and Markets*, United States Dept. of Agr., July 30, 1924.)

easily grow a vastly increased amount of this fiber if her land were not so badly needed for food crops. The areas of greatest production are the Yangtze valley and the Hwang valley in the provinces of Chihli, Shansi, Shensi, and Honan. The loose soils of these valleys and also of the Wei Basin of south central Shansi are admirably suited to cotton. The prohibition of the growth of the poppy for opium is increasing the cotton output of China. Cotton also grows over a large area in southern Korea, where it has been a family-supply industry. It is now under Japanese direction spreading out as a commercial crop, and is also grown to a small extent in southern Manchuria.

Other Asiatic and European sources. There is cotton climate from India to Asia Minor and the Straits of Gibraltar and cotton

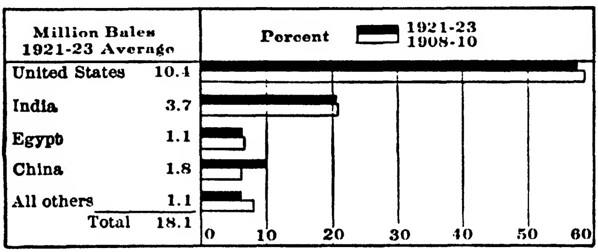


Fig. 198.—World's cotton production, three-year average.

is grown in scattered spots throughout the region, but most of it is so arid that the small proportion of arable land must be used to grow food crops. Under the stimulus of famine prices during the American Civil War, cotton growing in all these countries rose rapidly to an important amount. Turkey, for example, produced 235,000 bales, but soon declined and now (1924) grows about 60,000 bales. Cotton growing is important in Iraq (Mesopotamia), and has great future possibilities when new irrigation works shall again rehabilitate the land of ancient empires. Persia grows over 100,000 bales on the few scattered oases that enliven her ancient wastes.

The building of railroads from the Caspian Sea into the oases of central Asia made possible the export of cotton which has been grown in a small way for local use for many centuries. Within two decades after the railway was built, cotton became one of the most important money crops from the irrigated fields of the oases which are fed by the melting snows of the high mountains of central Asia. Asiatic Russia produced annually nearly one million bales of cotton before the war, an amount insufficient for the needs of the nation, however. The present acreage in Russian Turkestan[7] and Trans-caucasia is only a fraction of what it was, but it may be expected to revive in time to pre-war figures. There is small possibility of any larger increase because of the very limited area for which water is available. American upland varieties, which have been introduced into Asiatic Russia, constitute the major portion of the crop.

Most of Europe is too far north to raise cotton successfully. Greece produces about 12 thousand bales, one-third as much is grown in Italy, and a little in Bulgaria, Spain and Cyprus.

EGYPTIAN COTTON. The Nile Valley of Egypt is without question the best cotton field in the world. The alluvial soil of the Nile Delta fertilized by the flood waters, with almost continuous sunshine and warmed by a climate in which there is a steady rise in temperature from spring to summer and a steady decline from summer to autumn, produces 350 pounds of cotton per acre, which is nearly double the yield of any other country. Unfortunately, its area is not great. The total Egyptian crop is little over one million bales a year, though most of it is long staple cotton of excellent quality. It commands a high price, and the production which covered 1,350 square miles, or one-seventh of the cultivated area in 1885, increased to 3,880 square miles in 1923, an area greater than that of any other crop and covering about one-fourth the fields of Egypt. The cotton area is limited by the facilities for irrigation, which has been possible only since the introduction of modern engineering devices under European management. The greatest of these efforts at cotton extension is the building of the

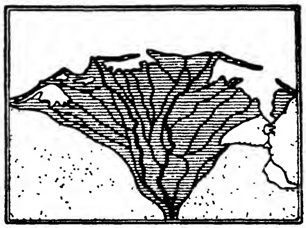


FIG. 199.—The Nile Delta surrounded by the desert shown in dots. One of the first oases in the world with a close counterpart in the Imperial Valley of California.

[7] "Cotton production in Turkestan, the most important producing province, suffered almost a total collapse during and since the revolution. Irrigation systems fell into disrepair and marauding bands destroyed dams and drove peasants out of the cotton growing areas. Time and a large amount of capital will be required to restore cotton growing in Turkestan to its pre-war status." (*Foreign Crops and Markets*, United States Dept. Agr., April 16, 1924.)

Assuan Dam, which holds back vast quantities of water from the season of flood until the time of need and permits irrigation at all seasons. Flooding of the Nile has annually spread a layer of mud over the Egyptian fields, permitting continuous cropping for many centuries without any other fertilization. Already there is complaint from the natives that the fields of lower Egypt are declining in fertility and that the yield per acre is declining since the Assuan Dam shut off some of the floods and the mud. The construction of new dams on the White Nile and the Blue Nile should extend the cotton area of Egypt.

Because of the dry climate, Egyptian cotton is superior to our own for knit goods, and for this reason the United States imports from 150,000 to 350,000 bales each year, an amount greater than our total cotton consumption of 1830.

Cotton in the Pacific southwest. The long staple Egyptian cotton is so much desired that attempts to cultivate it have been made in many parts of the world, but seldom with permanent success. The nearest approach to Egyptian conditions anywhere (probably) is found in the desert valleys of the lower Colorado basin in California and Arizona, with their long dry season, almost continuous sunshine and flooding Colorado. In the Salt River Valley of Arizona the construction of the famous Roosevelt Dam transformed some 300,000 acres of desert into a veritable garden, yielding citrus fruits, dates, almonds, olives, 8 tons of alfalfa to the acre, and all the produce crops. Experiments with a variety of Egyptian cotton (called Pima, after an Indian tribe of the Southwest) were especially successful, this cotton under irrigation yielding three-fourths of a bale to the acre. Pima cotton which is highly prized for its long fiber, fine quality, and pure white color was first used in the manufacture of tire fabrics, but was later found suitable for various fine textiles. Commercial planting commenced in 1912, and spurred on by war prices cotton cultivation spread into most of the irrigated valleys of the Southwest, but particularly the Salt River Valley and the Imperial Valley of California. Pima cotton rose from 20 cents to a peak of $1.25 a pound, and the 7,000 bales produced in Salt River Valley (1916) grew to 100,000 bales from California and Arizona in 1920. The post-war slump in prices checked cotton expansion and the farmers who plowed up their alfalfa and sold their pure bred cows in order to plant cotton are again turning to dairying, fruit and vegetables. It remains to be seen whether the

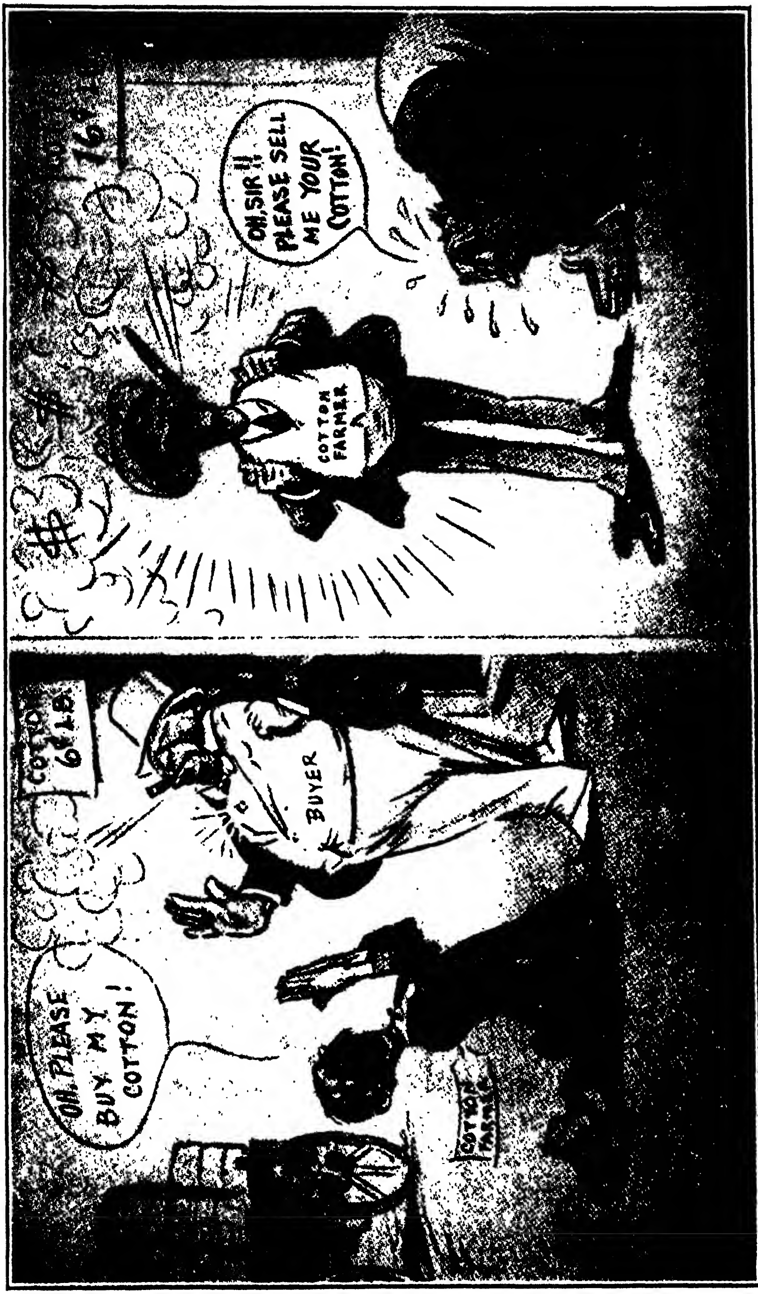


FIG. 200.—The cartoonist's presentation of the human ups and downs dependent upon the price of cotton in the South. (Courtesy *Country Gentleman.*)

Southwest with its high wages can grow large amounts of cotton in competition with Egyptian and other foreign cheap labor.

South American prospects. The early explorers found wild cotton in use among the Indians of South America and sometimes, as in Peru and Mexico, in cultivation. The Portuguese in Brazil soon adapted it to commercial use, and with the aid of slave labor Brazil became one of the world's leading cotton exporters at the end of the eighteenth century. The invention of the cotton gin in 1793 allowed America to displace Brazil in the world trade, and except for a temporary revival of the industry when the Southern ports were blockaded during our Civil War, she has been unimportant ever since. A large percentage of the cotton grown goes into home industry, but at the present time Brazil sends into the world market about 150,000 bales annually.

Although the cotton plant grows wild throughout the country the chief areas of commercial cotton-planting are along the northeastern coast, and near the city of São Paulo. In contrast to the extensive and well-managed Brazilian coffee plantations, the cotton is grown on small farms, and the methods of cultivation are practically the same as those prevalent two hundred years ago. Despite the fact that this tropical country with its vast areas of low priced land [8] has been often described as the greatest potential cotton producer in the world, there is small prospect of much change in production at an early date. At present the Brazilian farmer can make more in coffee or in sugar than he can in cotton, as the native labor supply is neither adequate nor efficient. The growth of the cotton industry in Brazil seems dependent on more labor, and the government is encouraging the immigration of agricultural workers, chiefly Italians.

Cotton in Peru is an irrigation crop, grown on the arid coastal plain wherever streams from the Andes furnish sufficient water for the fields. The nearby guano deposits provide cheap and abundant fertilizer, but the labor cost is high and the methods of cultivation primitive. About half of the amount grown is native Peruvian cotton with a long, crinkly fiber, highly prized for mixing with wool, or in making imitations of expensive woolen fabrics. Of the other

[8] There are millions of acres of suitable cotton land in the valley of the San Francisco River, which can be bought for $3 to $5 per acre. These lands are well drained, swept by breezes, and in a part of the country where fevers are unknown. As the Brazilian tax on agricultural land is quite low the cotton possibilities of this region are attractive.

cottons grown, a high-yielding Egyptian variety from the United States is the most popular, although it is less hardy and can be grown only in the valleys with the best water supply.

Northern Argentina with its mild climate and moderate rainfall has a large area where cotton growing has proved successful, the crop increasing from 3,000 to about 60,000 bales in the last decade. The climate and soil of this part of Argentina and the adjacent parts of Bolivia and Paraguay provide a cotton region far larger than the cotton belt of the United States, but the amount under cultivation is as yet small. Venezuela, in the vicinity of Valencia, has some cotton growing, as do parts of Colombia. Efforts are also being made to restore cotton planting in Surinam (Dutch Guiana) to the flourishing state it formerly enjoyed under slavery.

THE WORLD'S SUPPLY AND EUROPEAN EFFORTS TO ENLARGE IT. Of the world's commercial crop, the United States produces over one-half,[9] India one-fourth, China one-tenth, and Egypt about one-twentieth. The great dependence of Europe upon the United States for its cotton supply causes any kind of disturbance of cotton growing or export in the United States to be sharply felt in Europe, and gives an unpleasant feeling of dependence upon this country for the raw material of one of the most important of all industries. During the American Civil War, when the northern states blockaded the South and stopped the export of cotton, the price rose to a dollar a pound and the consequent closing of mills caused great hardship to the cotton manufacturers of Lancashire, England, and other European textile districts. Several times within recent years, a short production and subsequent speculation in American markets have caused high prices and the shutting down of mills in Europe. As a result every European nation with tropical colonies is making

[9] WORLD COTTON CROP

	1922–23	Percent
World	18,705,000 bales	
United States	9,761,817 "	52
India	4,348,000 "	23
Egypt	1,170,000 "	6
China	2,048,000 "	11
		92
Rest of world	....	8
		100

frenzied efforts to stimulate the growth of cotton, but the results so far have not been very encouraging, although the possibilities are doubtless very great. Good samples of cotton are reported from many places throughout the tropics and the possible areas are extensive. For instance, it is claimed that the supposedly unimportant Cook Islands in the Pacific have 200,000 acres of cotton land capable of producing enough cotton to feed the factories of a city. A British cotton-growing association is trying to increase cotton growing in the West Indies and in Africa and to improve the quality of that grown in India. The French, Spanish, Portuguese, Italian, and Dutch governments are making similar efforts, either in their home lands or their colonies. The ultimate results are entirely problematical,[10] but the production in the various British possessions in Africa exclusive of Egypt increased from 10,900 bales in 1905 to over 100,000 bales in 1922–23.

Probably the most promising of all the colonial tropical regions is that of Uganda and the Anglo-Egyptian Sudan, East Central Africa and Rhodesia. The potential cotton acreage of the Sudan is estimated at one million acres, and that of Uganda, together with Kenya and Tanganyika, is about 1¼ million. Climatic and soil conditions are favorable over all this area, rivaling in size the American cotton belt, and containing in places comparatively dense populations of natives who might be converted into a labor supply under European management. Much of this area, however, will require irrigation and there is doubt whether the head waters of the Nile will suffice, without robbing Egypt of her usual supply.

Uganda has 3 million acres of good cotton land, more uniform in character than our own south, and all of East Africa has approximately 60 million acres of such land. (Authority of Dr. H. L. Shantz, agricultural explorer of the United States Department of Agriculture.) The crop of Uganda (75,000 bales, 1922–23) now makes this British colony second only to Egypt as an African producer. One of the greatest drawbacks is transportation, the

[10] "John A. Todd, the great English authority on cotton, says that there is no immediate prospect of increasing supplies outside the United States even a million bales a year. Or, as an American authority put it:

" 'One week of favorable or unfavorable weather at a critical time in America means more to the world's immediate cotton supply than all the efforts being made to increase production elsewhere.' "—E. H. Taylor, *The Country Gentleman*, April 19, 1924.

But foreign countries *do* have the land for cotton.

Uganda farmer being obliged to haul his crop to Victoria Nyanza, then load it on transports across the lake and reload it on a railway in order to reach the port of Mombasa, where it can be sent to the world market.

The Union of South Africa is also paying marked attention to its cotton-growing possibilities.

Queensland, Australia, has much cotton land and is giving governmental encouragement to the growers, but the fact that the white population is very scanty and that colored races are rigidly excluded makes any large industry impossible.

PROBABLE IMPROVEMENTS IN AMERICA. The boll weevil gave the industry a great shock, but hundreds of keen minds are fighting him with poison, new varieties of cotton, and natural enemies. With the continued rapid spread of more scientific agriculture, with crop rotation and animal husbandry in the cotton belt of the United States, the production can probably be increased severalfold during the present century. The invention of a successful cotton-picking machine,[11] for which inventors continually strive, would work a great revolution by removing the greatest labor element in its production and putting it on a par with wheat, oats, and corn, in all of which crops machinery has made possible the production of many acres by a single individual. The cotton gin brought great emancipation to cotton growing, but cotton picking still depends upon human fingers. This alone restricts the possible production of the grower to a fraction of what it might be with a successful machine picker.

The stimulus to the breeding of early maturing varieties of cotton produced by the boll weevil outbreak is likely to permit the northward extension of cotton growing in this and other lands. For example, it is now thought that cotton will grow in the Crimea and the Russian province of Kherson north of the Black Sea. In the period of domestic industry it was grown successfully as far north as Washington, D. C.; every county in Maryland between Washington and Chesapeake Bay, and nearly all Virginia east of the Blue Ridge was producing cotton in 1839, according to the United States Department of Agriculture. The extension of cotton growing

[11] One of the newest of cotton pickers which is having some success is built on the principle of a vacuum cleaner, and a workman with a nozzle in each hand can draw the ripe cotton out of the open bolls and up into sacks many times faster than it can be picked by human fingers. All new cotton pickers should be taken with several grains of salt.

100 miles toward the poles would greatly enlarge its possible production, especially in the United States.

By-products from cotton. The cotton seed, one of the most nutritious of morsels, was for a long time thrown away, or even burned. Later it was returned to the fields as fertilizer. Then came the discoveries that the oil in which it was so rich could be extracted and put to many and rapidly increasing uses. The manufacture of cottonseed oil is now an important industry throughout the South. Over 4½ million tons of cottonseed are now crushed annually, the crop of 1923 bringing about $32 per ton to the grower. A ton makes from 36 to 42 gallons of oil. The oil cake which remains after pressure contains about nine times as much of the important plant foods, phosporic acid and potash, as does the fiber produced by the plant. It is thus evident that the returning of the seed to the land is an excellent way to maintain soil fertility, but the food value is too great to permit such use. The great richness of this cottonseed meal in proteid, of which it is now the cheapest available source, has led to its appreciation as food for dairy cows, and it is shipped to every important center of butter and cheese production in the United States, Canada, and Europe.

For the use of cottonseed oil in place of butter or lard, see the section on Dairy Substitutes in the chapter on Animal Industry.

2. MANUFACTURE AND TRADE IN COTTON CLOTH

Spinning and weaving in the hand labor era. Fibers of any sort, when twisted around each other, tend to cling together and form a thread, string, or rope. Cotton, being a flat hollow tube, has unusual spinning qualities. Primitive peoples in every continent have some method of spinning, also devices for weaving. In the rudest or most complex forms weaving is the same as the method by which splints are made into a basket. During the early centuries of the Christian era, the material to be spun was held on a distaff and the thread, often twisted by hand, was, when finished, wound upon a spindle. The spinning wheel, used at an early date in the Far East, was also independently invented in several parts of Europe in the fifteenth century, was universally used in that continent and was scattered over the world, wherever European colonists went. The thread thus laboriously spun was woven into cloth in hand looms, the industry being carried on in the homes of the workers even when the product was intended for sale. Some people were spinners, others did the weaving, and cloth making for sale was a common household by-industry throughout the western world in the middle of the eighteenth century.

TEXTILE MACHINERY AND THE FACTORY SYSTEM. In 1764, an Englishman by the name of Hargreves invented a machine called the spinning jenny which was the first machine ever used to make more than two threads at one time. This invention promptly sent the spinning wheels to the garret and greatly increased the output of a family of spinners. Five years later Cartwright invented the so-called "water frame" or throstle, a spinning machine which could make the heavy warp thread. Ten years later Crompton invented the "spinning mule" which was a combination of the machines of Hargreves and Cartwright and which has been largely used down to the present time. The present spinning mule contains over a thousand spindles upon each of which a thread is wound and one man can operate two of the machines, making over 300 pounds of thread per day. While the Hargreves spinning jenny was used in the homes of the old-fashioned hand workers, the spinning mule was best adapted to factories where larger amounts of power could be generated. This power was furnished at first by the water-powers of Lancashire, England, but steam, which was introduced into English factories about 1790, was soon utilized. For a few years there was a great surplus of thread. The weavers, who had previously been able to use the thread of six spinners and often had to go to the houses of many spinners in the morning to get enough to weave during the afternoon, now found themselves utterly unable to handle the vast quantities of thread which the new machines produced. In 1787, however, Cartwright invented a power loom which water wheels and steam engines could run, thus enabling weavers to use up the thread. One invention demands and usually produces another. The spinning machine demanded weaving machines and the weaving machines demanded cotton. In answer to this demand came the cotton gin (1793), six years after the power loom had made cotton scarce. Cotton quickly became cheap. This combination of cheap cotton, spinning machines, weaving machines, and the coal and the iron resources of England, enabled that country to forge rapidly ahead in cotton manufacture while all the continent of Europe was disturbed with the turmoil of Napoleon's wars. In 1785, the export of cotton goods from England was worth a million pounds sterling; in 1815 it was 22 million pounds, and during this period it increased from 5 percent of British exports to 38 percent.

That short period of thirty years produced greater change in British industry than many previous centuries had made. It has been well called the Industrial Revolution, and, like inventions, machines, and styles, it has spread and is spreading to many coun-

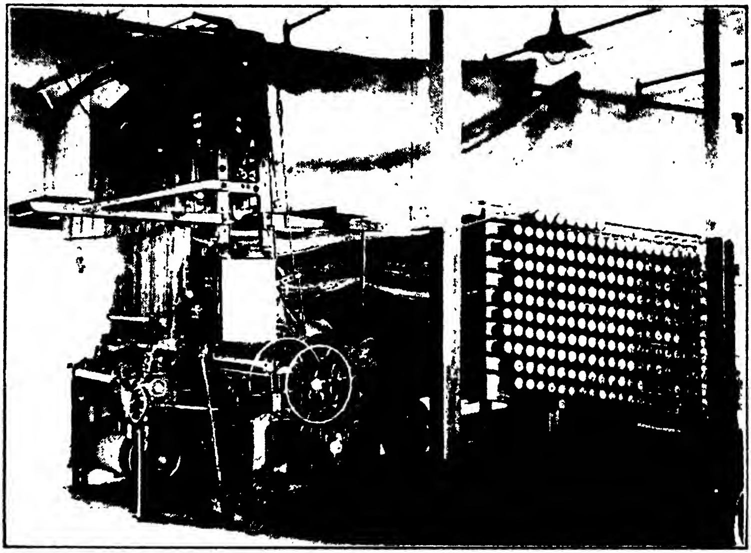


FIG. 201.—A modern loom. Spools of yarn to the right. Cardboard patterns overhead at left. Roll of finished cloth near floor at left. (Crompton Knowles Loom Works, Worcester, Mass.)

tries. Before this revolution, man used little artificial power and the manufacturer often lived in the village or in the country where he gardened, kept some live stock, and worked on near-by farms. He was near to the food supply and had opportunity to use his extra time to good advantage. Industry was organized around a man's time. After the Industrial Revolution, the worker found himself living in a city tenement to be near some other man's steam-driven machine in the big factory. Industry was organized around a machine, *a machine's time*. Man was away from the earth, the one great resource. He had no chance to produce food in his odd moments and was dependent upon the factory wage and imported food. As a result England's people have suffered some physical degeneration.

It is entirely erroneous to think of the machines of modern manufacturing as having completed their evolution. Mechanical improvement is going forward as rapidly now as ever, and to this improvement the textile industry is no exception. Between 1904 and 1919 the number of textile workers in United States increased 40 percent, and the value that they added to the raw material increased several times as much. As this was a period of decrease in the hours of labor, the increased result is plainly due in large part to the machinery.[12]

The completed modern cotton mill is large and often costs over a million dollars. While one plant often completes the process, it is still a characteristic of the cotton manufacturing industry that the yarn is made in one place and the cloth in another, as was done in the days of the wheel and hand loom. Thus, England is sending yarn to the Far East to be there woven into cloth; Japan and India are sending yarn to China; the mills of Massachusetts are sending yarn to Philadelphia, and the mills of Philadelphia are sending yarn to Rhode Island, while a truck carrying yarn from mill to mill is a common sight in every cotton manufacturing city. All this means a waste of effort and consequently higher prices for cotton goods than necessary.

PRESENT DISTRIBUTION OF COTTON MANUFACTURE. During the nineteenth century, cotton factories spread to many countries, and cotton cloth has traveled to the ends of the earth. The spinning wheel has disappeared before steam-borne commerce in ever-widening circles, until now it lingers only in exceedingly remote locations, where it continues, not because it is impossible to transport cotton cloth, but because it is impossible to send out any product with which to pay for it.

England's early leadership and present dominance in cotton

[12] Homespun cotton cloth is still made in native hand looms in some remote parts of Africa, the Andean districts of South America, and large parts of Asia. Japan is still in the process of emergence from the hand-loom epoch, and the Chinese are, in many cases, still clad in homespun. In the United States, the old method still persists in the heart of the Appalachian plateaus of eastern Kentucky and western North Carolina.

Of equal or greater significance is the persistence of the domestic system in Europe itself. Ireland is reported to have 6,000 women lace makers and from the Donegal peasant women's looms comes homespun cloth, much prized for its texture, figure and home-made vegetable dyes.

manufacturing is shown by her leadership in the number of spindles, cotton consumption, and export of manufactures.[13]

RELATION OF COTTON MANUFACTURE TO DENSITY OF POPULATION. The world's cotton mills produce many varieties of cloth, from the coarsest to the finest, and the distribution of the factories making different kinds is an admirable illustration of the effect of dense population upon manufacturing industries. A pound of raw cotton may, with much fabrication, become several dollars' worth of the best machine-made lace, or it may become a yard or less of coarse, heavy cotton duck. Several times as much labor and capital are required to produce the finer of these two products, even if machine

[13] MILLIONS OF COTTON SPINDLES IN THE WORLD

	1900	1912	1920	1923
Great Britain	45.5	55.3	56.4	56.6
Rest of Europe	32.0	43.0	43.5	44.7
Total Europe	77.5	98.3	99.9	101.3
United States				
Cotton states	4.3	11.5	15.1	16.5
Other states	15.0	19.0	20.7	20.9
Total U. S.	19.3	30.5	35.8	37.4
British India	4.9	6.1	6.8	7.3
Japan	1.2	2.1	3.8	4.9
China	0.5	0.8	1.6	2.6
Canada	0.5	0.8	1.1	1.4
Mexico	0.4	0.6	0.7	0.7
Total world	105.6	141.0	151.4	157.8

COTTON MANUFACTURED, 1922–1923

	Pounds of cotton consumed per capita	Exports, million dollars
United States	27.7	145.4
United Kingdom	29.0	833.9
France	13.2	119.0
Germany	8.4	0.8
Switzerland	13.6	58.5
Spain	8.1	9.2
Japan	19.7	160.9
Italy	11.2	81.2

made, while if the lace is made by hand it takes vastly more labor than that required for machine lace. Brussels has been the center of the world's hand-made lace industry for the natural reason that it has been the metropolis of the most densely peopled nation. Much of the lace is made of fine linen thread by the Belgian peasant women in the intervals of their farm work—a means by which they retain the great advantage of the domestic system—steady employment.

England's early monopoly in cotton manufacturing has given way, due to the rise of the industry elsewhere, as on the continent of Europe and in the United States, which regions were, in 1820, the chief British market. Although country after country has taken up the manufacture, the English product has nevertheless increased steadily, because it is the characteristic of new cotton industries to start with a crude product and England has held her own by making a finer and finer product for shipment to other lands.

The United States has an instructive distribution of the industry into regions of coarse and fine production. Cotton manufacturing had its origin in New England, where it is most developed, and it has had a recent rapid growth in the South, where it is less developed but progressing, as is shown by the fact that the average annual consumption of raw cotton per spindle in the South was 155 pounds in 1880, 119 pounds in 1905, and 104 pounds in 1919, while Massachusetts used 59 pounds and England 40 pounds in the latter year. Granting equal speed of work per spindle, the average of the southern cotton mills in 1905 was two and a half times as heavy, and the cloth, therefore, two and a half times as coarse, as the British product, and nearly twice as heavy as the New England product. Speaking broadly, the South is, in its cotton cloth, exporting primarily its raw material. New England and Old England are exporting primarily their labor. The product of the Middle Atlantic States, as might be expected, is midway in fineness between that of New England and the South.

British cotton manufacture. For more than a century the name of Manchester has been synonymous throughout the commercial world with cotton cloth. That city, the metropolis of Lancashire, has long been the center of the greatest cotton manufacturing district in the world. The industry, established there as early as 1640, was partly due to the Atlantic winds which gave the moisture necessary to the best cotton manufacturing. Later these same

Atlantic winds influenced the industry through the water-power of numerous small streams that descended from the central highlands (known as the Pennine Chain) and led to quick development after the invention of the new machines. Both of these advantages have now passed away. The moisture, like the temperature of the factory air, can be controlled and the factories of Lancashire have long since outgrown the water-power and turned to steam, for which the local coal fields are very convenient. The third factor in Lancashire's start was the convenient harbor of Liverpool, which has long had wide ship connection with regions producing and consuming raw cotton. The city of Manchester itself has now ceased

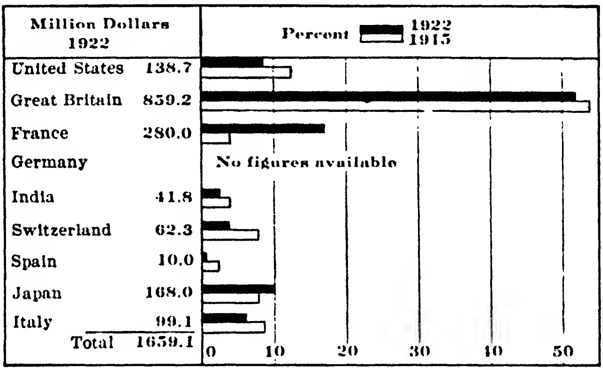


FIG. 202.—Exports of cotton manufactures.

to be so strictly a manufacturing city, and has become the sale and storage center for the product of many surrounding towns. Liverpool, the natural port of entry for this region, is the greatest cotton port in the world because back of it lies the greatest cotton manufacturing district. It is, indeed, surprising that in a century and a half, the British cotton industry should have spread so little beyond a radius of 40 miles from Manchester. This district clothes Britain with one-fifth of its output, the other four-fifths being for world export. The intensity of the industry has given to Lancashire eight times the population of Rhode Island although its area is only 8 percent greater. A son often succeeds to his father's place in the mill and the skill of the Lancashire operative may well be said to be hereditary, with factory work and school dividing the years of youth.

England has easily led all countries in the manufacture of cotton goods because she has had the great advantage of an early start, no wars on her home soil, capital while others have had to borrow, the most wide-reaching shipping connection, and the local advantages of unrivaled coal, iron, and harbors. Because of her tariff policy, she has had cheaper food than any continental country and she has had cheaper cash wages than America. As a result of all these advantages the equipment and also the operation of a cotton mill is much cheaper in Lancashire than in Massachusetts. Hence the United States like many other countries, places a tariff against the import of foreign (primarily British) cotton goods.

England sends fine cottons into the best cotton manufacturing districts of United States and of northwest Europe, and all kinds of cottons to the Mediterranean countries, to Russia, Norway, and Sweden. Her cloth goes to every colony in Africa, to the countries of west Asia, to the East and West Indies, to Central and South America, Australia and Polynesia; in fact, to the islands, colonies, and non-manufacturing countries everywhere. The total British exports of cotton manufactures, $850,000,000 (1923), compare favorably with the total foodstuffs exported from the United States, $1,050,000,000 (1922).

CONTINENTAL COTTON MANUFACTURE. The entire continent of Europe has fewer spindles than Great Britain, but owing to the coarser product produced there is a greater relative consumption of raw cotton. Bremen and Havre are the chief importing points, and the greatest center of manufacture lies between the Elbe River and Paris, the North Sea and the Alps. This district includes northeastern France where Lille is the leading cotton mill center,[14] and the populous Rhine Valley with a host of manufacturing towns in Germany, Holland, Belgium, and Switzerland, in all of which fine cottons are made for home consumption and for export.

Russia, which had about 9 million spindles before the war, lost about one-fifth of her former productive capacity to the newer states which were formed. Of her remaining spindles, only a small number have been active, owing to disturbed conditions and lack of cotton. Poland fell heir to numerous Russian and German

[14] The cotton-spinning industry of northern France was greatly damaged when the Germans overran this section of France and occupied it for several years during the World War. The industry may benefit in the long run, as the machinery removed or destroyed has been replaced by new installations of the most modern and improved type.

spindles when the country was reunited. Cotton spinning is its leading manufacture and is centered at Lodz with its millions of spindles, often spoken of as "little Manchester." The cotton mills are restored nearly to normal production and but for the disturbed conditions in central Europe and the artificial tariff barriers raised by other nations, Poland would have a profitable export. In populous Bohemia, formerly belonging to the Austro-Hungarian Empire but now a part of Czechoslovakia, the busy spindles and looms, working on imported materials, have made cotton and woolen manufactures the first export in value.

In Spain, which imports about 400,000 bales of cotton, the chief manufacturing district is Barcelona. Genoa is the chief cotton-importing port of all south Europe, because it receives some Swiss imports and is the point of supply for Milan and the manufacturing districts of North Italy. Here the water-power of the Alps is being rapidly utilized for manufacture, but Italy does not produce enough cotton cloth for home use, although Switzerland is per capita as heavy an exporter of high-grade cotton manufactures (chiefly laces and embroidery) as is Britain herself. Cotton manufacturing is important in the island city of Venice, to which the raw material goes directly from New Orleans, Galveston, Savannah, and New York.

COTTON MANUFACTURING IN THE UNITED STATES. In the United States the manufacture of cotton is concentrated in the region east of the Appalachians, in a long belt from Maine to Alabama, with its greatest centers in New England and at the eastern base of the Appalachians in the Carolinas and Georgia, with a lesser center in Philadelphia. New England, with 18 million spindles, leads in cotton manufacturing although the southern states with 16 million spindles are already consuming more cotton in a single year than does New England. During the decade from 1909 to 1919 the number of spindles in New England increased 14 percent while in the cotton-growing states they increased 42 percent. New England is making the finer and more valuable fabrics, and seems likely to retain this specialty.

THE INFLUENCE OF WATER POWER IN NEW ENGLAND. The cotton-manufacturing industry is, next to paper, dominated by water-power more than any other in the United States. The industry was established in New England along the waterfalls of her glacial streams. These locations were, like Lancashire, close to harbors for the service of shipping and in a region of good labor supply. The Merrimac River has falls of more than 50 feet at three places, and at these the great cotton towns of Lowell in Massachusetts and Manchester in New Hampshire have arisen. Taunton on the Taunton River at the head of the tide-water in eastern Massachusetts; Holyoke on the Connecticut in central Massachusetts; North Adams on the Hoosac River in northwestern Massachusetts; and Fitchburg on the Nashua in northern Massachusetts are all indebted to waterfalls for their prominence in the cotton industry, as are

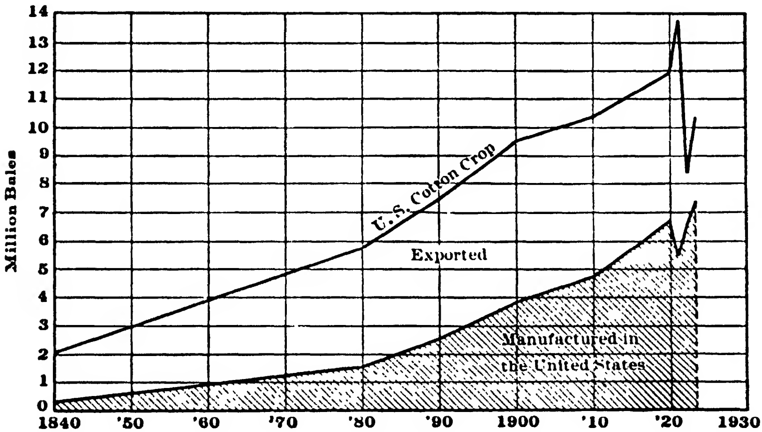


FIG. 203.—Final disposition of the United States cotton crop. One of the measures of our industrial growth.

Pawtucket, Warwick, and Woonsocket in eastern Rhode Island and Lewiston at the falls of the Androscoggin in Maine. Many mills which started with water-power have grown so large that steam must now be used.

The leading cotton-manufacturing city in the United States is Fall River, Massachusetts, where the little Fall River tumbles down to the sea, developing enough power to start the first mill. Being at the head of a bay, it can take advantage of ocean transportation for the delivery of cargoes of cotton and of coal, which now drives practically all the machinery of the city, the water-power having long ago become insufficient for the many mills.

Many persons point to the fact that New England, lacking alike food, raw material, and fuel, must, therefore, be unable to compete with other localities. The industries are established with the powerful momentum bred by an early start and the weight of her handicap in fuel is often overestimated. Pennsylvania bituminous coal sold for about $5.00 per ton in New York harbor in 1924, and for slightly less than that in Philadelphia. Virginia Pocahontas, one of the best steam coals in the world, was $4.25 per ton at Hampton Roads and the freight charge from there to New England was eighty cents a ton. The coal handicap of a New England mill on tide-water over one in Philadelphia appears to be little over 1 percent of the total costs, not a very important consideration, and super-power may in the near future create an even greater uniformity of power cost.

The New England textile labor situation is typical of many American industries. The people of New England, after a century's experience as textile workers, are skilled operatives, but the industry no longer depends upon native stock. Within recent decades large numbers of French Canadian workers have come from Quebec to the mill towns of New England to find employment which their own country with its rapidly increasing population lacks. Latterly large numbers of Europeans have come also with the result that Lawrence and other mill towns have many languages.

SOUTHERN COTTON MANUFACTURE. The cotton manufacturing belt of the southern states is located near the fall line which marks the boundary between the Piedmont district and the Atlantic Plain, and also in the Piedmont district, where it has been able to take advantage of many waterfalls. In Alabama it is close to the coal fields. Its nearness to the raw product which is often grown in the immediate vicinity is an advantage shared by no other important cotton-manufacturing district in the world. But owing to the fact that freight rates are usually less on raw than on finished products, this is a questionable advantage for the southern cotton mill when manufacturing for other localities.

It was the cheaper labor that was the chief factor in locating cotton manufacture in the South. The Appalachian Mountain district had a white population, dense in relation to the resources, and therefore with inadequate opportunity for employment, so that wages were much lower than in the North and West. When the cotton mills gave an opportunity for profitable employment these mountain people migrated in large numbers to the mills just as the people of Quebec and Europe migrated to the mills of New England.

In these localities, where agriculture with its low wages had been the only industry, and with an abundant supply of cheap labor, which was and is exclusively white, the cotton manufacture of the South increased with great rapidity. Between 1880 and 1923 the spindles increased from ½ million to 16½ million, and the cotton consumption from less than 200,000 to almost 4 million bales. The mills of New England have actually been surpassed in the amount of cotton consumed, but not in the total value of the product.

The South with its product of coarser cotton sheetings and cloths, a product requiring a large amount of raw material with a small

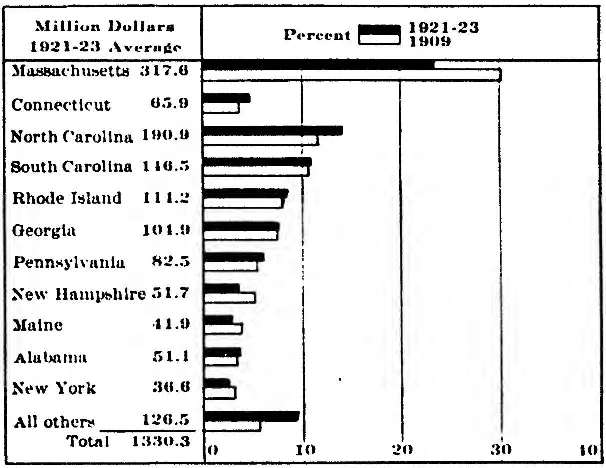


FIG. 204.—Value of United States cotton manufactures, three-year average.

amount of labor, has entered more largely into supplying our exports than has any other district, because coarse uncolored cloth constitutes the chief bulk of our exports. Our best cottons stay at home and our export is consumed in largest quantities in countries where, like China and Africa, the coarse cloth is desired by a poor population. China alone has in some past years taken the greater part of our entire export of cotton goods, and we furnish the scanty raiment (loin cloth, 3 x 10 feet) for some of the tribes of Africa.

COTTON MANUFACTURE IN OTHER SECTIONS OF THE UNITED STATES. Many English textile workers have settled in Philadelphia and their imported skill has made possible the introduction of textile industries that had not previously flourished in America. Philadelphia is the chief center of cotton manufacturing in the Middle

Atlantic States, the leader in the production of tapestries, chenilles and other cotton goods that require skill in coloring. This city also sells machine-made lace, hosiery, and knit goods.

The dependence of the textile industry upon labor more than any or all other factors has caused the amount of cotton manufactured west of the Alleghanies to be very small, and it is not increasing very rapidly.

THE EXTENSION OF COTTON MANUFACTURE. Cotton manufacturing is an industry which many countries are trying to foster by high tariffs. Brazil is an example. Rio Janeiro and São Paulo have large cotton mills with over 1½ million spindles, run by water-power developed where streams come down from the plateau. (São Paulo calls herself the "Electric City.") Cotton weaving has become Brazil's leading manufacturing industry, and, in addition to supplying five-sixths of all the textiles consumed at home, Brazil exports cotton goods to Argentina, Uruguay and Paraguay. A number of small cotton mills are scattered throughout Latin America, as at Lima in Peru, in Venezuela, and in towns on the east edge of the plateau of Mexico. Few of them are very profitable. It is often the case that the cotton factories of new districts are built by capital, equipped with machinery and staffed by foremen from an older cotton district. The mills of Carolina and Georgia are often branch enterprises of New England companies. The mills of Mexico are largely French. A British company owns one of the largest mills of Venezuela at Caracas. The textile industries of Italy and Spain even are largely British property.

The prospects of increased cotton manufacture in the Orient are manyfold greater than in tropic America or Africa. The people of tropic America are too few. The peoples of Africa are too little used to industry, but the half of the human race that lives in eastern and southern Asia has the patient diligence born of centuries of labor, and the density of population makes them welcome factory opportunity. In 1880, India with its millions of cotton wearers took about one-half of England's exports, but since that time the import has declined as a result of the introduction of cotton mills built by English capital, equipped with English machines and directed by English foremen teaching the cheap laborers of India. The mills of India use home-grown cotton almost exclusively, a very small amount being imported from the United States and Egypt. Her exports are now about one-fifth as large as her imports and comprise both cloth and thread sent to China and Japan. There were, in 1922, 285 cotton spinning and weaving mills, which employed 307,000 workers, while cotton employees of the United States numbered 425,000 and those of Britain 537,000.

The example of India is now being duplicated in Japan. With her small amount of arable land and dense population, Japan is of necessity turning to manufacturing. She is now importing raw cotton from Texas, China, and India, and her 5 million spindles are turning out large quantities of the cheaper cotton goods. While Japanese labor is said to be less efficient than the American, the average wage for Japanese textile workers in 1924 was 1.40 yen (70 cents) a day, and the Japanese millhand works a sun-to-sun day with only two holidays a month. Consequently, Japan with her new machinery and cheap labor can manufacture the low-grade cottons to better advantage than can Great Britain or the United States, and is even underselling Britain in India and America in the Philippine market. In 1923 Japan passed the United States in the value of cotton goods exported, and is now second only to the United Kingdom.[15] In fine quality goods she cannot compete with either of the older cotton-making nations, even for the Japanese market. But as Asia uses very little in the way of fine cotton goods, Japan seems likely to become the cotton manufacturer for the whole of the Orient.

China with her coal, her iron ores and her millions of laborers will almost inevitably follow Japan's lead in a general as well as a special sense. Mills at Shanghai are operated by a Japanese company using British machines, American engines, Japanese coal and Japanese foremen. The cotton factory epoch in China is just beginning—the spindles now reported, 2½ million (with 1 million more in process of installation), being less than 5 percent of the British number, but the use of machine goods is rapidly increasing. Small factories are even opening up in the far interior of China to absorb the cotton produced in their vicinity and supply some of the local demand for yarn and cloth. The enormous Chinese resources of coal, iron and labor become profoundly significant when it is remembered that the high value of the raw material permits it

[15] This fact, in combination with the British dependence upon the export of textiles and the stagnation and unemployment in British industry for years following the World War, is ominous for England's future, and emphasizes the previously mentioned peril of the world when we are all dependent upon international trade.

to be taken half way round the world for manufacture and then taken back for consumption.

Cotton and cotton goods in commerce. Cotton, the greatest staple of the world's clothing, gives rise to much commerce. As no important cotton manufacturing country except the United States produces enough raw cotton for its own use, we are sending it to nearly all the manufacturing countries, and even the United States is importing Egyptian and Peruvian cotton because they possess qualities not found in American cottons. As the greatest cotton grower is also a cotton importer, so no city, not even a great cotton-manufacturing center, like Fall River, produces enough varieties of cotton goods for its own use. This gives rise to a commerce in cotton manufactures so widespread that in the stores of almost any town will be found the cotton products of a dozen cities—the cotton duck of the South; the tapestries and knit goods of Philadelphia; the ginghams and dress goods of New England; the thread of Rhode Island; the fine products of Great Britain, Germany, France, and Switzerland. Cotton goods are one of the most universal staples of import. Made in few countries, they are imported by all, whether they are in the stage of breechcloth, sombrero or silk hat. Cottons, indeed, tend to be relatively more important in the breechcloth stage than in any other, comprising, for instance, one-fifth of the imports of Sierra Leone.

3. THE WOOL-MANUFACTURING INDUSTRY

Wool and its qualities. Wool was originally the under coat of the sheep. Many animals have an outer coat of coarse hair with a shorter warmer coat under it. The seal skin of commerce is such an under coat. On the sheep this under coat has the character we call wool and by long breeding and selection, sheep have come to have their chief coat of wool, although this animal also has some hair and in some hot countries it has hair only, like a deer or cow. Wool differs from hair and other fibers in being crinkly or curled, so that it makes an elastic cloth, and also in being covered with minute scales, whereas hair is smooth. These scales overlap each other as do shingles on a roof, and when the natural grease is scoured from the wool, the scales catch each other and hold the wool together as a tangled mass. This quality is utilized in making a matted threadless fabric called felt, produced by beating, shaking and rolling the fibers together. This felting process is also used in making hats, both soft and hard.

Woolen clothing is the best for cold climates because it prevents the escape of heat of the body, permits the moisture of perspiration to pass through and yet does not become wet so easily from rain as do fabrics made of other fibers.

THE PROCESS OF MANUFACTURE. The fleece as it comes from the sheep has impurities which amount to half or three-fourths its total weight. Chief among these is the grease which exudes from the sheep, and serves to make the wool waterproof and also keeps it from felting on the animal's back. Other impurities in wool are dust, sand, burrs, and other seeds of plants, which, in combination with the differing qualities of the wool from many varying breeds of sheep and the differences resulting from food, soil and climate, give wool an almost infinite number of commercial varieties, greatly complicate its manufacture, and make wool buying a highly specialized task. The process of preparing wool for use consists in washing it to get rid of the loose dirt, scouring it to remove the grease, combing and carding it to get rid of other foreign substances and to lay the fibers out straight ready for spinning the yarn for the final weaving into cloth. In its relation to household industry and the industrial revolution, wool manufacturing is like that of cotton and the other textiles, except that it is older and much more widespread. The wool industry has one by-product. The grease, long wasted, is now used for many purposes, including soap, lubrication and oiling leather.

WOOLENS, WORSTEDS AND SHODDY. The term "woolen goods" as used in the trade, includes only those woolen fabrics which do not show upon their surfaces the inter-twining threads of ordinary woven goods. Woolens are woven but the fact is hidden by a process called "fulling" in which the cloth is beaten to give a felting effect and finally the fibers are pulled up by being gently combed with teasles so that the surface has a uniform, smooth, almost furry, appearance. The chief woolen fabrics are broadcloth, cashmere, tweed, blankets, flannels and shawls. "Worsted goods," made of woolen yarns, show upon their surfaces their woven origin and are gaining in popularity over woolens. "Shoddy" is thick, warm cloth made of re-manufactured wool fibers obtained by tearing up tailor's clippings and woolen rags, mixing them with new wools, and weaving all into a warm cheap cloth. The demand of the English shoddy mills for wool rags is so great that they are imported from the United States, Holland, Belgium, France and Germany.

EUROPEAN WOOL MANUFACTURE. Flanders was in the middle ages the great leader in wool manufacturing. The fertile, well-tilled Rhine delta gave a good food supply for a manufacturing people, and canals, rivers, land routes, and sea routes made easy the distribution of the goods produced largely from imported wool, then the staple export of England. The English kings introduced Flemish weavers into England during the eleventh, fourteenth and fifteenth centuries, but for a long time unfinished English woolen cloth went to Flanders to be finished and dyed. This practice seems

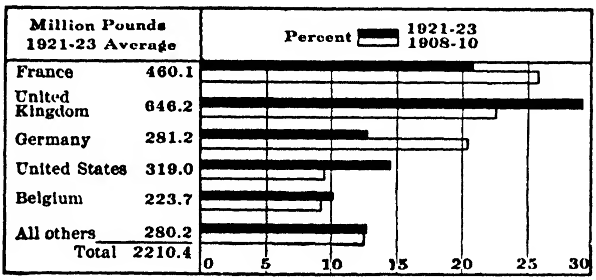


FIG. 205.—World import of raw wool, three-year average.

to have ended about 1650 and England has now surpassed her old teacher, Flanders, in quality of output. English woolen cloths have been much famed during the period since power-driven spinning and weaving machinery has been adapted to woolen manufacture, an occurrence that soon followed their application to cotton manufacture. England, long a wool exporter, now uses seven times as much as she grows, and leads other countries in the excellence of her wool cloth. The towns of Bradford, Leeds, and Huddersfield in Yorkshire, just across a low mountain range from Lancashire, are known wherever fine woolen cloths are bought and sold. The same resources of coal and iron that served the cotton industry have served other industries, and these Yorkshire woolen districts also manufacture some cotton cloth and a wide variety of metal manufactures, for they are also near to iron and to the eastern harbors.

England has been unable to secure such leadership in the world's supply of woolens as has been the case with cottons, nor is the industry so important. It employs about a quarter of a million workers, less than half the number employed in the cotton industry. There is considerable equality in the amount of woolen goods produced in England, the United States, Germany and France, while the rest of the world produces an almost insignificant quantity, but it should be remembered that Britain produces and exports the finest grades of woolen cloths. The explanation of this greater equality in wool than in cotton manufacture is to be found in the fact that wool manufacturing was a worldwide domestic industry. The Industrial Revolution found wool an established industry and merely transformed it. Wherever men made flour, they made wool cloth and the adaptation of primitive water powers to the hand loom was a small change, much smaller than learning how to use a new fiber such as cotton. Cotton manufacturing was thus a new business, resulting from what was the practical discovery of cotton when Whitney's cotton gin made its production cheap. This came after the textile machines were established in England. That country, being in much the best position to manufacture textiles in factories, seized the new raw material and built up a world's trade in cotton, while wool, an industry as old as history, was still being made upon hand looms in millions of farmhouses and in every textile village of Europe and America. With the tenacity which comes of an early start and the hereditary knowledge that lingers in families, wool manufacture has continued wherever, in the cooler parts of Europe and America, there is a population dense enough to develop any extensive manufacture. Upon the continent there is really but one wool district, extending from Vienna to the North Sea and the English Channel, including Paris and Berlin. This takes in the valleys of the Upper Danube, the Elbe, the Rhine, the Seine, and includes the densely peopled manufacturing region of Czechoslovakia, Austria, western Germany, Switzerland, northeastern France, Holland and Belgium. This continental wool industry is newest and most progressive in Germany, which leads the other nations in her deliberate and skillful promotion of industry. Silesia, Saxony and Westphalia, three German coal districts, are important wool centers.

WOOL MANUFACTURE IN THE UNITED STATES. In the United States we see the effects of the colonial importance of the woolen industry, for its manufacture is the most widely scattered of all the textile industries. Small mills, comparable to the rural grist mill and driven by small water wheels on insignificant streams, were established in the last half of the eighteenth and the first half of the nineteenth century over almost all the settled country, and small factories are to be found to-day in every state of the Union, although in many of them the output is insignificant. The large scale manufacture of modern type, with big factories, is concentrated east of the Alleghanies, north of Maryland, in an almost continuous belt reaching from Wilmington, Del., and southeastern Pennsylvania, through northern New Jersey, southeastern New York, and lower New England into southern Maine. These factories, like the modern American wool industry, have largely arisen since 1865. In this concentration of the wool industry, we see

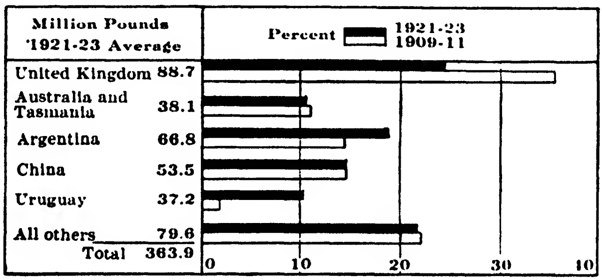


Fig. 206.—United States import of raw wool, three-year average.

another example of the dependence of textile manufacture upon dense population, the valuable wool of Texas, Wyoming, Ohio and distant foreign countries being carried thousands of miles to the place where abundant labor exists to manufacture it.

Philadelphia is the greatest single woolen manufacturing center in the United States, but almost every city of importance in this eastern belt has woolen mills. In the New England towns they are particularly common, especially in Massachusetts, which state leads all other states by producing about one-third of the total output. The two states of Massachusetts and Pennsylvania manufacture nearly half the woolen goods in the United States. In Rhode Island, which is little more than a collection of manufacturing cities, the woolen industry has great concentration, since that tiny state produces more than the whole United States south and west of Pennsylvania.

With the increase of population and capital woolen mills are now beginning to be built west of the Alleghanies. Ohio, the leading western state, with a growing woolen industry in Cleveland, ranked ninth in 1921, but her production was less than 1½ percent of the national output. The eastern mill cities, such as Philadelphia, Providence, Worcester and Lowell, seem likely to retain their supremacy for many years to come.

There has been rapid increase in the woolen industry in the United States since the Civil War, when very heavy protective duties were levied upon its import. In the year 1921 American woolen manufactures were worth nearly $900,000,000, but the raw materials cost over half of that sum. About 500 million pounds of wool were required by American mills; we import from one-third to one-half of what we use. Eighty million pounds of wool are also re-used in making shoddy. The declining importance of wool is indicated by the fact that the woolen mills recently used in one year 46 million pounds of cotton to mix with the wool.

Carpets and hats. Wool is important in carpet manufacture, but only inferior carpets are made of pure wool. The better ones, such as Wilton, Axminster, and even Brussels have a strong web of linen or hemp into which the wool is woven. Philadelphia has long been noted as the great carpet manufacturing center of the United States and although the carpet industry there is steadily growing, the increase of carpet mills in some northeastern cities has caused Philadelphia's share of carpet manufacture to decline from nearly a half to about one-quarter.

Turkish and Persian rugs, the best carpets in the world, come from the oases and villages of the remote interior of Asia. They are the product of pasture and flocks highly condensed by the slow laborious hand labor of a domestic manufacture which, it should be noted, is turning out a better and more highly prized product than the western factories with their mechanically perfect goods. These valuable products are borne by caravan to the larger cities or to the seacoast, where Turkish merchants or the rug buyers from Europe or America bargain for them. Before the war Constantinople was the center of this trade, but now it has been rather widely scattered among various eastern cities.

Hats are classed with wool manufactures, but they are made chiefly by felting rather than weaving, the usual material being the hair of fur-bearing animals, especially rabbits. The fur of the beaver is used for the finer "top" hats. The coats of domesticated hares and rabbits of North France and Belgium were formerly the mainstay of the American hat industry, but in 1923 Australia and New Zealand furnished well over half of the imported skins and fur. This branch of the American woolen industry amounts to over $50,000,000 a year, of which nearly one-half is paid for the furs. Hat manufacturing is chiefly centered in the district between Danbury, Connecticut, and Philadelphia, with New York, Connecticut, and Pennsylvania producing four-fifths of the output.

TRANSPORTATION AND IMPORT OF WOOL. The high value of wool causes the cost of transportation to be but a small percentage of the total cost of the wool bale at the mill, so that the place of production has but little influence upon the place of manufacture. This is even more conspicuous in the case of wool than with the less valuable cotton. Our chief wool-producing districts are west of the Mississippi River. The diverse requirements of different mills give us very scattered sources for our imports.[16] The best wools—known as "Combing" wool—are used for making the finest cloths and are chiefly the product of merino sheep. Our supply of these originates almost entirely in Australasia, Argentina and Uruguay, and the states west of the Mississippi River. The grade called "Clothing" wool, coarser than "Combing" wool, is chiefly home grown and from districts east of the Mississippi River. Of the heavy import of this class England supplies the greater quantity by forwarding from many lands. London is still the world's wool market. A third grade, "Carpet" wool, consists of the coarse, harsh wools produced in countries where breeds of sheep are unim-

[16] UNITED STATES WOOL IMPORTS

	Clothing		*Combing*		*Carpet*	
	Million pounds	Million dollars	Million pounds	Million dollars	Million pounds	Million dollars
Total	30.8	11.4	235.1	89.1	122.4	26.3
England	11.9	5.0	48.4	18.8	22.9	5.4
Argentina	6.1	1.5	55.3	16.2	9.1	1.7
Australia	3.8	1.5	49.4	24.6	......	......
Uruguay	3.0	1.0	35.5	13.6	......	......
British South Africa	......	......	14.1	5.5	......	......
New Zealand	......	......	12.9	3.8	......	......
China	......	......	......	......	51.4	10.6
Scotland	......	......	......	......	10.5	2.2

—From *Commerce and Navigation of the United States* (1923).

proved and the flocks ill-cared for. China, with the product from arid Mongolia, leads in the supply of this grade, largely exported from Tientsin. Other sources of important supply are south Russia, Turkey (both Asiatic and European), and Scotland, where the hardy highland sheep, braving the storms of his mountain heather pasture, produces a coarse wool little used in English manufacture, but well suited to certain American carpet factories. An extreme instance of the tendency of wool to make long journeys is shown by Australasia, the largest wool producer and grower of the best wool in the world. It exports nine-tenths of the wool it grows, sends it half-way round the world to west Europe and the United States, and then buys back, chiefly from Britain, several million dollars worth of woolen manufactures.

THE LIMITATION OF RAW MATERIALS. Wool, like leather, is scarce and becoming more so with small prospect of adequate increase of supply to meet increasing population. Wool is largely a by-product of the meat industry, and the conditions of the wool manufacturing cannot affect the raw material supply so directly as cotton manufacturing can affect its raw material, since cotton is a product grown for its own sake. A 25 percent increase in the price of wool, say from 24 to 30 cents per pound, amounts to 30 or 40 cents increase in income per sheep per year—a factor of small importance. A similar increase in cotton, from 12 to 15 cents per pound, changes the entire basis of the business and causes great and prompt increase of output, for the cotton grown to meet the new demand would be on the market in a year or even less,[17] while the wool resulting from a desire to increase the output would have to await the maturity of animals yet unborn. The cotton and wool industries have, therefore, fared very differently in the past 25 years. While cotton production and manufacture have been going up by leaps and bounds, the production of raw wool throughout the world has increased but little, and has at times remained stationary or even declined. The world's production of wool has remained about 3 billion pounds over the past ten years. As a result, cotton has been substituted for wool in many of its uses. If the process of substituting other fibers for wool does not continue, we are likely to have much higher prices for wool, because of the large amount of land needed to produce it.

[17] Therefore the cotton grower meets wild fluctuations of price and prosperity.

The industrial awakening of China and Japan, and their adoption of western ideas and methods, will increase rather than diminish the world scarcity of wool. They had worked out very efficient and satisfactory clothes of cotton and silk but are foolishly beginning to adopt western clothing.[18] European styles demand wool, and Japan, with practically no wool supply, has increased her import of wool and yarns from about 23 million pounds before the war to over 100 million pounds, and the Japanese woolen mills are increasing in number. China is now exporting most of her small crop of wool because the native styles of clothing can be supplied by cotton and silk, chiefly cotton. The adoption of western styles of clothing by modernized China may be expected to produce a demand for wool in that country.

The woolen industry is one peculiarly subject to the influences of style. As Dame Fashion causes skirts to lengthen and shorten joy and sorrow alternately fly back and forth between the camps of the cloth manufacturer and the hosiery manufacturer. A large part of the woolen cloth is used for external clothing and when the styles in women's dresses suddenly require 6 yards where they previously required 12, it makes dull business and gloom in wool-manufacturing towns of Britain and in the fine wool-growing districts of the southern hemisphere.

4. OTHER WOOLS AND HAIRS

The other animal hair fibers used for fabric seem destined to continue in very secondary place—as the alpaca wool with its resulting fabrics, the camel's hair with its fabric, the Cashmere goat's hair with its fabric. Certain coarse felts are made of cow's hair, but the uses for such fabric are limited and most of the hair that might be obtained is unused.

Mohair is the fleece of the Angora goat, of which four or five are raised as household pets by nearly every family in Asia Minor. Its high silky luster has made it popular in the manufacture of plush for upholstery, and in many woven fabrics, such as are used for men's summer suits. The value of the mohair industry in Tur-

[18] "Foreign style garments are becoming increasingly popular (in Japan), and the vogue for wool has become so infectious that even the traditional kimono is being made up in wool of gossamer-like texture." (*Commerce Monthly*, National Bank of Commerce, March, 1924.)

key attracted other pastoral nations, and in 1848 the first Angora goats were brought to the United States. The Edwards Plateau of Texas is an ideal goat country, offering the necessary features of a rugged country, mild winters, dry atmosphere, good browse for pasturage, and low land values. The United States now produces annually about 7 million pounds of mohair, three-fourths of it grown in Texas.

All of the minor animal substitutes for wool are insignificant in comparison to the greatest substitute of all—cotton.

In the last quarter of the nineteenth century, hair cloth was in vogue especially for furniture covering. It is a smooth, black, shiny, clean, cool fabric made from the manes and tails of horses. Hair cloth still has many uses, but this hair is now chiefly used for mattresses, for which purpose it is curled. The bristly hair of the pig is used for many kinds of brushes and the bristles themselves come in large quantities from China where the patience of the low wage workers prepares them for market. The softer hairs of the badger's coat make shaving brushes and the yet softer camel's hair supplies us with fine paint brushes.

5. SILK

HOW SILK IS PROCURED. Hundreds of species of insects spin cocoons in which to pass the chrysalis period of their lives. One of these insects, a moth, most commonly spoken of as the silkworm, makes a particularly fine cocoon, the fiber of which we call silk. The process of spinning is very similar to that by which the spider makes its web, except that the silkworm winds its thread around and around itself, as a result of which it can be easly unwound if the worm is killed—as it may be by roasting—before it cuts the thread by eating a hole in the end of the cocoon to emerge as an adult moth. The fibers are so fine that five are required for fine thread, and ordinary silk thread has ten to twenty fibers. The cocoons are soaked to loosen the fiber, the ends of several strands are placed together and the several cocoons easily unwound to make the thread of raw silk. This laborious process adds greatly to the cost of silk, which is ever the product of much labor.

The favorite and chief food of the commercial silkworm is the leaf of the white mulberry, a tree which will grow in the tropics and in the temperate zones as far as the grape extends, so that natural conditions for silk production are good in much of Europe, a large part of the United States, as well as some large part of every other continent. The successful prosecution of the industry, however, requires a second crop of leaves upon the tree and this requires a temperature of 54.5° F. for at least three months. Owing to the great amount of labor involved, the distribution of the production of silk, however, depends not upon climatic conditions, but upon the labor supply, which must be both abundant and highly skilled.

THE RAISING OF SILK WORMS. The eggs of the adult moth are carefully collected; and upon hatching, the voracious young worms are kept in a house upon trays which must be kept clean through the weeks during which the greedy worm devours his daily portion

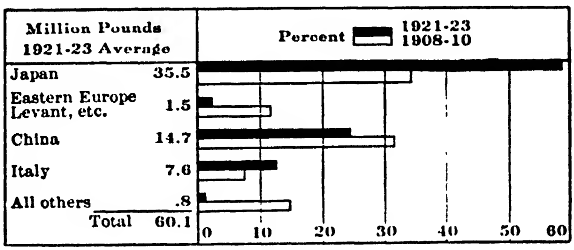


FIG. 207.—Production of raw silk, three-year average.

of fresh mulberry leaves, brought in at daylight, mostly by women and children. The worm can endure less cold than the mulberry tree, so the worms are kept in heated rooms in Europe and also in parts of China and Japan. Humidity and temperature must be closely watched or epidemics may carry the worms to a speedy death. When the worms have reached adult size, they crawl into bundles of straw to spin the cocoons which the women pick out by hand. Throughout the whole life history of this insect and in the preparation of the fiber, the labor must not only be cheap, but careful, patient, watchful, and deft of hand. It thus becomes an industry that thrives where the labor of women and children is cheap, as in the densely peopled parts of the old world. It is easy to understand why the various attempts at silk growing in the United States have failed, despite the many baskets of sample cocoons that have been produced, and despite the great anticipations that accompanied the planting of thousands of mulberry trees which have thriven.

Oriental silk production. The production of silk responds to this labor factor so surely that the industry is readjusting itself in accordance with it. The forcible opening up of China, the modernizing of Japan, and the resulting development of transport facilities have opened the silk growers of the world to the Oriental competition. France and Italy have been growing silk for centuries, the governments are aiding the silk industry all they can, but their silk growers feel Oriental competition and the output has begun to decline, the European crop in 1906–07 averaging 12.8 million pounds and that of 1922–23, 8.2 million pounds. During this period, the Oriental exports increased from 28 million to 55 million pounds per year. Perhaps the greatest silk-producing region is China, although we have no accurate statistics of the amount used by the Chinese themselves. It is a household industry of the peasants centered between 30° and 35° north latitude. This corresponds roughly to the Yangtze Valley, a region whose silk output makes its metropolis, Shanghai, one of the world's great silk markets. Canton in south China is also a considerable silk center with many silk filatures employing 500 persons each. In Yunnan, southwest China, there is a school of sericulture spreading the knowledge of silk production so that the people may have a substitute crop for the forbidden opium which has been so important there. In various parts of the country, several wild moths produce a marketable kind of silk, so that one-fifth of the Chinese silk is known as wild silk. With the silk industry more scientifically and systematically organized, there is almost no limit to the amount of raw silk China could produce.

Japanese silk production. The greatest silk-exporting country is Japan, and this people, being more forward than the Chinese in the use of scientific devices, adopted filatures, or machines for unwinding the cocoons and preparing the raw silk of commerce. The Japanese silk export has increased more rapidly, therefore, than the Chinese export, with the result that the Chinese are now adopting the new method of preparing it.

Silk is particularly suited to the conditions that prevail in Japan. The monsoon rains of summer give the moisture needed to make the mulberry trees yield abundant growth of leaves. The small proportion (less than a sixth) of the land that can be cultivated leaves abundant room on the hillside for the mulberry trees and the overcrowded population furnishes the labor. It is natural, therefore, that this opportunity should, in a land of scanty raw materials, be eagerly seized upon, as shown by a 50 percent increase in the export of raw silk within 10 years, 1912–1922. The Japanese export of silk is now more than double the entire world production of silk (domestic consumption of the Orient excluded) of 40 years ago.

Early attempts at introducing silk culture in India have led to a considerable production for local use, but the export has never been important nor does it under present conditions promise to be, either in India or in any of the minor producing regions of southern Asia (especially Syria) and Asia Minor. A little silk is produced for home use, but the labor conditions are not equal to those of the Orient.

THE COMMERCE IN SILK AND ITS PRODUCTION IN EUROPE. For centuries silk was the mainstay of commerce between the Far East and the Mediterranean world, and the Chinese jealously prevented the export of silk moth's eggs. However, according to legend, an enterprising traveler finally broke the embargo and carried some away in a hollow bamboo walking stick, so that in the sixth century A. D., the growth of silkworms became common in Greece, southern Italy, and Spain. In all of these districts the amount produced is now negligible, because the small amount of arable land is given over to crops with a richer harvest than mulberry leaves. But silk has become very important in northern Italy where, upon the level plains of the Po, nine-tenths of the European crop is produced. Here a traveler may never see an open field for miles, because of the rows of mulberry trees, bare in early summer, because leaves have been stripped for the silkworms during their seven weeks of rapid growth in the springtime. The intensity of Italian agriculture is attested by the fact that while wheat and other grains are grown between these rows of mulberry trees, the trees themselves are so trimmed that each tree holds out its two branches as arms to its neighbors and upon these outstretched arms grape vines are often trained. Thus three crops are obtained from the same land.

During the medieval prosperity of the Italian city republics, Bologna, Lucca, and other cities of north Italy were famed for their silk manufactures, and in 1515, when Francis the First of France conquered Milan, he introduced Italian silk workers into France. They established the silk-manufacturing industry at Lyons and the cultivation of silk in the valley of the Rhone. For a long time it was more important here than in Italy, but the greater density of Italian population in the Po Valley in recent decades has given that district the leadership in European silk production.

PASTEUR AND THE SILKWORM DISEASE. Silkworm production affords a fine example of the dependence of industry upon science. In 1853 a silkworm disease appeared in the Rhone Valley and threatened the silk industry of the world, as the phylloxera later did the grape industry. The French scientist, Pasteur, at the order of the French government, investigated the silkworm disease and found that, by the use of the microscope, he could detect the healthy insects. Only the healthy were permitted to lay eggs and thus a sound generation of worms was produced. The French silk industry, which had declined 90 percent between 1853 and 1876, again steadily increased for thirty years.

COMPARISON OF TRANSPORTATION AND LABOR FACTORS. Since the transportation cost is unimportant in silk production, labor is the determining factor in locating the business. The peasant who produces $6.00 worth of wheat must deal with the problem of paying freight on 360 pounds of freight, more or less. If he produces $6.00 worth of raw silk he has to pay freight on only 1 pound. A freight rate of 3 cents per pound is one-half of 1 percent on the silk and the same freight is 180 percent on wheat valuation. The freight is, therefore, an almost negligible factor in sending silk half-way around the world from the place with the most desirable conditions for the production of raw silk to the place with the most desirable conditions for its manufacture. It is easy to understand why the United States, the country with the greatest silk manufacture, does not produce a bale of the raw material.

SILK MANUFACTURE IN FOREIGN COUNTRIES. Silk fabrics have long been more largely used in China and Japan than in any other part of the world. Some of the hand-made fabrics are of most excellent quality, but, owing to the relative superiority of Chinese and Japanese in the production of raw silk, and to the influence of western tariffs, the oriental exports of fabrics have been limited to small amounts, and they are chiefly of the inferior goods made by the newly introduced western machinery. During the nineteenth century, France has been the great leader among the nations of the world in the manufacture of silk, the center of the industry being in Lyons, in the raw silk-producing section. The Jacquard loom which was invented there early in the nineteenth century produced figured brocades of great beauty and excellence, and French brocades became famous wherever ladies dressed in Parisian style. Toward the end of the nineteenth century, the ease of sewing made possible by sewing machines and the rapid communication established by mail and telegraph, caused fashion in ladies' dressing to change so rapidly that a valuable French brocade which would last for years would long outlast the style. Hence, the preference was for less expensive, less durable, but equally beautiful fabrics. These the Germans and the Swiss, with their policy of pleasing their foreign customers, promptly supplied. The prosperity of Lyons waned and it took years of depression to convince the manufacturers of that city that their silks were too good for the market. Lyons has again become the leading silk center of Europe, however, with

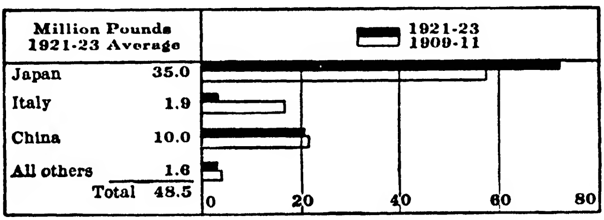


FIG. 208.—United States imports of raw silk, three-year average.

an output valued at $126,000,000 in 1921, and her looms are famous now for producing new and exquisite weaves to suit the ever-changing whims of fashion.

The Swiss silk manufacturers are scattered through many towns, but Zurich is the chief center of the manufacture of cloth. Near Basel, just across the Swiss boundary in Germany, is a great ribbon-manufacturing center with the largest ribbon mill in the world. The German silk industry is like many other industries of that country, rapidly increasing and availing itself of the teachings of science.

BRITISH SILK INDUSTRY. The silk industry in England is peculiarly unimportant for a nation so great in textile manufacture. England's early lead in cotton was duplicated by the similar early success of France in silk manufacture, which enabled the mills of that country to compete with those of England even in their own market. Of late years there has been some manufacture of cheap silk goods in the cotton and wool districts of England, but the best silk goods used in England are imported, and the total number of silk employees is only about one-third as great as that in the United States.

SILK MANUFACTURE IN THE UNITED STATES. This country leads the world in silk manufacture, which has increased with great rapidity from an output of $12,000,000 in 1870 to $103,000,000 in 1905 and $668,000,000 in 1919. One-third of the total value of our silk production is expended for the raw silk, which has risen in price during the last decade from about $3.50 to over $8.00 per pound. Two-thirds of our raw material comes from Japan, while China furnishes one-fifth and Italy one-twelfth. In addition to our own production we are both importers and exporters of various special silk fabrics.

The rapid rise of the American silk industry is quite typical of our national industrial development, being due largely to a protective tariff and to the rapidly rising standard of living in this country. In Europe silk fabrics have always been regarded as a luxury for the well-to-do. Silk is a luxury here too but we are rich enough for it to be enjoyed by the masses of the people. The industry is established on a basis of quantity production and every device that permits the cheapening of silk goods places them within the reach of an ever-widening circle of purchasers. There is every prospect of a continued increase in the American silk industry, for every general increase in purchasing power places more people in a position to use this attractive fabric.

RELATION OF SILK MANUFACTURE TO OTHER INDUSTRIES. Silk manufacture is comparatively light work, and the percentage of women operatives in the silk mills is higher than in any other branch of textiles. This predominance of women gives the silk mill a tendency to be what is sometimes called a "parasitic industry"; that is, it is located because of the presence of other industries which employ large numbers of men, so that the wives and daughters of the workmen make a labor supply which encourages the starting of silk mills. Paterson, N. J., an important place for the manufacture of various classes of iron goods, which employ large numbers of men, has for this reason long been the most important silk-manufacturing town in the United States, having produced over a quarter of the total silk product in 1890 and about a fifth in 1921. This relation of the silk to heavy industries is well shown in Pennsylvania, where the silk mills are located chiefly in and near the coal-mining towns, especially Scranton and Wilkes-Barre, and the cement-manufacturing towns of Allentown and Easton in the Lehigh Valley, and in the agricultural implement-manufacturing town of York, and more recently in the coal and iron region of western Pennsylvania. Silk manufacture has also made some headway in southern New England and in New York, but Pennsylvania and New Jersey each manufacture about one-third of the total. Thus it is seen that the industry is thoroughly concentrated in a rather limited industrial area.

ARTIFICIAL SILK. The silkworm's job is in danger. Man has entered into active competition with the silkworm, and although the worm has the advantage of several million generations of previous practice in the art of silk-making, man is rapidly catching up. Artificial silk is the most recent addition to the world's important textile fibers. The silkworm makes silk by drawing the fine threads from a jelly-like mass of cellulose in its head. This material is made from the cells in the worm's vegetable food, as changed by the chemistry of its body. Man has copied the worm's process. By the chemistry of the laboratory, sawdust or cotton waste may be converted into a jelly much like that from which the caterpillar makes its silk. By air pressure this cellulose is driven through very small apertures in glass. Each aperture makes filaments so small that, as with silk, it takes ten to twenty of them reeled together to make a thread.

Count Chardonnet, a Frenchman, after many years of investigation obtained the first artificial silk fiber in 1884. For many years it was considered nothing more than an interesting curiosity. By further experiment the early difficulties of weaving and dyeing were overcome, and artificial silk was finally recognized as a satisfactory raw material and in a class with the other vegetable and animal fibers. There is no direct competition between natural silk and the synthetic product. The high luster of artificial silk, generally superior to that of the real silk, and its lower price have enabled it to fill a place of its own between mercerized cotton and the natural silk fabrics. Its greatest use has been in the knit goods industry. Not only hosiery, sweaters, scarfs, ties and similar products, but even knit dress fabrics have been made from it. Its chief use for weaving is in combination with wool, cotton or silk. Hosiery constitutes its largest textile use. This successful commercial use of a purely chemical fiber represents a triumph for the man of the laboratory, of which we should have many more in the future.

The world production of artificial silk has had a striking increase in the last twenty years from 4.4 million pounds in 1902 to 80 million pounds in 1922. First made in France, it spread to Germany, Switzerland, England and finally to the United States. As late as 1913 our production of the new material amounted to only 1½ million pounds, but urged on by the high price of natural silk, its manufacture has increased with suggestive speed to over 35 million pounds in 1923, as compared to an import of natural silk amounting to 50 million pounds. The total world production of artificial silk now exceeds that of the silkworm product, which amounted to about 70 million pounds in 1923.

The possibilities of fiber silk are by no means all discovered, and chemists are still improving it. It should be noted that this fiber, still in its infancy, is made chiefly from cotton or wood pulp, both abundant raw materials. The United States, with its wealth of materials and mechanical advantages, can easily lead in developing not only fiber silk, but other new materials from synthetic sources. Man is no longer dependent only on what he can pick up in the plant or animal kingdoms, but is learning to alter their materials to suit his needs.

6. THE PLANT STALK FIBERS

Machinery has revolutionized the textile industry by giving it new ways to produce its old results. It has revolutionized it also by giving the new seed fiber, cotton, in place of the stalk fiber, linen, and it may cause further revolution by enabling us to use other cheap stalk fibers. Several thousand plants contain fibers of good quality for textile use if they could be secured in cheap abundance, and several dozen such fibers are actually in extensive use in various parts of the world. There is no guarantee of the continuance of cotton's leadership in plant fibers, as some stalk fiber cheapened by machinery may some day supplant it.

FLAX AND ITS PREPARATION. Flax is now, as in the past, the most important plant stalk fiber entering into our clothing. This plant, a member of the nettle family, has been yielding linen since the pre-historic lake dwellers inhabited the Swiss lakes, and the mummies, bound up in linen cloth, were placed in the Egyptian tombs four or five thousand years ago. Before the invention of the cotton gin, the common stinging nettle was much used in Europe as a substitute for flax. In 1790 when cotton was less used in manufacture than China grass or ramie is now, flax was the most important of all vegetable fibers. It was grown on almost every European and American farm, and in many an old American home the implements for the preparation of flax are still to be found. The introduction of cheap cotton caused the disappearance of flax from gardens at about the time that the spinning wheel and the hand loom disappeared from homes.

The plant is somewhat branching, but otherwise resembles the small cereals in appearance and method of cultivation. For fiber it must be pulled, piled up to dry, and the seed removed with an iron comb; then the straw is "retted,"—a process of partial decay to make easy the separation of fiber. In some places it is retted in bunches, spread upon the ground of moist meadows; in others, as in Ireland, it is immersed in water. In Belgium, where a small flax industry still survives, the water of the river Lys is of peculiar fitness in retting flax, and in it the straw is immersed for a few days' time, then dried, subjected to two more wettings, during which it decomposes and is ready for the "breaking." This is accomplished by running the straw through rollers, after which the separation of the fiber is accomplished, sometimes by hand, sometimes by running the straw through a machine with dull knives. Fibers thus obtained are from 8 to 50 inches in length, strong and durable, but since the coming of cotton, the labor of getting it out of the stalk has made its production impracticable wherever wages are high and import of commercial products easy.

Flax is unquestionably superior to cotton for many uses, but from the standpoint of competition on the point of cost, it rests under yet other handicaps. Although flax grows in a far wider range of climate than cotton, it is much more easily injured by drought or wet weather and the difficulty of preparing it gives lack of uniformity, a serious handicap to the manufacturer. The fiber is harder than cotton to manufacture, requiring more power and more labor. Machinery has increased the linen spinner's efficiency only about one-half as much as it has the cotton spinner's efficiency.

Distribution of flax. The flax plant has an exceedingly wide range, having produced good fiber all over the eastern United States and in Europe from Algeria, Italy, and Yugoslavia to Scotland, Sweden and Russia. The cultivation of the flax plant for its fiber, like silk culture, shows a decided response to labor conditions—

density of population. In sparsely peopled countries like Dakota and the Argentine the laborious hand processes of harvesting and preparing flax are impossible, but they fit well into the scanty opportunities of the small cold Baltic countries or of north Russia, where the Archangel district produces most of the flax fiber. The post-war chaos in Russia has interfered greatly with flax production, the export falling from 600,000 tons before the World War, to 20,000 tons in 1922. Considerable flax is now grown in part of the former Russian territory—Lithuania, Latvia and Esthonia, and Poland has now become the second largest flax-producer in the world. Belgium, France and Czechoslovakia are also flax growers.

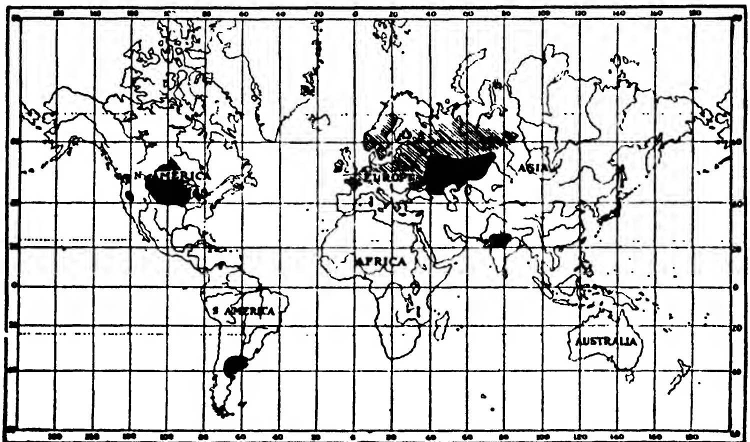
THE LINEN INDUSTRY. The manufacture of flax into linen is particularly important in the United Kingdom. The north of Ireland (especially near Belfast) and the south of Scotland, which a century ago grew flax and manufactured it in hand looms, now are the centers of the world's finest factory-operated linen manufactures, employing in good times 100,000 people. This location of the linen industry is an excellent illustration of the influence of an early start. Belfast gets most of its flax fiber from Belgium, from the small Baltic countries, and from Russia, which before the war was the chief dependence of the linen makers. Linen from the Belfast looms is exported all over the world where fine fabrics are appreciated, the United States taking the largest share.

In Germany the linen manufactures of Westphalia are famed, as are also those of Bohemia and Belgium, while certain grades of linen are made in the textile region of northern France. One of the surprises of the post-war readjustment has been a greatly increased manufacture of linen in Japan, which is now growing more fiber flax than Ireland. Japan has even sold her linen in London, in competition with the looms of Belfast.

Linen manufacture has thus far been exotic in the United States, and is of small amount, but a fraction of the import, which amounted to about $25,000,000 in 1923. We do not produce the finest grades of cloth nor the thread from which we produce the small amount of cloth now made.

Collar and cuff manufacturing is one of the most important American industries using linen, and this branch of manufacture shows a most astonishing concentration in the city of Troy, New York, where nine-tenths of the entire product of the United States is made. This concentration is best explained by the fact that, if a new collar and cuff factory is to be established, the best place in which to find labor already trained for the work is in the city of Troy.[19] This is one of the several good reasons why industries tend to stay in centers. See Keir, R. M., *Manufacturing Industries.*

SEED FLAX. While the fiber is produced chiefly in Europe, seed flax is grown in several of the important wheat regions, as Argentina (one-half of the world's crop), Central Russia, the spring wheat



Cultivated primarily for seed production: straw not used for fiber except to limited extent in Russia and Siberia.

Cultivated primarily for fiber; straw used for fiber and seed for oil, except in Ireland where seed is usually not saved.

FIG. 209.—Distribution of flax in cultivation. (Original by Lyster Dewey.)

belt in the United States and Canada, and northern India.[20] In all these districts, with a total crop of 112 million bushels (1923–24), flax is, from the agricultural standpoint, not a fiber but a cereal

[19] One hundred years ago the wife of a Troy shoemaker, weary of washing many shirts each week, rebelled one blue Monday, seized a pair of shears and removed a soiled collar from a comparatively clean shirt. Thus the first detachable collar made its appearance. A retired Methodist minister followed this innovation by having collars made to sell separately from shirts; Troy now sells detachable collars to the value of more than $40,000,000 annually, and is planning to celebrate in 1927 the centenary of the collar industry.

[20] The fact that flax can be grown in the winter on the same land that grows the Egyptian cotton crop has caused the Egyptian government to encourage this industry, which will in a sense be new for Egypt, though in a sense it is very old, for they wrapped their mummies in fine linen when the ancestors of all the rest of us wore we do not know what, nor where, nor how.

planted like wheat, harvested with the most improved reaping machinery, threshed by steam, and handled in every respect like wheat with no thought of saving the fiber that is in the straw. The only significant increase in flax growing since the war has been seed flax in Argentina, where the crop has doubled. The two Dakotas and Minnesota grow most of the United States crop of 17 million bushels (1923).

The seed, upon being crushed, yields linseed oil, much used as a raw material for the paint and varnish factories of Philadelphia and other eastern American cities. The "oil-cake" that remains is highly valued as food for live stock, and is shipped from Dakota by way of New York, Montreal, Boston, and Philadelphia to feed the herds of dairy cows in Holland, Denmark, and England.

A POSSIBLE TEXTILE REVOLUTION. The textile industry is constantly hoping for new and better fibers or cheaper processes of using the fibers we now have. Inventors are striving for two goals, either of which may make a revolution resembling that of the cotton gin. One is a successful cotton picker that will do away with much of the laborious hand work, and enable cotton to be sold at a much lower price than that which is yet expensively picked by human fingers. The second is a machine or process that will enable man to get the fiber from flax more quickly and cheaply. The success of the cotton picking machine and the flax decorticator, if both should come into use, will enable mankind to reap the benefit of the great industrial race to the fabric market—a cheapened clothing supply. If plant breeders set themselves to the task there is good reason to think that varieties of flax can be produced capable of yielding both seed and fiber.

The popular summer fabric called Palm Beach cloth is made of fiber that grows wild on a very common tropic tree called the Ceiba. This fact is very suggestive, especially in view of the further fact that apparently nothing has been done either to improve the yielding qualities of the tree or even to adopt the common horticultural practice of propagating the best.

RAMIE, one of the best of the Oriental plant fibers, is much used as a substitute for linen. Ramie and China grass are the same thing at two different stages of manufacture, China grass being the name for the rough brown fibers, which are called ramie when bleached out. The fibers are very strong, ramie having the longest individual cells of any fiber plant. When woven the cloth is fuzzy in appearance, and when properly dyed it holds colors well. It makes excellent embroidery and bobbin lace.

Ramie thrives best in temperate climates where the danger of frost is at a minimum. It is grown all through central China, and Swatow prepares more ramie for market than any other city. The de-gumming process is not difficult and the Japanese in Taiwan have in operation a successful decorticator. Ramie is spun in Japanese linen mills, and there are in addition some successful ramie mills. In the Orient ramie is in wide use, and it has possibilities of becoming a flax substitute and possibly to some extent a cotton substitute in the western world.

Hemp. Hemp, the fiber of common cordage, is closely allied to flax, of which it is really but a coarser variety and therefore fitted for coarser uses. It is used in almost every rope factory in the United States and Europe. The fiber is separated from the stalk by processes similar to those used in flax preparation. The bulk of the world's commercial hemp came from the flax districts of south Russia before the war. Italy produces the highest priced hemp fiber, which is imported into the United States for commercial twine, coarse toweling, and carpet yarns. American hemp has for a long time had a declining output due to the competition of cheaper labor in other hemp-growing countries, but especially, through the competition of cheap jute. A little hemp is still grown in Wisconsin, California, and Kentucky.

Several fibers rendering service similar to that of hemp have, upon their appearance in the world market, been called hemp regardless of their origin. Among these are sunn hemp and deccan hemp, much used in India. Both are fibers from the inner bark of plants.

Jute. Practically all the world's supply of jute, the cheapest fiber in general use, comes from the Ganges Valley. In northern and eastern Bengal near Calcutta, along the overflowing Ganges, there is the right combination of tropical climate, flooded land, and abundant labor to make a crop of this tropic plant. While adapted to all soils, most of the product is grown on the overflow land near rivers because the plants easily stand flooding. Like flax, hemp, and many other fibers that are not gummy, it is separated from the stalk by being soaked in water. After the bark is stripped off by hand, the plant tissue is washed away by beating the plant upon the surface of the water in which the laborer stands.

Jute has been long used in India where common gunny sack was first produced by hand looms. In 1835 the manufacture was taken up in Dundee, Scotland. The origin of the industry in that city is an interesting example of the chance location of industries. In the eighteenth century epoch of hand-loom textiles the vicinity of Dundee was famed for good flax which its people made into linen. After the removal of the source of flax supply to Russia, the Dundee weavers began to import and manufacture sunn from India, and with it the other Indian fiber, jute, which bore the same relation to hemp that hemp did to flax. As a result, Dundee established a jute industry in which it had for a long time a monopoly of the entire western world. By way of Liverpool and London, it exported and yet exports large quantities of gunny sacks, the cheapest of all strong fabrics—to America for the shipment of wheat and corn and the covering of cotton bales; to Brazil for coffee sacks, to Argentina for wheat sacks; and to Australia for wool bales. During the latter part of the nineteenth century, jute mills were established in other linen manufacturing centers of the United Kingdom, on the continent, in Calcutta itself, and also in Boston and Philadelphia. The manufacture of jute products is one of India's two leading manufactures, and Calcutta is still its greatest center. The total exports of finished jute products in 1922 amounted to over $106,000,000, while raw jute brought in $64,000,000 more—a very great addition to the wealth of India. The jute mills of India employ 290,000 workers.

Jute is used to some extent in the carpet mills of Philadelphia and many other cities. We are importing from 60,000 to 125,000 tons of it per year and it costs from 4 to 5 cents a pound delivered in America.

ABACÁ (MANILA HEMP). This best of rope materials is not hemp at all, but a coarse fiber sometimes eight to ten feet long, found in the pithy stalk of the abacá, a fruitless member of the banana family. This plant is cultivated only in the Philippines. It thrives best on the slopes of volcanic hills in a moist climate, and it will not do well in water-soaked or very dry soil. Its culture is easy, but a long drought is fatal to the plant. This plant conspires with the climate to keep the Filipino from steady work. Man does not usually like to work regularly and it is often not necessary in the productive climate in which fortune has placed the Filipino. He can from time to time plant a few suckers of the abacá plant, and in two or three years he can cut them down, split them into strips a couple of inches wide, scrape away the pulp with a sharp knife and sell the long, white, shiny fiber to traveling Chinese merchants, who gather it up and take it to Manila. They pay sufficient cash to meet the small financial needs of the tropic family for a few days or weeks until pressing need makes it desirable to scrape a little more fiber. Scraping thirteen pounds of good fiber is a day's work for a man.

Attempts at introducing Manila hemp growing into other parts of the world have thus far failed (save a little of poor quality in the Dutch East Indies), and it is practically a monopoly of the Philippines, where there is a great abundance of admirable, unused abacá land. Second only to sugar in its export value, the fiber is shipped in large quantities from Manila to London, Liverpool, New York, Philadelphia, and San Francisco. It makes the strongest of rope, which is especially prized in the rigging of ships, and when worn out for this use it is ground up to make the exceedingly strong paper known as Manila. It is also much used for the manufacture of twine used in binding up the bundles of wheat in self-binding reapers, for which purpose approximately $20,000,000 a year are expended in the United States for twine made of Manila hemp, and of its cheaper rival, the sisal or henequen, which is the great money crop of Yucatan.

HENEQUEN (SISAL). The rise of the henequen or sisal industry, which with a few insignificant exceptions belongs at present solely to Mexico, came about when the self-binding reaper caused a new demand for cheap string about 1880. This article of commerce was obtained from the long, tough fiber in the thick heavy leaves of the henequen plant, which grows wild over much of the dry limestone plain of Yucatan near Progreso. Henequen-growing on a commercial scale soon became a capitalistic enterprise, the plants being set out three by ten feet apart in hand-made holes in the unplowable rocky soil by Maya laborers. Rival vegetation is chopped down with a machete until the plants are grown. After this they yield 10 to 15 leaves every six months for 10 to 20 years. Tramways carry the heavy leaves to engine-driven machines that tear out the 3 percent (by weight) of fiber, which is then dried and pressed into 35-pound bales for shipment. In a few decades Yucatan has become the commercial slave of henequen, just as our South once was of cotton, this one product making up 95 to 98 percent of the export of Yucatan. This one money crop buys much of the food, even corn in considerable quantities being imported.

Every shred of the henequen fiber (called sisal) is exported and virtually all of it is consumed by manufacturers of binder twine in the United States and Canada. Sisal does not make as good twine as Manila hemp, but it is good enough and usually cheaper. Therefore, four-fifths of the binder twine used by the American and Canadian grain growers is made out of Yucatan sisal. During the

FIG. 210.—Cutting henequen leaves to extract sisal fiber. Yucatan. (United States Dept. Agr.)

World War, when there were no ships to bring the rival hemp from Manila the henequen dealers and the State Government formed a trust and reaped a golden harvest by getting more than war profits.[21] The State and Federal governments took heavy export taxes, over four cents American gold per pound. The post-war slump was shown by exports of 930,000 bales in 1920, and 460,000 bales in 1922. The price of sisal to-day is much lower than during the war—low enough just to avoid the active competition of Manila hemp—

[21] When the trust was established in 1915 sisal was selling for 3¼ cents per pound; in July, 1916, the price had been forced up to 10½ cents; in January, 1917, the trust demanded and received 16½ cents per pound.

and at present it seems to be secure from rivals. Good sisal can be, and is grown, in Africa, India, Santo Domingo and various other places over the globe, for it can endure much drought. Cuba and Jamaica have the most promising rival henequen plantations at the present time.

COCOANUT FIBER. The cocoanut, widely distributed along the tropic seashore, contributes to commerce the well-known hard-shelled nut, the dried cocoanut meat known as copra, and lastly the coir fiber, a part of the thick and spongy husk which protects the nut from bursting when it falls from its great height to the ground. By soaking the husk in water, the pithy packing between the fibers can be washed out by hand or by machinery, leaving the stiff fibers which are used for making brushes and ropes very durable in sea water, and the coarse, strong cocoa matting so often used upon the floors of public buildings.

MATTING. The ordinary matting used as floor covering practically all comes from Japan and China. It is also a native product of the adjacent Tonkin or French Indo China. The farmers grow a special kind of straw for the manufacture of this characteristic tropic floor covering.

7. CLOTHING

SIMILAR DEVELOPMENT OF THE TEXTILE AND CLOTHING INDUSTRIES. At the end of a century and a quarter of machine manufacture and world commerce, the making of clothing passed through an evolution similar to that which has occurred in the textile industries. The cloth was at first made in the homes of the workers from materials which were given out on contract. Later the whole work was done in the large factory with the aid of machinery. Some clothing is now made by the old domestic system, some on contract in the homes of the workers, and some in factories and shops with the factory-made product gaining on the others.

The supplying of sailor's clothing was the start of the ready-made clothing industry. In 1850 the sewing machine opened great possibilities, which led to the widespread establishment of the industry in 1861–65, when the Civil War demanded ready-made clothing for millions of absent men. In the latter quarter of the nineteenth century, the industry spread and located itself in the great cities. Great abuses arose through the "sweat shop," home work in crowded tenements, often at very low wages. In recent years legislation, aided by the invention of factory machinery, has partly broken up the "sweat shop" system and factories now make clothing more cheaply than can the most diligent workers toiling in their own homes at any fair wage. The first decade of this century was, as a consequence, a period of rapid increase in the manufacture of men's and women's ready-made clothing in factories rather than in sweat shops. In the sweat shop five persons usually work on a coat, each doing a particular part. In some of the great factories, as many as a hundred persons work on each coat, and the total amount of time required to produce a given output has been re-

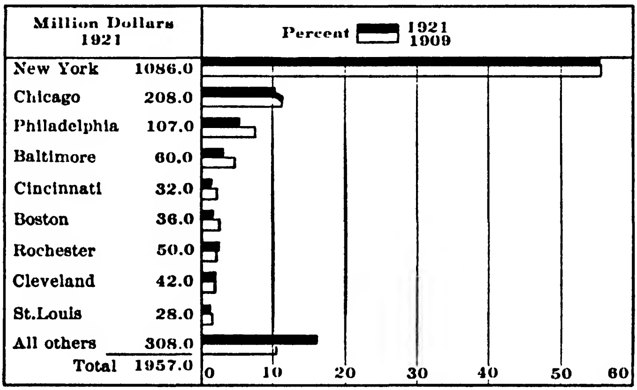


Fig. 211.—United States clothing manufacture by cities.

duced to one-third or even to one-tenth of that required before the introduction of the greater division of labor, new cutting machines, and the electric-driven sewing machines.

Why it is a city industry. Clothing manufacture belongs to large cities because of the double advantage of nearness to labor and to market. It is an advantage to be near the center where the product is sold, and the successful selling of ready-made clothing requires a market where vast numbers of persons are supplied, so that, by the law of averages, all of each of the many sizes of clothing may be called for. As the market widens it permits the finer and finer subdivision of the sizes, and the greater possibility of an exact fit for each person. The large city also possesses the labor which is so large a factor in this industry in which the transport of the raw material is so easy. The manufacture of clothing is concentrated to an astonishing but declining degree in the city of New York, the greatest distributing center of the United States, where it is the leading industry, with an output valued at over a billion dollars per year and equal to that of all the other cities of the country. Chicago is second, Philadelphia third, Baltimore fourth, Rochester fifth, Cleveland sixth, and Boston and Cincinnati next in order. This great predominance of New York grew up in large part because of the unusual labor condition that exists because it is the chief place for the landing of the new immigrant. Tens of thousands of these people know nothing of the language and little of the country, and they are accustomed to low wages and inexpensive standards of life. The clothing factory, where each person does a small operation, offers these helpless ones an opportunity to acquire in a few days the skill to make a better wage than they had in Europe, so they herd together in the cities. In one block on Broadway, New York, covered with twelve-story structures, 40,000 people were engaged in manufacture, largely clothing, in 1910. No other city block in the world could rival this as a human hive but it is no cause for pride. The industry in all the American centers is usually carried on by foreign-born persons newly arrived in this country.

The standardizing of clothing is steadily advancing and with it new additions to the list of manufactured articles. Thus the small tailor is suffering from the competition of the great factory through the competition of made-to-measure mail-order business. By this innovation, a country merchant in Texas shows a book of samples to a customer, measures him, and the suit is made in a New York, Rochester, or Chicago factory.

There appears to be no reason why standardized clothing, like shirts, overalls, etc., could not be made to better advantage in small country towns where comfortable and wholesome living is cheaper than in the big city. Some such development seems to be starting in southeastern Pennsylvania.

CLOTHING MANUFACTURE IN THE OLD WORLD. The use of ready-made clothing is less general in Europe than America, chiefly because the lower wages make it less necessary to use machinery. London occupies a position similar to that of New York, and the work is there done in the poorer or eastern end of that city by newly arrived immigrants of the same races of people who do the work in New York and Chicago. The only difference to point out in London and the large Continental cities is the greater proportion of sweat shops and the smaller proportion of factory workers as compared to American cities. But factory-made clothing is steadily advancing, as evidenced by the opening of a factory in Barcelona, Spain, with 1,600 workers, using American sewing machines electrically driven.

The increase in the use of ready-made clothing seems certain to continue, for it is attacking the market at the bottom and at the top. The people of Jerusalem, Constantinople, and Quito are reported as purchasing cheap hats, coats, and working clothes of European manufacture—Austrian, German, British, French. At the other end of the market is the well-known American advance in the quality and sale of factory-made clothes.

Manufacturing of clothing is increasing in the wool-manufacturing cities of Yorkshire. Factories here export the product to the British colonies and also make up clothing upon the specifications of tailors living in other localities. The people of Guatemala, for example, find that they can get suits made to measure in England and delivered by parcels post for only $2 more than it costs at home.

It is interesting to note that as Japan's industrial evolution advances along Western lines, a factory-made clothing industry begins to develop there also.

THE FASHION INDUSTRY. Paris, famed as an art center, and visited by thousands of moneyed people from all over the globe, has developed a specialized type of clothing manufacture which utilizes both the artistic qualities of the French, and its own fame as the world's pleasure capital. Thousands of men and women earn their living by fashion alone and all over France there are workers to feed the capital with material for what is in reality a national industry. Dress may be a frivolous pastime to the society woman but to France it is a serious business. In the hands of Paris dressmakers and costumers whose names are known to the wealthy in every land, the silks and fine linens from the French looms are cut and draped into ladies' gowns, new, beautiful and costly. The cunning touch of artist-milliners evolves Paris hats, supposedly more stylish and desirable than English or American hats. The magic word "Paris" on ladies' clothing has come to imply both excellence and the latest style. In 1922 France's three most valuable exports in order were silk fabrics, women's clothing, and cotton fabrics. Her export trade of the future is likely to remain these highly skilled manufactures in which she has come to have more or less of a monopoly advantage.

REFERENCES

See General References

"The Cotton Situation." *Yearbook* of Department of Agriculture, 1921.

U. S. Department of Agriculture has numerous special publications on cotton growing.

Annual Wool Review, National Association of Manufacturers, Boston.

Bulletin of National Association of Wool Manufacturers. Annual Volume, Boston.

Miles, Frank C. "Fiber Flax." Department of Agriculture *Farmers' Bulletin* 669. (1922.)

Edwards, H. T. "Sisal and Henequen as Binder Twine Fibers." *Yearbook* of Department of Agriculture, 1918.

CHAPTER XIII

LEATHER AND RUBBER

I. THE RAW MATERIALS FOR LEATHER

ANTIQUITY AND DISTRIBUTION OF LEATHER. Leather is made by cleaning and treating skins so that they will keep, and the skins are furnished by a great variety of animals. Naturally the domestic animals—the ox, sheep, goat, horse, and pig[1]—lead, but many other animals contribute their small quota to the world's leather. Among these are the alligator and crocodile, the manatee, or sea cow of tropical rivers, the shark, the monkey, the serpents, and the wolves. The skin of man himself is at times converted into excellent leather, and the white whale of the Arctic Sea yields a strong and water-tight skin called porpoise hide. With this great variety of sources, practically every trading people sends some kind of skins to the world's market, and even among the lowest savages skins are the chief riches.

Leather is as old as trade and the industry contributes to the commerce of every nation and every people, sometimes in the form of hides and of raw materials for tanning, sometimes as finished leather, which is the raw material of shoe factories and other leather works, and, finally, in the form of shoes and other leather manufactures.

THE TRADE IN HIDES AND SKINS. The term hides is applied to the skins of cattle and horses; skins, to those from sheep, goats, and smaller animals. The United States leads all other countries in the manufacture of leather, and although the meat of animals is one of our greatest exports, the import of hides and skins, amounting to over 500 million pounds a year, is one of the greatest items of our import trade. Practically every country in the world contributes some of these raw materials. Of goatskins alone we import

[1] The difficulty of curing pork after it is skinned causes us to lose a large leather resource estimated at $3,000,000 per year in Britain alone.

100 million pounds a year, their value being nearly equal to that of the cattle hides and they come chiefly from India (one-third), China (one-sixth), Brazil, Spain, and a number of other countries, most of which have the arid conditions in which the goat thrives better than any other domestic animal. Over two-thirds of the cattle hides we import come from Argentina and Uruguay, a great cattle range like our own western plains, and the Canadian extension of the American plains and plateaus supplies the next largest share. We also draw hides and skins from every country in Central and South America, because dried or salted ox hides, proof against rain, dirt, and blows, baled in any size or form, carried by any means, are one of the safest and most convenient commodities that can be carried over rough and difficult pack trails. The raw hides export much more easily than leather and the lack of industrial development in those countries makes tanning impossible there. In addition to the importation of hides from the rough, the arid, the poor, and the undeveloped countries, which cannot tan, we also get them from the richest and greatest manufacturing nations in the world—England, Germany, France, and Russia—where the fuller utilization of resource, due to a dense population, has produced a scarcity of tanning materials in which the United States is the richest country in the world.

TANNING PROCESSES AND MATERIALS. Tanning usually consists in treating the skin with a strong astringent, tannin, a very common vegetable substance which unites with certain elements in the hide and changes it from a material prone to decay, to one of great durability. Tannin, like sugar, is widely distributed among plants and is found in workable quantities in all continents. Its usefulness in tanning seems to have been discovered independently, long ago, in many parts of the world. Columbus found the American Indians with leather of excellent quality, and about the only people who do not know how to tan it are the central African tribes south of the Sudan.

Until a half century ago, the peoples of Europe and America depended for tanning almost entirely upon the bark of oak in southern, and hemlock in northern, locations. The growing scarcity of forests and the increased supply of hides which world commerce produced, has created a lively trade in other tannin-producing materials, so that now no less than fifty of them are in use. With the increase in distant commerce, there is a growing tendency to ship these materials in concentrated forms, thus lessening transportation costs. The concentrates were formerly made only in tanning factories where used, but now they are to a greater extent made near the centers of production. Thus the oak bark which England imported from Holland, Belgium, Hungary, and Italy contained from 10 to 12 percent of tannin, while the concentrated form now shipped has about 30 percent. The oak wood itself, which has from 2 to 5

Fig. 212.—Weighing station where natives of southern India (Yanadis) are being paid for tanning materials (nuts) which they have gathered in the forest. (Courtesy Sumner Cushing.)

percent of tannin, contributes its share through extraction from sawdust and waste scraps yielded by the sawmills of Hungary and Italy. In central Europe tannin is also extracted from the bark of Norway spruce for shipment to the tanners of England and Germany.

England gets from India another tanning material known as myrobolans, the dried fruit of a leguminous tree growing abundantly in central India and furnishing the chief tanning material of that large country. It is shipped in large quantities to Europe.

Sumac is a shrub or small tree growing wild in Austria and the Balkan States of Europe and in the Appalachian region of the United States. In Sicily, it is cultivated for its leaves, which are regularly cut and dried like hay and shipped to the tanneries powdered and in sacks. The Sicilian sumac industry fits well into the industrial conditions of that overpopulated island. The plant grows without tillage on land too dry and rough for other crops, and it affords employment when other work fails and other crops do not need attention. Appalachia once harvested and shipped large quantities of sumac for tanning but now has more lucrative employment for her workers.

Valonia, a rich tannin material, is nothing more than the acorn cups of the valonia oak, picked up by women and children in the forests of the Balkan Mountains and Asia Minor, and shipped to England where it has largely replaced the use of oak bark now so scarce in that country.

Australia exports the bark of the black wattle tree, a member of the acacia family, with bark yielding as much as 40 percent tannin, making it the richest of all tanning materials. In Natal this tree is planted for its rich harvest of bark which it yields in from five to twelve years.

Quebracho is to-day the world's greatest source of tannin. The quebracho tree (the name means ax-breaker), a natural monopoly of South America, is found throughout a large part of the Gran Chaco—an extensive unsettled tropical forest in Argentina and Paraguay. This medium-sized tree has a very hard wood containing 20 percent or more of tannin which renders the wood almost indestructible in the ground, thus making it valuable for railroad ties. Its richness in tannin has caused a rapid increase in the shipment of quebracho to the tanneries of England, Germany, and the United States, over 100,000 tons each of the extract and of the logs being exported from Argentina annually.

Since the wood is heavier than water and is very difficult to get and transport, the extracting plants are, like sawmills, in rough country, located as near as possible to the place where the trees are cut. The industry originally consisted of the exportation of logs for the manufacture of extract abroad. Since 1914 there has been a significant increase in the exportation of extract on account of the great saving in transportation costs. When used alone quebracho extract makes inferior leather but in combination with other materials it has become one the world's most valuable tanning materials.[2]

In the Mediterranean countries, where the chestnut is common, this wood is furnishing an extract, and the same industry has recently been established in the Appalachian districts of the United States. While this wood is much poorer in tannin than quebracho, it is light and soft, grows in open forests and is vastly easier to get to the mill than the heavy tropical wood. The chestnut tree increases in tannin content with age, and in America, at least, with lower latitudes. In New York the tannin content is about 4 percent, in southern Pennsylvania about 6 percent, at Lynchburg, Va., about 12 percent, in Tennessee, 14 percent, and even higher in north Georgia. After the chestnut has been cut to bits and the tannin digested out of it the pulp that remains is used for the manufacture of low-grade paper.

The imports of tanning materials into Great Britain show well the widely scattered origins of tannin.[3]

[2] Despite the concentrated efforts of technical experts during a score of years to discover new and more valuable tanning materials, quebracho still holds its premier position because of its high tannin content and the unrivaled excellence of its extract as a tanning agent for sole and strap leather. (Commerce Reports, April 9, 1923.)

[3] BRITISH IMPORTS OF TANNING MATERIALS, 1920

	Quantities in Cwts
1. Barks	
Oak (America)	2,586
Chestnut (France, Italy)	108
Quebracho (South America)	285
Other sorts (Bengal, Australia, etc.)	695,951
2. Sumac (mostly from Sicily and Algeria)	124,958
3. Gambier (Malay Peninsula, Sumatra)	64,862
4. Myrobalans (from India)	718,329
5. Valonia (Greece, Turkey)	174,228
6. Other sorts (Chile, Venezuela, etc.)	22,075
7. Extracts	
Oak (America)	5,060
Chestnut (France, Italy)	303,346
Quebracho (South America)	447,710
Other kinds (South Africa, etc.)	146,830
8. Nut galls (China, etc.)	39,270

The United States, with its large domestic sources of tanning materials, relies on chestnut, bark or extract, for about one-half of its supplies. One-third of our tannin comes from quebracho wood or extract imported from the Argentine, and lesser amounts of valonia, sumac and other materials come to us from all over the world.

THE MAKING OF LEATHER. The United States makes over $400,-000,000 worth of leather per year. The industry, which gives employment to 80,000 people, is one that has had greater changes in material than method. The common method is to put layers of bark between the hides and then soak in water while the tannin does the work. The supply of oak bark, which was the chief dependence of Europe until 1850, lasted longer in the United States, because of our great forest resources, so that the forest with its bulky bark located the American tanning industry down to the end of the nineteenth century. The valuable hides and leather were easily portable. Tanneries were small affairs like the little country grist mill, and were scattered in rural hamlets and mountain valleys throughout Appalachia and New England. Hundreds of thousands of acres of oak and hemlock forests were bought by tanners who cut down millions of good trees simply to strip them of their bark and let the logs rot because bark could be carried from rough nooks whence it was unprofitable to move the logs, and bark could be used in localities where there was no market for such a bulky commodity as lumber. The tanners often kept a team busy hauling hides and leather to and from some port, as Alexandria, Baltimore, or Richmond.

Since 1870 we have had a remarkable diminution in the number of leather-manufacturing establishments, six-sevenths of the total having disappeared. The old tannery has followed the country grist mill. Many an Appalachian county that once had five or ten tanneries, now has none. But the capital invested in tanning has increased eightfold since 1870 and the value of the product has increased 100 percent. Bark tanneries are still dependent upon the location of forests, but the building of railways has made it economical to carry bark by rail to a large tannery rather than to have many small tanneries away from the railroad. We have, therefore, two bark-tanning belts, one reaching the whole length of the Appalachian Mountains from New York to Georgia and including Virginia on the east and Tennessee on the west, the other in the hemlock region running from Massachusetts to Wisconsin, both of which are important leather states.

CHEMICAL TANNING AND ITS EFFECTS. Fortunately for the forest resources of the United States and the world, a new tanning industry has arisen practically independent of wood materials because it depends upon chemical compounds of chromium. This chrome process was first developed in Philadelphia, where it has grown with great rapidity and helped to make that city the greatest leather-manufacturing center in the world. Philadelphia's specialties are patent and enamel leathers and vici kid. The chrome leather industry, depending on factory products, labor, and markets, tends to

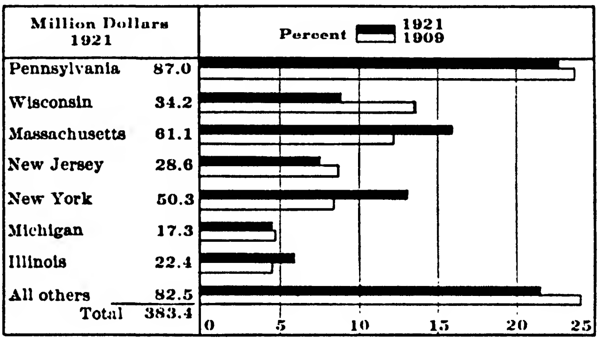


FIG. 213.—Leather tanned, cured and finished in United States.

locate in manufacturing centers rather than forest districts and since it depends almost entirely upon imported goatskins for its raw material, there is some advantage in being near the ports of entry which are often near to shoe manufacturing districts. Some kinds of leather must still be made with bark.

While still importing quantities ($16,000,000 in 1923) of special European makes, the United States has a much greater leather export ($42,000,000 in 1923). Two factors explain our leather export. One is the forest for the unrivaled bark-tanned sole leather. The other factor is the new chrome process, particularly in connection with several patented processes for leathers of especial finish. The bark is a natural monopoly, the new processes are covered by patents. Thus we have the unusual spectacle of raw materials forwarded to us via Hamburg and Marseilles and Liverpool, and the finished product sent back to the same countries.

Leather making in Europe. Germany is the greatest leather-manufacturing country in Europe, the German specialty being colored leathers. Among the European nations France is next to Germany, and each of those countries exports more leather than does Great Britain. British imports of leather (nearly $50,000,000) are the largest in the world and she also imports some hides for tanning. England buys nearly all of her hides from India, which country (with more cattle than any other) is even beginning to export leather as well as hides to the mother country. In France, as in Holland, Belgium, and parts of Germany, we see in the leather industry an interesting adjustment to the density of population. The scarcity of forests long ago caused the establishment of willow plantations so trimmed as to grow long slender twigs for weaving the baskets that replace the boxes and barrels used in this country for the shipment of agricultural and manufactured products. These same basket willows yield a bark suitable for tanning a leather especially adapted for glove making. The dense population of France, Germany, and Belgium gives the labor supply to turn these good leathers into a large glove output. The position of Paris in the world of style has long enabled France to lead all other countries in the export of gloves, of which vast quantities are sent to both England and the United States. Germany, however, is rapidly gaining on France as a glove maker and exporter, especially since the World War. Russia still manufactures, at the city of Kazan, the famous Russian leather with its peculiar odor due to the oils of the birch bark in which it is tanned. Morocco is the name applied to a special variety of goat-skin leather first made in Morocco and then introduced into Cordova, Spain, where it gave that country great fame in the world's leather market. But both of these are now relatively unimportant because of the much greater production of this kind of leather (leathers bearing the same name) in Alsace, France, and in Philadelphia. Morocco is still unexcelled in the fine quality of its leathers made in many colors, each hue the result of some particular vegetable tannin.

Scattered local leather industry. There is some leather produced in almost every country of the world, because it is a simple manufacture which almost any people can carry on to a limited extent for home use. The town of Valdivia in the forested part of southern Chile, chiefly settled by Germans, is producing and exporting large quantities of excellent sole leather. There is a large-scale French tanning plant in Santiago, Chile, and other good leather industries in Argentina, Brazil and Peru, most of them started by Europeans.

2. LEATHER MANUFACTURES

Leather manufactures include belting for driving machinery, harness, and finishings for carriages and automobiles. It is also used for a host of small trinkets and many industrial purposes, but the making of boots and shoes is much the most important use.

THE OLD AND NEW SYSTEMS OF SHOE MAKING. During the first half of the nineteenth century the shoemaker, with his kit upon his back, was an annual visitor to thousands of households in the eastern United States where one or two tanned hides awaited his coming to be converted into the family shoe supply for the ensuing year. The wandering shoemaker competed with the local shoemaker who had his shop beside the country store and had his regular customers as the physician had his patients. The old order is rapidly passing away before the development of the shoe factory, which, during the last quarter of the nineteenth century, began to roll out shoes through the aid of very complex machinery and a minute division of labor in which dozens, sometimes scores, of persons worked on each shoe. This division of labor and factory manufacture gave the industrial center an advantage over the skilled shoemaker and has caused his almost entire disappearance, despite the superior wearing quality of his product. The passing of the roadside shop was followed by a surprising concentration of manufacture. New England, with her lack of natural resources but abundant labor supply, early developed shoe manufacturing and now makes half of America's total output. The state of Massachusetts makes more than twice as many shoes as any other state, the industry being centered in Brockton, Lynn, Haverhill and Boston. Manchester, New Hampshire, and Auburn, Maine, are really a part of the same shoe district, which sends shoes to every state in the Union and to many foreign countries. The shoe factories of these New England towns use soles stripped from Texas cattle in Chicago slaughter houses tanned in Tennessee with Appalachian chestnut oak. The upper parts of the shoes are usually made of imported goatskins tanned in Philadelphia. The shoe industry of the United States employs over 200,000 people and the product in

1921 was worth $867,000,000, of which about two-thirds was the cost of the expensive raw materials. As with the ready-made clothing, so with ready-made shoes, a wide market and large sale make possible the production of a great variety of shapes and sizes so that greater and greater numbers of people can be fitted with the factory product. This factor in combination with the smaller cost [4] of machine-made goods in comparison to hand output, helps to explain the great and quick concentration of the industry.

THE FOREIGN TRADE IN SHOES. The foreign trade in shoes seems destined to be small. The superior fit and comfort of American

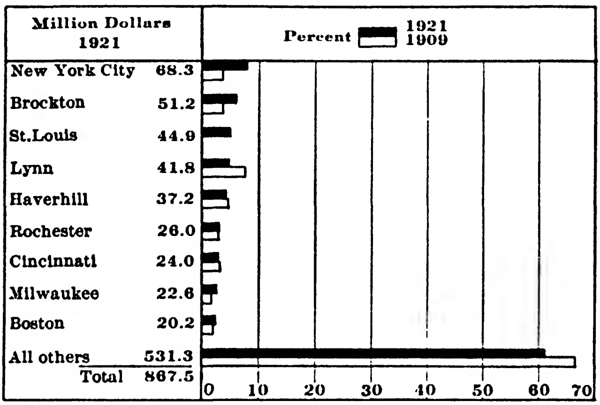


FIG. 214.—Boots and shoes manufactured in leading cities of the United States.

shoes is appreciated and a few years ago a large trade seemed to be in prospect, but the export of American shoe machinery to Europe has been followed by the ability of Europeans to compete in quantity production and American shapes. This, in combination with preferential tariffs, has cut down the American shoe export to European countries. United States shoes find their best market in the neighboring countries of Cuba, Canada, and Mexico, though smaller quantities are shipped nearly all over the world. The total export for a number of years, however, has amounted to the comparatively small number of 7 or 8 million pairs annually (10.3 million 1913, 8.9 million 1921), while the total United States produc-

[4] One of the few make-to-measure shoemakers remaining in Philadelphia has to charge $23 a pair for men's French calfskin shoes, but they have great durability.

tion is around 300 million pairs. In connection with shoe export, the tropic habit of going barefoot should not be overlooked.[5] Shoes are almost unthought of by races that buy cottons by the million yards. Many nations that buy nearly all their cotton and woolen goods make nearly all of their shoes. The Indian who wears store clothes often prefers to make his own moccasins or have his wife do it.

TENDENCY OF SHOE INDUSTRY TO SPREAD. High freight rates and the heavy expense of shipping a bulky though valuable commodity like shoes help to explain the rise of new centers nearer the western markets than the Brockton-Lynn-Boston district. New York City is now the second center for shoe production. St. Louis, where the shoe industry was established by the aid of Massachusetts foremen taken thither at extra high wages, has since 1900 advanced to the third shoe center in the United States. Rochester, Cincinnati, and Columbus, Ohio, have growing industries.

GLOVE MANUFACTURING IN THE UNITED STATES. While many fine gloves come from France, Germany, and England, there is a production, chiefly for home use, of something like $40,000,000 ($46,000,000 in 1919) worth in this country. The glove industry is remarkably concentrated, the two towns of Gloversville and Johnstown, in Fulton County, New York, neither of which has 25,000 people, making over half of the gloves in the United States. There appears to be no reason for this other than that more than a century ago some Scotch people, members of the Scotch glove-makers' guild, settled here and the house and village industry has been handed down from generation to generation until the sewing machine and the factory made it possible for these cities that had the start to maintain the leadership in this branch of manufacture, for which they have no natural advantage over a thousand other towns.

HARNESS AND SADDLES. The English people have for centuries been the greatest lovers and breeders of horses in the world, and it is quite natural that harness and saddles should be exported from this more than from any other country. In general it may be said that harness making is an industry that tends to be located in cities and small towns everywhere in the United States and Europe, no great centers having yet arisen.

[5] Cuba, drunk with sugar money, bought six million pairs from us in 1920. Sugar prices collapsed. Cuba bought 1.4 million pairs in 1921.

The future supply of leather. There is no sign of any diminution in the demand for leather. As standards of living rise, the people of Holland, Belgium, and Germany tend to lay aside wooden shoes, as do the Chinese and Japanese their leatherless footgear of straw, cotton and wood. But leather is rising in price because it depends on animals and animals are now becoming relatively scarce and must continue so if people keep on increasing. The world does not possess the leather to make western shoes for the Chinese. In the United States, which draws upon the world, the number of hides and skins used increased 15 percent between 1909 and 1919, and their cost increased 165 percent. Leather substitutes should be welcomed and are increasing, especially in baggage, automobile and similar uses.

3. FURS

Furs comprise a branch of the leather trade that tends to go down rather than up as the population of the world increases. This is because nearly all the furs are taken from wild animals, many of which are carnivorous. As a further limiting factor, most of them live in forests and the forests are being cut and burned. Thus the woods of our two northern forest belts[6] are the chief home supply of furs, but the chief part of the world's product comes from the great sub-arctic forest that practically girdles the world from southern Alaska to Labrador and from Norway to Kamchatka. Throughout this vast and frosty region the wandering trapper annually makes deep journeys into the wild forest and emerges at the end of weeks or months with a bale of fox, muskrat, mink, martin, beaver, otter, sable, and other skins.

St. Louis is the great fur market of America, receiving thousands of bales of furs from all over the world, which are sold annually at a fur auction. In like manner, Leipzig has been for many years the most important fur center of Europe, but its trade and position suffered greatly by the World War. In 1915, the price of furs went to almost nothing, because of the war, and the manufacturing of steel traps at Oneida, New York, suddenly stopped. In 1919 fur prices soared to unheard-of levels during the

[6] The wild animals in our agricultural midst should not be overlooked. Louisiana reports a fur income of five million, divided among 15,000 people. The state produces three million skins of wild muskrat.

post-war speculative boom. In 1921 they slumped with dull times.

Fur farming has at last begun in a small way in Canada and the United States in response to a keen and normally increasing, but fluctuating, demand. Starting in Prince Edward Island this suggestive new industry has become established throughout Canada. The enormous prices paid for the furs of the black fox have caused eight million dollars to be invested in fox farming, and several thousand dollars have often been paid for a single fine breeding fox.

In time we may expect to see furs from wild animals superseded almost entirely by furs from animals raised in captivity, just as wild rubber and wild quinine have given way for the cultivated crop. Already, fur farming has a busy output of literature and advertising and the high prices are stimulating a fury of experimentation with fox, skunk, muskrat, opossum, mink and others.

4. RUBBER

Columbus, the first explorer of the western hemisphere, took back to Europe among other things the tale of a strange substance derived from the sap of a tree and which the natives used for balls and ornaments. Later explorers found it in use as a crude waterproofing for clothing. It was not until the last half of the eighteenth century that an English chemist found that it would erase pencil marks; hence the name "rubber." For eighty years it was used only as an eraser, for which small quantities sufficed. In 1823, a Scotchman, named MacIntosh, used caoutchouc or rubber to waterproof cloth (which yet bears his name), but in hot weather the gum got sticky and in cold weather it grew brittle and broke. In 1842, Goodyear, an American, discovered that the process of vulcanizing, or mixing rubber with sulphur, remedied these faults and gave it the qualities so suitable for waterproof clothing, shoes, and boots. His invention started the rubber boot and shoe industry which has for half a century supplied what was considered at first a luxury for the well-to-do, but is now the common clothing of the ditch digger, farm laborer, miner and lumberjack. About the year 1890, rubber consumption entered upon a period of great increase due to the adoption of the pneumatic tire. The resulting sudden development of the bicycle industry, to which rubber is an essential, promptly followed. A few years later came the automobile with its still larger demand for rubber in heavy tires. The huge expansion of the automobile industry during the decade 1915–25, caused the rubber industry to expand in like proportion, and raw rubber is now one of the staples of commerce. So much so that any rise in crude rubber prices or threat of a shortage sets the rubber-using nations of the world (chief of which is the United States) hunting frantically for new sources of supply.[7]

EARLY SOURCES OF RUBBER. Our crude rubber supply has followed the age-old course of man's progression from the hunter to the grower. For over half a century the major part of the world's rubber was obtained from the wild rubber trees found chiefly in the upper valley of the Amazon River. This rubber-yielding forest includes about half of Brazil and those large parts of Bolivia, Peru, and Ecuador which lie east of the Andes and receive the heavy rains brought by the trade winds from the Atlantic. Colombia also has a part of her territory in this basin. Throughout the length and breadth of this enormous valley from Para to the Andes, and reaching beyond it into Venezuela and Guiana on the north and Paraguay on the south stretches one continuous forest through which the traveler must fight his way with knife and ax. Scattered here and there in this gloomy jungle are trees of the dozen or more varieties from which the natives gather the rubber to ship down the Amazon.

Rubber hunters ascend the river in boats, and after locating a hundred or more trees and cutting paths to them through the dense tropical jungle, tap them for the latex, or rubber milk, which is laboriously coagulated on paddles by smoking it over wood fires in the forest. A paddle that has been dipped in the thick sap is held over the flames and the acetic acid and creosote of the smoke cause the juice to harden into crude rubber. The process is repeated until a lump of rubber about the size of a man's head is formed on the paddle. It is then ready for shipment to market. Para at the mouth of the Amazon is the assembling center for all of the wild rubber from the Amazon basin, and has given its name to the finest grade of crude wild rubber. This commerce in rubber and the supplying of the rubber gatherer's wants is the chief reason for the existence of Para, the city of Manaos a thousand miles up river, and Iquitos in eastern Peru, to which small steamers regularly ascend.

[7] See U. S. Department of Commerce for reports on our official world rubber study—a result of the British control of price after the 1921 slump.

The methods of the Brazilian rubber industry are primitive, the product is often uneven in quality, and the facilities for getting the balls of rubber to market are poor. The wild rubber trees of Brazil, Peru, and a few other scattering tropical countries have never produced much over 50,000 tons of rubber annually, but this relatively small amount was quite sufficient for the needs of the world before the arrival of the automobile. The beginning of rubber culture about 15 years before the arrival of the automobile (in quantity) seems almost providential, if one may assume Providence to have an interest in automobiles.

PLANTATION RUBBER GETS ITS START. The best rubber tree of the Amazon (Hevea Brasiliensis), which requires a rainfall of 80 to 120 inches with the full torrid temperature of 75° to 90° each day, is at home nearly everywhere below 2,000 feet in the equatorial rain belt. In 1876 an English scientist carried seeds of the Hevea from Brazil to England. The rubber trees were grown successfully in the National British Botanical Gardens at Kew, near London, and distributed thence in 1881 to India and Ceylon. The Ceylon trees seeded and these seeds were sent to the Federated Malay States and the Dutch East Indies. The temperature and rainfall of the equatorial Far East differ but little from that in Amazonia; a Hevea tree in the Malay Peninsula often grows to 60 feet in three years' time.

The transplanting experiment was successful and rubber plantations, financed by British capital and worked by coolie labor imported from China, gradually arose in the Far East. In 1900 the output of the plantations was only 4 tons of crude rubber, while the wild forests produced 54,000 tons; by 1913 the output of the two sources was equal; in 1922 the production of the plantation article had grown to 340,000 tons, while the wild supply had decreased to 23,000 tons. Thus from a few seeds collected in the Amazon Valley[8] have grown the vast rubber plantations in the Eastern tropics, with over 300 million trees and supplying over 95 percent of the world's needs from three million acres of land (1925).

PLANTATION METHODS. Numerous changes in rubber methods have come about through the shifting of production from the isolated tree, to which the rubber hunter laboriously cuts a path, to

[8] It is rather an interesting fact that in recent years seeds for rubber cultivation have been sent from Ceylon and Singapore back to tropic America.

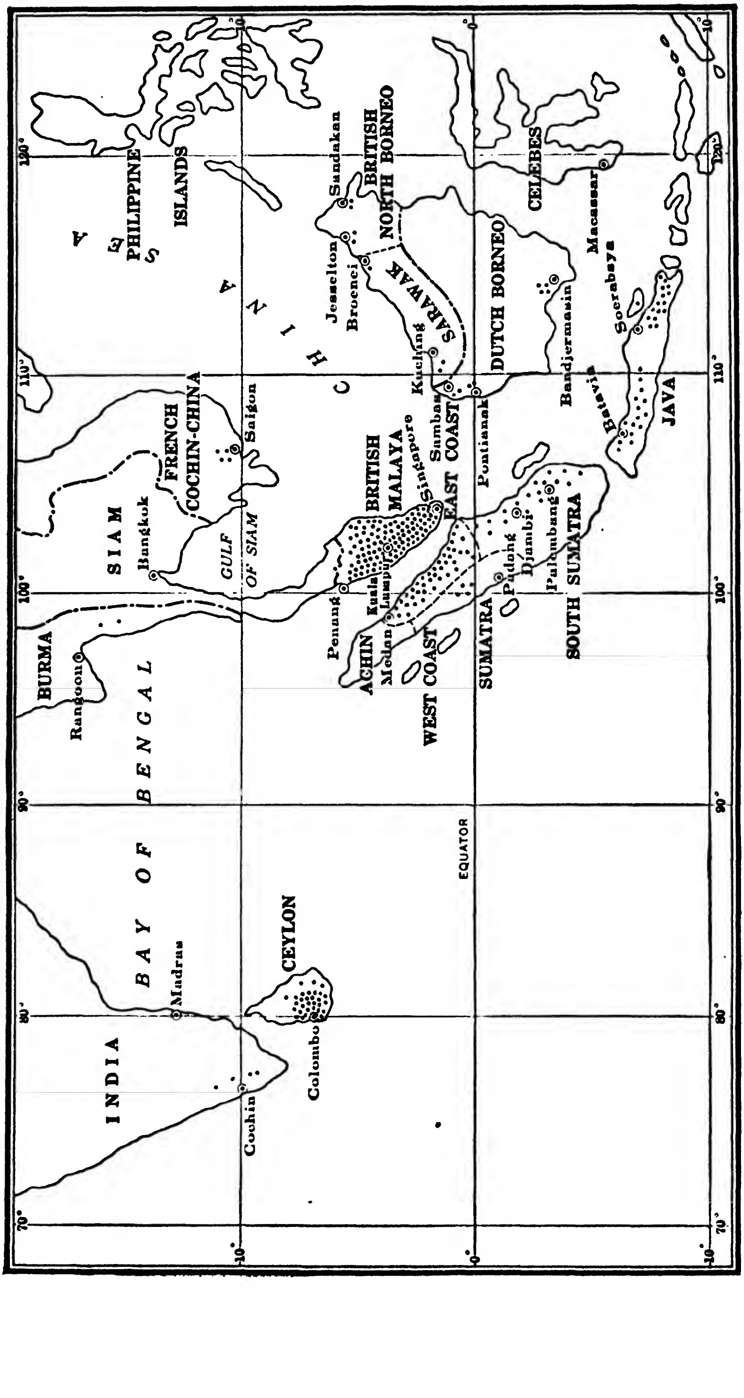


FIG. 215.—Map showing the chief centers of plantation rubber.

the scientifically managed rubber plantations in which tens and even hundreds of thousands of Hevea trees yield an annual crop. The rubber trees are set out in rows like fruit orchards, usually 12 feet apart, and grow to tapping age in six or seven years. At seven years old the plantation should be in its prime, possessing no tree less than 20 inches in girth, and producing a yearly return of 400 pounds of dry rubber to the acre.[9]

FIG. 216.—Rubber tree in the East Indies, showing the gashes made to extract the latex.

The contract system of labor is used almost everywhere[10] in the Far East, the laborer, Chinese or Malay, being imported to serve on the plantation for a period of three years. His contract specifies the hours of labor (usually nine) and the kind of work. The work may consist of anything from clearing forest or keeping down the weeds between the rows of young rubber trees, to tapping the trees for the latex.

[9] Actual averages for 1923 were: Dutch East Indies, 374 pounds per acre; British Malaya, 264; Ceylon, 270.

[10] In Java the contract system is forbidden by the government, the labor being left free to "float" from one plantation to another.

The plantation method of collecting the latex is primarily the same as in Amazonia. The plantation laborer starts out before dawn in order to complete his work before the heavy midday rains. Passing down a row of trees he makes a few gashes on each with his knife and puts a cup underneath to catch the liquid. About two hundred trees is an average day's work. Later he returns to collect the latex in a large pail and carry it to the plantation factory.

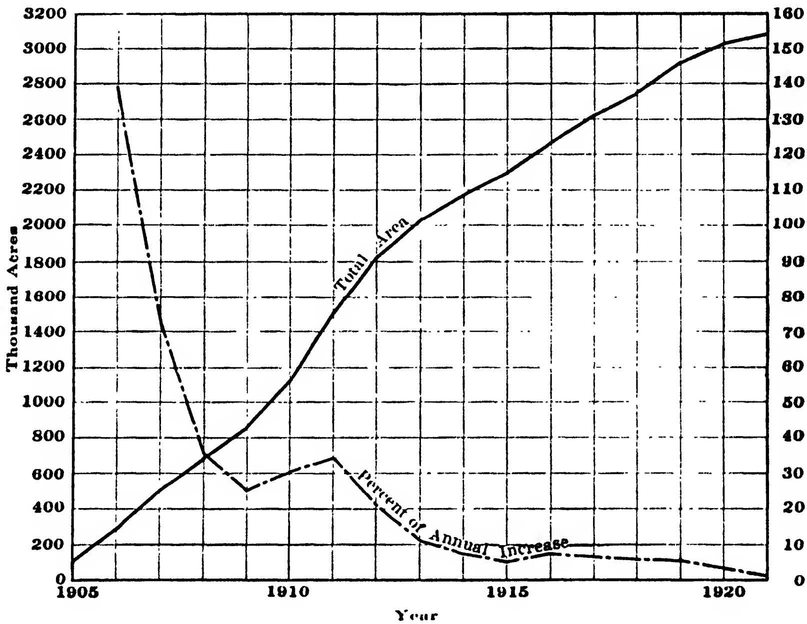


FIG. 216a.—Growth of area under plantation rubber.

The preparation of rubber for shipping takes place on the plantation and is part of the work of the laborer. The latex is mixed with acetic acid and allowed to stand until it coagulates. The spongy substance resulting from this process is then washed and hung up in sheds to dry, or put into artificially heated ovens in places where the climate is too moist to dry it naturally. The dried rubber, called crêpe, is then cut into strips resembling rubber-bands and the strips pressed into blocks for packing and shipping.

The slow drying process is often combined with smoke-curing similar to that practiced by the natives on the Amazon. This smoked rubber has been commanding the higher price, since in the process the rubber is strengthened and preserved by the creosote and other substances in the palm leaves used. A machine for smoking the latex has recently been tried out with some success. Plantation rubber is usually of more even quality, and the curing is better than that of the forest-smoked product. The rubber market of the world has now shifted from Para, Brazil, to Singapore.

Recently latex as it is gathered from the trees has been piped into tank ships and transported from Singapore to the United States. If successful this method may cut the costs of rubber production still further, but only 1½ million gallons of latex came to the United States in 1923. At present we use it only for a few special purposes.

PRESENT WORLD SOURCES OF RUBBER. The world's rubber plantations to-day would cover an area about the size of Connecticut if brought together in one block. Half of this acreage is in the Malay Peninsula and Sumatra. Ceylon and Java come next and there are lesser areas in southern India, Borneo, Burma, Cochin-China and the islands of the Pacific. Brazil with practically no cultivated plantations has dropped into an inferior position in the rubber world, and the Amazon Valley remains almost as sparsely settled as the Sahara Desert.[11] The trade in wild rubber goes fitfully on, but the quantity production upon which the world depends is at present to be found only on the carefully tended plantations of the British and Dutch East Indies. British Malaya alone is exporting well over half the world's crude rubber, the Dutch East Indies one-fourth, Ceylon one-tenth.[12]

[11] Principles of economics and human nature have been well illustrated in Amazonia. The rubber price slump of 1920 did the same thing to these hungry one-croppers that the boll weevil did in our cotton belt—started diversification: corn, rice, timber. The rising price of 1925 sent them out again for rubber.

[12] PRIMARY RUBBER MARKETS, 1922*

	Tons
British Malaya (mainly Singapore and Penang)	248,158
Ceylon (Colombo)	47,367
Sumatra (Medan principally)	40,552
Java (Batavia and Soerabaya)	31,558
Brazil (mainly Para and Manaos)	21,735
Africa (various small markets)	3,205

* Marketing of Plantation Rubber, Trade Information Bulletin No. 180, U. S. Bureau of Foreign and Domestic Commerce.

The plantations in the Far East are almost without exception owned abroad, three-quarters of them being controlled by British capital. Next to the British in plantation ownership are the Dutch, while the French and Belgians also control important holdings. American interests, however, control less than three percent of the acreage, although this country is using two-thirds of the crude rubber marketed.

THE FUTURE SUPPLY OF RUBBER. Because the United States is the greatest rubber consumer in the world and must buy all of its raw material from other countries, most of them on the opposite side of the globe, much attention is now being given to the possibilities of developing new sources in this country and in tropic America.[13] Already our rapidly growing rubber industries take over 6 pounds of rubber per capita for all the 110 or more million people in this country. Future increase in the automobile business will cause increased rubber demand, and the chemist is constantly finding new uses for it. If the price were low enough we could make our desks of rubber instead of wood, roof our houses with rubber instead of slate, pave our streets with rubber in place of asphalt or concrete.[14]

The scientific improvement of the trees is yet in the experimental stage. Rubber trees will be selected to yield larger returns, as was the case with the sugar beet, and grafted as is the case with most commercial fruit orchards. The grafting of rubber trees at the West Java Experimental Station has progressed far enough to indicate that some of the grafted stock when full grown may give a return of latex from two to five times greater than the present normal output. (*London Times Trade Supplement*, June 3, 1922.)

Similar experiments conducted by the United States Rubber Company on its great plantation in Sumatra indicate an improvement in yield of some of their budded stock so that it will approach 600 to 1,200 pounds an acre annually instead of the usual 250 to 300 pounds. This company is also attempting to develop trees of the super-yielding type by a process of gradual selection.

The chemists have also succeeded in making synthetic rubber in the laboratory, although it has not yet been reduced to an indus-

[13] A special appropriation was made by Congress in 1923 to investigate the whole rubber situation as it affected the United States.

[14] Roads in Colombo, Ceylon, have already been paved with a rubber solution rolled on like asphalt and which wears better than asphalt.

trial basis. It is quite possible that a few decades hence we may find the rubber plantations sore pressed by a product of the chemical engineer—cheap, synthetic rubber made by European, American and Japanese factories.

Possible new rubber areas. As far as soil and climate is concerned rubber growing is very far from being limited to the East Indies. The best possible rubber region as we now know it includes the equatorial rain belt which encircles the world. Rubber can be extracted in small quantities from over 200 different plants, trees and shrubs; it could probably be successfully produced by nearly that many different tribes or peoples in South America, Central America, Asia, Africa and the islands of the sea. But as

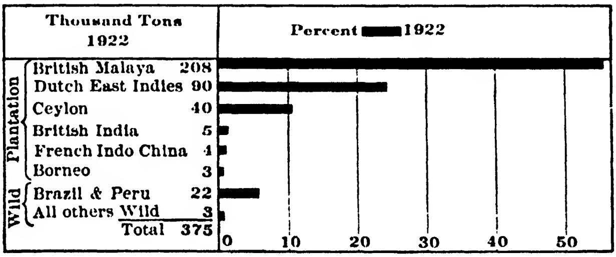
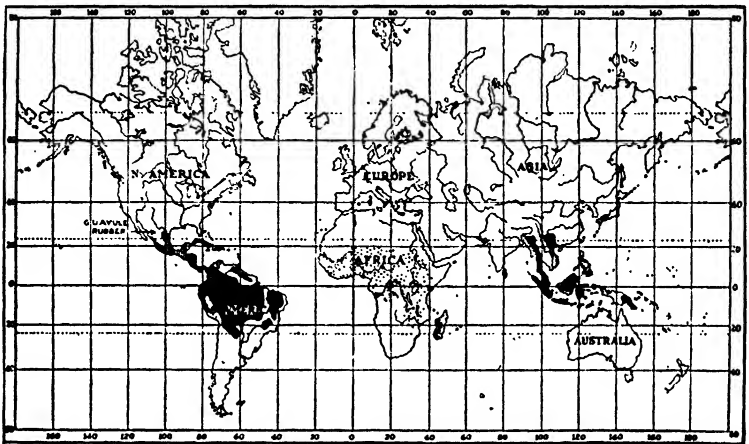


Fig. 217.—World production of plantation rubber and wild rubber.

one of the incidents of the near future will be the virtual disappearance of wild rubber, in favor of the cultivated variety, the rubber-user of to-day is chiefly interested in the most favorable spots for cultivation. The rubber tree has been introduced and found to thrive not only in the East Indies but in Northern Queensland, and Fiji Islands, some of the West Indies, the Seychelle Islands in the Indian Ocean and the west coasts of Africa and there is good reason to believe that it will be as much at home in the forests of the equatorial Congo as in those of the equatorial Amazon. Add to these lands the Amazon Basin where Hevea originated, and other areas in South and Central America and it is apparent that we have only scratched the surface of our rubber growing possibilities. With a sufficient world demand there could be a hundred times greater production.

Taking only one area as an example, investigators sent to the Philippines by the United States Department of Commerce brought back the report that vast tracts of land in those islands have a soil as fertile and a climate as suitable as the best of the rubber plantations in the Malay Peninsula or Sumatra. The island of Mindanao, about the size of the state of Indiana, and one of the most fertile undeveloped regions in the world, was especially recommended as favorable to plantation rubber development. Like hundreds of other places in the world, the Philippines have every requisite for successful rubber growing except the most important—labor.



Hevea brasiliensis.
Ficus elastica.
Castilloa elastica.
Manihot glazioni and Hancornia speciosa.
Vines and other varieties.
Guayule rubber not yet mapped.

Fig. 218.—Distribution of leading varieties of rubber plant. (From A. Vincent, *Industries du Caoutchouc et de l'amiante.*) Few products are produced by so many plants over so much of the earth's surface.

Rubber possibilities in temperate lands. Even outside the belt of equatorial rain we still find possibilities for rubber production. The Ceará (a state in East Brazil) rubber tree has demonstrated its ability to thrive on dry, stony, tropic uplands, and the guayule bush of north Mexico, in the latitude of Texas and a climate of frost, grows and produces rubber in lands too arid for a forest or even the tilled or pastured field. In the days of high-priced wild rubber Mexico had a thriving industry based on the semi-desert guayule shrub, dug up and ground up for the extraction of rubber. The flood of cheap plantation rubber from Malaya killed this industry but guayule is still one of our temperate zone possibilities.

It has been definitely established that the rubber-producing Tu Chung tree of China is adapted to the United States, and several healthy specimens have been grown in the Arnold Arboretum near Boston. Whether the product of its bark,- leaves and fruit is to be regarded as rubber or gutta percha is a question. In either case it is valuable since gutta percha often brings higher prices than Hevea crêpe in the market. Moderately high valleys of the Alleghanies, Blue Ridge, Rockies, Cascade and Sierra Nevada foothills suggest themselves as localities which resemble its Chinese habitat.

Other rubber-producing trees are growing even now in the United States without cultivation. A tree related to the Hevea was brought here several years ago from the sub-tropics and escaped from cultivation into the woodlands of Georgia and South Carolina where it grows to its native height of 40 feet. Still another tree related to the Ceará of Brazil is now growing in Florida. In pointing out that there is a possibility for trees of this sort to become acclimated and useful in their new environment, the United States Department of Agriculture calls attention to the fact that cotton was not originally a native of the temperate zone. When one considers what cultivation and deliberate improvement have done for the sugar beet as a result of Napoleon's search for sugar, we see vast possibilities of rubber, if the present scientific era lasts.

We are almost bound to have price troubles, no matter what the source, so long as it is from trees. Seventeen cents a pound (1924) discourages, and $1.20 (1925) booms planting, after which it takes years for the trees to affect the market, during which the market starves. Then for years the trees keep on producing, during which time the market gluts—one of the great troubles of tree crop agriculture.

Cheap labor the basis for rubber success. While the best rubber trees can be grown nearly everywhere in the rainy tropics there is a limiting factor—labor. The problem of getting a labor supply which will be skilled, hard-working and above all *cheap* is the one which is causing all the would-be rubber growers over the world to despair.

The labor supply of Malaya is unique. The Straits Settlements (British) are a few settlements along the Straits of Malacca comprising a small fraction of the land area of the Peninsula. Here the British Government has kept the ferocious natives in order, so that the Chinese, industrious, quick to seize opportunities, have gone there for the business opportunities in a climate which they can stand better than Europeans. In 1921 the population (total 883,000) consisted of 8,000 Europeans and Americans, 9,000 Eurasians, 432,000 Chinese, 274,000 Malays, 94,000 natives of India, and 66,000 other Asiatics. In the Federated Malay States under British control are 500,000 native Malays, 500,000 Chinese, and 300,000 natives of India, the latter two groups being largely immigrants for plantation work of some sort. Within a comparatively short distance of Singapore are enormous additional labor supplies that can upon demand be furnished by the millions of China, of Java, of India. The Dutch East Indies have a teeming population of their own. Ceylon, the third largest rubber producer, has a dense population and, moreover, is able to draw tens of thousands of laborers across the straits from India.

It is only too apparent that rubber growing in the British and Dutch East Indies has succeeded mainly because, in addition to peace and order enforced from the outside, they have available a large supply of cheap labor to clear the forest, tend the trees, and gather the latex. Skilled Chinese rubber workers in British Malaya are paid 34 to 57 cents per day, while the Indians, Javanese, and Malays get from 17 to 28 cents per day for unskilled labor. (Commerce Reports, Dec. 9, 1918.) This kind of labor supply tropic America does not possess, and the feverish talk of Brazil about entering upon the cultivation of rubber seems destined to poor success unless she imports Chinese laborers into her empty Amazon lands. Asia, Africa, South America, and the Philippines, with huge areas of jungle in every way suitable for rubber growing, will be able to compete with Ceylon and the Malay Peninsula only if they can obtain a sufficiently cheap and well-trained supply of workers.

5. THE MANUFACTURE OF RUBBER

Although crude rubber is a product of the tropics, its manufacture is largely confined to American and European cities of the north temperate zone, where most of the finished products are used. The art of rubber-making has progressed far since the inventions of MacIntosh (1823) and Goodyear (1842) made possible the first waterproof clothing, shoes, and boots, and modern factories now unite with laboratory skill to give us an ever-increasing number of useful articles. We encounter rubber in the kitchen, in the bath-room, in the hospital, on the train. We wear it on our heads and on our heels and cover ourselves with it in stormy weather. A single concern manufactures 30,000 commodities into which rubber enters, while the inventor is constantly discovering new uses. It is no wonder that the American import of crude rubber has risen from less than 5,000 tons in 1870 to around 350,000 tons in 1924.

Although the chemist and the machinist now coöperate to turn out such a huge variety of rubber articles, the fundamental process of rubber making still remains practically the same as in Goodyear's day. Raw rubber is mixed with sulphur and then heated to bring about the chemical change known as vulcanization. From

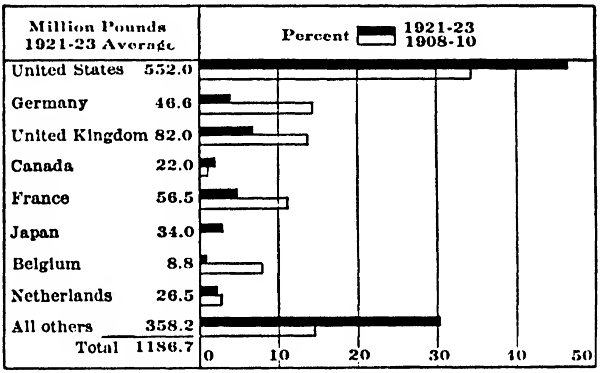


FIG. 219.—World's rubber import, three-year average.

2 to 10 percent of sulphur is added to make soft rubber, while over one-third sulphur may be added to make the hard rubber used for combs and fountain pens. Certain manufactures such as the automobile tire and rubber hose also use a reënforcement of cotton fabric.

Rubber footwear, the earliest of our rubber products and still a large user of the raw material, is made to a large extent in Massachusetts and other places where leather boots and shoes are manufactured. The industry as a whole, however, is centered in Akron, Ohio, where an accidental early start plus the development of the automobile industry near by has caused a remarkable concentration in the last two decades. The twenty rubber manufacturing companies of Akron (with 101,000 workers, 1925) use one-third of all the rubber consumed in the world.

The use of rubber which at present dwarfs all others is that of automobile tires and inner tubes. The 18 million cars and trucks of America travel on 72 million tires which are constantly being worn out and replaced, and it is estimated that this growing industry uses four-fifths of America's present rubber import. In addition to the cushion-footed automobile, rubber hose is a universal necessity filling a thousand uses; the airbrake system of every train requires it. Rubber packing in engines, pumps, and valves, and rubber electrical supplies show how universal is the distribution of manufactured rubber, which goes wherever steam goes and water is lifted by the western engineer. For these purposes the products of American rubber factories are sent to every country in the world.

REFERENCES

See general references

GEER, W. C. *The Reign of Rubber.* Century Company, 1922.
FIRESTONE, HARVEY. *History and Development of Rubber.*
Trade Journal, *The India Rubber World,* New York.
The Bureau of Foreign and Domestic Commerce, Washington, D. C., also publishes bulletins on various phases of the rubber situation.

CHAPTER XIV

THE MACHINERY, SHIPBUILDING, AND METAL INDUSTRIES

I. FACTORS OF LOCATION

Shipbuilding must be done where the ships can be launched, but the location of other classes of machine building is influenced by two factors which often tend to conflict but which sometimes coincide—labor and the market. Machinery of all kinds is made primarily of metal, mostly iron and steel, and secondarily, of wood. It is easy to see how a carload of iron, steel, or wood is much less bulky than the same materials made up into machinery. It is therefore a transportation advantage to have the factories located near the market rather than near the raw material. On the labor side it is true that the distant market is often in a region of small purchases and high wages so that there is an advantage in labor cost if the machinery is made where the labor supply is abundant, the wages low, and a large product can be marketed. In some classes of machinery, such as agricultural machinery, the transportation cost is heavy in proportion to the weight, and the dominating influence of the market is strong, tending to locate the industry. In other classes of machinery such as clocks and watches the freight element in the cost to the ultimate consumer is relatively small and the labor element is large, with the result that the labor element has strong influence in the location of the industry. Waterbury, Conn., and Waltham, Mass., have thus maintained their watch and clock factories in the East, where, for decades, their workmen have been trained. Another important difference to be observed among the different classes of machinery is the narrowness or wideness of the area of consumption. In this respect equipment machinery of the class used in textile or sugar factories is much more restricted than clocks, firearms, or vehicles which are for general consumption rather than for equipment of restricted industries.

The manufacture of machinery for factories is nearly always a sort of second stage in industry, the first stage being the growth of the industry which uses the machinery, thus developing the market for it. Heavy machine manufacture tends to develop near each particular industry using that machinery. Philadelphia and Worcester, Mass., make textile machinery and Denver heavy mining machinery. California makes peach canning machinery, while cotton gins are made in Southern cities. The order of development is somewhat as follows, as shown, for example, by Russia—first agriculture, then after importing agricultural machinery for a time its manufacture begins, but in factories equipped with machinery from countries more advanced in manufacture. The manufacturing of machinery to make machinery is a yet more mature stage of industry.

With world commerce the use of machinery is spreading into the remote corners of the world, hence a rapidly increasing export from the manufacturing countries. It takes much thought to realize how fully this is an age of machinery.

2. THE MANUFACTURE OF AGRICULTURAL MACHINERY

THE ORIGIN OF AGRICULTURAL MACHINERY. Large areas of cheap land in combination with the consequent high wages have dominated industrial conditions in the United States and made it impossible for the farmers, under the old system of hand labor and simple devices, to cultivate as much ground as they could easily secure. Necessity has in this form been the mother of the invention of agricultural machinery, which has been perfected to a greater degree in this country than in Europe. The decades beginning with 1840 and 1850 saw the settlement of the American prairie, a natural home of the farm machine, going on in good earnest: and it was in 1851 that the first reaper was made. After this beginning the new machinery came rapidly. These inventions and the great demand for the machinery have given rise to an important manufacturing industry, and the excellence of the product has led to a large and growing export to the agricultural countries of the world. The thoroughness of our invention and the scope of our agricultural machine works is shown by the virtual absence of imports of machinery of this class, while we have exports far greater than any other country.

The service rendered by agricultural machinery. In 1850 we produced 1 ton of cereals per person. In 1900 with a smaller proportion of the population engaged in agriculture, we produced 1½ tons of cereals per person. This increase in the efficiency of the producer of breadstuffs is due largely to the machinery he has used. The inventors and manufacturers of agricultural machines have produced many devices to do each important agricultural process. Thus agricultural machinery has replaced hand labor in production as the locomotive and the motor truck replaced the wagon in transportation, and the two classes of machinery together

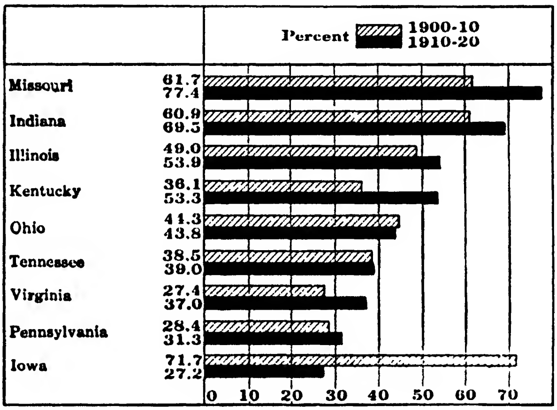


Fig. 220.—Percentage of counties losing population in nine great agricultural states, 1900–10, and 1910–20. Most of these states depend upon modern and thoroughly mechanical types of American agriculture. The effects upon population are startling.

have given the world cheaper food and raw materials than it ever had before.

It would be a great error to think that this process of machine improving has ended or that its results are all in sight. The census of 1920 showed astonishing changes due to agricultural machinery. Within 20 years the rural population of Ohio, Indiana, Illinois, and Iowa had declined 7 percent. This was due to the use of machinery which increased over 300 percent in value per farm. It was accompanied by an increase of 6 acres in the size of the average farm, and a decrease in the number of people per farm. Where it can be used agricultural machinery removes man from the land as shown by a population of seventy-one persons per 1,000 acres on the best level Ohio land and seventy-four per 1,000 acres on the much poorer hilly lands of southwestern Ohio.

Manufactured near the market. Agricultural machinery is very bulky; freight rates are therefore high, giving a great advantage to the factory located as near as possible to the place where it will be used. Therefore, this industry has always kept close to the edge of the great farming region, especially the grain belt. For a time the leading manufacture was near the city of Auburn in central New York where the Erie Canal gave easy transportation to both east and west, but the center of the industry has moved west with the westward movement of agriculture. The first centers beyond the Alleghenies were Columbus and Springfield, Ohio, on the edge of the vast level plain of the corn belt, which has been the compelling force to make men use farm machinery. With the further westward movement of the market, the industry centered in Chicago, the greatest agricultural market in the world, the greatest railway center in the world, in the hearts of the corn belt, the hay belt, and of the oat belt, and also near the wheat regions. Here are the best facilities in the United States for reaching agricultural districts, and here the Harvester Trust located its plants. These influences have made Chicago's manufacture of agricultural implements five times as great as that of any other city in the country, although in 1880 it was but half as great as that of Springfield, Ohio. All the other centers of importance are located in states near or bordering on the Great Lakes. Lake shore localities have as favorable conditions for the assembling of raw materials as are to be found anywhere. On or near the shores of these lakes are abundant supplies of wood and iron, the chief raw materials used. Some firms have developed so far as to own forests and sawmills in Missouri and Arkansas, iron mines on Lake Superior, and blast furnaces at Chicago for the manufacture of iron and steel. Important centers in a position to share Chicago's advantages are South Bend, Indiana, and Racine and Milwaukee, Wisconsin.

The westward trend of the industry is shown by the fact that Springfield, Ohio, once the second city in importance, has recently been surpassed by Moline, Illinois—a town on the banks of the Mississippi River distinctly to the west of the important manufacturing part of the United States, a fact reflected in its present great dependence on the manufacture of agricultural implements. Peoria, Illinois, and Richmond, Indiana, are other important centers. Thus far the export trade has not led to the manufacture of this machinery in seaports convenient to the place of shipment, nor is there any apparent prospect. The export is a by-product of the huge home industry which amounts to nearly half a billion dollars.

Interchangeable parts. The manufacturing of agricultural implements has received a great impetus from the practice of making machines with interchangeable parts, so that one machine in the factory turns out one piece which will fit any one of the thousands of a given kind of completed machine in the field. Be-

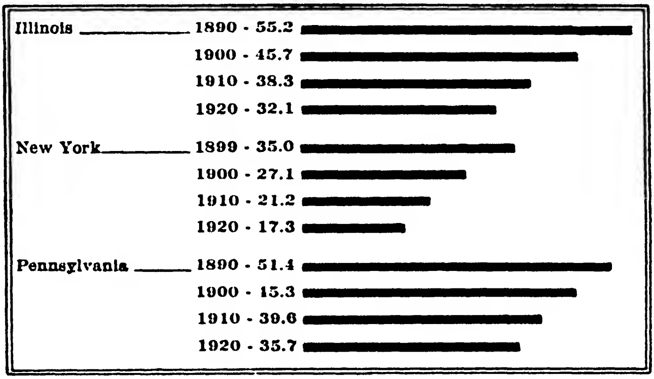


Fig. 221.—Rural population: percent of tota's. The supply of machine-made agricultural products has combined with the factory lure to cause a steady decline in the proportion of our population that lives on farms.

fore this practice was established, a breakdown in the field meant that the machine had to be taken to some nearby expert mechanic to be repaired. With interchangeable parts, the owner of the broken machine can get quick repairs, by ordering a new piece by catalogue number from some nearby warehouse—an ability which has made possible the easy use and prompt repair of Chicago reapers and Moline plows in the wheat fields of Argentina or Russia, thus greatly stimulating our foreign trade.

The interchangeable part, by emancipating the user from the limitations that follow distance from the factory, has enabled the American manufacturer to reap the advantage of the adjustment of his product to the environment. American agricultural machinery has, as the result of numerous inventions and specializations, been made to fit the great variety of conditions existing in the United States, and for this reason it also suits any other country. Each kind of land and of farming has had machinery adjusted to it; thus we send machines of the so-called "stump jump" types to the newly cleared Australian "Bush." In contrast to American adjustment to special needs, the English have long prided themselves on the substantial character of their manufacture. Much of the American agricultural machinery is lighter in weight, less durable, but less expensive, and for these reasons it appeals strongly to the frontier bonanza grain farmer with his limited capital, whether he be on the plains of the United States, Canada (taking 27 percent of this export), Argentina (26 percent), Australia, or Russia, in all of which countries our machinery is much used. This combination of patents and adaptation in addition to the fact that American factories now specialize in rapid quantity-production and belt assembly has enabled us to often undersell foreign countries with cheaper labor and approximate equality of raw materials. We are even exporting over a million dollars' worth of agricultural machinery per year to the United Kingdom, long our chief rival, while France takes one-tenth of our total shipments.

THE WAGON INDUSTRY has an economic kinship with farm implements. Wood and iron are the raw materials in both; both are relatively bulky when completed, and, therefore, need to be made near the market, which is located primarily in the same region. Every farmer must have one or more wagons. The fitness of the North Central states for leadership in both industries is therefore explained.

The deciduous trees or hard woods (see chapter on Lumber) furnish nearly all our wagon woods. Second-growth hickory, which was picked out by Peary to make the sledges for his dash over the Arctic ice fields towards the north pole, is one of the monopolies of the United States. This wood, unrivaled for strength combined with elasticity, grows from New York to Georgia and Missouri, and is used for making the spokes and hubs of wagon wheels.

The manufacture of wagons has gone through the process of concentration similar to that which has occurred in the shoe and textile industries. Two generations ago the country blacksmith and wheelwright had their shops side by side. One did the woodwork and the other the ironwork, and they manufactured wagons for their neighbors, while the shoemaker next door made the shoes and the tanner at the foot of the mountain made their leather. As shoe machinery has replaced the shoemaker, so automatic woodworking machinery has displaced the country wagon-makers whose hand-made product can no longer compete with the cheaper product of the factories in the North Central states, which send their output to every state and county in the Union, and, in limited amounts, to foreign countries.

3. THE AUTOMOBILE INDUSTRY

The automobile, although only thirty years old, has already assumed vast, almost revolutionary proportions in the social and industrial life of America. What steam did for long distance transportation during 100 years of development upon sea and land, the internal combustion motor has already equaled and in some respects excelled in three decades of development for short distance transportation. It has been estimated that the motor cars on the highways of this country now carry yearly ten times as many passengers as do all of our railroads. From an expensive plaything and a luxury for the wealthy, the motor car has now become an everyday conveyance for everyday working people, especially in rural America, where its use has made living conditions easier and more pleasant for millions of farmers and artisans. The automobile has now become thoroughly interwoven with the fabric of American life and activity and has eclipsed all previous records for a sweeping change in a people's mode of living.[1]

SWIFT DEVELOPMENT OF A NEW INVENTION. The first automobiles were made in France about 1891. A few years later pioneer inventors and mechanics in the United States began to experiment with this new mode of locomotion. The early automobiles were rude adaptations of high-wheeled carriages, into which a one-cylinder gasoline engine was installed. They usually gave more trouble than service. It was years before the standard four-cylinder engine of to-day became practical, as in the early models one cylinder could stall all the others. Gradually American engineers improved the motor, the transmission, the chassis, the body, until

[1] The motor car has increased the radius of suburban residential territory near our large cities. Ten or twenty miles to work is not a difficult drive, and it is possible for the city worker to live in a nearby village, or have a country home with an acre or so of ground on a convenient highway.

the automobile became easy to operate, reliable enough to be used day by day by the ordinary individual, and cheap enough to be purchased and driven by even the workingman and the farmhand. Since 1910 cheap and medium priced cars have been made and sold in such enormous numbers in the United States that by 1925 there was one for every six people. France, the second largest automotive manufacturer had one for each 90 inhabitants, while in Germany only one person out of 320 owns an automobile. Out of a

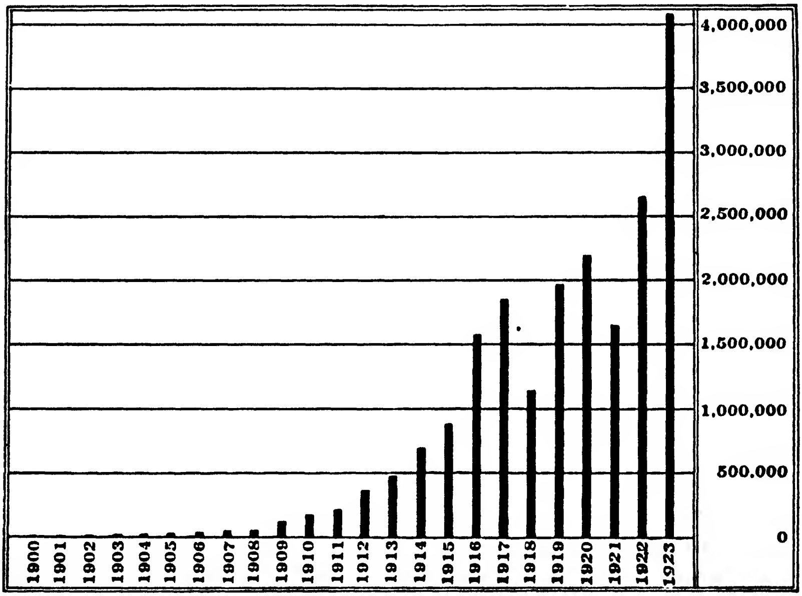


FIG. 222.—United States production of motor vehicles, 1900-23.

total of 21 million motor vehicles registered in the world, the United States now (1925) has nearly 18 million.

The speed of the arrival of this industry is illustrated by these two facts. In March, 1905, the *New York Tribune* reported that the appearance of two automobiles on Riverside Drive, New York, had made much commotion by scaring horses, and gave the names of persons injured in resulting runaways. Twenty years later there were 421,105 motor vehicles registered in Greater New York, and if there had been room for them there might have been many more. Meanwhile, as evidence of the almost unbelievable riches of the American people (the machine-using American people), Vienna, with its nearly two million population, had 3,200 private automobiles.

LOCATION OF THE INDUSTRY. In the strictest sense motor car manufacture is not a new industry but rather a successor to the American carriage industry. It was a natural development for the large carriage makers of the middle west to take up the manufacture of this new kind of vehicle, propelled by a new kind of horsepower, and many of our present-day automobile factories are a continuation of well-known carriage and wagon factories. The rapidity with which the motor superseded the horse for driving purposes is evidenced by the fact that in 1904 the United States produced nearly one million carriages and 22,000 automobiles, but in 1923 the carriage output had dwindled to a bare 10,000 while we were making 4 million motor vehicles.

The lower lake region with its cheap water transportation and its supplies of heavy metal and wood, is a natural place for this industry. In addition to ore vessels, coal barges and lumber vessels, it has also the best of railway transportation, for it is threaded by the various lines connecting Chicago with Philadelphia, New York, Boston, Montreal and other large eastern cities. This region is also close to the population center of the North American continent.

In this natural manufacturing area, the early dependence of the automobile industry upon other factories and machine shops gave it a strong tendency to build up recognized city centers where metal working predominated. In the automobile area, which includes among others Cleveland, Toledo and Akron, Ohio, Indianapolis, and Chicago, the city of Detroit, strategically located on the water route between the Upper and Lower Lakes, has become the recognized leader. In spite of the favorable location, it was probably an accident that made Detroit the center, rather than Toledo or Cleveland or some other city—the accident of having the Ford factory, where the principle of cheap mass production was first applied to the motor car. Detroit has become a busy hive of metal-workers, with over 60 percent of her products in 1919 coming from some form of metal manufacture, of which three-fourths was from the automobile industry. Motor cars and the allied metal industries in the first quarter of this century have caused Detroit to increase its population fourfold, Lansing, fourfold, Flint, eightfold, and scores of other Michigan towns have shared this growth.[2] No other industry has a national field for its distribution that is quite so extensive or uniform as that of the motor car. It promises on the average an enduring prosperity to its workers.

MASS PRODUCTION AND LOW-PRICED CARS. While this country produces some of the finest and most costly of motor cars, its greatest achievement has been in standardization and mass production, with its resulting low prices. The early cars were built individually, each part ground and tooled to fit its particular fellow. Then, by the extensive use of automatic machinery, American factories began to make standard wheels, axles, bolts, nuts, bodies, and engines, all so alike that any part would fit any other. The parts are turned out in indefinite quantities and the cars are put together by the use of a belt conveyor. The conveyor passes between rows of workmen, each repeating his small part of the speedy and endless assembling performance. As the growing car moves along in front of the workers piece after piece is bolted into its proper place. An engine already assembled in another part of the factory swings out on a little crane, drops upon the moving frame and is bolted on. A gasoline tank follows, and after a few more finishing touches a car rolls off on its own wheels, ready for its trial run. Behind it, the endless belt is full of other cars, each going through the various stages of assembly. So rapid is this process and so thorough the organization that the Ford factory is able to turn out over 6,000 cars a day. This leading manufacturer of low-priced, standardized cars, has increased its production by cost-cutting methods, from 1,700 cars in 1903 to over 2 million automobiles, trucks, and tractors in 1923.[3]

[2] Urban growth has often been at the expense of the rural districts. The lure of high wages in automobile factories caused thousands of farms to be abandoned in Michigan alone in a short period after the 1921 slump in farm prices.

[3] The Ford Company with its unprecedented surpluses has built up a gigantic example of vertical consolidation of industries. It makes most of the things it needs, even down to glass and paint. At River Rouge near Detroit is an iron plant smelting ore dug from Ford's own mines, using coal brought from Ford's own coal-lands in Kentucky and carried from Toledo to River Rouge in Ford's own boats. Ford's steamers carry lumber to Detroit from Mr. Ford's large timber holdings in the Upper Lake Region. Forestry is being applied to the 125,000 acres of coal-lands in Kentucky and also to Ford's other timber-lands. Mr. Ford's railroad, the Detroit, Toledo and Ironton, renders great service by connecting Ford enterprises with each other and with various markets.

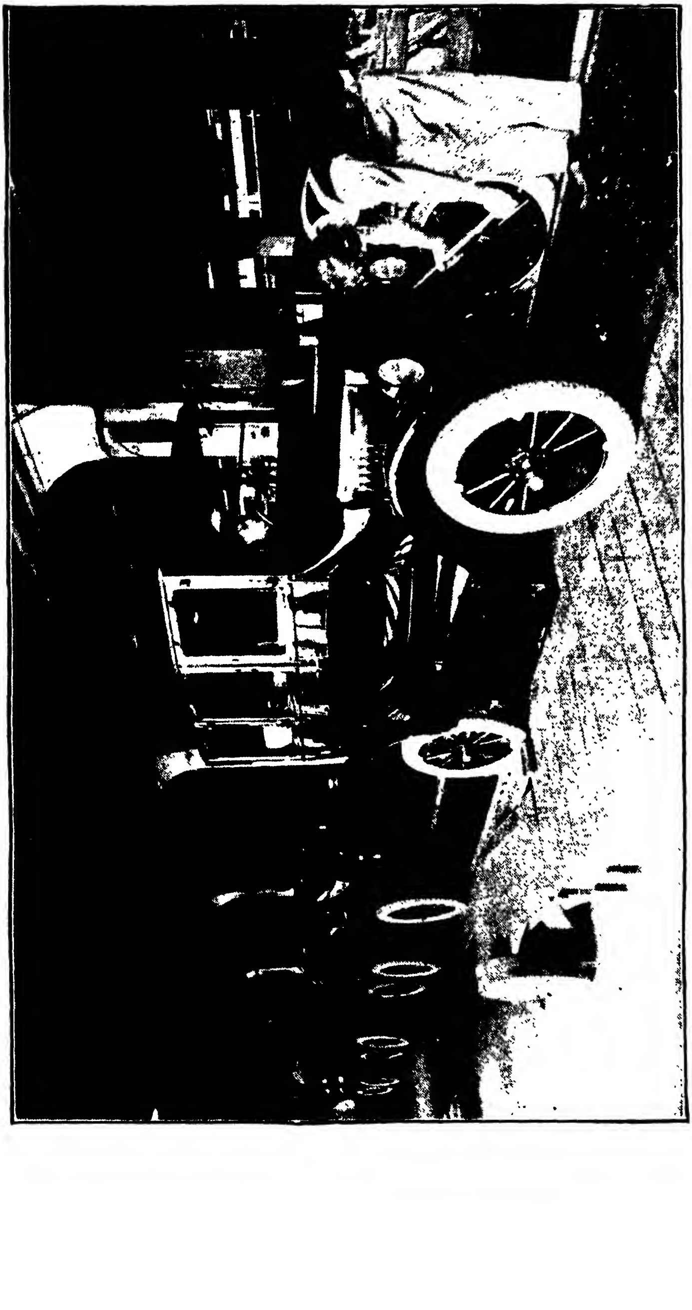


FIG. 223.—Last operation in a motor car assembly. Note the endless chain conveyor on which the cars are carried forward. (Ford Motor Company.)

The standardized machine is far from being the best that can be made, but it is a wonder for the money. It has been well said that there are about ten million farmers in the United States who cannot afford to be without automobiles, now that standardization has made them so cheap.

OTHER EFFICIENT PRODUCTION METHODS. The Ford factory has not been the only automobile plant to standardize, systematize and cut production costs in every way possible. The larger and more expensive cars are also made in factories which use only the most modern methods and the best machinery that money can buy. Savings have been made possible by building large plants fitted with special equipment of the latest design for short-cut production in building motor blocks, bodies, tops, and in many cases every possible part used in an automobile. In many of these plants almost every possible operation in manufacturing a car has an automatic machine doing the work, and doing it much more quickly and accurately than could be done by hand. Power trucks are used to keep every workman supplied with materials. Automatic conveyors, electrically driven, are everywhere, and overhead cranes deposit heavy castings and motor blocks in the exact spot where wanted. The middleman's profits have further been eliminated by manufacturers who have erected their own forge shops, electric power plants and iron foundries. These efficiency methods have been so successful that the automobile industry has risen to first rank in value of product among all the manufacturing industries of America.

FOREIGN TRADE IN AUTOMOBILES. While America has no monopoly on the mechanical or administrative skill requisite for the production of automobiles and motor trucks our high domestic buying power has enabled us to lead the world in this branch of manufacture. France, England and Germany still specialize largely in producing expensive custom-made cars, while most of the American manufacturers have adopted standard designs and quantity production. Europe makes fine cars but they are too costly for the average man. Europe is also an old continent, heavily populated, with many of its natural resources already on the decline, and a much lower per capita wealth. Hence it has not the consuming capacity for large numbers of automobiles.[4]

[4] The largest automobile plant in the British Isles is the Ford Branch Plant at Manchester—capacity 30,000 cars in 1924.

American imports of motor cars have decreased until they consist of only a few high-priced and specially built cars. On the other hand, the American Ford car, universally acknowledged as the standard cheap road vehicle of the twentieth century, is shipped all over the world and driven in every land. The popularity of the standard makes of American low-priced and medium-priced cars has been due not only to cheapness and efficiency, but in no small measure to ease of repair. The car owner or local garage man in Argentina, Australia or South Africa is not dependent on a machine shop for his repairs, but can usually obtain from his dealer a duplicate part whenever needed and make the repairs himself. Consequently, our exports of automobiles and parts in 1924 were not only greater than all the rest of the world combined, but were third in value of all United States exports, being exceeded only by raw cotton and wheat.[5]

MINOR AUTOMOTIVE MANUFACTURES. The motorcycle, a development of the once-popular bicycle, provides one of our important minor industries. The motorcycle might have become still more popular in the world of transportation except for the fact that the cheap four-wheeled automobile approaches it so closely in price and far exceeds it in utility.

It is yet too early to predict whether the airplane will duplicate the success of the motor car. Airplanes flew under control by a pilot for the first time in 1903 at Dayton, Ohio, and at Kitty Hawk on the North Carolina sands. For two decades the makers of airplanes have been striving for safety and mechanical perfection, and the brilliant feats of aviators during the war stand out as significant advances in flying development. The trans-continental mail service and the recent adaptation of airplanes to commercial flying give promise that a new mode of transportation for mankind is on the horizon. As yet the airplane has become neither cheap enough nor safe enough to permit people at large to adopt flying as a regular method of getting from one place to another. The manufacture of planes for government and commercial uses, however, is a large and growing industry, not only in the United States, but in several of the European countries.

[5] While Europe was in death grips with a World War we captured the world (and European) market in automobiles. We have no monopoly on the method and by 1925 European use of these methods was beginning to cut in on our automobile exports especially in the low-priced car.

4. MACHINERY FOR MANUFACTURING

The manufacture of machinery for manufacturing tends to occur near to the place where used. Aside from the advantages of freights and transportation there is a great convenience resulting from the increased ease of running back and forth to see that specifications are carried out and repairs promptly delivered. There is yet another reason. Improvements in machines are most likely to be conceived by people who use and repair them and watch them while they work.

Textiles, our oldest modern industry, give ample illustration of these factors in the location of their machine supply industry. The bulk of the English textile machinery is made in Manchester, Bolton, Oldham, Accrington, and Rochdale, all of them in the Lancashire district. As this district has led the world in making cloth, so it has led the world in the export of textile machinery, in which Britain far exceeds all other countries together. The distribution of British exports of textile machinery is almost a record of the geographic distribution of the textile industry.

Worcester, Massachusetts, near the center of the New England textile field, and Philadelphia with its many mills, are leading centers for the manufacture of textile machinery. Other cities of southern New England, especially Massachusetts and Rhode Island, share in this manufacture, and as the textile industry is growing in Philadelphia, so also is the manufacture of textile machinery springing up there.

Importance of metal-working machinery (machine tools). The machine tool is the keystone of machinery manufacture. It is a recent invention for the easy shaping of the wood and iron parts of the machinery upon which manufacturing depends. The fashioning of wood and metal can be reduced to a few simple mechanical operations—planing, boring, turning, milling, and slotting, which have for ages been done by hand or by very simple mechanical aids. For each of these operations large, heavy, expensive, but exceedingly efficient machines have been devised. Planing machines will, when once set and started, work for hours smoothing one side of a piece of metal as big as the floor of one or two small rooms. Boring machines will make holes as desired, milling machines will cut notches upon the outside of pieces of wood or iron, and by this process will take a smooth, round disc of metal, and, with no attention whatever from the operator, grind away for hours leaving it a completed cog wheel. Lathes make pieces of wood or metal almost any shape that a pattern may prescribe, even when the pieces are as thick as a man is high and as long as a telegraph pole. The irregular shaped handles of axes and hatchets are good examples of lathe work, and even the last for a shoe is a product of the turning lathe. The fifth of these fundamental machines is the slotter which cuts any kind of grooves in metal or wood, and like the other four works by mechanical power and needs little attention from the operator. These mechanical units have been combined into a class of machines called turret lathes which perform a number of different operations by having tools arranged on a rotating wheel, each of which automatically comes in turn to do its part of a finished whole. Thus a rod will be cut into a series of perfect bolts, nuts, or screws of exact dimensions and each just like all the rest. That likeness is the great economic secret of this mechanical age. These mechanical means produce the many parts which, upon being put together, make the complex, efficient machines of the modern factory.

Many of these machine tools have been improved to the point where they become automatic. This condition is attained when a machine will take pieces of material and turn out a uniform product. Thus a roll of wire is fed into one end of a machine and finished wire nails come out at the other. A roll of brass or steel wire is by these processes converted into screws and each of the three necessary processes is done by a machine that takes the blanks by the bushel and works them up into a finished article of remarkable cheapness.

THE MANUFACTURE OF MACHINE TOOLS. The machine shop is the market for machine tools, and the machine shop is located where machinery is to be repaired or made. It is plain that repair shops, even more than plants for new construction, must cling to the places where machinery is used. The machine-tool industry is therefore located by the machine users, and interesting responses of location result. It is an industry without any great center, but in seeking its market it tends to concentrate in regions of important manufacture. Thus the lower lake region with its natural resources for the manufacture of automobiles, agricultural implements and other metal products, has become one of the recognized centers for machine-tool manufacture. Detroit, Chicago, Cincinnati and

Cleveland are among the leaders, while Hamilton and Dayton are also important.

In the East, Philadelphia is a center for this line of manufacturing, because of the need of her textile mills, her engine factories, her locomotive works, and the shipyards of Camden, Chester, and Wilmington upon the Delaware.

In New England, the mother of our manufactures, machine-tool making is important in Worcester, Massachusetts, and surrounding towns, for without them the manufacture of textile machinery, firearms, and other metal products, could not well go on. Machine tools are also made in Providence, Rhode Island, and New Bedford, Massachusetts, both of which are textile centers, and in Hartford, Waterbury, and New Haven, Connecticut, close to the varied manufactures of southern New England. It is almost impossible to appreciate how definitely the machine tool, maker of other machines, is at the very base of this modern economic society. It is a good exercise to enumerate its services.

Engines and motors. Engines or electric motors are used in almost all kinds of factories, and also in nearly all mines and on many farms. Their market is not quite so restricted as that for machine tools, but their manufacture is located by the same factors and is distributed in the United States from Lake Michigan to the Atlantic and southward to southern Pennsylvania. Some of the heaviest engines in the United States are made at Milwaukee, Wisconsin, which is conveniently located to distribute them by boat to all manufacturing cities on the Great Lakes and by rail to the North Central States and the mining regions of the Rocky Mountains. Further east, Pittsburg with its huge iron-manufacturing plants, requiring so much heavy machinery, is an important center for the manufacture of heavy engines and electrical machinery. Philadelphia, New York and environs, and southern New England have other important engine manufactures. At Schenectady, New York, on the main line of railway from Boston and New York to the West is one of the greatest electrical manufacturing plants in the world.[6]

In the manufacture of engines, Germany is the leader on the scientific side. Science is respected more and taught more there than in any other country, and new types of engine are primarily the result of a great amount of scientific study and experiment.

[6] See opposite page for footnote.

Another force driving to this result is the German scarcity of good fuel, a fact which places a premium on economical power generators. One of the most significant of the German inventions is that of the Diesel engine, which burns low-grade fuel oil as automobiles do gasoline and develops power more cheaply than any of our other internal combustion engines, and far more cheaply than a steam turbine.

5. MACHINERY FOR TRANSPORTATION

RAILWAY CARS. Transportation, which plays so vital a part in this country, employs an enormous number of people. The mere building and repairing of the two and one-half million freight cars employs more laborers than does the cotton industry in Great Britain, and the number of workers, 600,000, far outranks the 462,000 in the American cotton industry. The annual value of this work exceeds $1,900,000,000, an amount greater than the value of the product of the American blast furnaces.[7] Although every railroad has repair shops scattered along its lines at junction points and at ends of divisions, this work is, so far as possible, concentrated in the best locations. Illinois, with Chicago, the greatest railroad center in the world, leads all the states in the Union in the manu-

[6] MACHINERY EXPORTS OF THE LEADING COUNTRIES

	1910 millions (*a*)	1920 millions (*a*)	1923 millions (*b*)
Great Britain	$142.0	$ 232.1	$203.4
Germany	119.0	112.5	125.2
United States	110.0	536.3	260.6
France	20.0	37.0	49.9
Belgium	12.0	17.1	16.1
Switzerland	14.0	47.5	27.3
Netherlands	6.0	10.6	9.5
Sweden	......	31.7	29.3
Canada	......	14.6	15.9
All other	43.0	40.6	37.8
Total	$468.0	$1,080.0	$775.0

(*a*) From Chart in The Philadelphia Commercial Museum.
(*b*) From *Commercial America*, July, 1924, page 15.
These figures merit careful study.

[7] The United States has well over 2½ million cars (about 2,650,000). We have in addition 50,000 locomotives in service, the highest number in our railroad history, also 14,000 locomotives in repair shops.

facture and repair of cars. In addition to having a great many railroad repair shops upon the numerous lines which have their headquarters in Chicago, there is at Pullman, a suburb of that city, one of the largest car factories in the world, devoted almost exclusively to the manufacture of parlor and sleeping cars. The recent rapid change from wood to iron as the material for car making tends to locate car manufacturing in the iron belt, and the Pittsburg district of western Pennsylvania is now a great center for the manufacture of steel cars. There are also important manufactures of this product in western New York, southern Michigan, Indiana, and Missouri. St. Louis, the great railroad center for the southwest, is an excellent place for the manufacture of this class of railroad equipment and it also has one of the two largest trolley-car manufacturing plants in the United States, its only rival in size being in Philadelphia. Owing to standardized manufacture and individual repair, and owing to the violence of their use, the repairing of cars in the United States employs eight times as many men as their construction, and the cost of new cars is less than one-third the cost of the repairs. With street-railway repairs the ratio of repairs to cost is over four to one, but the total of both repairs and cost is only one-thirteenth as great as for the steam cars. Manifestly the repairing of electric cars must be in the localities where they are used.

LOCOMOTIVES. In the manufacture of locomotives, Philadelphia leads every city in the world. One plant there makes about one-third of the output of the country, and, with the assistance of plants at Pittsburg and Scranton, gives to Pennsylvania one-half the entire output of the United States. Philadelphia's leadership is due to no one cause. It is an industry which, so far as the general situation is concerned, is almost equally at home anywhere between Chicago and New York. The Philadelphia plant has a unique labor organization, the city has excellent supplies of coal, is reasonably near the sources of iron, and, being a city of homes, has an abundant supply of workmen for the plants. The great locomotive works of Philadelphia have outgrown their city location and are gradually moving to a more roomy suburb on the banks of the Delaware.[8]

[8] "The Norwegian steamship Kaponia will sail to-day with fifteen completely equipped locomotives, built by the Baldwin company, and loaded at Eddystone. It is the first time in the history of the port that such a large shipment of locomotives completely equipped has been shipped from here." (News item, July, 1923.)

New York state produces one-fourth of the locomotives of the country, the most important center of manufacture in that state being in the city of Schenectady, which also produces so much electrical machinery. The ease with which a locomotive can run to its place of final delivery on the American railroads makes this branch of machinery manufacture less dependent upon market and more dependent upon labor than are most kinds of machine manufacture.

Few important industries approach locomotive manufacture in the extreme degree of fluctuation in prosperity. In periods of promising traffic and easy borrowing, the railroads order locomotives, and at other times they do not. The booming prosperity of 1906 resulted in the manufacture that year of 6,592 locomotives in the United States. After the panic of 1907 the output of 1908 fell to 2,342.

6. EUROPEAN MACHINE MANUFACTURE

The European manufacturing districts have in their midst a machinery manufacture similar to that of the United States. The most important manufacturing region in this country, bounded by a line connecting Chicago, Boston, Baltimore, and St. Louis, thence back to Chicago, has its counterpart in Europe in a line connecting Edinburgh, Berlin, Vienna, Florence, Lyons, Dublin, and thence back to Edinburgh. This European manufacturing district is older, its industries are in some respects more advanced, more mature and more refined than those of America. One of the most conspicuous differences between American and European machine manufacture is the greater element of labor value in much of the European output. This arises naturally from the cheaper labor of Europe. The high cost of labor in America has driven us to the second difference, the greater degree of inventiveness which shows itself in the excellence of our automatic machines and the superior design of many of our machine tools. It is manifestly design, rather than cheapness of material or skill of workers, that causes the great Swiss firm of Sulzer, manufacturer of engines, pumps, and refrigerating machinery, to secure half of its machine tools in the United States. The increasing excellence of German and other European machines of this type is leading to the prediction that our leadership through patents is temporary, and that we may lose some of our machinery trade. As further evidence of this increasing European similarity of industry is the opening of an Italian thrashing-machine factory that has cut off the import of those machines. Most suggestive of all is the opening in various European countries of branch plants by American companies. This has long been the case with sewing machines, and one of our American agricultural implement companies has an established policy of building European branches.

The European machine plants are usually smaller than those of the United States. As the home market is usually the main dependence there as elsewhere, the possibilities of market have been much smaller than in America, and the rapid expansions so common in America are not common in Europe. Our huge automobile and locomotive plants which sometimes increase their output several hundred percent in a year's time are a source of wonder to most Europeans, but one significant fact should not be overlooked. The World War forced European munition makers to standardize and specialize. They achieved an excellence (in munitions) that we have never attained. The industrial effects of this should begin to appear shortly.

7. SHIPBUILDING

How ships are built. The ship is the largest object that man can move, the most complex of all his devices, and the one with the most thoroughly correlated parts. The usual method of building a ship is to lay down its keel or backbone upon a series of inclined blocks called a "way," from which the ship is finally allowed to slide into the water when the hull is completed. As it lies in the water the masts and machinery are added and the finishing work is done. In some places the method of building is varied by laying down the keel in a large dry dock, from which the water is pumped but into which it is allowed to run to float the ship when it is finished. Sometimes for repair work, especially of war vessels, floating dry docks are constructed which can be taken from place to place and do repair work where needed. A Brooklyn company has a floating drydock with the ability to lift clear of the water a ship 725 feet long and weighing 30,000 tons. The method of ship construction shows the necessity of locating ship yards upon deep, quiet rivers with an abundance of available land along the shore. It is better that the shipbuilding river have fresh rather than salt water, because it is less injurious to the hull of the ship. All of the important shipbuilding localities are near to iron- and steel- and machine-manufacturing districts.

INFLUENCE OF DIFFERENT SHIPBUILDING MATERIALS. The American shipbuilding industry has had its ups and downs, due partly to the influence of the change in building materials. From 1800 to 1850 the world's ships were wooden sailing vessels, for which New England, with her pine forests, not far from the oak sup-

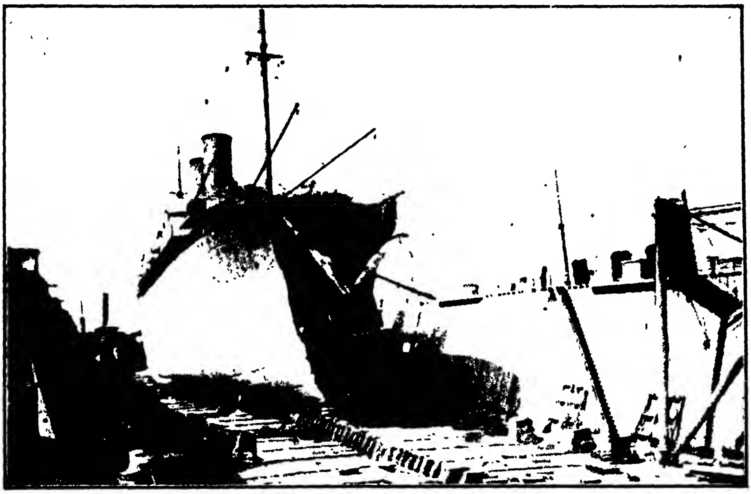


FIG 224.—Steamer in dry dock at Fifty-fifth Street, Brooklyn, after collision off Massachusetts coast. Steel construction preventing shivering of ship and water-tight compartments preventing filling and sinking. Ships are sometimes built in dry docks like this one.

plies of the Middle Atlantic States, had the best and cheapest material in the world. All along her coast, especially in Maine, many shipyards were turning out vessels that were better and cheaper than those built in Europe. About the middle of the nineteenth century it was discovered that iron ships were better for most purposes than wooden ships, and their use rapidly increased. Iron was later replaced by steel. In the supply of the raw material for this new type of ship, England, with her leadership in the iron industry, was far ahead of the United States. Within the United States similar changes occurred. In the wood ship era before the Civil War the output of the New England yards was nearly twice that of the Middle Atlantic and Gulf Coast, but the latter, adjacent to iron and steel supplies, had twenty times the New England output in 1923.

BRITAIN LEADS IN SHIPBUILDING. England normally builds ten times as many ships as we do. Her leadership since the latter part of the nineteenth century is due partly to cheaper raw material, partly to cheaper labor, partly to the limitations of home opportunities, partly to the habit of seamanship, but largely because she is a world trading nation and needs shipping to import her raw materials and export her manufactured products. Having capital to invest is another factor. During the World War Britain temporarily lost her shipbuilding supremacy to the United States, when we built ships as we built Ford cars, but peace-time adjustment has again made her the source of the world's shipping.[9]

With the cheapest iron in the world, produced immediately beside the sea, England's advantages in the shipbuilding industry were even greater than for the cotton industry. Her methods have also been the best. In America and on the continent of Europe, vessels are commonly built one or two at a time, but in the large shipyards of the British shipbuilding centers upon the River Clyde in west Scotland, the Tyne in northeast England, and the Irish harbor of Belfast, a half-dozen or a dozen steamers all alike are built at one time. As each part is duplicated several times, the cost for each ship is less than when built singly.

The single city of Newcastle on Tyne built more shipping (240,000 tons) in 1922 than the whole United States (219,000 tons) in the same year. The Glasgow district equals the Tyne, and the cities of Sunderland and Greenock each rival the United States in normal peace-time output.

For some decades England has been the chief source of supply for the shipping countries carrying the world's ocean freight. Thus Norway, a land of sailors for fifteen centuries past, has had to turn to British yards for ships now that steel instead of Norwegian

[9] Having got started at shipbuilding about the time the World War closed the United States government inanely kept on for months. As a result whole fleets of steamers, a hundred or more in a place, lay idly in American rivers for years thereafter. Mr. Gregg, United States Bureau of Commerce, estimated the world's idle shipping at 11 million tons January 1, 1922, and 6 million July 1, 1924.

January 1, 1925, the tonnage under construction was as follows: Great Britain, 1,296,900; Germany, 379,000; France, 197,170; Italy, 154,790; United States, 58,174.

pine is the prevalent material. The navies of many foreign countries from Japan to Chile depend upon British yards for their vessels, and large amounts of partly used British shipping are annually sold to foreign owners. Britain built nearly one-half the world's vessels in 1922 and possesses a vast merchant fleet containing one-third the world's tonnage. British-built ships are also flying almost every flag upon the sea, and on January 1, 1925, the British shipyards had under construction 1,300,000 tons of new

WORLD'S MERCHANT MARINE

World's Merchant Marine (Figures from the Shipping World for 1915 and Lloyd's Register for 1922–23)

Country	Tonnage in thousands, 1915	Tonnage in thousands, 1922
British	19,988.0 (46% of total)	22,042.5 (34% of total)
German	5,072.0	1,887.4
American	2,380.0	17,062.5 (26% of total)
French	1,861.0	3,845.8
Norwegian	1,914.0	2,600.9
Japanese	1,680.0	3,586.9
Italian	1,442.8	2,866.3
Dutch	1,508.0	2,632.7
Russian	970.0	.....
Swedish	1,016.3	1,115.4
Austrian	1,016.6	.....
Spanish	876.0	1,282.8
Danish	745.0	1,038.1
Greek	830.0	668.1
Belgian	347.0	579.5
Brazilian	275.6	492.6
Argentinian	163.7	181.6
Chilian	86.4	131.4
Turkish	116.0	.....
Chinese	87.0	188.4
Portuguese	80.0	285.9
Cuban	.....	62.7
Esthonian	.....	45.3
Finnish	.....	213.7
Latvian	.....	40.1
Rumanian	.....	72.3
Peruvian	.....	101.2
Uruguayan	.....	76.3
Other Countries	.....	691.6
Flag not recorded	.....	309.1
Total for all Countries	42,742.7	64,370.8

vessels for 16 different nations. Her leadership in shipbuilding may be better appreciated by examining the table of the world's merchant marine (page 609).

SHIPBUILDING ON THE CONTINENT AND JAPAN. The rise of the German iron industry, the German merchant marine, and the German navy, caused the establishment of fine shipyards in the German ports, especially at Stettin, so that that empire built many fine ships in the fifteen years before the World War. In 1911 the German ship output was slightly larger than that of the United States, supplying nine-tenths of the German demand of that year. Germany lost nearly all of her large merchant fleet as a result of the war, but her shipyards have increased activity since 1920 and she is gradually replacing her shipping and again building up a fleet. In France there are shipyards in Marseilles, Havre, and Bordeaux; in Italy, at Genoa, Naples, and Venice, but the Italian output does not exceed 5 percent of the British. Most of the commercial or merchant ships that carry the commerce of Holland, of Sweden, of Spain, of Australia, of all South American countries and most of the foreign commerce of the United States (except for the temporary war boom) are built at the English shipbuilding centers of Glasgow, Dumbarton, Sunderland, Newcastle and Dublin, and the German port of Stettin. The shipyards of all the world have to pay more for their raw material than it costs the British. Their absence of tariffs gives low costs. Many foreign shipyards would not exist but for the favoring influence of governments providing for a naval necessity. Thus Japan, with no iron industry worthy of the name, now builds battleships complete, 14-inch guns and all.

INFLUENCE OF AMERICAN NAVIGATION LAWS UPON SHIPPING AND SHIPBUILDING. In order to afford protection to American shipyards, all vessels that engage in the United States coasting trade and all vessels of the American navy, are required by law to be built in this country. These two classes give the normal employment to our shipyards. Our navigation laws compel vessels flying the American flag to have American citizens for a certain proportion of the crew and further require that the men shall have better food and quarters than are provided on the ships of other countries. As the tariff protection to the iron and steel industry gives us high-priced steel, the American ships cost more both to build and operate than do foreign ships, and they cannot compete on the open sea. Thus practically all our foreign commerce before the World War was carried in foreign-built vessels which also bore a foreign flag. Our shipbuilding industry, therefore, has little to do with the foreign trade during normal times, and our large coastwise commerce and our navy do not even keep it in a flourishing condition.

American shipbuilding. Our shipbuilding has had a revolution in material which has tended to shift the location of the

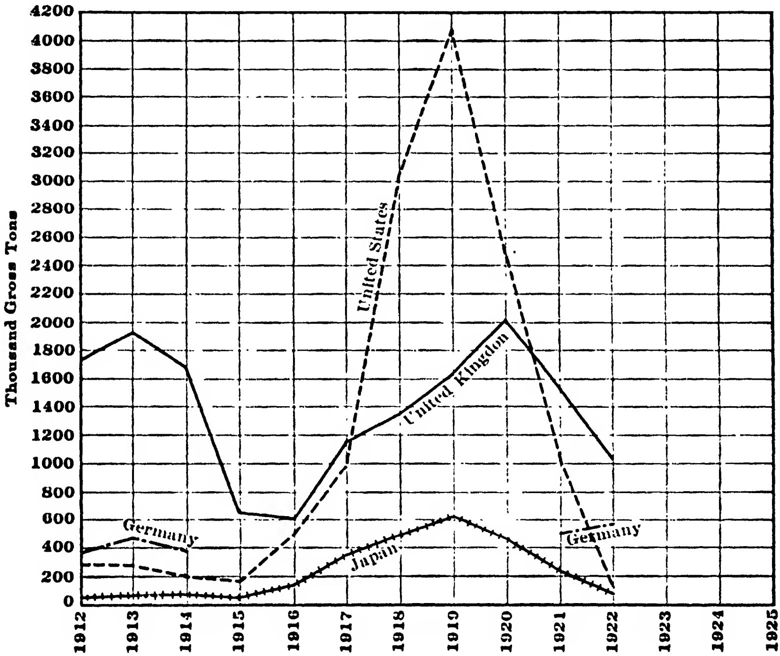


Fig. 225.—The peace-time shipbuilding of Great Britain is more important to the world than the war-time shipbuilding of the United States.

industry. Of the ships built in 1880 those made of wood were three times as valuable as those made of iron, but in 1905 those made of iron were five times as valuable as those of wood. This revolution has changed the character of our shipyards and changed the relative fitness of different regions for shipbuilding. New England, with its yards for building wooden ships, is not so well located to build iron ships as are cities in the Middle Atlantic States. The many yards at Brooklyn and other points upon the waters of New York harbor, make that our greatest single shipbuilding center. The Delaware, sometimes called the American

Clyde, with yards at Philadelphia, Camden, Chester, and Wilmington, is the most important shipbuilding river in America. There are also shipyards at Baltimore and Newport News on Chesapeake Bay. The more southern yards have less interference by ice, storms, and cold weather, and are about the same distance as Philadelphia from the great source of steel supply at Pittsburg. The yards upon Chesapeake Bay have a slight disadvantage in comparison with those of the Delaware and Boston bays because they are not so near the machinery and engine-manufacturing centers of the Middle Atlantic states and southern New England. Nature has favored this industry in the United States. The Clyde is but a creek dug out at great cost, while the Delaware is a wide open estuary with room enough to build the shipping for all the world.

Shipping upon the American Great Lakes renders great commercial service, and the vessels, being so large that they cannot leave lake waters, are built upon the lake shores. The most important centers are at Cleveland, Chicago, Detroit, and Buffalo, although there is some shipbuilding at Lake Erie ports other than Cleveland and Buffalo.

Although the Pacific states produce practically no iron, the need of equipment for repair work and the building of battleships has caused the establishment of first-class, modern shipyards at San Francisco, Los Angeles, and Seattle, but the normal output of new shipping is limited almost entirely to war vessels, a fact which suggests political influence and the idea of defense.

Shipbuilding during the war. The necessity of building ships fast enough to beat the submarine caused the development of a new type of ship construction in the United States during the World War. By minutely standardizing the vessels and limiting them to a few types, the builders were able to use the machine shops of the whole nation, rather than remaining dependent upon works immediately beside the river bank. Thus a bridge plant in Pittsburg, a boiler plant in Ohio, a structural steel mill in West Virginia, and a plate mill in Illinois made hundreds or even thousands of duplicate parts for hundreds of duplicate ships. Before one of the best known of the fabricating yards was even done, 49 steel works were making the larger parts for the vessels it was to build.

Like knock-down houses, parts of vessels were made all over inland America, delivered at the shipyards, and put together with all possible speed. Reaming, riveting, and caulking were done by engine power, through the aid of pneumatic tools, and the various yards vied with one another in the speed with which their fabricated ships slid off the ways. The New York Shipbuilding Company built at Camden, N. J., the *Tuckahoe,* a 5,488 ton vessel, in 28 days from the time the keel was laid, and made another record by fitting it out in 10 days more. The end of the war found the United States building ships much faster than a peace-time world needed them, so the huge shipyards, after finishing part of their contracts, were gradually dismantled. One of the results of America's war-time shipbuilding was to increase her merchant fleet of sea-going vessels from two million tons in 1914 to about 17 million tons in 1924, at which time we had ships to give away and no one to take them.

Standardization methods are not suited to the shipbuilding industry as a whole, but many of the economies learned during the war can be applied to the building of certain types of ships, such as oil tankers and freight carriers. The more a vessel can be standardized, the more it can take advantage of spare parts and the less it will have to depend on costly individual repairs. But it appears that only the British can apply these principles in times of peace.

NAVY YARDS. The enlarged navy of the United States requires Government Navy yards equipped for the repair of war vessels. As these repairs are often extensive, some yards are now able to build, and have built, large vessels and should therefore be ranked among the important shipbuilding enterprises of the United States. They are located at Portsmouth, N. H., Boston, New York, Philadelphia, Norfolk, Va., Charleston, S. C., Puget Sound, and Mare Island, Calif.

8. SMALL METAL MANUFACTURES

RELATION TO GOOD LABOR SUPPLY. An inspection of a hardware store reveals a collection of hundreds and even thousands of articles, such as saws, axes, cutlery, firearms and ammunition, radio sets, plumber's, tinner's and carpenter's tools, and that very long list of articles known as builders' hardware, nearly all of which are made of metal. A jewelry store reveals a collection of still more valuable metal products in which, as in the hardware, the metal plays a relatively small part, and the labor a large part in the cost of production. This high labor and small material value means that these articles are likely to be produced where population is abundant and manufactures well established, as in New England, not where they are scarce, as in Virginia, Kentucky, Texas or Oregon.

THE DISTRIBUTION OF THE INDUSTRY. The manufacture of most of these small articles in the making of which machine tools and automatic machinery are very important, particularly in America, originated in England and in Germany. It soon started up in this country, in southern New England, the home of the so-called "Yankee notions," and has gradually moved westward through New York and Pennsylvania into the North Central States. Thus, at Gary, Indiana, a suburb of Chicago, the United States Steel Corporation has recently built the most perfect steel plant in the world. In it ore is unloaded from steamer at one end of the enormous plant and from the other end are shipped many small articles that may be bought in a hardware store. In the meantime New England is holding a leading place by making more and more refined articles as regions farther west take up coarser branches of the metal manufacture. She continues to be a great center for the manufacture of firearms and ammunition, important industries of Springfield, Massachusetts, where rifles and revolvers are turned out by the tens of thousands and cartridges by the tens of millions. Two towns in Vermont make a large part of the fine scales that weigh goods all over the United States and also in foreign countries. Philadelphia has one of the largest saw factories in the world. A large part of the jewelry made in the United States is produced within 30 miles of Providence. Rhode Island, being the most densely populated state, becomes a natural home for such an industry, in which labor is so dominant a factor when you consider that both the valuable raw material and the finished product can be transported so easily. Silverware has its center of manufacture in some of the towns of Connecticut, which state also leads in the manufacture of clocks and watches, especially the very cheap varieties.

In this class of industries it is plain that America is at a disadvantage with Europe in the combined factors of labor and raw materials. We have made advantages by inventions, in which we have thus far led the world. Most of the articles of this type are patented, such as firearms, and typewriters, of which one factory in central New York exports millions of dollars' worth per year and sends its product to all lands. Sometimes the patent control lies not in the design of the article but in the method of making. Skill and fine workmanship make the cutlery and silver plate of Sheffield, England, known all over the world. When it comes to plain unpatented, simple things, labor decides it, as in the case of toys, of which the world's supply comes so largely from south Germany and from Japan.

STANDARDIZATION AND INTERCHANGEABLE PARTS. The New England clock business has been made possible by the American system of manufacture, in which standardization and interchangeable parts have replaced the old hand methods by which every clock was different. Switzerland has long been famed as the best watch-making country in the world, Geneva and vicinity being the center. These watches are made by hand, each wheel carefully fitted to the next wheel, so that if one breaks the new one has to be shaped by hand to fit its mates. By the American method of interchangeable parts, fifty watches can be taken to pieces, each piece put into its own bin, and the watches may then be satisfactorily reconstructed by chance selection of the necessary parts. Thus, Connecticut can make alarm clocks and cheap watches at extremely low prices, because of new methods of manufacture, perfected largely through American inventions. The house furnishing store has now entered the class of machine dealers, witness 4,300,000 vacuum cleaners in use in the United States. The number of kinds of useful machines is rapidly increasing—adding machines, writing machines, printing machines, talking machines, picture machines—of the making of machines there is no end.

The mechanical methods of manufacture, in combination with the patented devices owned by American firms, have enabled the manufacturers of New England, New York, Pennsylvania, and Ohio, to sell builders' hardware, rifles, bicycles, clocks, typewriters, and many other patented articles in many foreign countries, despite the fact that England and Germany have cheaper material and cheaper labor. Apparently this trade can only be kept up by the continued improvement of the patterns and methods, for if an article, like a microscope for instance, falls into the class where it is a plain matter of labor and skill, it is made where skilled labor is cheapest. Thus America has never thought of establishing a wood-carving business. It belongs in Europe as the yet more difficult ivory carving and lacquer-work belongs in the Far East with its cheapest and most skillful of all labor. Indication of this adjustment of industry to population is shown by the complaints of German makers of cheap clocks that Japan is selling them in China at prices no European manufacturer can meet.

EUROPEAN JEWELRY CENTERS. The centralization of jewelry making in the United States around Providence is matched in England by the leadership of Birmingham, and in Germany by the towns of Pforzheim and Hanau. Pforzheim became the residence of fleeing French Huguenot jewelers, and the industry was well established 130 years ago. By 1907 there were 1,078 factories, and 30,000 workers, a number nearly equal to all those of the United States. The town has special schools to train jewelry workers, many of whom work in their own homes. Hanau has world-wide fame for its manufactures of jewelry and jeweler's novelties. The fact that highly skilled workmen can be secured in Hanau for a very cheap wage is its only advantage, as all the raw materials must be imported.

REFERENCES

See General References

CHAPTER XV

CHEMICAL RAW MATERIALS AND MANUFACTURES

CHEMISTRY: THE LABORATORY AND THE FACTORY. Chemistry, the science, and the chemical industries are of universal importance in manufacturing. The printer depends upon them for his ink, the railroad builder for his dynamite, the blacksmith and the tinner for materials to make their metals weld, the glassmaker and iron manufacturer for chemicals for fluxing and reducing ores. The chemist produces the painter's colors, the dyes of the weaver, the tans of the tanner, the fertilizer for the tiller of the soil, the drugs and medicines for the apothecary and the physician, and raw materials and commodities without number. The processes of the chemical laboratory which supply these necessities are coming more and more to be performed in factories on a large scale (the work of the chemical engineer), as the basis of a rapidly growing industry of an importance in manufacturing that is to be likened only to the use of power. Every hour some new chemical is discovered or some new device is so perfected that another laboratory process may become an industrial process, with the result that the prices of many chemicals are rapidly declining and the output rapidly increasing.[1]

EARLY GERMAN LEADERSHIP IN CHEMISTRY. Germany leads the world in chemical industries, because her people are, upon the average, the most thoroughly educated and especially because her uni-

[1] "Are you the owner of the stocks, bonds or other securities of any of the more than 200,000 corporations engaged in manufacturing, mining, transportation and various other pursuits in this country? If so, you had better begin to make inquiries with respect to what the companies in which you are interested are doing in the matter of keeping in step with progress in chemistry and chemical engineering.

"The chemist is revolutionizing industry. He is developing new products and new ideas every hour of every day. As a result of this work flourishing industries are being scrapped overnight.

"Manufacturers go to bed satisfied that all is well with the world only to wake up the next morning to find that their businesses have been swept away while they slept."—Hugh Farrell, financial editor *New York Commercial.*

versities had developed the science of chemistry for decades before it was important in any other country. The trained chemist of the German university very early found employment in German chemical works, and thus gave Germany her easy leadership over all other countries. The German government has also encouraged this and other industries in many ways. Since 1880 many German chemists have sought employment in England and America, and many Americans, trained in Germany, have returned to this country, where the teaching of industrial chemistry has become general and the chemical industries are rapidly on the increase.

One of the far-reaching developments of the World War was the expansion of the American chemical industry to the point of virtual independence of foreign sources. The blockade forced American textile manufacturers to foster domestic dyes. With imports of foreign pyrites greatly curtailed, American chemists turned to the pure sulphur beds of Louisiana and Texas. The new industry, born of a war emergency and protected by embargo or tariff, became so strong that the United States is no longer dependent to any great extent upon German chemical interests. In its advancement toward industrial maturity the United States seems to have added the chemical products to its list of self-sustaining industries.

I. THE RAW MATERIALS

The chemical industry resembles the textile industry in having a few raw materials of great importance, and a host of minor ones. Thus sulphuric acid, most important of the acids, soda ash, similarly important among the alkalies, nitrate of soda, the potash salts, ammonia, and coal tar are to chemicals what the major fibers are to textiles. In both chemicals and fibers the far ends of the earth have their contributions. Seeds and extracts from the plants and trees, rare minerals, and even the sea water itself are sources from which the chemist with his laboratory is ever fusing, distilling, and extracting new substances of use to mankind.

SULPHURIC ACID. Sulphuric acid is the most important manufactured material (6 million tons a year in the United States) used in the making of chemicals; and, for this reason, it is sometimes spoken of as the chemical barometer. Some persons even go so far as to say that one can gauge the civilization of a people by the amount of sulphuric acid they use.[2] Used extensively in fertilizer factories and nearly all other chemical works, it is made by a comparatively easy process from sulphur and water, and costs but a fraction of a cent per pound. Until within a decade ago most of the sulphur used in the manufacture of acid came from the mines of Spain and Italy. Formerly a large importer of sulphur from these two countries, the United States developed a sulphur industry of its own during the war, which has superseded most of the import of sulphur from abroad. Nearly all the sulphur produced in the United States comes from the Gulf coast deposits in Texas and Louisiana, where superheated water is forced down into the ground. This melts the sulphur which is then pumped out, giving a product of extraordinary purity. The United States can mine it and sell it so cheaply that we have become exporters of sulphur and to-day dominate the world's market,[3] with over three-fourths of the annual production, to the sadness of the Sicilian and Spanish sulphur digger. America has vast reserves to mine and it is predicted that sulphur for acid-making will be available at low prices indefinitely.

Sulphuric acid as a by-product of copper smelters can also be produced at a cost of only 58 cents per ton, and a company at Anaconda, Montana, is now making a high-grade super-phosphate and at the same time using up a noisome gas which was formerly destructive to the vegetation for miles around.

SODA ASH. Almost equally important with sulphuric acid as a chemical raw material is soda ash, or sodium bicarbonate, used in manufacturing of soap, glass, and many chemicals. It is chiefly made by the Solvay process, a Belgian invention that has done much to cheapen alkalies. The sodium in the soda ash is furnished by common salt, in the form of brine secured either from salt springs or by the easy method of pumping water down through the earth to the salt beds through one pipe and pumping it out by another after it has done the work of the miner by dissolving the salt hundreds of feet below. Coal, coke, and limestone are also used in the process of manufacture; and the plants are usually located where salt and limestone both exist. The chief works are at Syracuse,

[2] For varied uses, see *Mineral Industry*. The McGraw-Hill Co.

[3] The expected return of the industry to pyrite after the War did not happen, and so the United States' production increased from 300,000 tons before the War to 1,260,000 tons in 1918 and 1,880,000 tons in 1921 with an export of 285,000 tons.

New York, Detroit, Michigan, and other points along the salt deposits of these two states. The increase of this useful chemical product has caused a great decline in its import from Germany.

We are not compelled to depend upon factories for soda. Certain lakes in the western Nevada deserts are highly charged with soda to be had by evaporating the water; a similar lake at Megadi, East Africa, has dried up, leaving a crystalline bed of soda. These lakes with their hundreds of millions of tons of soda have remained unutilized because it was cheaper to make it near the place of consumption.

THE MANUFACTURE OF EXPLOSIVES. Explosives have long been the most spectacular of the chemists' products. Long used for destruction only, they have at last entered industry, and are performing rapidly increasing services, since dynamite has become cheap. Without dynamite and gunpowder the prosecution of the mining and quarrying industries, and the building of our railways, tunnels, subways, and canals would be impossible. Our per capita consumption of explosives amounts to over 5 pounds per year, and in 1910 we shipped over 10,000,000 pounds for use in the Panama Canal. The danger and consequent cost of transport is the dominating factor which scatters the centers of manufacture, as high freights scatter cement plants. The assembling of the raw materials is much easier than the handling of the finished explosives, but it is a distinct advantage to have the plants on tide water. The Delaware River has long been the greatest location for the manufacture of explosives, with the center at Wilmington, Delaware. The great danger of explosions causes the plants to be removed from city limits to isolated locations often in or on the edge of swamps. Among the raw materials for this industry nitrate of soda is important along with nitric and other acids, sulphur, and charcoal. Most of our chemical industries are capable of considerable expansion in time of necessity. Witness the fact that during the 19 months the United States was in the World War we produced 632 million pounds of smokeless powder and 375 million pounds of other high explosives. (Authority of Munitions Division, United States War Dept.)

THE PRODUCTS OF THE ELECTRIC FURNACE. Another new and important group of chemical products meriting mention here are those produced by electricity or electro-chemistry. The great heat of the electric furnace is used in the manufacture of a number of crystalline substances produced by the cooling of fluids made by the melting of refractory substances in the consuming heat of the electric spark. One of these is carborundum, and is made by fusing coke, glass, sand, and sawdust. Pieces of carborundum are exceedingly valuable when cemented together or made otherwise usuable as abrasives for the cutting of metal, stone, glass, or wood. Another of these products is artificial emery; and for making non-fusible retorts, the artificial graphite from Niagara Falls furnaces now far exceeds the output of the mines in the Adirondacks.

Calcium carbide is another product of similar process of manufacturing, namely, the fusing of materials under the great heat produced by the electric current. This material in combination with water produces the brilliant acetylene gas. It is manufactured at Sault Ste. Marie, Michigan, and at Niagara Falls, where the great power plants, run by the waterfalls, produce also all the carborundum made in America. These same products are produced in Norway and Sweden, where the moist Atlantic winds blowing against the high mountains give an abundance of rainfall and cause numerous swift streams that yield excellent water power for the production of cheap electric current, which seems to be the locating factor in this industry. Similar water-power advantages have developed the industry to large proportions in Switzerland which shares with Scandinavia the leadership in exports of this nature.

2. SUGGESTIVE MINOR CHEMICAL INDUSTRIES

"Essential oil" is the name applied to oils that are characteristic of particular plants. Thus the cinnamon flavor is in the essential oil which can be entirely extracted from the cinnamon bark. Essential oils enter largely into drugs, medicines, perfumes, and flavors. The extraction is sometimes by distillation, sometimes by other processes. The production of these oils is a combination of agriculture and chemical manufacture—agriculture furnishing the raw material. Orange, lemon, and bergamot oil are citrus products made chiefly in Sicily and Calabria, where the fruits are cheap and labor abundant. Lime oil comes from Montserrat and other West Indian islands.

India exports a number of seeds producing essential oils, and China ships, largely through Hongkong, nearly a million pounds a year of aniseed and cassia oils.

Another class of these oils appears in perfumery. The growers of Damascus roses in Bulgaria give to the western world its chief supply of the precious attar of roses. Its costliness results from the fact that to make one pound of attar of roses requires 11 tons of roses or about three million blossoms.

The principal perfume center of the world lies between the Bay of Cannes and the mountains beyond Grasse in southern France, though flowers for perfume come from every country and climate. The flower farms in Alpine villages are the mecca of lovers of perfume. From December until March fragrance is extracted from rosewood, sandalwood, and other herbs; in March work begins on fresh flowers, including the violet, and then the jonquil, orange blossom, rose, mignonette, jasmine, tuberose and cassia buds.

Essential oils are merely one class of chemicals and drugs. There are also numerous vegetable extracts other than oils, such for example as nux vomica and strychnine, the products of a bean yielded by a tree growing wild in the forests of India. The few oils and extracts mentioned here are suggestive of the rapidly widening use of a class of products in which discovery has but begun, and in which cultivation and manufacture follow on the heels of demand made effective by new laboratory processes.

Three great industries of a chemical nature, fertilizer, dye-stuff and soap, demand particular discussion because of their intrinsic importance and also because of their importance in enabling us to understand other industries.

3. THE FERTILIZER INDUSTRY

The heaviest of all chemical industries is that devoted to the production of chemical plant foods known as fertilizers. Of the several important chemicals necessary to the growth of plants, three —namely, phosphorus, potassium, and nitrogen—often exist in the soil in insufficient amounts or in unavailable forms, and must be supplied if prolific crops are desired. These three substances in many different forms and commodities are the main raw materials of the fertilizer manufacturer, and he ransacks the world to get them.

Guano. The first article extensively used as a commercial plant food was guano, the excrement and dead bodies of sea birds which have lived and nested in places where the rainfall is insufficient to dissolve and carry away the deposits. Of all the accumulations of valuables upon the surface of the earth, none have been more productive of easily gathered wealth than the guano beds of the rocky Chincha Islands off the desert coast of Peru, where for unknown ages myriads of sea birds had lived and nested. Upon the discovery of the value of guano, these islands became a mine rich with the newest fossil accumulations, and yielding between 1830 and 1880 about $600,000,000 worth of valuable plant food (nitrogen and phosphorus) which was chiefly taken around Cape Horn to Europe and America, and sold at from $30 to $60 per ton. As the taxation of this industry was most easy, it was for a long time the support of the Peruvian Government; but the exhaustion of the deposits has caused the industry to decline to an annual harvest of 40 to 50 thousand tons per year, of which the larger part is used in Peru itself. Small amounts of guano are still exported from the west coast of South America and from some of the drier West Indian and other tropic islands, but its place as a fertilizer has, since 1880, been quite largely filled by chemicals from widely different sources.

PHOSPHATES. The bulkiest, cheapest, and possibly the most important of these rival plant foods are phosphates, which furnish phosphorus to the plants. Much of the phosphorus of the world has been concentrated as phosphates in the bones of animals. Consequently, it is from animal sources, directly or in fossil form, that nearly all available phosphorus is obtained. Thus, ground bone is an important fertilizer, and for many years the bone hunters, with their wagons, roamed the western plains of the United States, getting these last remnants of the buffalo and cattle that had perished in blizzards, by the wolf pack, or by the hand of the hunter. Shiploads of bleached bones were picked up on the plains of Argentina and shipped to the fertilizer plants of the eastern United States and Europe. To-day the great slaughter house of the large city and the small butcher of the village both furnish their contribution.

But by far the greatest amount of phosphorus is now obtained by man from the fossil remains of animal life, known as phosphate rock, from which, by chemical process, fertilizers are made.

FOSSIL PHOSPHATES. No other country approaches the United States in phosphate rock resources. The lime phosphate rock in this country is usually found so near the surface that it can be dug from pits. This industry started near Charleston, S. C., but its greatest development now is near Tampa, Florida, which state produced five-sixths of our entire output of 3 million tons in 1923. Most of the remainder is mined in Tennessee. The phosphate deposits of Montana, Idaho, Utah and Wyoming are the most extensive yet discovered, and estimated to contain 6 billion tons of high-grade rock.[4] The location lacks the advantage of cheap water transportation to grain and cotton fields and mining has scarcely begun, but these western deposits constitute one of our great reserves for the high-priced future. In addition to supplying the American market, we export nearly a million tons a year, chiefly to England, Spain and Germany, about three-fourths of our export being shipped from the port of Tampa, which has the most modern phosphate-loading machinery in the world.

Northern Africa has phosphate deposits second in importance only to those of the United States. While the African phosphates are somewhat lower in grade than those of America, they are near the sea and so close to the hungry lands of Europe that in some years the combined output of Tunis, Algeria, Egypt and Morocco exceeds that of the United States. The development of these deposits is being pushed rapidly by French and British interests employing Arab workers.

The phosphorus only becomes available as plant food after it is dissolved, a service which sulphuric acid renders in the factory, making the so-called acid phosphate.

Of late years the so-called basic process of purifying iron and steel has given us a new source of phosphorus. The limestone linings of the furnace draw the phosphorus from the molten iron and steel, and are later ground up and sold under the name of basic slag, quite largely used as fertilizer in Europe. It is used less in the United States because of our fossil phosphates. The greatest seat of its manufacture is Germany.

Potash. The second great raw material in the fertilizer industry is potash, of which we are heavy importers (750,000 tons, 1923) chiefly from Germany and France. Potash differs from phosphorus in that there are vast quantities of low-grade material as a possible future dependence. Mountains of feldspar in various parts of the world contain about 8 or 9 percent of potash; but it is unavailable under the existing state of chemical knowledge. The whole world before the late war depended upon the mines of Stassfurt, near the Elbe River, in Germany, where, overlying a large deposit of common

[4] United States Geol. Survey.

salt, is to be found the most important collection thus far known of available potash salts, of which there are several varieties. This collection of natural chemicals makes Stassfurt possess the greatest variety of chemical works to be found in any city of the world. From it the materials of the soap-maker, the bleacher, the glass-maker, the dyer, the photographer, the potter, the gunpowder manufacturer, the fertilizer manufacturer and the druggist go forth in great variety. The adjacent town of Schoenbeck, upon the Elbe, has the largest salt works in Germany. The potash mines of Germany are controlled by a trust, which formerly distributed the product at a rather high price throughout the commercial world.

While Germany has under present conditions almost a world monopoly, with four-fifths of the total production, there are smaller deposits on the upper Rhine in French Alsace. The vast salt beds that underlie an area from Salina, Kansas, to New Mexico also have a possibility, perhaps probability, of duplicating the German deposits. They are similar geologically.

The scarcity of potash caused by the shutting off of German exports during the World War encouraged the hope that a potash industry might be established in the United States. Under the spur of necessity the production of crude potash rose from 4,000 tons in 1915 to 207,000 tons in 1918. Most of this was from natural brine lakes in Nebraska, California, and Utah, while a lesser amount came from kelp or seaweed, of which several hundred square miles exist off the Pacific Coast of the United States. Conservative estimates place the possible output of 100 square miles of this kelp at one million tons of chlorites of potash, worth $35,000,000 per year, or more than double our present imports from Germany. This output permits the permanence of the beds because they feed upon the exhaustless resources of sea water. The manufacture of this potash was begun in California but discontinued when German potash came back upon the market. Most of the other potash concerns closed down, except some of the by-product manufacturers of cement mill dust. America has proved however that in time of need she can be independent of foreign sources for her potash, but at a higher price than that of easy German mining.

Nitrogen. The third, and most expensive, of the fertilizing materials is nitrogen, of which, despite the apparent scarcity, there are many and unlimited possibilities of output, because this rather inert element comprises three-fourths of the air, and we can draw upon it as we do upon water. Until recently we have had to draw upon the indirect sources of nitrogen. All animal matter is more or less nitrogenous, and fertilizer factories receive as raw materials the inedible animal products from the butcher shop, the slaughter house, and the fish cannery. Dried blood and tankage, the general refuse collection of otherwise unusable animal material in a slaughter house, are high-priced fertilizers. Dried fish and fish scraps and dried crabs are also important nitrogen fertilizers, especially in Japan. In that country the cake which remains after oil has been extracted from the soy bean is also used.

Nitrate of soda. The greatest nitrogen-supplying raw material at present is nitrate of soda, which, like guano, accumulates in commercial quantities only in deserts, where the rainfall is insufficient to dissolve and carry it away. Small quantities come from the deserts of northern India; some is produced in Death Valley, California, and the other deserts of California and Nevada, where it is found in small quantities as a white crust along with borax on or near the surface of the earth, and only needs to be hauled away and refined. But the supply of the nitrate in commercial quantities is practically a monopoly of Chile.

The method of mining the nitrate of soda is simple. After the removal of a little sand and earth from the surface, it can be shoveled up like clay and gravel and taken away in carts or temporary railways to the nitrate works, where it is dissolved in water, boiled down and crystallized. The export, depending on the prosperity of importing countries, is over a million tons a year. A by-product of the nitrate industry is iodine, a valuable chemical, and Chile having a practical world monopoly of both nitrates and iodine at the present time, limits production, and fixes prices almost at will. It is doubtful if in all America we have a trust that is so thoroughly monopolistic.

While there is a large and growing output of copper in near-by districts, the nitrate fields produce two-thirds of Chile's exports. By export duties on nitrate they produce most of her revenue, and by their food demands, most of her domestic trade. The nitrate towns have been enabled to secure a water supply by laying pipe lines to the Andes, sometimes more than 100 miles away. But the desert destroys all possibility of any local food crops. Everything for the use of man and beast in the nitrate fields must be imported, so that Iquique, the nitrate metropolis, a city of 37,000 inhabitants, Antofagasta, and many smaller ports and nitrate works, are depending upon the farms of central Chile, several hundred miles to the south of them, for every potato, cabbage, bale of hay, or loaf of bread necessary to support the daily life of these thousands who are extracting from the desert the nitrate accumulations of the past. The same dependence upon distant foods applies to the nitrate, manganese, and borax works in the same vicinity but across the boundary in southwestern Bolivia. The desert miners sell minerals in Europe and the United States; these countries send manufactures to central Chile to pay for the food and forage sent thence by coasting steamers to the dwellers in the desert. "The meat supply for nitrate camps of northern Chile is derived by driving herds of live animals from Salta and Jujuy in northern Argentina. The animals are driven summer and winter over passes 15,000 feet high, where they sometimes have to spend 3 days without food in the desert." [5]

The United States imports 300,000 to 400,000 tons annually of the nitrate, about a fifth of the whole. Most of it goes to west Europe; Germany has long been a good customer, using it mainly in her beet fields.

MANUFACTURED NITRATES. The Nitrate Trust controls a supply that is variously estimated to be sufficient for a few decades or possibly a century. Fortunately this monopoly is not destined to pass into a world famine, but into an era of plenty through new inventions. Ammonia, one of the by-products of coke making, yields approximately as much nitrogen pound for pound as does nitrate of soda. The more economical use of our coal would enable the United States to make a half a million or a million tons of this product.

While the coal may be exhausted some day, the air and waterfalls will not. The air is our final source. The chemist and the electrical engineer have solved the problem of fixation of free nitrogen. Manufactured nitrogen is now a regular export from Norway, a product of the free air caught in the electric furnace by the electric spark from a hydro-electric current, generated in the defiles of the Norwegian mountains.

These atmospheric supplies of nitrogen depend upon ample power for their extraction. A very small population is required for the

[5] From Isaiah Bowman; *Bulletin American Geographical Society*, Vol. XLVI, March, 1914.

operation, and any distant source will do. For this purpose a 410,000 horse-power plant has been erected beside an Iceland waterfall and another is projected in a fiord on the coast of Labrador.

Nitrate of calcium, called cyanamid, is made at Niagara Falls, but its production did not develop there until after it had been successful in Norway and France, where water-power is cheaper than in America. One of the ideal sites for a nitrogen fixation plant using the electric process, is at Muscle Shoals, Alabama, where there is a series of rapids in the Tennessee River, furnishing abundant hydro-electric power, and near to the other necessary raw materials—limestone and coal for coke. This project was begun by the government in 1918 in order to secure an adequate supply of war nitrates, and may ultimately supply cheap nitrates for the farmers' fields. For a number of years its chief use was as a political football. German technique and equipment for manufacture of all nitrates has gone to the point where the import of the Chilean product is forbidden.

THE FERTILIZER INDUSTRY AND ITS LOCATION. It is plain why the fertilizer plant, drawing each of its staple raw materials from a different continent, finds the best location upon navigable arms of the sea, so that a shipload of potash from Germany, bones from Buenos Aires, or nitrate from Chile, fossil phosphate from Tampa, or sulphur from Galveston, can be unloaded direct from ship to factory. We thus find fertilizer plants established in or near almost every Atlantic port from Maine to Florida. Here fertilizer plants are also near their greatest market. Since fertilizers are so largely used by the truck-crop growers throughout the Atlantic plain and on nearly all farms east of the Alleghanies, fertilizer manufacture is essentially an eastern industry. Georgia is the leading state in the manufacture, chiefly because it is an important cotton state, and the exhaustive one-crop plantation system of growing cotton makes the use of chemical fertilizers imperative.

In new countries the soils are usually fertile enough to make unprofitable the use of fertilizers, and in the United States their use began in the older east and is now steadily going westward into the Central States. The manufacture is rapidly on the increase in Ohio, Indiana, and as far west as St. Louis. Upon the more valuable and carefully cultivated lands of western Europe, particularly of England, France, Germany, Holland, and Belgium, the use of chemical fertilizers is very general, and their manufacture is relatively a more important industry than in this country. By the aid of chemical fertilizers lands in Holland, Germany, and the United States Atlantic Plain previously worthless have been made productive.

THE FUTURE OF FERTILIZER AND FERTILITY. We are agricultural barbarians just entering the era of artificial fertilization in the United States, because we have an increasing population, soils of decreasing fertility, and the new science of agriculture which is being disseminated with great rapidity. The comfort of our future

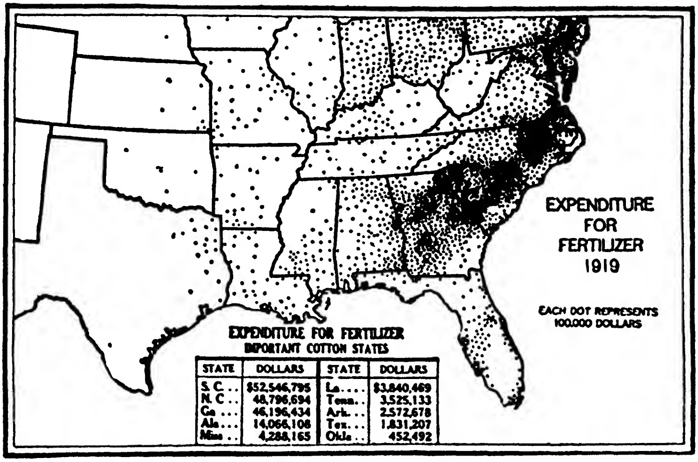


FIG. 226.—The location of our fertilizer market shows why this industry belongs to the South Atlantic ports. (Courtesy United States Dept. Agr.) (From *North America,* published by Harcourt, Brace and Company.)

depends upon commercial fertilizers, almost as much and perhaps more than upon coal or iron. Granted the ability to grow plants abundantly science can probably adjust and meet man's wants. Without any one of the three constituents, potash, phosphorus, or nitrogen, a field rich in every other requisite of plant growth lies barren. Even the careful Chinese have to abandon otherwise good land where they can get no fertilizer. It is therefore fortunate that we have, even without the aid of the nitrogen-gathering bacteria upon plant roots, unlocked indefinite stores of nitrogen and potash. With phosphorus it is otherwise. Speaking in terms of generations its supply is scanty and no ultimate reservoirs are yet in sight. Phosphorus is therefore probably the point of man's weakest hold upon the earth, and its waste in sewage, the loss of animal manures, and soil leaching, is a form of resource destruction with which the future must deal unless perchance we can open some avenue of phosphorus recapture from the great reservoirs of the sea.

4. SOAP-MAKING AND ITS MATERIALS

Soap is produced by the action of soda or potash upon fats. This chemical reaction causes soap manufacture to be classed among the chemical industries. In the United States the product amounted to $316,000,000 in 1919, or nearly 3 dollars per person, and in Europe it is also important. There is a considerable international commerce in soap, but a much greater commerce in its raw materials. Oils and fats used in soap making, like many other raw materials, seem to be of especial importance in countries of comparatively undeveloped industry. Tallow, olive oil, cottonseed oil, oil of sesame from India, groundnut or peanut oil, and cocoanut oil, are all the basis of large commerce. Many other fatty substances of animal and vegetable origin are also used, even including the grease that is removed from sheep wool in preparing it for the loom.

TALLOW, OLIVE, COTTONSEED, AND PEANUT OILS. Tallow, the standard fat of northern countries, has for a century been the product of the most remote sheep and cattle pasturing districts, and it comes to-day from the sheep ranches of Falkland Islands, from those of New Zealand, and from central Asia, as well as from slaughter houses in our big cities. Since the coming of soap olive oil has been the standard soap fat of Mediterranean countries; and Marseilles is one of the great world centers for the importation and processing of vegetable oils and fats. It is located near the French olive district. It is also the natural gateway to northern Europe for the olive oil shipped in small vessels from the numerous parts of Spain, Italy, and north Africa. In recent decades new industrial movements have given other oils as rivals of, and substitutes for, the oil of olives. Marseilles, the oil center, has attracted much of this trade. One of the new materials is cottonseed oil, produced chiefly in the cotton districts of the United States, and, in its purer grades, largely used for food in south Europe as a substitute for olive oil, while the lower grades serve as a soap material in the Marseilles markets and factories. Peanut oil is another rival of olive oil for both food and soap, and is imported into France from a dozen places in Africa, Asia and the Americas.

Cocoanut oil. The cocoanut, one of the most promising of all oil producers, thrives upon the tropic sea shores almost everywhere, but the largest producers upon a commercial scale are the Dutch East Indies and the Federated Malay States, where the natives have numerous small cocoanut plantations and Europeans have made large plantations. The European planters of Ceylon also have a proportionally greater area under cocoanut plantations than have the corn growers in the United States. In the Philippines, the third

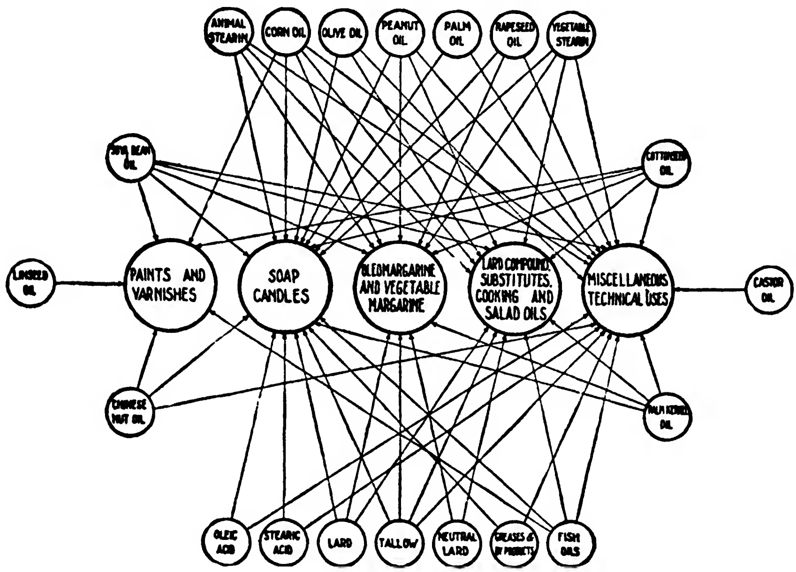


Fig. 227.—This diagram shows some of the varied uses of oils and fats. (Courtesy United States Dept. Commerce.)

largest producer, the rapidly increasing output of copra is an important element in the economic life of the islands, and gives promise of becoming still more important there and elsewhere. Nearly all tropic continents and islands have large areas suited to the cocoanut. Cocoanut meat (copra) is a very durable product when dried, or even when allowed to lie upon the ground, so that it is an admirable commercial product for the easy-going tropic native, who can pick up his crop and dry it ready for the oil press when it suits him. To the South Sea islander copra furnishes the principal cash crop. It supplies directly an amazing variety of wants and furnishes the only means of purchasing the products of the outside world which come to them in small vessels, veritable floating department stores that skirt the populous archipelagoes trading for cocoanut meats and cocoanut oils, which finally find their way to the European soap factories—at Antwerp, Liverpool, Hamburg, and Marseilles.

Cocoanuts are also shipped from Jamaica and Trinidad to the United States, and these places are so near the market that the nut arrives fresh and is used for food, leaving the soap factory supply to come from more distant localities.

Fig. 228.—Copra, the dried meat of the cocoanut, is one of the largest sources of oils for soap-making.

Palm oil. Marseilles, Liverpool, Antwerp, Hamburg, and other centers of African trade are now receiving large and ever-increasing quantities of a comparatively new soap and candle fat. It is the oil of the palm, the olive of tropic Africa—exported from the west coast, between the upper part of the Gulf of Guinea and Fernando Po, from the east coast between Zanzibar and Pemba, near the Tropic of Capricorn, and also from the shores of the African lakes. The breech-clothed African climbs the 30-foot palm tree and cuts off its head of fruit, as big as a basket. The many small fruits are boiled, thrown into a kettle of water, and tramped by bare feet to crush out the oil, which is skimmed from the surface of the water. This is refined by further boiling, and used throughout much of Africa as a choice morsel of food, a substitute for the olive oil of Europe and the butter of America. It is also the chief money crop of West African countries and is one of the important articles of freight for the many steamers that skirt the African coast. The kernel of the seed is also quite largely exported for the manufacture of oil in European ports.

Oil materials supplanted by oils in commerce. There is a growing tendency to press out the oil in the country of production and add the manufacturer's profit to the producer's profit. Since the war France has increased her import of oils, while the import of the raw materials from which the oils are made has been falling off. In the Philippine Islands, for instance, the export of copra has declined until it is of greatly lessened importance while the export of cocoanut oil is rapidly increasing.

The soap industry. The great slaughtering industry of the United States makes its inedible grease into soap materials. Of late the progress in the fuller utilization of by-products has given increasing importance to the manufacture of soap by firms that began as slaughterers of meat animals. The soda ash factories of New York and Michigan produce most of the other raw materials required, and soap manufactories are quite generally distributed throughout the manufacturing parts of the United States from Chicago to Boston; Philadelphia, Cincinnati, and Chicago are especially important. Our riches of animal fats combined with our facility in invention and discovery have given us a large soap industry. Consequently, although we import a few hundred thousand dollars' worth of valuable toilet soaps from Europe, we have come to export thousands of tons of cheaper soap of much greater total value to Europe, and to almost every country in the world.

5. COAL-TAR DYES

A new source of colors. One of the chemical manufactures most typical in its scientific nature, its importance, and its relation to other industries, is that of dyestuffs. For thousands of years man dyed his clothing with natural colors made from herbs, barks, and other vegetable and animal products. Their quality has not been excelled. The famous Tyrian purple of the ancient Mediterranean peoples was made from the pulverized shells of certain mollusks. Scarlet was later obtained by the use of cochineal, a dyestuff prepared from the dried bodies of insects native to Mexico and Central America. The rough homespun of the American backwoodsman was dyed a rich brown by the use of butternut hulls.

Artificial dyestuffs derived from that well-nigh infinite chemical mine, coal tar, are of relatively modern discovery. In 1856 an English chemist, while experimenting with aniline, a substance derived from coal tar, produced a brilliant violet dye. Still other experiments resulted in the chemists' developing a whole range of colors, which became known by the name aniline. Over 700 distinct color dyestuffs have been developed and the total number of aniline dyes recognized by chemists is over 62,000. Chemistry has thus turned a former waste product from the by-product coke oven into a source of the rainbow hues used by man in coloring his clothing, food, and articles of daily use.

Germany develops dyestuffs. As in many other fields of commercial chemistry, Germany was the successful pioneer in the coal-tar dye industry because she has fostered science in her universities more than any other nation. The first aniline colors were so inferior to the natural dyes that people became suspicious of anything named aniline, a prejudice which was hard to overcome. By years of careful laboratory work the German scientists finally produced a range of artificial colors so excellent that they displaced the natural dye products, and so low in price that the rest of the world found it cheaper to buy from Germany than to develop a color industry. Synthetic indigo was so successful that the export of natural indigo from India decreased from 21 million pounds in 1896 to a little over one million in 1922. Only the cheap labor of India makes any competition possible.

Prior to 1914 Germany controlled the dye industry, with over three-fourths of the world production. In addition she furnished over one-half the primary or intermediate products used by other countries in their limited dye industries. The total export of coal-tar dye products from Germany in 1913 amounted to over $50,000,000.

Rise of the American dye industry. Soon after the beginning of the war a number of the largest textile manufacturing countries, including Great Britain, the United States, France, and Italy, found themselves cut off from their regular source of dye supply. The development of colors at home became an urgent necessity. The manufacture of coal-tar chemicals had never been seriously attempted in the United States, and the first colors produced by the hastily organized industry were nearly as unsatisfactory as the crude dyes of the early aniline experimenters. However, the manufacturers called in the best chemists, spent money freely on technical research, and finally were able to develop home dyes which compared favorably with the imported ones. Stimulated by the war demand chemical and dye plants were erected almost overnight and succeeded not only in supplying the home demand, but in capturing a large part of the former German export trade. In 1913 only seven dye plants, including one which was German-owned, were in operation in the United States. No primary dye materials were produced, the plants depending upon imported intermediates. In 1923 there were about 70 dye plants in active operation, manufacturing the crude as well as the finished colors, and producing 93.5 percent of the dyes consumed in this country, whereas in 1914 we imported 90 percent. The yearly output of the American dye industry is now valued at about $60,000,000, and our dye exports are more than double the imports.

REFERENCES

See General References

The Production of Sulphate of Ammonia, Annual. American Coal Product Co., New York.

Utilization of Atmospheric Nitrogen. Report, Bureau of Commerce and Labor, Washington.

Reference List on Electric Fixation of Nitrogen. Bulletin, Bureau of Soils, U. S. Department of Agriculture.

Baron, Harold. *The Chemical Industry on the Continent.*

CHAPTER XVI

THE MINERAL INDUSTRIES

The mineral industry is and has long been characterized by a steady increasing importance of the baser materials. Coal and iron together make more than half of the total value of all minerals.

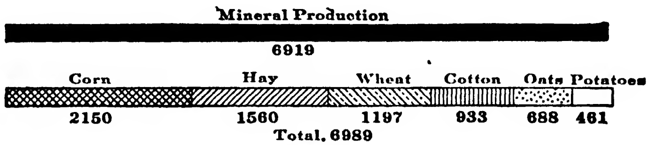


FIG. 229.—Mineral production of the United States compared with production of crops in millions of dollars.

The mineral industry of the entire world employs about six million persons, yet its output is not one-half as valuable as the product of the farms of the United States alone. The value of trap rock annually crushed for road making in the United States is greater than all the gold output of the world in the rush years that followed the discovery of America.

I. BUILDING MATERIALS

The scarcity of wood and the resulting increase in the price that came with the twentieth century are forcing the people of America, like those of older countries, to find building materials in the earth's crust. After our nineteenth century saturnalia of tree slaughter and cheap wood, we are being driven more and more to adopt the building materials used in Ancient Rome and used now in most parts of Europe, east Asia and north Africa. It is a sign of the declining ratio of land to man that necessarily accompanied the increase of population and the end of the frontier period. Rome had these conditions and cement was more largely used there in the days of the Empire than at any time prior to the present. The whole Roman world still bristles with its remains, Clay in the form of burned or unburned brick has commonly been the first resource of peoples with whom wood was scarce, especially in warm and arid countries. Houses of adobe or sunburned bricks have been widely used from ·Pharaoh's time to the present, and adobe is still a common house material through western Asia, north Africa, parts of south Europe, southwestern United States, Mexico, and some of the Andean section of South America. In these countries the mild winters (freezing tends to disintegrate brick and stone) and the small rainfalls permit such a building material to suffice. In the middle temperate latitudes, brick must be hardened by burning to make them endure, and they become by this process more durable than many kinds of stone.

THE EFFECT OF BULK AND MATERIALS IN LOCATING THE BRICK INDUSTRY. The low value and great bulk of bricks make them relatively and absolutely expensive to transport. Then, too, the clay suitable for making them is very common, so that the industry can be located near the cities that furnish the market for bricks. In its wide distribution in response to scattered demand, the making of common brick resembles the production of fresh milk. Of the total output of $63,000,000 in 1919, twenty states had each over $1,000,000 worth, and but four over $3,000,000. The regions of high output are the regions of large population—New York, Pennsylvania, Illinois, and Ohio. Thus, New York, the state with the greatest city population, has also the greatest amount of brick manufacture. The industry has its chief development in the Hudson Valley between New York and Cohoes where both railroad and river navigation furnish easy access to the enormous market of the cities about the mouth of the Hudson River.

It is only occasionally that long transportation of brick is warranted because of some special quality of the bricks. Such are the widely disseminated yellow bricks made in Milwaukee, Wisconsin, Winslow Junction, New Jersey, and elsewhere and also the vitrified brick made so largely in the Ohio clay belt. The bricks of special quality above mentioned are for facing fine houses. Others called fire bricks are very resistant to the fusing effects of heat and are used to line blast furnaces and other heated receptacles used in metallurgy. Some of the best clay for this purpose is found beneath the Appalachian coal seams and the most important fire brick center is in the western Pennsylvania coal field.

Occasionally conditions of ocean transportation are such that bricks of no special quality may be taken great distances chiefly as ballast for vessels. For this reason lumber and tobacco ships of the eighteenth century brought back many cargoes of English bricks, which the farmer's otherwise empty wagon hauled surprising distances where they may still be seen in the old colonial structures of the Tidewater region of the Atlantic States. In the same way Belgian and British bricks are yet carried to Argentina. But the brick yard, with its smoking kilns and clay mixing machines that masticate the clay, shoot out the bricks by the mile and cut them off into lengths, is usually an industry with a very limited local market.

BUILDING STONE. Although brick must be manufactured and stone merely taken from the earth, the building stone is often more expensive to use because of the large amount of labor involved in quarrying and shaping stone, or in fitting rough stones together in the wall. The great weight of its product and the widely scattered deposits of stone, make the quarrying industry, like the production of brick, tend to be local, that is, near the consuming markets. Exceptions are found in several places in the United States where stones of peculiar merit or unusual accessibility give rise to large quarrying industries with a distant market. For this reason, New England has important quarrying industries along the seacoast where the scraping glaciers have exposed bare hills of slate, limestone, and granite. These quarries have access to the best possible transportation facilities, namely, that afforded by the sea-going vessels that can come amazingly close to the side of the quarry in many sheltered bays upon the indented coast. Massachusetts is the second granite producer and Vermont is first. Quarrying is more important to this state than any other. Its granite for buildings and monuments is shipped to great distances and its output of marble is nearly double that of either Tennessee or Georgia, its nearest rivals.

MARBLE. In south Vermont near Rutland is one of the greatest marble industries in the world. A splendid marble deposit is almost as accessible to the quarrymen as are the granites of Maine or New Hampshire. As in other extensive quarries, the rock is cut and lifted by mechanical methods and the product is sent surprising distances when one considers how many other good marble deposits there are in the United States. It is a tribute to Yankee energy. There are unused deposits around the Great Lakes, especially Huron, and in many parts of Appalachia. Fine marble is produced in Georgia and Tennessee, and Colorado quarries are now being worked in the sides of whole mountains of white marble.

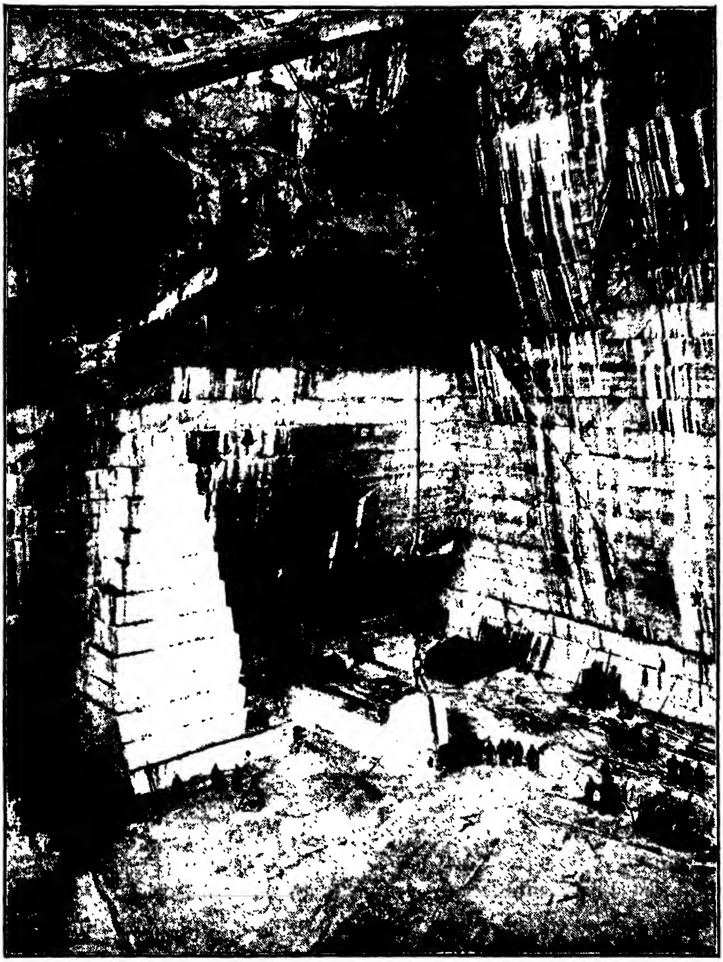


Fig. 230.—Marble quarry, Proctor, Vermont. (Vermont Marble Co.)

The most famous of all marble districts in the world is that at Carrara not far from Leghorn in Italy. This district has furnished practically all the world's statuary marble for several centuries and, in addition, much beautiful building stone.

Limestone. The beautiful marble is far less important than more vulgar stone. Its output is not as great in value as that of trap rock, the hardest of all, which is quarried in immense quantities and crushed for road surfaces. Common limestones, used for road making, railroad ballast, concrete, and building stone are seven times as valuable as the marble output and furnish half the stone sold in the United States. The region of chief production is from Pennsylvania to Missouri. The limestone most used for building is the Indiana limestone (Bedford, oölitic) from the two towns of Bedford and Bloomington. This stone is widely used in eastern states because of its durable character and the ease with which, when first quarried, it can be sawed and worked into blocks and other desired building forms. Upon exposure to the air it hardens, as do some Ohio sandstones.

Although they send their products to great distances, these important quarry centers produce but a small amount of the total building stone, which is commonly dug from the quarry most nearly available to the place of consumption.

European quarrying. In Europe quarrying is more important relatively and much more important absolutely than in the United States, for reasons arising from the number and density of population and the scarcity of forests. The quarries of the United States are chiefly worked by men (especially Italians) who learned their craft in Europe. In commercial quarrying, Switzerland is the New England of Europe. There, as in New England, there is dearth of other resources and great abundance of stone. The solid Alps give abundant supplies of granite, in great demand in the home country and in the Rhine Valley. Rhine boats which bring to Switzerland coal, grain, cotton, and other raw materials for her dense population, take a return cargo of stone for the alluvial lands of Belgium, Holland, and Rhenish Germany, districts entirely devoid of stone. The Dutch dykes which keep out the sea are, in part at least, constructed of Swiss granite brought in the Rhine boats. The quarries of Belgium have given the name of Belgian blocks to a paving stone of a certain shape. The Belgian quarries have of late suffered from the competition of Norway and Sweden, which possess fine bare ledges on tidewater. Italy, so poor in wood that many houses have stone floors, supported on arch work,[1] probably has a greater domestic dependence on stone than any other country.

[1] This caused great slaughter in the Messina earthquake.

Cement. Cement is a mixture of lime and clay burned to drive off the water. Upon being wetted the cement absorbs water, hardens and becomes as durable as rock. Experience has proved it to be good for two thousand years. Cement has been known since the Roman times, the people of that Empire having been very proficient in its manufacture and use. Chunks of it lie to-day in the wheat fields of Tunis, Spain, and many other parts of the ancient Roman world. From that time to the late nineteenth century, cement was little used and was a builder's luxury. Three new factors, the reënforcing of concrete, the rotary kiln and high

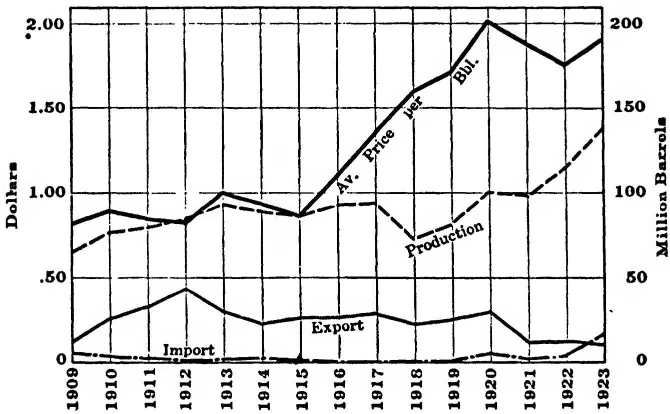


Fig. 231.—Price, production and import of cement in the United States.

priced wood and iron, have combined since 1890 to produce what is sometimes called the cement age in America. When reënforced by having a kind of skeleton of steel wires or steel rods within it, its strength is greatly increased and it becomes a substitute for stone, for iron, for steel, and even for lumber, and can be used to build an entire house save for a little wood for finish and trim.[2] The resulting new uses brought increased consumption and the demand for cheaper processes of manufacture. This brought the invention of the rotary kiln which cheapened production, and until the World War caused new economic levels, cement declined in

[2] The progress of cement technique has been dependent on an amount of experimentation that is almost unbelievable. A similar amount of work applied to crop-tree breeding might double the food supply of the United States.

price at the same time that its rivals, steel, iron, and lumber, were increasing in price. The resulting unprecedented increase in the industry has been one of the most sudden of all industrial changes. The United States is now producing more than a barrel of cement each year for every inhabitant.

It will take us many years to appreciate the full importance of having buildings which will last for centuries rather than those which need renewing in a few decades. At the present time we are losing by fire nearly half as many buildings as we erect and the life of past constructions has at best been short. Good concrete buildings are permanent, and enrich the nation by their durability as well as by the saving in other materials. Cement has, in addition, exceptional ease of construction. Building stones must be laboriously shaped, bricks must be slowly laid by hand, but cement is mixed by steam power and poured into molds with an ease that makes it a natural product of machinery and unskilled labor. Standardized forms of wood or metal are now used repeatedly for all types of building construction. Its use for girders, boats, fence posts, and shingles seems to indicate that there is almost no limit to the service cement can render.

RAW MATERIALS AND DISTRIBUTION OF CEMENT MAKING. Fortunately the raw materials, limestone and clay or limestone and shale, are to be found in every state and the fuel for burning is also widely scattered so that there is the possibility of having many cement districts as the demand increases. The fact that the manufacture of cement uses about half its weight in coal has helped to make the Lehigh Valley in eastern Pennsylvania the leading cement section of the United States. Here the limestone and shale are close together, at the surface, but a few miles removed from the anthracite coal fields and near an abundant supply of good labor from the adjacent Pennsylvania German settlements. This field is less than 100 miles from Philadelphia and New York, which are both great markets and also convenient places for shipment by water to places where cement is used in large quantities. But the Lehigh Valley is making relatively less and less of the American supply because of competition of newer plants in the Shenandoah Valley of Virginia, in Georgia, eastern Tennessee, Pittsburg, New York, Ohio, Michigan, Illinois, Kansas, and elsewhere. Like other earth-building materials, cement tends to be a local industry and it is now being made in over half the states of the Union. The average

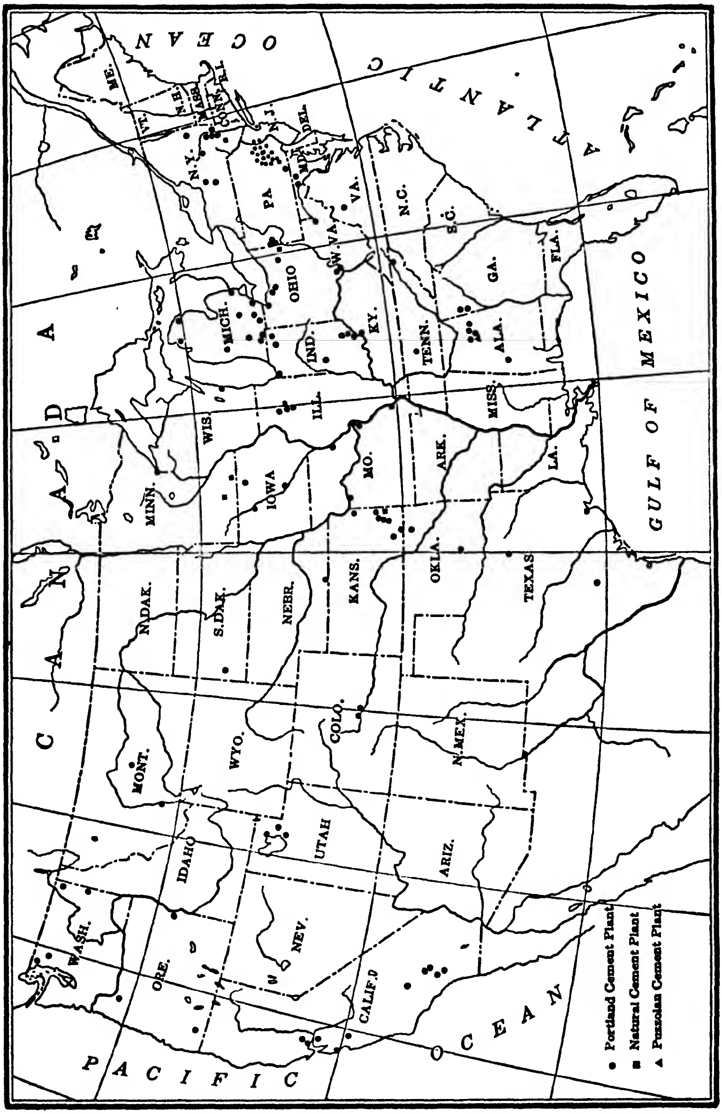


FIG. 232.—The location of the cement plants in the United States shows that the industry tends to be a local one. (After United States Geol. Surv.)

factory price of a 380-pound barrel of cement in 1922 was $1.76. As shipping such a cheap and heavy product very far will more than double the cost to the consumer, it is plain that a local plant has a great advantage over distant plants.

Cement from the iron furnace. The making of cement from blast furnace slag, with or without addition of other substances, is a recent innovation, important alike to iron and cement makers.

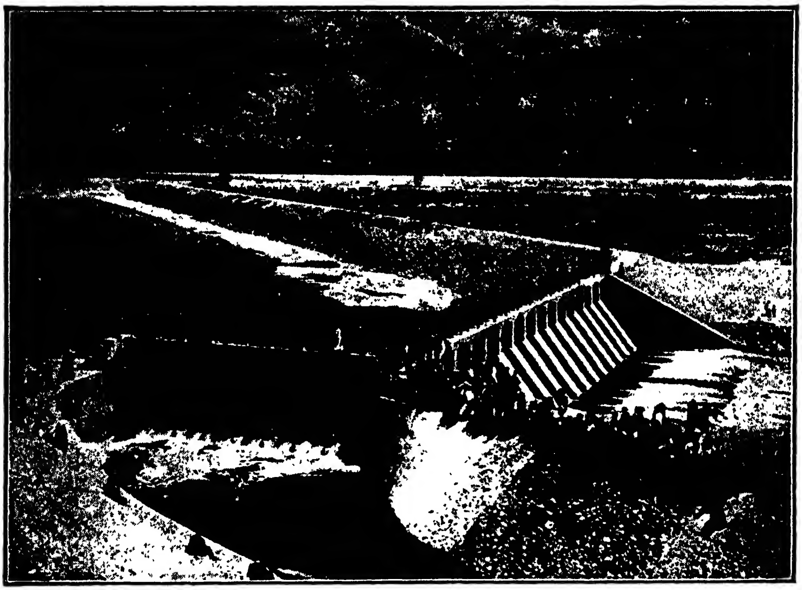


Fig. 233.—Irrigation canal and diversion dam on Truckee River, Nevada. Note cement construction. (United States Reclamation Service.)

Since the disposition of this practically useless by-product of the blast furnaces has been a serious problem at many plants, the making of it into cement is a double advantage and is being extensively carried on at many American iron plants.

Foreign cement industry. Cement making in England, Belgium, and Germany was developed earlier than in the United States. The product is having the same extensive use there as in this country, but our dependence upon European supplies is rapidly falling off due to our large home production. England, Belgium, and Germany for a long time sent some cement to our Atlantic ports, and even to the Pacific coast of the United States because of the very cheap freight rates which can be given by vessels outbound in search of cargoes to take back to Europe.

The foreign cement industry shows the same wide distribution found in the United States. Agricultural Bulgaria has two plants. Cement is manufactured in Peru and other parts of South America, and even the Far East is practically capable of supplying its present needs from plants in Sumatra, Hongkong, Canton, on the Yangtze River, at Tientsin and the many Japanese plants in Manchuria and Japan.

2. POTTERY, PORCELAIN, AND GLASS

Utensils of earth materials were made in most ancient times and by primitive peoples in widely scattered places. Pottery is common even among those whom we call savages. It was left by the Mound Builders of America and is made to-day by the Indian tribes of our Southwest. The ancient Egyptians and Phœnicians were expert glassmakers before the beginning of the Christian era and porcelain has been made in China for over a thousand years.

SIMPLICITY AND DISTRIBUTION OF POTTERY INDUSTRY. Glass is made by melting pure sand which, by the aid of certain chemicals called flux, melts under high heat and remains transparent after hardening. Pottery, including its finer form, porcelain, is made by burning clay mixtures, which harden without melting. Pottery making in its simpler forms is a local industry which has survived the competition of the modern factory somewhat better than the textile industry has. The product is much more difficult to transport and clay suitable for some kind of pottery work is very common, although pure kaolin, the kind of clay used for the finest ware and which can be heated to 3,000 degrees without melting, is somewhat limited in its distribution. In addition to the abundance of the material, the simplicity of manufacturing makes the pottery industry easy to carry on; so that in its simpler forms it antedates the commercial epoch, and was widely scattered over Europe and America a hundred years ago. Large factories tend to concentrate the production of the better grades of product, but the cheapest grades tend to be made close to the market, as illustrated by the present manufacture in Iowa, Illinois, Indiana, and Ohio of 80 percent of the drain tile produced in the United States. Drain tile, an article cheap, bulky, and difficult to transport because porous and weak, is mostly used as a sort of field sewerage system, to carry off surplus water from the flat lands of the North Central States, and make them fit for tillage soon after the rain.

POTTERY AND PORCELAIN IN EUROPE. Special porcelain centers have been important since the origin of world commerce. Early in the eighteenth century a German rediscovered the very old Chinese art of porcelain making. A royal factory was established at Meissen, Saxony, and there is now another at Berlin. From this start, Germany has become the leading porcelain-manufacturing country of the world. There are over 100 large factories devoted entirely to the manufacture of fine porcelain for export, this branch of the German foreign trade being three times as great as that of any other country. Austria, another German-speaking state, also has important porcelain manufactories, the products of which are exported in considerable quantity. In Bohemia, the porcelain and glass works employ thousands of workers and have an exceedingly valuable export trade.

For the last century and a half, France has been Germany's chief rival in the production of fine porcelain, the factory at Sèvres having long been the rival of the German one at Meissen. The town of Limoges has given its name to a fine porcelain ware, much exported to the United States.

In a treeless and stoneless country like Holland, earth products, like brick and tile, are very important. Most of the houses of that country are roofed with a beautiful red clay tile, and one of the favorite interior house decorations is a glazed blue tile called Delft ware from the little city that for centuries has been well known throughout the western world because of this ware.

Since the fifteenth century, Italy has been known for its export of Majolica ware, the name being a corruption of Majorca, one of the Balearic Islands, where the industry originated through the influence of the Saracens.

The pottery industry in England has had an interesting shift in its sources of raw materials. It first began in a large way in a district of Staffordshire, known as the "Potteries," where there was an abundance and variety of clays in close proximity to the coal necessary for burning them. Burslem, one of the pottery towns of England, was the birthplace of Wedgwood, the originator of the ware that bears his name. Upon the introduction of porcelain making, which requires pure kaolin, mixed with flint and sand, it was found necessary to import a clay from southeastern Cornwall and Devonshire. This import of the fine raw material from a distant source did not cause the shifting of the industry, because Staffordshire had an organized industry, the necessary fuel and the coarse clay suitable for the manufacture of seggers, the heavy vessels, in which, as temporary casings, the porcelain is burned, and which often require actually more clay than is used for the fine porcelain itself. England exports large quantities of chinaware, the United States, Canada and Australia being her best customers.

POTTERY AND PORCELAIN IN THE UNITED STATES. The pottery and porcelain industries of the United States have increased very rapidly since the Civil War, but the best grades are yet imported from Germany, Bohemia in Czechoslovakia, and France. The two cities of Trenton, N. J., and East Liverpool, Ohio, manufacture much the greater part of the good pottery produced in the United States. Trenton alone has more than fifty potteries. The supply of raw materials for this city is diverse, like that for the English porcelain industry. The coal comes from eastern or western Pennsylvania, and the local clay suffices for the coarser uses of the industry. Quartz and feldspar are brought from the Adirondacks and the southern highlands of New York. Some of the clay comes from distant southern states, the best from Florida. Much of the finest clay is imported from England, being brought back very cheaply by vessels which took out thousands of tons of American agricultural products and must otherwise come back well-nigh empty. The freight rate from Cornwall to New York is a dollar a ton, and from New York to Trenton by rail costs about the same as hauling a local clay four miles from the local pits. Trenton is one of the best places in the United States, if not the best, for a new pottery plant to secure adequate skilled labor and supplies—hence the concentration of the industry.

Ohio is the leading pottery state, with centers at East Liverpool, Zanesville, and Cincinnati, the last city manufacturing some of the best known American art pottery. The state of Ohio, with its great variety of glacial clays, its abundant underlying coal and its transportation by lake, river, and numerous trunk-line railroads, is in an excellent position to ship pottery in all directions. New Jersey ranks second, and the coal-mining state of West Virginia is third.

There are extensive deposits of good kaolin in North Carolina, Georgia, and other southern states. Small amounts are dug in

Delaware and Maryland, but there is no prospect of the industry moving to these southern supplies of raw material, which can be so cheaply and easily transported to centers of manufacture upon the edges of the coal fields.

CHINA AND JAPAN. China, rich in china clays, and so long famed for its porcelain, taught the trade to the Japanese centuries ago, and the pupils now rival their teachers in the excellence of their porcelain. This old Japanese industry has long depended on charcoal from the wooded hills and hammers driven by water wheels to grind the clay and stone. The practical destruction of forests in the pottery districts has recently caused the use of coal to be introduced; but fuel is economized by having the ovens placed one above the other upon the sides of steep hills, so that the heat passes from one oven to the next, and is thus made to perform its greatest service. The Japanese porcelain makers, like the other Japanese artisans, were, until a recent date, individual artists, but the quality of their product is declining, because of wholesale manufacturing and the desire to make cheaper goods for the foreign markets. The Japanese porcelain industry is relatively unimportant in comparison with that of England, Germany, or the United States. It is nearly all made for export, which amounts to one-third that of the United Kingdom.

GLASSMAKING. The quartz sand and flint for glassmaking are commonly melted at about 2,500° F. with an alkaline flux, usually soda, to hasten the melting. Various other fluxes are used; and, in different factories, numerous other materials are added to give particular qualities. The only substance always present is silica, which is usually in the form of pure sand, a product most widely distributed. It occurs in practically all countries, and near all our manufacturing centers.

THE AMERICAN GLASS INDUSTRY. The United States leads the world in the manufacture of glassware. Like iron, the industry began with a wood-burning epoch, which caused it to be centered in New England and the eastern states. In 1776 a glass company established itself at Glassboro on the sands of south central New Jersey, where a tract of 35,000 acres of woodland made of sand was secured to produce the fuel. Glassboro and Millville, N. J., and Philadelphia were until recently the leading glass-manufacturing towns in the United States. These eastern glass centers have abundant sand, but they are at some distance from their coal supply which they use in the form of producer gas. The gas-fed flames play around the pools of melted sand as it waits its final shaping at the hands of the glass blower or glass machine. Owing to the great fuel advantage possessed by the natural gas region of western Pennsylvania, West Virginia, Ohio, and Indiana, great gains have occurred in these states, which now manufacture three-fourths of our glass. The East has gained little in recent years. Muncie and Gas City, Indiana, have had a great rise in glassmaking. The exhaustion of the natural-gas supply has centered attention upon bituminous coal as a fuel. As a result the Pittsburg district with both coal and natural gas is now the greatest glass-manufacturing district of the United States, and Pennsylvania makes a third of the product. The Ohio Valley dominates this industry as it does the iron industry and for the same reason—fuel. New Jersey limits herself largely to the finer kinds, such as laboratory equipment.

Processes of glassmaking. For a long time practically the only means of shaping glass was to dip a long tube into the clear pool of liquid glass and blow through the tube, so that, by whirling and blowing, the expanding bubble of molten glass became, upon cooling, the desired vessel—a craft of almost unbelievable skill. For window glass it was blown into cylinders, which were cut open and allowed to fall upon a table to cool. Glass blowing is difficult work, requiring very great skill and commanding high pay. During the first few years of the twentieth century, glassmaking machines were invented. Some of them do the work with great rapidity; for example, two men working twelve hours a day, or three men, working eight hours a day, attend to machines which will turn out 360 gross of bottles. The machines take the molten glass from the furnace and deliver the perfect bottle.

Plate-glass is the name given to a product of such special quality that it can be passed between rollers, which give it the beautiful, smooth surface. The greatest plate-glass center in the world has long been in the Belgian town of Charleroi, and a Pittsburg glass company has established similar plants for producing the same plate-glass at a town named Charleroi near Pittsburg.[3]

[3] Henry Ford, nettled by the high cost and large breakage of the plate glass part of an automobile, thought it ought to be made more cheaply. He had an idea. He called into consultation all the plate glass experts. They told him his idea was crazy. He paid them their fees and dismissed them. He started a little plant and worked in it a large part of the time for two

GLASS INDUSTRY IN FOREIGN COUNTRIES. It is probably true that the glass industry is relatively more important to the Belgians than to any other people. This small country, but little larger than Maryland and with a population one-fourteenth that of the United States, has a glass industry one-third as great as this country. It is located along the edge of the coal-fields of Liége and Charleroi close to sand quarries and soda factories. This district, which has long been the leading window-glass center of Europe, furnishes Belgium one of her leading exports.

Germany is second to the United States in glass production. As in the Pittsburg district, the chief centers are located close to the iron districts, being along the Rhine, and near the coal-fields of Saxony, and Silesia. This southeastern coal-field in Silesia borders the Czechoslovak province of Bohemia, which has long been famous for its colored glass. In the south German states of Bavaria and Saxe-Weimar, special qualities of glass are made for use as lenses. In the little city of Jena, the Zeiss factory with its highly trained scientific workmen, produces the glass of exceptional fineness, which is to be found in the lenses of the microscope or telescope in almost every observatory and laboratory throughout the civilized world.[4]

The French glass industry is located near the northern coal-fields along the Belgian frontier where the town of Baccarat is the center of the manufacture of French crystal glass. In England the best glass sands are found along the south coast of England near Hastings and on the Isle of Wight; but the chief centers of glass manufacture are upon the three coal-fields near Birmingham, Bristol, and Newcastle. There is also much manufacturing in London, where the factories have exceptional facilities for easy delivery of the brittle product to the vast market in the metropolis.

Glass resembles pottery in the abundance of its uses and it presents even greater difficulties of transport, but the heat is too great

years, and as a result he cut the cost 80 percent. He is making it by a system which begins by running a stream of molten glass across a moving platform at the rate of 53 inches a minute. Careful study showed this to be the speed to let the glass cool off at such a rate that it can be pressed, polished, cut into lengths without ever stopping its movement. As a result this continuous stream of plate glass flows night and day and the machinery stops only when it is to be replaced after being worn out and thrown away. Henry Ford is a (mechanical) genius.

[4] The origin of this glass—the joint work of Professor Abbe of Jena and Carl Zeiss, a local glassmaker and optician—is another good example of the influence of German university science on industry.

to make it in the tropics, the high heat and suitable fuel are much more difficult to secure than for pottery, so it is not so widely distributed and is not, like pottery, an industry of very primitive peoples. Uruguay has recently opened a glass plant on the banks of the river Plate where the flowing current brings an unlimited supply of properly washed sand. Mexico makes a little glass; but most countries with undeveloped manufactures and practically all the colonial territories are importing their glass from Germany, England, Czechoslovakia, and, to a lesser extent, from the United States.

COMMERCE IN GLASS. The United States imports some European glass, especially the finest grades for lenses and for scientific work, but we also export to many countries the products of our inventive ability, in the form of our machine-made glassware. Machines have replaced hand labor and skill in much of the cheaper glass.

3. COPPER, TIN, AND ALUMINUM

Machines, power, explosives, chemical processes, and the large corporation have, within fifty years, transformed the mining of the less abundant metals to an extent comparable to the changes in the making of textiles.[5] In some kinds of mining, operations are on a

[5] WORLD'S MINERAL OUTPUT IN 1913

Commodity	Metric Tons	Percentage Contributed by					
		Europe	North America	South America	Asia	Africa	Oceanica
Bauxite	539,000	60	40				
Coal	1,342,300,000	54	40	(a)	4	1	1
Copper	695,310	13	65	7	8	2	5
Gold	685	1	27	3	11	45	13
Iron Ore	177,207,000	59	38	(a)	(a)	1	(a)
Lead	1,222,000	30	43	(a)	3	4	20
Manganese Ore	2,350,000	59	(a)	5	36	(a)	(a)
Nickel	29,000	3	86				11
Oil Shale	3,592,000	99					(a)
Petroleum	53,818,000	21	72	1	4	(a)	2
Phosphate	7,141,800	8	45		(a)	37	7
Potash	1,110,000	99			1	(a)	
Pyrites	6,000,000	90	8		2		(a)
Silver	7,000	7	76	6	3	(a)	8
Sulphur	1,000,000	42	51	1	6		
Tin	135,700	4		20	50	4	22
Zinc	1,027,000	38	37	(a)	4	4	16

(a) = less than one-half of 1 percent.

gigantic scale and the miner is no more of an industrial unit than the weaver. A recent mining enterprise in Nevada expended $20,000,000 in the purchase and equipping of two mines including 141 miles of railroad, a smelter, three towns, and a concentration plant. This latter marvel uses 6,000 horse power, crushes nearly 5,000 tons of ore per day (and can be enlarged to handle 15,000 tons) at a cost of fifty to sixty cents per ton for milling (crushing). The porphyry ore that this large plant works has only 2.34 percent copper, 0.019 ounces gold, 0.07 ounces silver per ton. Of this the concentrating plant with the new concentration processes extracts 87 percent of the copper, 55 percent of the gold, and 56 percent of the silver, the precious metals being worth but twenty-three cents per ton of ore, but yielding over $1,000 per day to the company.

Copper, tin, and aluminum occupy a position intermediate in cost between the precious metals, gold and silver, and the cheap and common but more important iron. In their industrial use, they are rapidly increasing in importance because of the many new uses to which invention subjects them. It is a fact humiliating to modern scientists that the ancients were better artificers in copper than are the moderns who know nothing of the means by which the soft ductile metal was, by the ancients, tempered into a splendid cutting tool. The service of copper as coin is very ancient, and at the present time of very great importance, particularly in India and China, where large quantities of copper coins are hoarded by the natives as a safe and convenient storage of wealth. Bronze, an alloy composed of copper and tin, is a most durable metal prized alike by prehistoric and by modern man. A mixture of copper with zinc makes brass.

COPPER. The universal demand for copper in electrical work has caused an enormous increase in the use of this metal in the last 40 years. The production of copper has increased 300 percent since 1890—the total world production now being over 1 million tons a year. Constant discoveries of copper ore and new methods of smelting assure sufficient supplies for the immediate future, but some authorities expect it to become scarce in about fifteen years.

This increase in copper production and in our ability to use low-grade ores has been brought about by the very rapid improvement in mechanical devices, which in a few years have increased the daily capacity of copper smelters from 30 tons to 3,000 tons. The improvements in extracting the metal and hence our increased supply are instanced by the recently acquired ability to use large deposits of porphyry ores that exist in Nevada, Arizona, Utah, and Queensland, but which were of no value a few years ago.

The United States, producing but 1 percent of the world supply in 1850, when we depended upon the relatively insignificant deposits of the East, now has more than half the world's output and produces more than three times the output of our nearest rival,

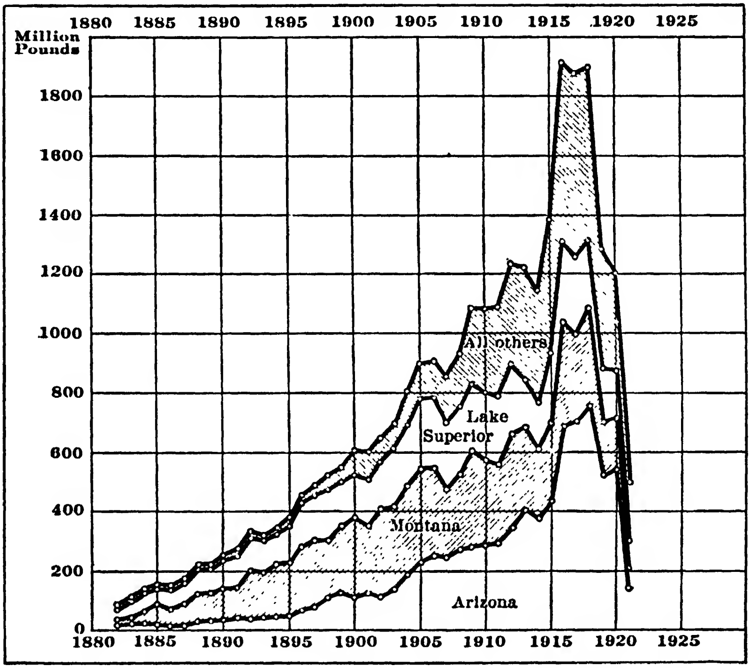


FIG. 234.—The production of copper in the United States. What effect does war have on the demand for copper?

Chile, and ten times that of Spain, long the world's great copper producer. Arizona alone exceeds in copper output any two foreign nations combined.

THE OCCURRENCE OF COPPER. Copper usually occurs in combination with many other substances. A single copper mine in Utah, for example, contains silver, gold, and iron, while a Montana copper company (the Anaconda) is the largest producer of silver in America. Other mines, especially in Colorado, have the copper in combination with silver and lead.

Sulphur is one of the commonest substances found with copper and it is commonly driven off by roasting the ore, which causes the sulphur to unite with oxygen of the air and pass off as sulphurous gases very injurious to the comfort of the people living in the vicinity, and destructive to the vegetation for miles around, as at Butte, Montana. The sulphur of these furnaces can be made into sulphuric acid at a cost as low as 58 cents per ton, and one of the largest Montana copper companies is building concentrating plants for the production of acid to use in the manufacture of fertilizer from phosphate rock, two tons of acid being required in the treatment of one ton of rock. Thus a noisome gas may be utilized in a valuable by-product industry. (*Mineral Industry*, 1922.)

MICHIGAN COPPER. The upper portion of Michigan was for many years the leading copper producer of the United States and of the world. In the old rocks of this glaciated district, there exists a large copper deposit, unusual in that some of it is pure. This fact, which at first appeared to be an advantage, is often otherwise. The masses are often too large to be taken out whole, the metal too ductile to break with blasting, and the labor of cutting off pieces of pure copper made the cost of mining higher than it would have been had it occurred in the more complex form of ores.

Easy transportation to this region by the Great Lakes caused early and profitable development of mining. Some of the mines are now a mile deep, their productivity is declining, the output of the district is stationary and shows small possibility of increase before further decline results from the gradual exhaustion of the known deposits.

ROCKY MOUNTAIN AND WESTERN COPPER FIELD. About the end of the last century Montana surpassed Michigan in output. This was due to the one great deposit in the hill at Butte, responsible for the flourishing cities of Butte and Anaconda. The smelter capacity of Butte—over 300 million pounds of copper per year—is greater than the production of any foreign country. At Great Falls, a single smelter has a capacity of 4,500 tons of ore per day and sends its sulphurous fumes from smoke stacks 500 feet high in the effort to avoid contaminating the atmosphere; yet it kills all the trees in the vicinity. Since 1880 the Butte district has yielded over 8 million pounds of copper, or nearly one-third of the total output of the United States.

In 1910 Montana was in turn surpassed by Arizona, due to newly discovered deposits which now yield half of the American output. Bisbee, Globe, Jerome and other Arizona towns are practically dependent on the red metal, which is more valuable per capita to the sparse population of Arizona than is wheat in North Dakota or coal in Pennsylvania. When the copper is gone the towns will die, as many western mining towns have already died.

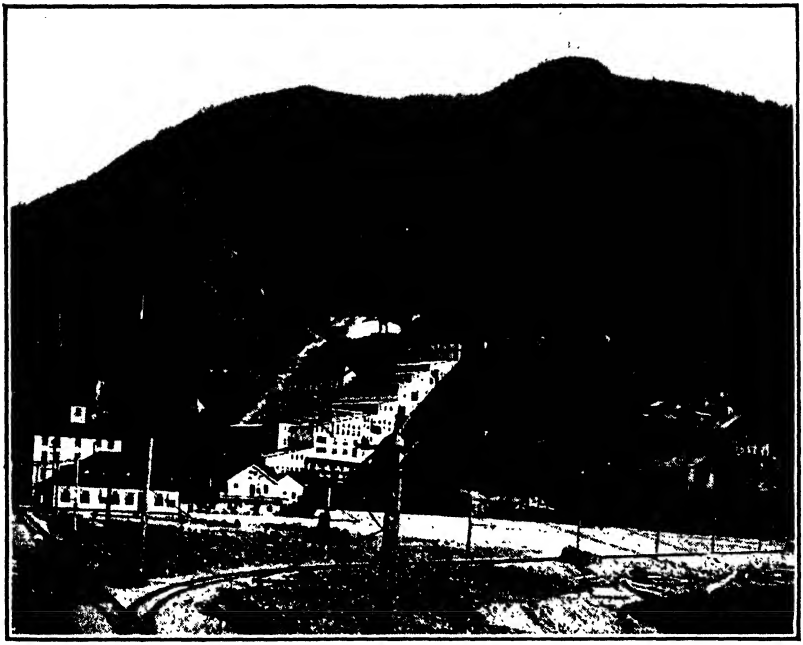


FIG. 235.—The equipment of this copper mine in the mountains of British Columbia shows that the mine, like the farm, depends upon the vast expenditure of physical raw material. (Courtesy Natural Resources Intelligence Service, Ottawa.)

In Utah and Nevada recently discovered deposits of the newly conquered porphyry ore can be mined by steam shovels as are some of the Lake Superior iron ores. A typical example of porphyry mining is to be found near Salt Lake City. The depth of the bed is first ascertained by drilling, then the overlying soil is stripped off by steam shovels, the ore is scooped up by the same means, loaded into railroad cars which dump through the bottom, and hauled 20 miles to the concentration plant. The ore is very low grade, but the ease of mining it and the great size of the deposits has given Utah and Nevada fourth and fifth rank among our copper-producing states.

World trade in copper. In addition to being the greatest producer of copper, the United States also smelts a great deal of copper ore produced in foreign lands. This is due partly to our great wealth in the necessary coal and also to the fact that from many sections ships returning practically empty can carry the ore cheaply. For these reasons, New York, Baltimore, Norfolk, and other coast cities smelt hundreds of thousands of tons of copper ore brought from Labrador, Newfoundland, Spain, Belgian Congo, Chile, Peru, Cuba, and Canada. These imports are not for sale in the United States, but are sent here for smelting or refining, the American plants being so efficient that even half the copper from the Congo region of Africa comes to the United States for refining.

The Old World is at the present time deficient in copper. Europe produces less than one-tenth and uses one-half of the world's total supply. The importance of the United States in the world copper trade is evident from the fact that we produce half of it, refine three-fourths of it, and export one-fourth of it annually. The United States export of refined copper was worth $138,000,000 in 1924, making it our sixth export in point of value.

South america. The Pacific Coast of South America is rich in copper deposits, many of which were mined in a small way by the Indian long before the coming of the white man. The desert region of north Chile has become the world's second largest copper producer, with one-sixth of the total output in 1923. Of the Chilean copper mines the richest are those of the famous Chuquicamata deposits, situated in the desert 10,000 feet above sea level, and cheaply worked by the open cut method like the porphyry ores of the United States. Chuquicamata is estimated to contain the most extensive copper reserve yet known in the world—700 million tons of ores containing 2 percent copper or better, and sufficient for 150 years of steady mining at the present rate of production. Most of the copper reserves of Chile are owned by Americans. Antofagasta and Valparaiso are the ports from which nearly all the copper is exported, most of it going to the United States.

Peru is also an important copper source, chiefly through the output of the Cerro de Pasco district upon the high Andean plateau. This section was until recently dependent upon pack trains, but now sends its product to the sea by means of the railroad that passes Lima and Callao. Peruvian copper is mined largely in conjunction with silver.

Bolivia is the only other South American country where copper mining is commercially important, although Argentina has a copper district in the Andes mountains, and other rich deposits are reported in Venezuela and Colombia.

Africa a growing source. Africa has recently become the third most important source of copper, largely through the phenomenal development of the Katanga district in the Belgian Congo, which now ranks among the great producers of the world. The metal is found in a belt about 250 miles long and from 25 to 40 miles

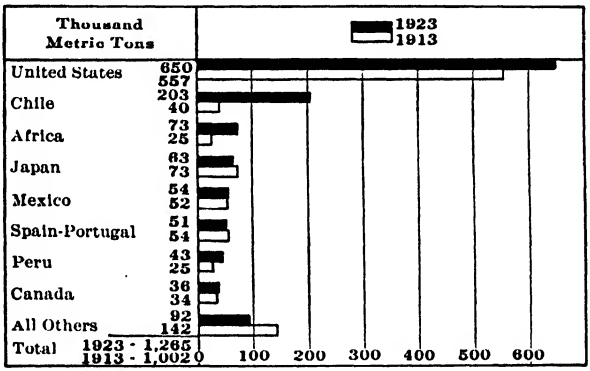


Fig. 236.—World production of copper.

wide, extending east and west across the southeastern part of the colony. The rich ore, some of it running as high as 30 percent, occurs near the surface and can be mined by steam shovel as in the case of the famous Star of Congo mine. Beginning with less than 1,000 tons in 1911, mining operations in Katanga have increased until the production in 1923 was 57,000 tons, nearly equal to that of the state of Michigan. The future will probably see still greater production, as this vast copper field in the center of Africa is one of our great reserves, the known deposits already promising one hundred years' supply of eight percent ore.[6]

The inland position of the Katanga field and its great distance from the sea make the marketing of its copper a problem in cheap transportation. The present outlet is south and east through Rho-

[6] Davis, Watson. *The Story of Copper,* Century Company, 1924.

desia and Portuguese East Africa; a railway runs from Bukama south through Elisabethville, the principal settlement of the province, to Capetown, with a roundabout branch extending east from Bulawayo to the Portuguese port of Beira, on the Indian Ocean. Copper is smelted at Lubumbashi, hauled to the main line at Elisabethville and finally shipped from Beira, a long and expensive railway haul which in 1921 represented half the cost of the copper. So great is the value of the Katanga field that it has become an object of railway building from three other directions, two of them from the Atlantic coast, which will provide (when and if completed) a cheaper and shorter haul to the copper consuming countries of Europe.

The second greatest African copper field is in northern Rhodesia, geologically part of the Katanga district, and like Katanga dependent on cheaper transportation to the sea. Southern Rhodesia and the Union of South Africa also have a number of producing mines.

OTHER COPPER PRODUCERS. Japan, one of the few important Old World sources of copper, now ranks fourth in output. The Japanese production is less than one-fourth that of Arizona, yet such is the poverty of Japan that copper is one of the most important mining industries. Japan produces little more than enough to satisfy her own domestic requirements.

The largest copper mines in Mexico are in the state of Sonora near the American border—a continuation of the Arizona field. A second copper district is near Santa Rosalia in the peninsula of Lower California, where for many years a French company has smelted its ore with coal and coke brought from Europe. The copper industry has been greatly injured by unstable political conditions, but by 1923 it had recovered sufficiently to give Mexico the fifth largest output.

Spain, now next to Mexico in copper production, resembles our southwest in its aridity, in its mountainous character and in its mineral wealth. Two-thirds of the Spanish copper comes from the Rio Tinto mines, which also furnish in the form of iron sulphide or pyrite a large output of sulphur. Mined for copper since the days of the Phœnicians, the Spanish deposits are capable of producing at their present rate for several decades yet.

Canada, with her principal mines in British Columbia, and Cuba with mines in Pinar del Rio, both ship considerable copper to the

United States for smelting and refining. Most of the larger copper mines in Russia and Siberia, important before the World War, remain closed down, and the Australian production is no longer large, due mainly to labor difficulties.

TIN. Despite the popular impression that it is hard and tough, tin is really the softest of our commonly used metals. Tinfoil is nothing but pure tin rolled out into thin sheets, while the "tin" can is a steel can with a thin coating of tin. This metal is valuable chiefly because it is air-tight and does not rust, therefore making it a good protective covering for sheet iron and steel in manufacturing so-called tin cans, tin roofing, and many other articles.[7] In the canning of fruits, vegetables and other products the tin-coated can is invaluable because it excludes every bit of air, while air can get through the pores of thin steel.

Fortunately, new applications of science to industry have not increased the uses of tin as rapidly as they have of copper. Any greatly enlarged demand would have created an acute tin famine, as the annual production (about one-tenth that of copper) has increased very little in the last two decades, although the price has been rising steadily. It is the only metal of importance to industry in which the United States is entirely lacking. We are using in this country well over half the tin mined in the world, the value of our tin import in 1924 being $69,000,000. Alaska is the only part of the United States where any regular production of tin continues and the industry there is and has been insignificant. The tin mines of Cornwall, England, are among the most conspicuous mines in history, as they were worked long before the Christian era, and seem to have been the basis of important trade between England and the Mediterranean countries in the time of the Phœnicians. At the present time these mines are doubtless producing as much as they did in ancient times, but the amount has become inconsequent in the world's total of 127,000 tons (1923) because of the great production by Chinese laborers in the region near Singapore. The Malay Peninsula produces over 30 percent of the world's supply and the nearby Dutch islands of Banka and Billiton 25 percent, also by Chinese labor. Bolivia

[7] Nearly half of the tin used in the United States goes into tin plate, one-quarter of it into solder, and 15 percent into bronze and babbit for bearings. Tinfoil and collapsible tubes for pastes, creams and vaseline consume a large portion of the remainder.

contributes nearly 25 percent and the balance comes largely from China, Siam, Nigeria and Australia.

CONDITIONS OF TIN PRODUCTION. The centuries-old Cornwall mines are hundreds and even thousands of feet deep, but in the Malay Peninsula and adjacent Dutch islands, there are large areas bearing alluvial gravels in which 200,000 coolies have worked for years as the individual miner works placer gold. This mining is done very carelessly. The regions promise a great output in the future if the same lands shall be reworked with such a dredging device as that which now reworks the old alluvial gold-fields of Australia.[8] By this device, a centrifugal pump and six or eight men per shift can do as much work in twenty-four hours as do 500 Chinese under present hand methods. Alluvial deposits are usually trivial in comparison to the lodes from which they were washed. Several lode mines are now being operated with considerable success in the Malay Peninsula, and the era of deep mining such as is followed in Cornwall should be long.

In Bolivia, second only to Malaysia and the Dutch East Indies, the tin is practically all derived from veins in many mines in the districts of Potosi, Oruro and Uyuni. This region is in the high, dry, and very cool plateau, the mines being between 14,000 and 18,000 feet above sea level, an altitude greater than any mountain peak in the United States or the Alps. Many of the mines are far from the railroad, are operated by crude hand methods and ore is carried to Oruro on the Antofagasta line on the backs of llamas. The lode mines of Bolivia offer the best prospects for an increase of tin production.

Most of the Chinese tin comes from the Kochiu mines in the province of Yunnan and is exported through Tonkin by means of the French railway. Siam has an important and growing output, half of it produced in 1923 by dredges. The rise of Nigeria in tin production has been rapid and significant, the largest production being from the alluvial deposits of the Bauchi plateau; when the mines were first opened (1911) Nigerian tin ore was carried on the

[8] Three steel dredges of modern type and costing approximately $500,000 each have been dismantled upon the exhaustion of gold ground in Alaska, shipped across the Pacific to the Malay Straits Settlements, and set up again on river beds from which they are to extract vast quantities of tin ores. This unique enterprise will mark the transition of a former gold-dredging concern in Alaska to the position of a tin-dredging company half way around the world.—*Philadelphia Public Ledger*, April 19, 1923.

backs of natives 190 miles to the navigable waters of the Benue, the eastern branch of the Niger, making a freight cost of $60 per ton to the coast. The most important single tin district in Australia is in the vicinity of Mount Bichoff, Tasmania, where tin is won from ores and also from the stream beds by dredging. There are other tin mines in India and South Africa, and the Katanga district in the Belgian Congo is believed to be rich in it.

As unknown portions of the earth are prospected more thoroughly, additional tin deposits should be discovered. Better processes and deep mining as practiced in Cornwall will enable the known deposits to yield an increasing output for many decades.

ALUMINUM. Aluminum is the newest of the important metals. It is especially attractive because it conducts electricity, is light, tough, and non-corrosive, being strong in qualities in which iron is weak. As one of the six commonest elements of the earth's crust, it exists in enormous quantities in ordinary clay. Hence, great hopes for the future are entertained, but the extraction of the element in its metallic form is very difficult. In 1880 the price was $10 per pound and the world's production only 2 or 3 tons per year. In 1907, as a result of new processes of manufacture, its price fell to 42 cents per pound, and in 1923 to 25 cents, with a production of 179,000 tons, over half of it made in the United States. Canada was the second largest producer, followed by Norway and Germany.

The manufacture is still costly. An aluminum plant at East St. Louis requires 1 ton of bauxite (aluminum ore), 1 ton of coal and 1 ton of very pure limestone to make half a ton of alumina (an oxide of aluminum). This requires further treatment in the electric furnace, a process requiring a large amount of electricity, by present practice about 1 horse-power for a day to produce a pound of aluminum. The world's aluminum is, therefore, made most easily where power is cheap, namely, the regions of great water power. Most of the companies working in Europe are located in the mountainous districts of Savoy, France (western Alps), of Switzerland, of Germany, of Italy, and of Norway. One of the American companies has plants at Niagara Falls, using 40,000 horse power, others in Massena, New York (on the St. Lawrence), using 20,000 horse power; and Shawinigan Falls, Canada, using 15,000 horse power.

Nine-tenths of the bauxite mined in the United States in 1923 came from Pulaski and Saline counties, Arkansas.

With the reduced price of aluminum, came new demands. For example, aluminum wire is a strong competitor of copper for high-tension power transmission lines. Automobile construction and aërial navigation have opened a new field for the lightest kind of strong construction, and the motor car has become the leading user of aluminum and its alloys. It is estimated that cars and trucks now average 100 pounds of aluminum each, at which rate the 4 million motor vehicles made in America in 1923 called for 400 million pounds. With the increasing use of cars and the growing demand for light weight, strength, and beauty, the demand for aluminum seems likely to become still greater. New alloys are constantly discovered and each new alloy gives new uses. Since common clay is largely aluminum silicate there is the constant hope that some one may discover a way to give man access to these mountains of metal that look down upon us in every continent.

4. GOLD AND SILVER

On account of their remarkable malleability, durability, and beauty, these metals were highly prized for ornaments and coins even before the period of recorded history. After the discovery of America, the Spaniards' quest for gold led them to remote corners of the New World; this American gold is said by some historians to have been the chief source of the power of the Spanish monarchy in the sixteenth century and of its later economical downfall.

The appeal gold makes to the imagination tends to cause an overestimate of its value. The world's output is of less value than the corn and oats raised in the single state of Iowa; yet, because of its use as the basis of all our commercial transactions, gold production becomes one of the most potent economic influences.

How GOLD IS OBTAINED. Widely scattered in the earth's crust, gold is collected into veins of quartz in many kinds of rock. The destruction of exposed veins in the wearing down of mountains by streams has caused the transportation of gold along the courses of streams to great distances from the original veins. Sometimes the search for gold along these streams leads the prospector back to the vein or mother lode, from which the stream supply has been eroded. The miner's pan, not unlike a wash basin, suffices to extract the gold from the sand if there be water present in which to agitate the sand until the gold settles to the bottom so that the sand can be gradually separated from it. Large banks of sand and gravel, containing very small quantities of gold, are worked by hydraulic mining, which consists of washing down the gravel banks by the force of a stream of water from a nozzle. The water carries the sand through long sluice boxes, with crevices in the bottom, in

FIG. 237.—A quartz vein (the white band) in metamorphic rock. Muchals Caves, Kincardineshire, Scotland. (From Salisbury, Barrows, and Tower.) The uncertainties of mining are apparent.

which the gold is caught, because, being the heaviest of the materials, it gradually settles to the bottom. This method has been used extensively in many parts of the world, especially in California, where streams have been so choked by débris as to fill up valuable channels in their lower courses and to cover rich agricultural lowlands with worthless beds of sand and gravel. To prevent this destruction of agriculture, California has wisely passed laws which control and often prohibit hydraulic mining. Much gold is thus made unavailable; but the farm lands which are saved are of greater value to the community since the metal-bearing bank yields once while the tilled valley will yield thousands of harvests.

Dredging is another method largely practiced in California, parts of Alaska, New Zealand, Montana, and elsewhere. A dredge resembling that used in deepening river channels takes up the earth in front of it, runs it through sluice boxes, catches the gold and drops the earth behind the dredge.

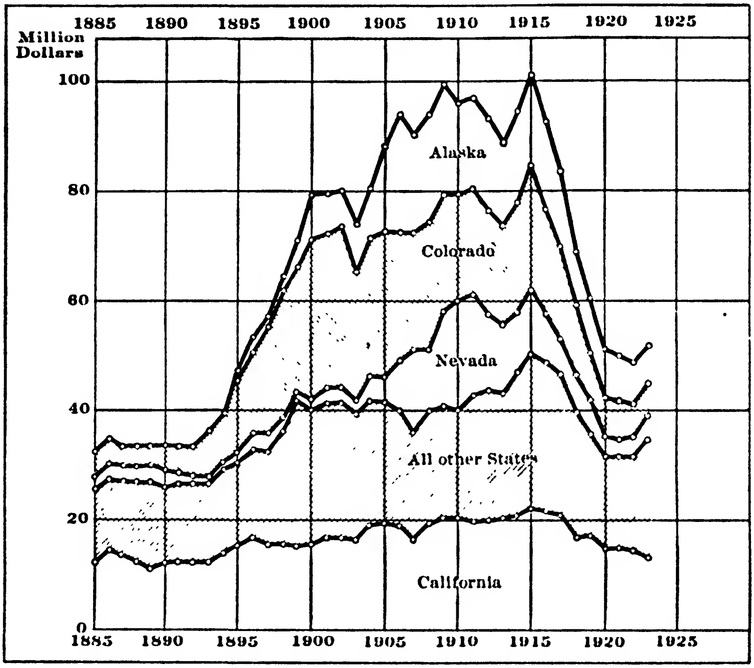


FIG. 238.—The production of gold in the United States and in the principal states.

The most permanent kind of gold mining consists in working the ores that are found in the veins themselves. The ore is usually ground fine by a stamp mill, and then washed by a process similar to that pursued in placer mining. This process does not, however, get out all the gold, and a newer method called the cyanide process dissolves the gold out of the pulverized ores by soaking them in tanks, and makes profitable the use of ores containing as little as $2.50 (less than one-eighth of an ounce of gold) per ton and sometimes even less than that. This chemical process has greatly cheapened the extraction of gold from some ores. This and other improvements explain the fact that the world gold production more than tripled in the twenty years from 1892 to 1912.

THE UNCERTAINTY OF GOLD AND SILVER PRODUCTION. Few industries have less permanence in any given locality than gold mining, and it may be that the peak of production for all time has been reached. It may be likened to a fever because of its sudden great activity, its decline and its intermittent revivals. Rumors of gold discovery start a "rush" of miners from all parts of the world. In the desire to stake out a good claim, it matters not if they must penetrate thick forest, hot desert or arctic waste. In 1849 men went from every land to California, in 1851 to Australia. In 1897, the news of gold on the arctic Yukon in Alaska and the Klondike caused the speedy departure, to that death-dealing land, of miners, professional men and even women, who struggled with their packs through the snowy passes of the south Alaska mountains into a region of which they knew nothing, to undertake a business of which many of them knew nothing.

The quickly exhausted deposits of the Klondike were in sand and gravel along the streams where the individual worker could easily get the gold. The increase after 1907 marked the beginning of the period of large-scale production at the hands of a powerful corporation which built 62 miles of flume and pipe line to operate placers, and a water-power plant with 36 miles of electric transmission line. With this equipment, the Klondike had a few more years of prosperity, and then another decline which will be final unless the mother lode is found. The mother lode, if discovered, should last several decades before mining reaches its ultimate depth, which is now about 1 mile, and has been reached in the Victoria gold mines of Australia.

The population of Nevada fell from 60,000 in 1860 to 40,000 in 1890 because of the exhaustion of one mine—the Comstock mine (chiefly silver) near Virginia City. California, long the leading gold producer in the Union, shows the uncertainties of the industry. The gold discovered there in 1848 was in stream beds. These were soon exhausted, and the miners next discovered many old abandoned river beds and even buried river beds which could be reached by tunneling under lava deposits. Then came placer deposits, and gravel worked by huge floating dredges. Finally the mother lode was discovered and the hard ore worked by deep shaft mining. California, which had been surpassed by Colorado with its vein mines, has been the leader from 1911 to date. Dredges produced half of California's gold in 1923.

Relation of gold to other metals. Aside from the gravel and placer deposits, few mines in the United States are worked for gold alone, because gold is generally closely associated with silver, copper, or lead. Thus most of the mining cities of the western mountain regions have several mineral products. This is particularly the case in Colorado, which in 1923 was second only to California in gold output, was sixth in silver and also produced copper and lead and zinc. Colorado cities, depending entirely upon mining, have arisen in almost inaccessible places in the Rocky Mountains, such as Leadville, more than two miles above the sea, and Cripple Creek, which produces over half of Colorado's present gold output.

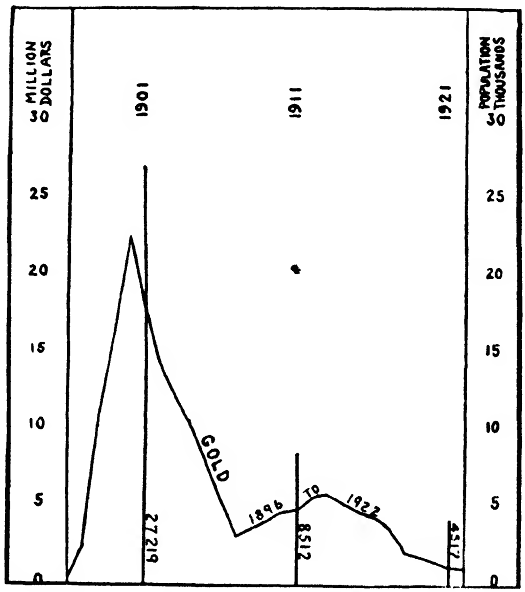


Fig. 239.—Gold production of the Canadian Klondike (Yukon Territory). Notice how the population has declined with the falling gold output.

Gold in Alaska. Alaska, which in 1923 was the third largest American gold producer, has three distinct fields. On the southeast are gold ores of low grade, worked in stamp mills, operated economically by fuel oil. In the Yukon Valley the centers at Klondike (in Canadian territory) and Fairbanks, may eventually be succeeded by other discoveries. Cape Nome (beyond the Arctic Circle), on the west coast of Alaska, had a most unusual deposit, a sea beach so enriched by gold-bearing streams that a miner could pan $10 per day from the sands. The day of the individual miner is passing; the gold beaches of Nome are now worked by dredges and the future of Alaskan mining lies in machinery and large-scale operation.

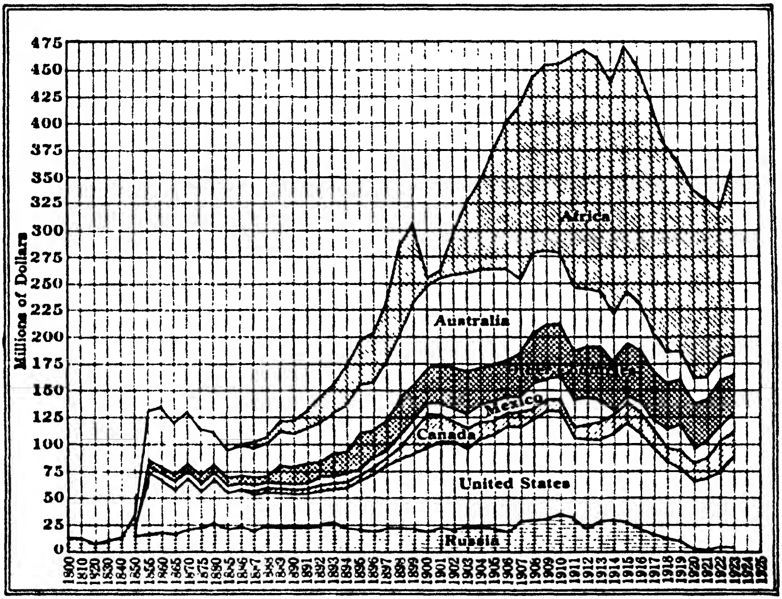


FIG. 240.—Gold production of the world and leading countries.

GOLD MINING IN AFRICA. The United States, with about $50,-000,000 in gold per year, is second to the Transvaal, which in 1923 had an output of $187,000,000 (over one-half of the total world production), while the adjacent colony of Rhodesia yielded $13,-000,000. The producing district of the Transvaal known as the Rand is a long range of low hills, the leading gold district of the world with Johannesburg as its chief center. It is in a semi-arid country like New Mexico or Arizona, where other industries are few and communities of hundreds of thousands of people must live by mining alone. The deposits are of great depth,[9] and the companies

[9] A number of shafts are from 5,000 to 6,300 feet deep.

can therefore plan to work for many years. The resultant great mining booms which occurred in 1895 and 1902 led to disappointment because of the scarcity of labor. This difficulty will be somewhat alleviated by the extension of railway lines into central Africa whence black workmen can be easily transported by rail. It is the practice to bring men from great distances to work in these mines on time contracts. They also come from China, but the Chinese must be returned to their native land by the mining companies when these contracts expire.

Some gold is being found in the forest lands of West Africa, in the Belgian Congo, and in Madagascar.

Gold in Canada. The famous Fraser River rush of 1858 inaugurated gold mining in Canada, and British Columbia was the leading producer from that time until the previously described rush to the Klondike in 1897. The largest output of gold ever reached by the Dominion, $28,000,000 in 1900, occurred when the Klondike was at its peak. Gold mining in the Klondike has declined steadily since that time to about one million dollars in 1923, but Canada still holds third place in the world's production ($25,000,000 in 1923), due largely to the recent discovery of new fields in Ontario. The richest of these, the Porcupine district, where the first camp was established in 1912, is about 150 miles northwest of Cobalt and covers an area only six miles square. Kirkland Lake is another of the important Ontario gold camps. The thousands of square miles of unprospected territory in Canada give promise of yet other possible gold discoveries in the future.

Gold mining in Australia. Australia (including New Zealand), with an output of $18,000,000 in 1923, is fourth among the world's gold producers. One of the most exciting chapters of Australia's history was the discovery one after another of rich gold fields—those of central New South Wales in 1850, Ballarat and Bendigo (Victoria) in 1851, Mount Morgan (Queensland) in 1882, Kimberley in 1886, Coolgardie in 1892, and Kalgoorli in 1893, the last three in West Australia. Miners flocked to the new diggings, many of them deep in the Australian desert, and water was in one case brought a distance of 360 miles by pipe line. By 1920 the mines of Victoria had produced a total of one and one-half billion dollars worth of gold, and those of West Australia nearly half as much. The richest deposits are now about worked out and few new discoveries are being made. The total production fell from one-fourth of the world's output in 1903 to one-twentieth in 1923, and the number of men engaged in mining dropped from 70,000 to 14,000. The individual miner and prospector have been succeeded by the mining company with its machinery. In Victoria the deposits discovered in 1851 have now been worked to a depth of a mile, which is about the limit for profitable mining at present. Unless new deposits are discovered—the vast uncharted wastes of the interior make such a discovery not improbable—Australia is faced with a steady decline of her mining industry.

Gold in Latin America. The mountains of western America from the United States to Chile are rich in gold and also silver, which have been alike a curse and a blessing to those regions. They urged on the conquest by the Spaniards and for many districts have been the chief basis of commerce since the discovery of America. The Spanish succeeded in getting gold by enslaving the people, one-half to work the mines, and the other half to produce food for the miners. In Peru, Mexico and other parts of the Americas, the Spanish task masters mined huge quantities of gold. Throughout the mountain districts only the best vein deposits could be worked and by the crudest hand methods, so that in many parts of the Andean region and in much of Mexico numerous deposits, although worked for many decades, may now be considered as new fields, in view of modern improvements in methods of mining, which, however, demand the railway for their proper installation. Mexico had led all the other Latin American countries in the development of gold mining, reaching a peak output of $25,000,000 in 1910. Revolutions and internal troubles followed soon afterward and gold production fell to less than $5,000,000 in 1915. Since that time more stable political conditions have permitted the resumption of mining and in 1923 gold production had reached $16,000,000, giving Mexico fifth rank in the world's output.

The mineral resources of the South American continent, nearly the equal of North America in size, are still largely undeveloped. Thus far the modern operations in South America have been limited to the temperate zone and to mountains where temperate climate prevails, as in the interior province of Antioquia in Colombia (output about $6,000,000 a year, the largest in Latin America outside of Mexico), the east slope of Peru and the Bolivian and Peruvian plateau. There has also been a small output from the plateau of Brazil and from Venezuela. Yet the resources of South America are such that even with the surface-scratching methods of the past, Colombia has yielded over a billion dollars in gold. One of the best ways to appreciate the advantages and possibilities of the present machine epoch is to remember that ordinary mining stops at the level of ground water unless power pumps remove it.

SILVER. The bulk of the world's silver comes from the North American continent and from this source in 1923 the aggregate yield was 180 million ounces, against which total the rest of the world supplied but 60 million. Thus North America produced three-fourths of the total silver supply.

Mexico is the world's silver leader (90 million fine ounces, 1923), has long been so and will likely continue to lead, unless civil wars again stop industry. The mineral resources in her western mountains appear to be enormous, and many foreign-owned mines have been opened, particularly in the provinces of Hidalgo and Chihuahua, which produce nearly one-half the silver. In the past she has been preëminently a silver producer, partly because of the great number of silver deposits, and partly because these deposits can be mined in remote localities of a dry and rugged country where ores are concentrated by the simple device of the arrastra—a stone floor on which ore is crushed by a stone wheel, rolled around upon the ore by beasts of burden. From the crushed ore the silver collects in the cracks of the stone floor and in the concentrated form is carried scores or even hundreds of miles on pack mules. The building of American railways into Mexico has made it possible for the mines to use the most improved machinery and processes, and has caused rapid increase in the output of gold, silver and copper in times of peace, bringing the production of silver (usually associated with gold) up to a point where the declining price serves as a check to its production—a situation unique among important commercial products in an era of rising prices. Mexico probably depends more for prosperity on minerals than any other country, except Chile.

In the United States, second to Mexico in output, silver mining depends for its prosperity upon the output of gold, copper, and lead, since silver is largely a joint product of such mines. The mines operated for silver alone are relatively few.[10] Utah is the leading silver mining state, closely followed by Montana, Nevada and

[10] The largest producer of silver in the United States is the Anaconda Copper Mining Company of Montana, the silver being obtained from its copper ores.

Idaho. The total output of silver in the United States (73 million ounces), worth $60,000,000 in 1923, barely equaled in value the corn crop of North Carolina, exceeded by 13 other corn-growing states.

Canada, the third producer, gets 10 million of her 17 million ounces (1923) from the very rich silver district of Cobalt in the forests of upper Ontario. Six million ounces were produced in British Columbia, and most of the rest came from Yukon Territory.

In South America, silver is largely a by-product from copper and tin ores, with Peru, Bolivia and Chile as the leading producers.

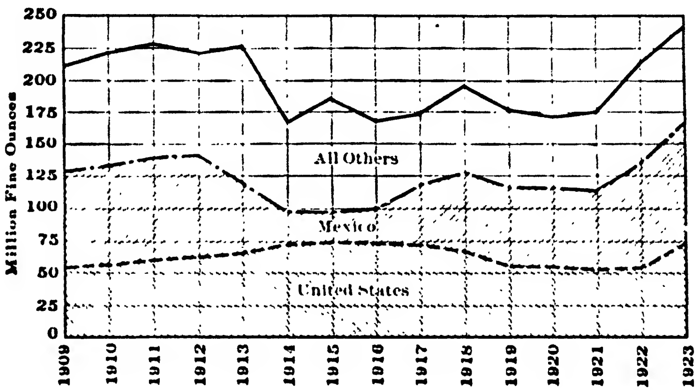


FIG. 241.—Silver production is unusual in that its output does not increase as rapidly as that of most other metals. This is due in part to financial legislation.

The relatively small output of Europe comes chiefly from Germany (the source of silver for the western world in the Middle Ages), from Spain and from Bohemia. British India and Japan have some silver mining, and in Australia the Broken Hill deposits of New South Wales are among the richest in the world, the silver being recovered in combination with lead and zinc.

THE FUTURE OF GOLD AND SILVER PRODUCTION. The World War caused a decline in the output of both these metals, due to the increased cost of mining and to interference with the industry. Russia, which produced $28,000,000 of gold in 1914, fell to less than one million in 1921 ($3,000,000, 1923), and many mines of low-grade ore all over the world were closed down. If the costs of labor and mining machinery decline sufficiently from their war peak many of the old mines will probably be reopened and new ones sought. Much of the world has not been prospected adequately and further discoveries may be expected in Canada, Siberia, South Africa, and other little explored regions. Increase in production may even take place too rapidly for the welfare of the world, owing to the disturbing influence that large production is supposed to have upon prices, probably the most interesting aspect of gold production. Any one can take gold to the mint and have it coined. Thus most of the gold becomes money. Money is used to buy goods. If money is plenty it becomes relatively cheap, so that a piece of land or a piece of meat commands more money than formerly and we say prices have risen. When prices rise faster than wages, people who depend on wages or investments are made poorer.

5. DIAMONDS

SOURCE OF OUR PRESENT SUPPLY. Long known and valued in the Orient, diamonds were first discovered in quantity upon the interior plateaus of the state of Minas Geraes, Brazil, in 1727. They were panned by miners from the beds of streams where they had been left by the same process which leaves gold, namely, the washing down of the mother lode. For a century and a half the washing out of these alluvial diamonds made Brazil the leading producer. Then alluvial diamonds were discovered in South Africa, and in the last quarter of the nineteenth century the finding of several so-called diamond pipes near Kimberley [11] in the Transvaal enabled South Africa to vastly outdistance Brazil. These deposits are believed to be the cores of old volcanoes with diamonds imbedded in the lava, now existing as a hard formation known as blue clay or diamond clay. The washing of the clay from these old volcanic necks produces diamonds so much more cheaply than the hunters of Brazil can find them that since 1872 South Africa has virtually supplied the world.

In the mines the diamond clay is lifted from the bottom of enormous open pits, then crushed, washed and picked over by hand. Owing to the difficulty of preventing the native Kafir workmen from stealing and carrying the diamonds out of the mines, they are kept on the premises almost like prisoners during the term of their

[11] In the 33 years since its organization, the De Beers Company (of Kimberley) has paid out in dividends 11½ times the original par value of its capital stock.—*Mineral Industry*, 1922.

labor contract. The mines are so rich that they can easily produce over two million carats annually whenever the world market will absorb that many. There is also an output of about 200,000 carats of alluvial diamonds each year, worth two or three times as much per carat as those from the mines. Diamond prices have been rising steadily since 1900, although there is no scarcity of the stones. A Diamond Syndicate, one of the tightest trusts in the world, controls prices by regulating carefully the supply furnished to the market.

Other diamond fields. There is little probability that the long diamond monopoly of South Africa will be broken in the near future. For a time the increase in production from other alluvial fields in South Africa and Southwest Africa, and the competition from the Belgian Congo, Angola and British Guiana appeared to be weakening the position of the Syndicate. In 1922 an agreement was secured whereby diamonds produced in Southwest Africa, the Congo and Angola would be disposed of in conjunction with the Syndicate, thus giving it virtual control of all the principal diamond producing regions of the world.

Southwest Africa, formerly a German colony but now under British control, has had a development similar to the Transvaal. The first diamonds were alluvial, secured in the sand on or near the seashore for 300 miles north of Elizabeth Bay. Miners wash the sand for diamonds the same way the gold miners wash the Cape Nome sand for gold. Unfortunately for the easy prosecution of the industry, this region is a desert, and supplies must be brought hundreds of miles. Finally the mother lode was discovered and the industry passed into the mining stage.

Diamond-mining in the Belgian Congo produced 450,000 carats in 1923, while the annual production of Angola is about 100,000 carats a year. British Guiana has a diamond producing district on the upper Mazaruni, where some 10,000 workers are employed, the production being over 200,000 carats in 1923. Diamond mining is still carried on in a small way in Brazil, the state of Bahia being the principal source of the commercial stones used for diamond drills. The finding of new diamond-bearing areas in places as widely separated as the Gold Coast of Africa, New South Wales, and Venezuela seems to indicate that there are abundant supplies yet undiscovered. A few diamonds are produced by three mines near Murfreesboro, Arkansas.

Diamond cutting. Although the mines of South Africa supply nearly all of the diamonds of commerce, Amsterdam and Antwerp are in a sense the real centers of the industry, for it is there that expert workmen cut and polish the rough stones to their final brilliancy and perfection. The cutting of diamonds became a factory trade in the Netherlands over a century ago and has grown until there are now nearly 200 diamond cutting establishments in Amsterdam, employing in good times about 10,000 workmen. With a later start the Belgian city of Antwerp has slowly forged ahead until it has become the great rival of Amsterdam, employing more workmen and sharing equally in the industry. While most of the world's diamonds are cut in these two cities, there are other smaller centers, such as Hanau in Germany, and Brooklyn, in New York City, where some 500 cutters, most of them Belgians, carry on a thriving business.

Diamonds and prosperity. The mining and cutting of diamonds is a luxury industry and as such is peculiarly sensitive to the checking influence of financial depression. The United States, richest of all nations, is the greatest diamond market in the world, purchasing about 80 percent of the output. When there is a business slump in America, there is a corresponding slump in diamond-mining activities. Thus the panic of 1907 caused the mines to shut down in 1908, and the recent business depression of 1921 forced many of the South African mines to suspend operations until Americans were again in the mood and the financial condition to purchase diamonds.

REFERENCES

See General References
See References to Chapter X

CHAPTER XVII

THE EXPANSION OF INDUSTRY AND OF RESOURCES

I. THE BALANCE BETWEEN RESOURCES AND HUMAN NEED

DEFINITION OF RESOURCES. A resource is something which may be turned into, or made to produce, a useful commodity, and thus give rise to an object of consumption or of commerce, and aid in the support of population.

There is frequent expression of the idea that opportunities for the making of a living are getting fewer, that the world holds fewer opportunities per man than it previously possessed. This belief is not founded in geographic or scientific fact. If it appears true, it is due to the shortcomings of our financial and industrial system, and from our irrational method of distributing wealth and holding property. Despite our reckless waste of resource there is good reason for the belief that the total *available resources* of the world are increasing quite as rapidly as the population and that they may continue to do so for some time to come.

The complaint about the lack of opportunity is old. At various times in the world's history industry has apparently caught up with the available resources, so that there actually were few opportunities available. Such a period was the warlike and piratical seventeenth century. As commerce and the desirable and available world then existed, there seemed to be little room for enterprise for the daring, or investments for the capitalist. Foreign people were positively or potentially hostile and, therefore, their lands were unsafe. The sea was unsafe for merchantmen, railroads were absent, highways were bad and while lands lay idle they could not be reached by industry. The people of Holland, then the greatest financial country and the chief money lender in the world, found themselves in a land of small opportunity, as a result of the great scarcity of resources to develop. There were few new enterprises in which they could invest their surpluses, hence interest rates sank to a very low point. At the beginning of the twentieth century, on the other hand, the railroad and steamship and the security of peace had made almost the whole world available to commerce, to investment, and to settlement by commercial people. The rapid progress of science, showing us new ways to utilize resources, has brought the world into a period of really rapidly increasing resources (opportunities for industry). These resources need developing and offer employment to the capital and labor of all nations. The Dutch investor owns railroads in the United States, plantations in Java, nitrate works in Chile, and the rate of income is several times as great as it was in the seventeenth century.

THE DEGREE OF UTILIZATION OF RESOURCES. The question naturally arises, when are resources fully utilized, and when is a country fully occupied. It is difficult to say when a country is full because of the present practice of living by manufacturing and consuming the products of other localities. The question of the standard of living is a second factor making it difficult to determine when resources are fully utilized. If the population is content to live in small houses rather than large, to eat grains, vegetables, and beans rather than meat and other things requiring more land to produce, then the population can be large. Under the system of household industry many localities of Europe and Asia have become populated up to the food limit, the non-flesh food limit, and the record of famines in India shows that country to be far beyond the food limit in years of crop failure. Millions there have starved beside the railway, which could have brought them food if they had had goods or money with which to buy it. Belgium, Massachusetts, and other densely peopled western lands, have passed the point where they can under present standards feed their people from their own land; but they have passed into the stage of buying raw materials, selling them again as manufactures and importing food with the proceeds. The steady increase of commercial facilities in many places shows evidence of continuing growth in manufacture, population, and dependence upon the foreign markets and upon foreign raw materials. To a large number of people in manufacturing districts, their land is a home space, their sustenance space being, in part at least, in other lands.

The best example of a country approaching the full development of its resources is Japan, with meager mineral wealth, rugged [illegible]opography, a small proportion of arable land, and a population of [illegible]00 per square mile of tilled land, nearly four persons per acre. Until the recent sudden shift to commerce, this population supported itself almost entirely by agriculture, with an average area of 2.6

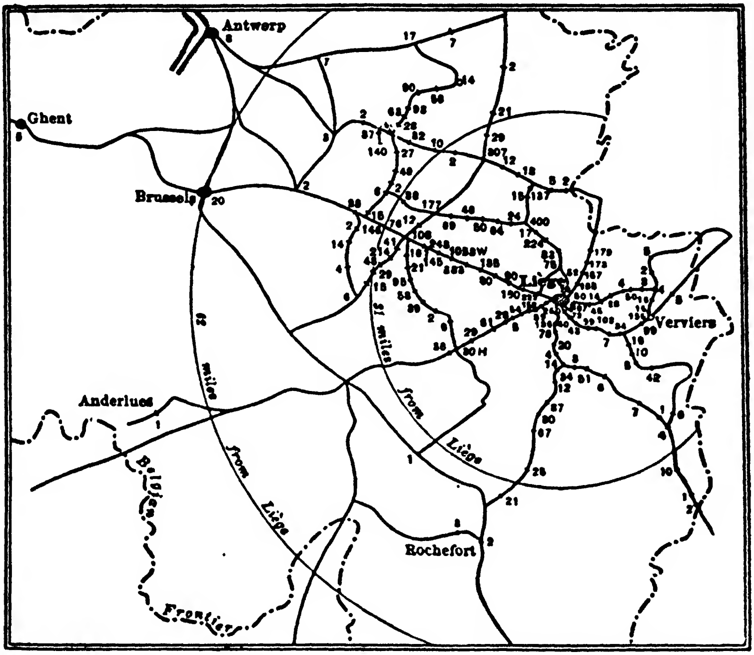


FIG. 242.—Distribution of city workers of Liége, to village homes. Figures represent number going from each station to Liége, June 1–5, 1906. Small agriculture is added to factory wages. By trades: miners 1,832, factory men 2,871, building trades 1,440, unskilled, 1,493, dressmakers and milliners 360, apprentices 242, other trades 1,167, railway workmen 520, total 9,925, of whom 5,830 went daily and 4,095 weekly. (From *Land and Labor*, by B. S. Rowntree.) Belgium is ahead of any other western nation in the scientific utilization of her resources. Her factory workers live upon the land to a degree unknown elsewhere. With his plot of ground there is room for production by the aid of women and children, old persons, and the spare time of the artisan himself. This garden product, the poultry, hares, and possibly the cows are great additions to a low wage and they help to give large return per unit of land.

acres per farm family. Upon this slim resource, the nation had maintained its physical and intellectual vigor and a high civilization; but to do so they have entered almost exclusively upon the ultimate stage of agriculture, namely, the non-flesh diet, and the garden stage of hand labor.

The mystery of the way in which China supports her millions is explained by a skilled American agricultural observer's account of a visit to the farms of the densely peopled province of Shantung.[1] Every scrap of vegetable matter and excrement is saved and returned to the fields which yield a harvest of wheat or barley in June and then, with the aid of midsummer monsoon rains, a second crop of millet, corn, sweet potatoes, peanuts or soy beans. The last two are nitrogenous meat substitutes and help explain the observer's statement that "one of the farmers in this province with

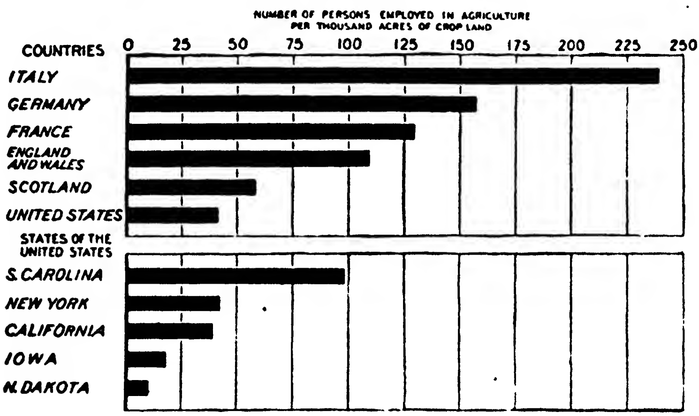


FIG. 243.—Why does Europe use more men and fewer machines than the United States? South Carolina uses more hand labor than Iowa or North Dakota. Why? (United States Dept. Agr.)

whom we talked had a family of twelve people which he was maintaining on 2.5 acres of good farm land, keeping besides one milk cow (also used as a work animal), one donkey, and two pigs. The crops raised were wheat or barley, millet, soy beans, and sweet potatoes." This is at the astonishing rate of 3,072 persons per square mile and also on the same square mile 256 cows, 256 donkeys, and 512 pigs. It would be impossible to find an American square mile that could feed, under American methods, the animals alone. Japan and apparently China are now entering upon the second stage of development, in which there will be (as now in Europe) a large manufacturing population added to this agricultural population.

[1] *Farmers of Forty Centuries*, F. H. King.

In the light of these achievements and tendencies of the yellow race it is plain that even they have by no means caught up with the resources at their disposal. Japan, with a population of 400 to 500 per square mile, is the nearest approach to it, and in Europe, Italy, average 329 per square mile, is probably the nearest western counterpart of Japan. A part of Italian agriculture has reached the ultimate garden stage, with the terracing of hillsides, yet work animals are still quite largely used in most parts of the country. As in Japan, there is great scarcity of mineral resources and there was, until a recent date, but small development of factory manufactures. Unlike Japan, Italy has a dry summer which is a great limitation to the production of food and the support of a large agricultural population, so that Italy's high percent of usable land has not served to prevent great poverty, especially in the southern provinces. As a consequence of the approach to the agricultural limit, Italy has had great emigration and is rapidly entering upon the second or manufacturing stage. Much of the power used in manufacturing is derived from the streams that rise in the glaciers, upon the southern slopes of the Alps. The Italians use the suggestive name of "white coal," for this stream energy, which, in a coalless country, is serving to locate most of the Italian manufactures in the north of that country. The emigration is chiefly from the non-manufacturing south.

2. UNUSED AGRICULTURAL RESOURCES OF THE TEMPERATE ZONES

It is plain that there are two standards for the utilization of land—the *Oriental standard* of a non-flesh diet grown by intensive hand labor, and the *Western standard* of a meat diet produced by grazing, work animals and machine agriculture. Judged even by the western standards the temperate zones have large unused agricultural resources. In contrast to Italy, China, and Japan, North America, the south temperate zone, and even parts of Asia are relatively unoccupied lands. So little is farm land utilized and sought in the United States that in large areas east of the Alleghenies it is a common saying, based upon fact, that when a man sells a farm he gives away either the value of the building or the value of the land, for the price obtained is often less than would be required to replace the buildings. Very little of the land culti-

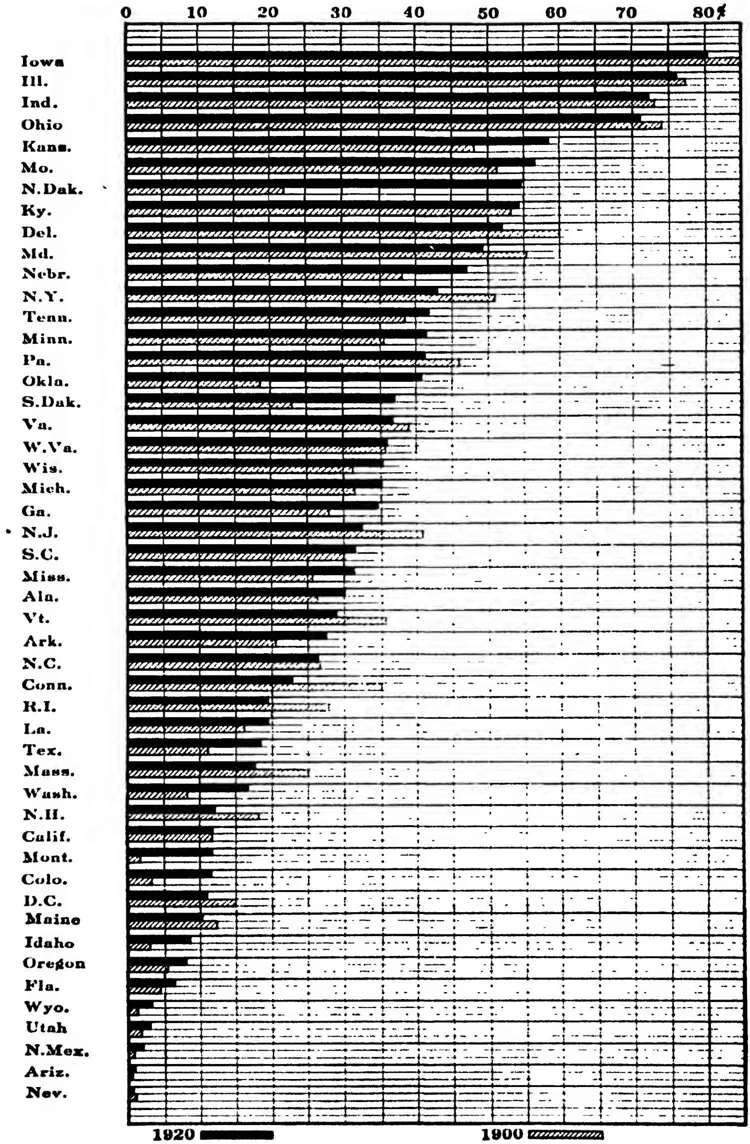


Fig. 244.—This graph is more worthy of study than statistics of area. (From Report of U. S. Conservation Commission.)

vated in the United States has reached the intensive stage and we have an advantage unique among lands of large resources—the great gift of corn for which we have a vast area. Over 1 million square miles of the United States can produce this king of forage. crops, the most productive and easily grown of all the grains. Further, this grain lends itself to double cropping, the resource of the crowded people. In Japan and China, and wherever possible in Italy, the land is made to yield two crops per year, winter grain between October and June, and rice or other summer crop between June and September. Similar double cropping, now almost unknown in the United States, can be done, if need be, in most of the United States corn belt. For example, as far north as New Jersey a good crop of peas can be harvested in May and June, and young corn, sown between the rows, will ripen a full crop before frost. Even a third crop can be grown and agriculture yet maintain its western standard. Cowpeas, clover, and several other leguminous plants will thrive with the corn or cotton, enriching the soil with their roots, feeding animals with their tops and making possible a wealth of agricultural production now undreamed of in most of the United States and impossible in sunny Italy, with its rainless summer. Yet even there more than 300 people per square mile succeed in extracting a living from the earth. The American cotton belt, with its summer rain, now supporting only from twenty to fifty people per square mile and six times the size of Italy, has easily twice the abilities of Italy in the production of food, raiment, and timber and is manyfold richer in minerals and water power.

We have in the United States 100,000 square miles of swamp lands, scattered among the old glacial lake beds in the northeast, in tidal marshes along the Atlantic coast, in cane brakes south of the Chesapeake and in the alluvial lands along the Mississippi and other rivers. These swamps when drained are twice as productive as uplands, and are at the present time almost untouched. Moreover, we have in the west 60,000 square miles which irrigation can make almost or quite as productive as the reclaimed marshes.

Canada, with a population slightly greater than that of Belgium, has in the east a large area relatively unused, just as the United States and the vast plains west of Winnipeg contain several hundred million acres of fertile lands which would support scores if not hundreds of millions of people if tilled like similar plains in Germany, Sweden, or north Japan.

Alaska, to the surprise of all Americans, has been found capable of producing luxuriant grasses, ripened grain and potatoes and, if need be, it can easily be made another Finland, which supports several million agriculturists with millions of farm animals and exports a vast amount of lumber.

The Trans-Siberian Railway has opened up a wide belt of unused grain lands, almost another Canada, which may possibly permit the Russians to double their population with ease. Manchuria and Korea, for which Japan and Russia fought, have unused lands several times greater in area than those which support the 55 million Japanese; it is probably true that these lands are not so productive as those of Japan because of the high percentage of irrigation in Japan. With a population which taxes the food-producing resources of her empire, China has a huge labor supply, and untouched mineral resources second only to those of the United States, with the result that the manufacturing possibilities there are much more stupendous than in the United States.

In Western Asia the era of railroad building has scarcely begun in what was once the seat of empires and kingdoms—Asia Minor, Syria, Mesopotamia and Persia. The richest part of Asia west of India is Mesopotamia, the Valley of the Tigris and Euphrates Rivers, where the irrigated soil supported dense populations of farmers and townsmen from before the days of Abraham until after the fall of Rome. Since the Turkish conquests, it has lain waste for several centuries, with abandoned irrigation ditches reaching through several million acres of alluvial soil. Under the development of European engineers and capitalists, it may again have great agricultural production and a large population.

In Argentina and Uruguay in South America, in South Africa, in Australia and in New Zealand, the south temperate zone has millions of square miles of land, with a total population less than that of Holland and Belgium. These large territories, while greatly limited by aridity, have a wholesome, invigorating climate, and ample resources for food production as population increase demands it. Moreover, like most of the world, their mineral resources are but slightly prospected.

The late desire for immigrants. With the knowledge of numerous unused resources of the temperate zones, we are in a position to understand the great efforts that have been made by many countries with unoccupied and undeveloped lands to induce immigration from the densely populated countries. For decades the United States gave away 160 acres of land to any potential citizen of any color or nationality who would come and live upon it. At the present time many American states, especially those in

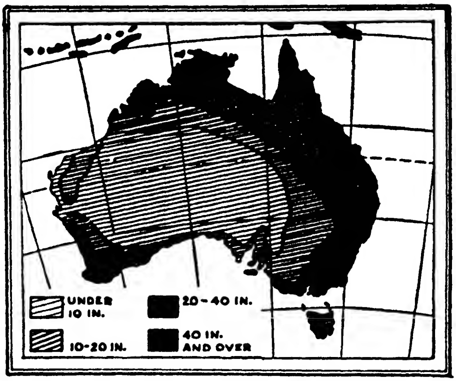


FIG. 245*a*.

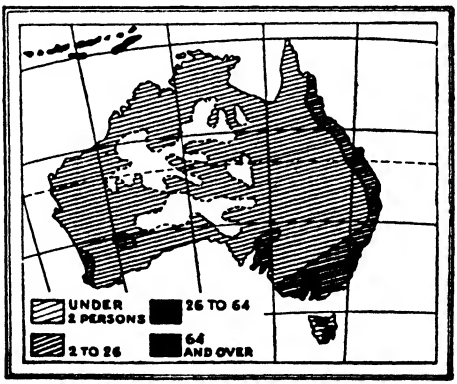


FIG. 245*b*.

FIG. 245*a*.—Mean annual rainfall for Australia. (Diercke.) *b*. Map showing density of population per square mile in Australia. (Lyde.) (From Salisbury, Barrows, and Tower.) Australia is a relatively empty shell.

the west and south, but also in the northeast, are making an organized and persistent effort to spread knowledge of their unused lands to attract settlers, but there has arisen a new note, namely, a desire to be sure that the newcomer will fit into our scheme of things. For many years Canada expensively advertised in many countries the fact that she, too, had good farms to give away to all settlers. The post-war depression in the wheat market killed Canadian prosperity and immigration for a time. Australia, Chile and the Argentine have actually loaned immigrants money and assisted in their transportation to the lands which were to be their new homes. At present the chance for emigration is greatly reduced. It is chiefly limited to South America and Mexico and in most of this area the governments, because of their inefficiency, hold out, in effect, a questionable welcome.

3. SCIENCE CREATES RESOURCES

In the face of all these usable but unused resources comes the great growth of science, which is yet young. Our new knowledge applicable alike to agriculture, manufacture, mining, and transport, gives us many new facilities for utilizing things heretofore unavailable. Science may be said to create resources of great aid to every land from empty Australia to the teeming Orient still depending upon human muscle for bearing burdens and running the loom. The tractor is an example of this new knowledge working in the form of mechanism applied to agriculture.

We have made great strides in the cheap production of wheat by getting tools that depend on the muscle of our strong beasts rather than on the muscle of our weak selves. The horse-drawn harvester has reduced the cost of grain. The iron horse, hitched to the wagon and the boat, has made a new world. The iron horse (tractor) hitched to the plow is beginning to work another transformation, particularly in the world of wheat, probably also in the world of corn and potatoes. It has just begun. The wheat crop of the world is to-day dependent, with few exceptions, upon the muscle of beasts. The Italians are even still cutting much wheat by hand on their terraces and little odd-shaped patches on their steep and rocky mountain slopes. But most of the land for the world's crops is plowed by the horse, the mule, and the ox, who also draw the seeding drill and the reaper. Enough camels are helping to make the list picturesque. At the most, these farm animals may be needed for only six or eight weeks of work in producing the grain crop; but they must eat for twelve months. If there is a crop failure every third year they must eat for thirty-six months in order to make two crops; and if there is a failure every other year, they must eat forty-eight months in order to make two crops. Despite their months of necessary loafing they get tired when they work, and must rest. They get hot, they get sick, they go lame. The farm tractor does not get tired, it does not eat when it is not working. We can probably improve it to the point where it will rarely go lame. It can go night and day, and in the rush season a man who has had a long period of rest can work fifteen or sixteen hours a day for many days. Then some one else can take his tractor and, with our present knowledge of lighting, keep it going throughout the night. One man, instead of driving three, four or even eight horses, turns on the power of twenty, forty or sixty horses that will work twenty-four hours a day. The acreage of level plain that a family can plant with this new help is several times as large as that within the reach of man aided merely by beasts. It is already claimed that in level Dakota a man, wth help of his wife and one child, can plant 120 acres.

This enlarged acreage means reduction in the cost of wheat growing. It means that wheat can be grown in lands that we before thought worthless because of the uncertainties of rainfall. Take the case of some experiments at Cheyenne, Wyoming, which in three seasons produced respectively 9.3, 7.8, and 37.6 bushels because of the difference of four inches of rain in the growing season. The average was 18.2. Four of the low crops and one of the high would still average 14.3, a figure that looks well among national averages, made possible by one good season in five. Such farming would scarcely be profitable with the aid of beasts, but it is easily practicable with the aid of the tractor.

In lands of low rainfall it has been well proved that the wheat yield can be increased in quantity and certainty by the practice of summer fallowing, which means plowing the land one year and raising the crop the next. By this means no plant is allowed to grow during the fallow season and the water which would otherwise evaporate through the growing plants (a surprising amount) remains in the subsoil, where it welcomes the next year's rainfall and combines with it to water one good crop out of the two years' supply. One trouble with this system is that it requires much cultivation. It is easy to see how the tractor helps at summer fallowing and so will push the wheat fields out into the lands of little rain and of frost. The tractor will enable wheat growing to become a dependable business in climates where frost or drought would drive out the team farmer. Thus farms, towns, and food-supply may then be found in places where now the farmer gives up in despair.

There is no way as yet to reduce to figures what the tractor may do for us, but it probably will enable seven wheat-belts running through five continents to be widened out—toward the region of drought and frost through central Asia and central North America, and toward the region of drought through Argentina, Australia, and South Africa. The great increase of wheat production between 1915 and 1920 (in response to a fleeting demand) is partial proof of this point.

Taken altogether, the undeveloped lands of the present wheat regions, the possible regions of the new wheat growing, the new varieties, the new fertilizers, the new knowledge, and the farm tractor, seem to promise that a wheat supply is within our reach for many, many decades if we can devote our powers to the conquest of nature rather than to the destruction of men.

It is possible to adopt much of the Old World intensification of agriculture and still keep the American large-scale machine processes (see Louisiana rice industry in chapter on cereals) which permit large production per man and a high standard of consumption. The application of science to agriculture is just beginning in the United States and all other new countries, and is now being rapidly pushed forward by the governments of all the leading countries. The greatest work for the promotion of agriculture now is the teaching of science to the masses—not merely more discoveries, but the practice of what is now known, so that we may have an agriculture that is adjusted to resources and conditions. As an example of results of such endeavor, note the following great increase in average yield resulting from 25 years of teaching in Belgium.

	1880–85, bu. per acre	1907–10, bu. per acre	Increases, bu. per acre
Wheat	24.54	38.55	14.01
Rye	23.86	36.69	12.73
Oats	49.79	81.48	31.69
Winter barley	38.25	57.57	19.32

THE SCIENCE OF CHEMISTRY is one of the great resource creators. Suggestive of progress from this source is the synthetic method of making indigo, which is now almost entirely produced from retorts of coal tar rather than the vats in which the people of India and Central America fermented the stalks of the indigo plant. The indigo fields are now free to produce food. The manufacture of air nitrates by the use of water power is another example. There is no estimating the number of things of this nature that may be invented or discovered. Chemistry appears to be as yet young.

NEW RESOURCES FOR MANUFACTURE. Aside from the production of food, the most important single resource for the maintenance of existing civilization is that which will give power to drive machinery.

The wealth of power resources at our present and prospective disposal was discussed in a previous chapter. One more aspect needs to be pointed out here, i.e., the reasonable prospect of almost universal distribution of power to almost every farmhouse and hamlet throughout the United States, Canada, Europe, most of South America, populous parts of Asia and possibly even Africa. This carries with it the chance to partially undo the industrial revolution and yet keep its advantages. The revolution sent man to town to get at the factory. It shut him away from the earth. Now the power wire takes energy to the farm kitchen, the barn, the village or town, so that manufacturing can once more be done where people live. This may restore the two-job aspect of the domestic system, when nearly every man was a farmer as well as an artisan. It once more permits food producing capacity and good climate to assume in part the great rôle which they had in bygone centuries.

SCIENCE INCREASES MINERAL RESOURCES. The application of science to the art of mining and purifying minerals and metals has produced changes quite as great as in other fields. Its effect in developing industry and supporting populations is well illustrated in the cement industry. Rough limestone farms, whose projecting rocks have made it difficult for a family to make a living, suddenly become the quarries where for decades scores of men blast limestone for the neighboring cement mill. The cyanide process of extracting metals from ore has vastly increased the amount of gold and other metals which it is possible for mankind to obtain from the earth's crust. Similar improvements have been made in almost all branches of mining. As it is now possible to work deposits at least a mile in depth, and of the 50 million square miles of the earth's surface we have prospected thoroughly less than 1 percent, it is evident that we have scarcely touched the world's mineral resources.

New resources in agriculture. Food is man's limiting factor. He absolutely requires a certain amount of it and the increase of the food supply is the thing that will permit man's numbers to add billion on billion in the peopling of the earth. Thus agriculture outranks all other industries in importance. By the creation of new resources in agriculture, science can give to man his greatest aids to increased support upon the earth. Thus agriculture outranks all other industries in importance.

In the utilization of the earth for agriculture, we have, down to the latter part of the nineteenth century, used a haphazard method. With regard to the twentieth century possibilities, we have often been like the Indian who in a field of buffaloes killed a hundred and carried off only their tongues. Science is now beginning to examine all parts of the earth with regard to its usefulness, as the by-product savers of a modern slaughter-house examine and use every part of an ox.

The essential thing about the earth from the agricultural standpoint is its fertility. How to unlock it is man's problem. The key for this unlocking is vegetation, and vegetation must have as aids, first, heat, second, light, and third, moisture. Therefore, in the past it has been the warm moist places that have produced man's food, and in addition agriculture has thus far done but little where the land could not be plowed. The past insistence on this fourth factor (arability) has caused vast possibilities of fertility, heat, and moisture to be practically unused, and vast soil resources to be barbarously wasted and destroyed through erosion to the permanent and profound injury of the earth. The barriers that have held men especially in the temperate zones from utilizing fertility have been, first, cold; second, aridity; third, steep and rocky surface; fourth, excess of moisture; and fifth, unwholesome climate.

Down to the end of the 18th century, man's progress in the increase of powers and the combat of difficulties was essentially the result of the unscientific effort of untrained workers and the enthusiasm of the individuals who tamed the wild animals of the forest, cultivated and improved by selection those plants that seemed most useful, and, by accident,[2] made inventions and discoveries.

[2] The first great invention in cloth making that led to the industrial revolution was made by a minister whose attention was called to the awkwardness of hand tools. The cotton gin, that most revolutionizing inven , *happened* because a Yankee school teacher, sojourning in South Carolina, *happened* to have his original mind called to the problem of seeding cotton;

We have now entered upon a new epoch, in which governments and institutions as well as individuals are promoting science and its applications.

We have recently discovered the laws of heredity and the art of breeding and therefore of improving the plants, and to some extent the animals, which furnish us most of our food, clothing, and raw materials. These plants become machines, man the mechanic, and the things he can create by the deliberate use of heredity in plants are quite beyond speculation at this time. It would probably take many thousand experimenters several centuries to work out any large fraction of the possibilities. Nature has furnished a rich raw material for us to start with. We understand the effects of environments in fitting plants to survive particular conditions. If the climate of Arizona is dry, we now know that each and every desert in the world has been developing plants to thrive in Arizona. For example, the date is an Old World adaptation of nature to the dry environment. Knowing this, we no longer depend upon chance introduction of plants by emigrants, patriotic enthusiasts or plant-loving botanists. The search has become definite and organized. Thus a new alfalfa from Siberia, or a peach from Mongolia is hardy by the natural selection resulting from 10,000 to 10,000,000 raging winters. It is raw material for the plant breeder of the agricultural experiment station, the special endowment, or the garden of the plant lover. By this work of the plant explorer and the plant breeder, we can get the new cold-resistant or quick-growing plant that pushes the farm line north, or the new drought-resistant plant that pushes the farm line into arid regions, or the better yielding plant for the fields now under cultivation. The sugar beet has had its sugar content increased severalfold within a century—suggestive of changes for the better that may come to any plant and of changes now actually in progress for many plants. Thus surprising results have been obtained in getting strains of corn to be (a) more vigorous and productive, (b) more oily, (c) more starchy, (d) more highly charged with protein than before.

In 1924 the United States Department of Agriculture sent a man

many other similar stories might be noted. But the technical nature of present industry has removed revolutionary changes from the chance visitor to the [illegible] who had been educated and trained, without the too usual accompaniment of having his mind shackled.

to South America where he secured 200 samples of seed corn which matures in the high Andes at a temperature 20 degrees cooler than that necessary for our own corn. Amazing!

By the combination of the searching of the world's cold and arid deserts and the improvement of plants there found, new crops are already being produced and harvested in lands previously too arid or too cold for any use but scanty pasturages (see Kafir corn in chapter on cereals). Every mile the farm line is pushed westward in the Great Plains opens to cultivation 1,600 square miles of farms. Under existing American conditions, this added mile will easily support 75,000 people, and in some countries of the world would support several times that number.

THE DOMESTICATION OF NEW PLANTS. Vast additions to wealth, comfort, and industry are to come from the domestication of plants now unused or only produced by unaided nature. For two centuries cinchona bark for quinine manufacture was gathered from trees growing wild in the forest, and no one thought of questioning that the east slopes of the Andes had a permanent world monopoly of this precious product, until in 1852, the Dutch government introduced it into Java, and in 1860 the English introduced it into India and Ceylon. The cinchona plantations of the Dutch East Indies islands, with their populous valleys and humid mountain slopes, exported 6,600 tons of cinchona bark in 1922, besides 137 tons of manufactured quinine. The price is one-thirtieth that which prevailed in 1870 when it was gathered wild upon the Andean slopes. The export from South America has practically ceased, for the hunter in the sparsely peopled forests is unable to compete with the myriad villagers and the systematic plantations of Java.

Twenty years ago the world's chief supply of rubber came from the South American forest, while to-day it is largely a cultivated crop in the East Indies and Malaysia. (See chapter on rubber.) Every decade of the twentieth century should witness several such important transfers of supply of an important product from the forest to the field or orchard, from the hunter to the cultivator, with great increase of supply and reduction in cost.

New uses for plants long cultivated are equally suggestive. Thus the peanut is replacing corn on the edge of our southern Great Plains where the drought makes corn uncertain. At the critical period of setting the ear, corn is blasted by a shortage of water, while the peanut vine merely waits for rain and grows when it comes. Then the hogs root the crop up and fatten upon it. The peanut may be considered a partner of the cocoanut in the vegetable onslaught on the animal industries. While the cocoanut is a substitute for butter and other fats, the peanut (see its contents in table of food values) is a substitute for butter, cheese, and meat. Taken together, these two nuts form an admirable example of the shift from animals to plants as sources of food supply (a step toward easy support of larger populations), and also a shift of support from cool to warmer lands.

Animal breeding. Another great field where science affects agriculture is the breeding of animals. It follows the same laws as plant breeding, and has been understood longer. The work already done in this direction is easily appreciated by comparing the useful cow with the wild buffalo or deer. By the application of known science to animal breeding, the efficiency of our domestic animals along many lines can be approximately doubled with little increase in the amount of man's effort in their behalf.

The introduction of the domesticated reindeer into Alaska promises to convert the treeless Arctic America into a vast ranch. Starting in 1892, twelve hundred reindeer became more than 200,000 in thirty years and will soon be ten or a dozen million.

4. NEW RESOURCES THROUGH TREE CROPS

Possibly the greatest of all agricultural benefits will come through the utilization of crop-yielding trees and the breeding of new ones—a piece of scientific work for which we are now ready.

Man began agriculture at the wrong end of the plant kingdom. The grains upon which we feed are all weaklings. Harvest is often but a small handful in comparison to yields of tree crops—the engines of nature which have for ages been giving man the most astonishing object lessons of production, and inviting him to improve them rather than the feeble grains at their feet; but the grains are annuals—a profound advantage to the primitive man (probably woman) who started our agriculture.

Great productivity and profit of tree crops. The chestnut orchards of France, Italy, and Corsica yield *per acre* nuts in amount approximately equal to the per acre of wheat fields in the United States. The wheat grows on the best, most nearly level, and most easily tillable soil of America, while the chestnut orchards often occupy the steep, rocky, untillable mountain sides.[3] While the wheat lands must be plowed for each crop, the chestnut orchards produce their crop without tillage. The trees stand among the rocks and at their feet are pasturage and herds to match the laborious plowing and seed time of wheat culture. This tree crop is the bread supply, pig feed, horse feed and the money crop of many thousands of mountain dwellers in the higher regions of Mediterranean countries.

Despite this productivity of trees we have until the present depended almost purely upon chance to produce the fruitful strains. Freak trees have arisen by accidental hybridizing here and there to become the parents of a variety—Baldwin apple, navel orange, etc.

Now, however, science has caught up. We need no longer depend upon chance, the well-tried method of the ancient nomad. Plant breeding (scientific, not accidental) is a force that is transforming agriculture as the steam engine has transformed transport and the factory. It will enable us to harness the trees, the great productive engines of the plant kingdom, and as a result tree crops, the crops of great yield, are to come out of the corners where they now occupy so inconspicuous a place. It is probable that the cultivated fruiting trees of all sorts in the United States do not cover over two percent as much ground as is given over to the less productive grains. As agriculture adjusts itself suitably to resources, the area of tree crops, with their great superiorities, may eventually outstrip the grain crops. It is almost certainly true that an orchard of selected oak trees will yield in acorns more carbohydrate food, for man[4] or beast, per decade than corn can be

[3] The value of these orchards is most evident. In crossing the Apennines from Bologna to Florence, the first 2,000 feet of the climb upward from the level plain of the Po is through an unproductive and almost unpopulated district. At 2,000 feet the forest line begins, groves of grafted chestnut trees cover the rugged hills for many miles, and numerous villages show that these groves support a large population.

[4] Any one who thinks that bread from acorns sounds fantastic should remember three things: (1) that bread is merely a carbohydrate food, (2) that whole peoples have lived on acorn bread for unknown centuries—the Missouri Botanical Garden has made good bread from common acorns (A.D. 1924) which yield their bitterness when grated and given a water bath, and (3) there are hundreds of millions of people who do not eat bread, certainly not cereal bread, but that is no sign that they are savage, barbarian, or even heathen. They get carbohydrate and protein, but the climate in which they live produces them most easily in other forms. One evidence of tropic

made to yield on similar land in much of the hilly land east of the Mississippi River. But the idea seems like a joke to most farmers. After all the human mind is wonderfully sealed against new ideas.

Already many crop-yielding trees have rare specimens that are good enough to be made into crops without any plant breeding at all. Among these may be mentioned the pecan, shagbark, hazel, black walnut, English (Persian) walnut, persimmon, mulberry, sugar maple, pawpaw, and above all the oaks—so important in Spain and Portugal.

What New England and all hill countries need more than any other thing in the whole list of relations between man and nature is an application of science to give them an agriculture that is adjusted to their unplowable soils. The present agriculture of New England is an imported misfit from the lands suited to the plow.

The uses of land run through grades of intensity in utilization and value of output somewhat as follows: First, the forest with its game, furs, and gums; second, the forest with its lumber; third, pasturage; fourth, tillage and grain; fifth, tree crops. Whenever we find agriculture going over from the annual grains to the perennial tree crops, we find an agriculture of increased output rivaled only by the market garden. Wheat, corn, and oats yield but poorly in comparison to the heavy harvest and large income furnished by

riches is the great abundance of starch-producing plants that are bread substitutes. Throughout the length and breadth of the damper part of the tropics several easily grown plants afford foods which are the essential equivalent of the bread so dearly beloved by the western world that two thousand years ago it got its place in the most widely used prayer in Christendom.

Cassava, one of the tropic bread substitutes, helps to fill the local need in many lands. Like the sweet potato, cassava is grown for its starch-producing roots. The native grates and dries it, making of it not only a nutritive equivalent of bread, but actually a piece of bread, although it is not the light bread to which the northern world is accustomed, but a thin, stiff cake, rather insipid to the wheat-eating palate. That, however, is a matter of habit.

In many tropic lands, cassava cakes and boiled or baked cassava roots are standard articles of diet for the natives, partially taking the place of the corn bread of the American negro, the boiled potatoes and rye bread of the European peasant, and all the other breadstuffs of the temperate zone.

Very suggestive is a Hawaiian discovery, a war bread manufactured and sold for a time in all bakeries there. It was made of thirty percent banana pulp and sixty percent white flour—the invention of a pastry cook in a Honolulu hotel. Perhaps the future bakers of Chicago, Oslo, or Melbourne will for a part of their mixture roll out a cask of banana pulp, frozen in a fruit preserving factory on the banks of Albert Nyanza.

the apple, peach, orange, date, olive, or Persian (so-called English) walnut.

The plant breeder, the constructive botanist, now tells us, for example, that it is only a matter of time and patience to make, by repeated crosses, a good crop-yielding hickory tree, almost an ideal hickory tree. It can have the delicious sweet flavor of the

Fig. 246.—Tree crop agriculture. Grafted chestnut trees on granitic hillside in the Department of Ardeche, 70 miles southwest of Lyons, France. Value $160 per acre, producing nuts, pasture for goats and cows, and bedding of leaves and Scotch broom.

shagbark, the thin shell of the Kentucky nut, and enough of the size of the giant Missouri mocker nut to put it in the English walnut class so far as food value, accessibility, and desirability are concerned, but with one great difference from the standpoint of production. It is thoroughly acclimated by thousands of years' adjustment to our changeable climate, and the English walnut is a Mediterranean exotic, at home in the United States only on the Pacific coast where Mediterranean conditions prevail.

For two centuries the white man has been felling the forests of America to make fields. Many an eastern field, now of low fertility and scanty harvest, has, or has had, upon it the acorn-bearing oak, the nut-bearing walnut, chestnut, and hickory (or pecan), the seedling apple, the seedling peach, the redheart and blackheart cherry (wild mazzard) and the fruitful persimmon and pawpaw. Yet year by year for generations, all these astounding possibilities of crops have been negligently brushed aside, cut down, rolled in piles, burned up to make room for wheat and corn.

Science, backed by money and patience, promises some good tree crop for a million square miles of American hills. But science is as yet doing little to bestow this precious gift upon us, because the work depends upon appropriations by far-seeing legislators.

Trees do not depend upon the plow. They laugh at rocks. They can wedge their trunks in between the rocks, send their roots far down into the moist subsoil, rear their heads into the abundant sunshine, and *produce*. What care they for rocks? If there is earth among them, the tree roots will find it. If the rocks encumber the surface they merely serve as a mulch to keep in the moisture.

Everywhere east of the Mississippi trees will grow where there is earth standing above the water level. With the properly improved varieties of tree crops there is no reason why Massachusetts might not, square mile for square mile, produce as much food as Kansas does now with her fat pigs or fat sheep or fat turkeys—possibly more. The proper succession of fruiting mulberries, persimmons, chestnuts, walnuts, pecans, hickories, shagbarks, filberts, and many other tree crops that might be introduced from this and other lands would give us an abundance of good food or one continuous succession of workless harvests to which the pigs, sheep, and turkeys could walk and eat if man himself did not want them.

Thus may the eastern country double its possible production. The one-third that is now too hilly for good cultivation will, with tree crops, double and more than double its present meager output. The roughest third, now hopeless of tillage, can with tree crops match in productivity the best third which should remain for the agriculture of the plow, to which it is by nature adjusted.

The benefits that tree crops can render the arid and semi-arid [5]

[5] See "The Real Dry Farmer," by J. Russell Smith, *Harper's Monthly Magazine*, May, 1914.

land may be equal to those that may be conferred upon the hilly lands. The grasses, grains, and ordinary forage plants are ill equipped to fight for life against the rigors and uncertainty of aridity. Corn, for example, must have water within a certain two weeks or it is blasted, but the trees can prepare for siege. In the first place, their roots can go down from 30 to 60 feet. These roots can

FIG. 247.—A forest remnant with soil preservation. Soil destruction on the tree-stripped slope opposite. Shansi province, China. (F. N. Meyer, explorer, United States Dept. Agr.)

store up energy, and when the time comes they can make fruit. Further than this, many of the trees of the arid lands are legumes, with the legume's power of gathering nitrogen from the air, leaving a part of it upon their roots to enrich the soil, and using the rest to make seeds that are rich in nitrogen and, therefore, meat substitutes and tissue builders.

A claimant for superiority in the possible desert harvest is the wide-pod thorny honey locust, a leguminous tree with a big pod easily picked up and full of rich beans. Its seed is one of the richest of all stock foods, being high in protein and often analyzing over 50 percent of sugars and starches. It nearly duplicates in quality the carob bean, the "locusts" of John the Baptist's desert sojourn. This leguminous tree is now a crop grown in all Mediterranean countries, and the beans are largely exported from Cyprus to England for stock food. In Spain it is the oats of the cavalry horse.

This honey locust is but one of nature's many desert possibilities. One of the botanists of the Department of Agriculture has found six species of woolly fruited wild almonds growing on the desolate shores of Pyramid Lake in the so-called Nevada Desert. These six varieties bear nutritious though small and bitter fruit. Mr. Frank Meyer, Plant Explorer of the Department of Agriculture, brought back from central Asia the seeds of wild almonds producing good fruit and good edible oil in a climate with an estimated rainfall of 8 inches per year. The desert may yet bloom with almonds.

Foreign lands certainly have great numbers of promising trees to offer us when once we set out in earnest to breed up tree crops. If we will, it seems that we may easily breed the crop-yielding trees and convert hundreds of thousands of square miles of almost vacant western range into fruitful orchards for the fattening of beasts or the feeding of men.

One of the best examples of a new tree crop is the Hawaiian experience with the algaroba, a species of the mesquite, many species of which will grow in considerable areas of the United States. Hawaii has, after many difficulties of a mechanical nature, learned to grind up the beans and pods of the algaroba bean, and thereby added an industry of great promise. The meal resulting from this grinding is worth about as much as bran for stock food, and is the "mainstay" of the dairy industry of the Islands. The Hawaii Experiment Station states that an algaroba forest yields four tons of the beans to the acre per year, and one ton of wood. That puts to shame 50 bushels of corn (2,800 lbs.) and its supporting fodder. The labor of production consists of picking up the big beans, which grow upon a leguminous tree introduced about the middle of the last century from Peru or California.

The tree-crop possibilities of the fecund tropics are beyond description here, but it should be remembered that most tropic products are already tree crops—tea, coffee, cacao, rubber, cocoanut, palm nut, Brazil nut, allspice, nutmeg, cloves, cinnamon, cinchona, orange, mango, avocado, grapefruit. The crop trees are particularly valuable to the tropics because many tropic lands have irregular rainfall, making it difficult to know when to plant a

Fig. 248.—A Georgia gulley, one of the ways by which, with our present system of land ownership and agriculture, we permit a man in a few years with no gain even to himself to ruin forever the home possibilities of those who come after him. What is economic treason?

grain crop. The permanently established tree is *there* ready to use the rain when it comes. We have thus far used but a small fraction of the possible crop trees of the tropics, and many of those we have used have not been used commercially.[6]

[6] See Smith, J. Russell, *North America,* for account of Pejibayes. A most astonishing story of our ignorance concerning an important economic resource.

After man the desert. The proper development of tree crops as indicated here will effect the greatest saving in the world conservation movement—the conservation of the soil, our greatest and irreplaceable resource. The Roosevelt Country Life Commission uttered this warning: "A condition calling for serious comment is the lessening productiveness of the land. Our farming has been largely exploitational, consisting of mining the virgin fertility. On the better lands, this system of exploitation may last for two generations without results pernicious to society, but on the poorer lands the limit of satisfactory living conditions may be reached in less than one generation." The saying "After man the desert" is much too true, as the frightful desolation of most ancient empires attests. It has nearly all come through erosion, and tree crops with their earth-gripping roots will practically stop it all, for the tree is nature's method of holding earth on the rocky framework which erosion reveals so near the surface of most of our hills and mountains. It is pathetic to think how helpless are *civilization* and the *race* in the face of the individual's desire to seek to-day's gain by wasting something that will stay wasted for a million years.

The ultimate uses of the land. The final uses of land to get maximum return with conservation of the soil seem to be about as follows:

(*a*) Where heat, moisture, and fertility abound,
   1. level or gently rolling lands will be tilled as at present but planted to more productive varieties of plants; and
   2. hilly, steep, and rocky lands will be put to tree crops;
   3. if too wet it can be drained and put to intensive plow agriculture.

(*b*) Lands that we now call arid or semi-arid can in many cases also be used for tree crops and other varieties of dry farming. A small percentage can be irrigated.

(*c*) Cold lands where the cost of keeping warm is great or where frost interferes with crop production will be left to produce our timber-yielding forests.

(*d*) Beyond the tree crop and forest zones will come deserts of bush and bunch grass and moss-covered tundra to be used as open pasture ranges by animals, suited to the conditions.

(*e*) Very steep and rocky land may be terraced, tree cropped, or forested.

(*f*) The bare desert, the bare rock, and the snow field will then as now remain without harvest other than
1. possible minerals where the earth is visible, and
2. possible utilization of deserts for sun-power generators,
3. snow field water storage.

5. THE ECONOMIC POSSIBILITIES OF THE TROPICS

The tropics are quite the equal of the winter lands, as a field for the creation of new resources by science. While the tropics have great possibilities in the new era of scientific industry, they have for ages lain practically unused. Considerable areas of the temperate zone, as in parts of Europe, China, and Japan, have approached the food limit, and most unfortunately a great part of the remainder of the temperate zone lies under the withering limitations of aridity or of low temperatures. In contrast to this, the tropic areas, which include about half of the land surface of the globe, have more than half of the area of abundant rainfall. Add to this its greater heat with absence of winter, and we behold possibilities of the growth of food plants and, therefore, possibilities of the support of population as great as that of the temperate zone, perhaps greater.[7] One great drawback must be noted. Tropic rainfall is less reliable than that of the temperate zone. This factor has not been studied much nor its results worked out. Its chief injury to man has probably been in the tropic grasslands rather than the forests and the emptiness of most tropic grasslands is probably a monument to drought.

Despite this richness, 90 percent of the tropic forest stands to-day virtually undisturbed, save for the roving garden patches of the primitive agriculturists, who occupy parts of it. A United States Consular Report gives an interesting example of tropic emptiness:

"British North Borneo (area 31,000 square miles) is owned and governed by an incorporated company under a charter from the British government. The population of the colony is estimated at 180,000, made up mainly of aborigines, about 15,000 Chinese, and not over 400 Europeans.

[7] Prof. Penck, Director of the Geographic Institute of the University of Berlin, announced in 1924 that he thinks the world will hold 8 to 9 thousand million people where it now contains 1,800 million people, and that he thinks that in 300 years Africa and South America will dominate the world because they can maintain the bulk of its population.

"The natives clear small patches of the valleys and hillsides, where they plant rice and vegetables for food. For other foodstuffs they depend upon hunting and fishing. The manner of farming is decidedly primitive. The hoe is the main instrument, and there is no demand for agricultural implements or any kind of hardware except the hoe and a long knife used in war and in cutting the underbrush. In all Borneo there is not a cultivated tract of ground worthy of being called a farm."

British North Borneo is about one-seventh of the whole island, which is as large as France and naturally several times as productive because the unending heat and moisture of the equatorial belt permit the continuous growth of crops.

With the exception of certain island colonies which have become populous under white man's influence, and a few minor exceptions chiefly in southeast Asia, the tropic forest in its full force has baffled man, save the primitive agriculturist. The sedentary agriculturist has developed only the less productive corners, where nature goaded him with difficulties, stung him into action, made him work or starve, and then often starved him by drought and flood despite his pathetic efforts.[8] Man seems inclined to take his ease where he can and it seems to require intermittency in supplies to make him work. Thus except under Caucasian influence, he has advanced in the tropics only on its arid edges and in southeastern Asia where the monsoon rains of summer make a season of growth alternating with the dry season of the winter monsoon. Under this stimulus and this limitation, India and South China alone among large tropic areas have become populous, and the occasional failure of the summer rains produces crop failures and famines—catastrophes inconceivable to us of the well-fed West. It is a curious commentary on man's relations with tropic nature that he should have become numerous where the famine comes to slay him, and that the equatorial belt with its abundant and more regular rains should have remained idle until the Dutch showed us by their wonderful object lesson in Java that this is the world's natural belt of heavy population.

[8] Famine deaths, India (from William Digby, *Prosperous British India*, pp. 130–1).

1800–25	5 famines	deaths	= 1,000,000
1826–50	2 famines	deaths	= 500,000
1851–75	6 famines	deaths	= 5,000,000
1876–1900	18 famines	deaths	= 26,000,000
Total since 1800			= 32,500,000

Since 1798, the Dutch government, leaving the forms of native government alone, has kept peace in Java and to a considerable extent directed and compelled the industry of the people to provide food for home use and export. As a result the population has increased more than fivefold in a little over a century. In Java there are 50,000 square miles with 35 million people, or 689 to the square mile. Only half of the land is under cultivation, and a recent European scientist has estimated that Java may easily support more than twice as many people as it now possesses. This would bring its figure up to nearly 2,000 per square mile. By applying half of this figure to the whole Dutch East Indies, of which Java and Madura are a sample, comprising less than one-fourteenth, we would have a population greater than that of Europe, and five times as great as that of North America. Population of this density over the forested tropics would permit that zone alone to contain three or four times as many people as the entire world now contains, and they would be no more liable to famine than they are in India to-day. This estimate includes the Amazon Valley where there would probably be a task of flood control greater than man has yet essayed.

Evidence of the correctness of the high possible estimate for Java and for other tropic localities is found in the fact that Barbados, in the Lesser Antilles, has 940 people per square mile; that Porto Rico has 378 people per square mile supporting themselves by agriculture, some of it primitive, in hilly country that is far from fully populated; that Cuba, the size of Virginia, with but 3 percent of the land under cultivation maintains a population of over 3 million people with 70 to the square mile, there are three persons to the cultivated acre and the character of their culture is very unscientific. There is nothing exceptional about Barbados or Porto Rico or Cuba, except that by the accidents of geography and history they are used more than the rest of tropic America. If Brazil were as populous as Porto Rico, its population would exceed that of the four continents touching the Atlantic, and there is every reason to think that Brazil could easily support that many people if they chose to dispossess the monkeys, the parrots, the serpents and the other wild life now in undisturbed possession of hundreds of thousands of square miles of forest in the earth's most productive belt. The whole of Brazil and the rest of tropical South America have a population less than that of the little island of Java.

This part of South America possesses, as do similar latitudes in Africa, large areas of absolutely unexplored territory. It is, therefore, perfectly natural that, except Java, the few commercial products of the equatorial belt should still be the wild products of the forest, namely, rubber and gums, palm oil and ivory, with a little cocoa, which grows in orchards little better than a modified jungle. The jungle is an almost untouched resource teeming with possibilities of crops and food.

THE INHABITANTS OF THE TROPICS. If the tropic jungle becomes a field who will labor in it? If three centuries of colonization have shown us anything they have shown that under present conditions it will not be the white man. The white man has settled all these tropic shores—the Spanish main, the Indies East and West, Africa, South America, and Asia. He settled them before the United States was settled and he has settled them since. He has repeatedly settled them and the settlements have always melted away. The white man is a product of the temperate zone. We do not like heat. We fly from it as it shows itself in the summer of Washington, New York, Boston, and London. The unending heat of the tropic lowland is one of the persistent forces of nature that, as a people, the Caucasians have been unable to withstand. In three centuries of trial on every tropic shore, there has been no single case of a group of Europeans who have physically thriven, increased from generation to generation, and maintained the culture of the founders.[9] Several races, as the Malays, the Negroes, the Hindoos and the south Chinese, have by many generations become somewhat adjusted to this climate of which they are a product. They can live and work and increase on the tropic lowland—witness Java. The white man can only come in as the ruler, the capitalist, the plantation manager, the engineer, the sanitarian, the expert, and the professional man. He cannot raise his children there.

The distribution of population in tropic America affords excellent illustration of the influence of climate on the white man,

[9] The population of Jamaica shows an interesting analysis at the end of three centuries of repeated colonization by strange races from Europe, Africa, and Asia—from the temperate and from the tropic lands. That island has had the incomparable advantages of 250 years of British rule and a large proportion of upland with its cooler climate. Adjustment of these forces shows a population of over 200 per square mile and 1.6 percent white, 77 percent black, 18 percent "colored," 2.1 percent East Indian. Within thirty years the increase of the colored races has been over 200,000 and the white population, now 14,500, has declined a little.

the location of his home, and his place in the development of the country. The white race has here retreated to the cool plateaus of the interior. It has always remained a small, very small, minority, and the native Indian, or the introduced negro, make up the bulk of the population, with the half-breeds the second element in numerical importance. But the handful of white people rule—a fact not without significance.

If these vacant tropic lands which we of the North claim, but may not inhabit,[10] are to become peopled, it apparently must be by the various black, brown, or yellow races that have become adjusted to the tropic climate.[11] Left to their own devices, the forested tropics have produced tribes with sultans, wars, head huntings, piracies, slavery, pestilences, and diseases that have effectively kept down population. They have never yet developed even a second-rate power and have fallen an easy prey to colony-annexing European powers. Given order and protection and guidance as in Java, they clear up the jungle, populate the earth, and have crops to sell. Thus, by the aid of the acclimatized peoples, these untouched continents may yield unlimited amounts of rice and rubber, sugar, cocoa, oil and nuts, cotton, hemp and other fibers, and a whole host of tropical products which we can buy with our northern goods, especially with the products of factories located in comfortable and energy-creating climates.

Relation of tropic peoples to northern prosperity. The development of the dense populations of Barbados, Porto Rico, Java, and Bengal shows that these lands are almost certain to remain essentially agricultural or, at best, in a low state of manufacturing. The tropic lack of ambition means that they will probably stay indefinitely as colonies or in a low stage of political power so long as temperate zone countries maintain their present civilization. The white races of America and Europe would have nothing to fear from three or five billions of black, brown, or yellow people in the tropics. History seems to indicate that a small fraction of this population in a frosty climate would in time break out into a

[10] Once upon a time somebody made the outrageous suggestion of making a fire to heat the cave. This heretic started the population of the world to northern climes. It is time for another heretic to start back by building a cool house in the tropics.

(See Smith, J. Russell, *North America*, p. 310.)

Is the idea any more fantastic than heating the house?

[11] *Control of the Tropics*, by Benjamin Kidd. Macmillan.

world-conquering foray; but in their monotonous tropic atmosphere they would probably be, as they now are, non-militant agriculturists carrying out, as now, the instructions of northern men. Our trade with them, largely the exchange of manufactures for raw materials, would be a great source of temperate zone riches, and would easily enable northern lands to double their population. But can the white race keep on sending some people to the tropics without its own destruction thereby? It is very doubtful.

REFERENCES

Rowntree, B. S. *Land and Labor in Belgium.* The Macmillan Co.

King, F. H. *Farmers of Forty Centuries.* Madison, Wis., 1912. An excellent account of oriental agriculture by an expert.

Smith, J. Russell. *The World's Food Resources.* Henry Holt & Co., 1919.

Kidd, Benjamin. *The Control of the Tropics.* Macmillan, New York, 1898.

Smith, J. Russell. "Economic Importance of the Plateaus in Tropic America." *Bulletin American Geog. Society,* January, 1911.

Smith, J. Russell. "The Reindeer Industry in America." *Scottish Geographical Magazine,* March, 1924.

See list of publications by the Division of Foreign Seed and Plant Introduction, United States Dept. Agr.

PART II

COMMERCIAL GEOGRAPHY

GENERAL REFERENCES FOR PART II

In the main, the second part of the book has been worked out from such fragmentary sources that satisfactory references for class use are not available.

Teachers who are having their students make reports may find this part of the book a fruitful field. Standard reference works—atlases, Commerce Reports, advertising matter of transportation companies, the annual volumes of encyclopedias, the Statesman's Yearbook—these and many others give fruitful material for the working out in greater detail of many points in Chapters III to XI, inclusive.

SMITH, J. RUSSELL.—*The Ocean Carrier.* Putnam's. Goes quite fully into the ground covered by Chapters II and XII, and touches to some extent on the subject matter of the intervening chapters.

Those caring to go more fully into the theory of the Balance of Trade will find it covered in treatises on Political Economy.

Chapter XIII is partly covered by most of the Histories of Commerce.

"Dun's International Review," monthly, New York, has for a number of years covered very closely the field covered by Part II of this book.

"Fairplay," London, and the "Marine Review," Cleveland, are two journals dealing with ocean transportation.

The Shipping World Yearbook, published by the "Shipping World," London, and the "Exporters' Encyclopædia," published annually in New York, contain valuable collections of foreign trade and shipping data for every country in the world. The Panama Canal is exhaustively discussed in E. R. Johnson's report to President Taft on Panama Canal Traffic and Tolls, 1912.

CHAPTER I

THE LAW OF TRADE

Commerce exists because individuals and peoples, having different goods, exchange their surplus to mutual advantage. This difference in the production of peoples arises from three main reasons—first, the difference in the peoples themselves; second, the differences in the stages of industrial development; and, third, the difference in the resources of their respective lands.

RACIAL DIFFERENCES. The first reason for a difference in production arises from a difference in the peoples themselves. The Japanese and Chinese export to other countries their porcelains, lacquer ware, metal work, fancy paper goods, and other products, which have their distinctive character and value because they reflect a skill peculiar to these oriental peoples, whose culture is so different from our own. From India come many carvings and curios, which are prized as examples of Indian art. The chief commerce of some American Indians is in basketry, blankets, birch bark work, and other products of their tribal life, and native arts and crafts. Among the peoples of Western civilization, the French are conspicuous in commerce through the export of products which are valuable because of the French skill and taste which give them a superior artistic character, and make them precious to the lovers of the luxurious and beautiful everywhere. Pre-war German commerce reached an important position partly through the influence of the scientific attainment and thoroughness of the German people. This was particularly true of their leadership in the chemical industries and the industries that have through their chemical basis a close dependence upon the laboratories of a nation which has led the world in chemistry. It may at first thought seem that the difference in the skill, genius, or culture of races is the greatest cause of trade; but this is not the case. Racial difference is the least important of the three main causes.

Racial differences and their commercial results are conspicuous for their tendency to be evened up and to disappear. The relative advantage of German scientific leadership is passing because the Germans themselves are teaching other peoples their own sciences and arts. America, Japan, and England have adopted German sciences and scientific instruction, while the Japanese art products are declining because of the influence of European and American machine manufacture under the factory system. The arts of the Indian and the tribesman everywhere tend to vanish before the machine-made product of world commerce. This is usually a great blow to tribal life and native culture.

Difference in the stage of industrial development. The second cause, a difference in the stage of industrial development, is much more important in explaining the world's present commerce. The difference in stage or intensity of industrial development is largely a matter of the density of population. Two people to the square mile will inevitably support themselves by means which differ greatly from those that will be adopted by 200 people per square mile in the same kind of territory. The sparse population seizes upon the raw products of nature, or produces raw materials requiring the least labor. A dense population, having few raw materials per capita, must fabricate them to a high degree to make value. In the new forest lands, one person to two or three square miles will make a satisfactory living by the trapping of fur-bearing animals and the gathering of nuts, gums, herbs, and roots. A population slightly more dense will cut down the forest and sell logs as lumber. If this sparse population is upon the open plain it will employ itself in tending herds of sheep and cattle, and will export wool, hides, and animals. If the population increases and the climate is suitable, the level plain will be carelessly plowed up and sown to grain, which will be exported to the densely peopled region.

This, in brief, is the explanation of the great commerce of the second half of the nineteenth century. The European peoples settling the comparatively empty lands of America have been producing wheat and sending it back to the better yielding wheat lands of Europe; they have been sending cattle, meats and dairy products to the European countries, where the pastures are fatter and cattle more numerous per square mile; they have been exporting lumber to the countries where the forests are better kept, because the European population is dense and the American population has been and still is relatively scanty. This is the chief explanation of the commerce between the German-American in

Wisconsin, the Scandinavian-American in Dakota, or the grandsons of the Englishmen in Nebraska with their kinsfolk in the old country. We even send to and get from Europe articles of the same material but of different degrees of manufacture. Thus we export raw cotton and buy fine fabrics and lace; we export logs and planks and import wood carvings from Switzerland and the Black Forest region of Germany; we export sole leather and import the fancy tans of France and Germany; we sell steel rails and pig copper and buy English cutlery and Swedish scientific instruments; until the war forced us to develop a dye industry of our own we even sent coal tar to Germany and brought back the drugs and dyes that her chemists made from it.

Owing to the westward movement of the main line of migration and settlement we see, within the old world itself, a duplicate of the trade that passes between America and Europe. The densely populated manufacturing parts of Europe, west of Vienna and Berlin, carry on a most active commerce with the territories of the Baltic and Black Seas, deriving from them products identical with those that come from across the Atlantic. These manufacturing regions have been sending to us and to eastern Europe woolen goods, cottons, silks, leather goods, machinery of all kinds, metal manufactures, cutlery, gloves, lace, and the thousand products which reflect the much labor and the relatively small raw material of densely populated regions. The new outposts of Western civilization in Australia and Argentina are to manufacturing Europe but two other Missouri valleys, with grain fields and sheep and cattle ranges, inhabited by people who buy their manufactured goods and pay for them with grain and animal products. This trade will appear wherever these differences of population are found and land permits. Thus in Roman times, France and west Europe sent to Rome furs, cattle, timber, food and slaves in return for the more valuable goods of Rome. To-day these conditions, with the exception of British coal, are reversed in the trade between Britain and Italy. This basis of trade, like that depending on racial differences, from which it cannot completely be distinguished, has a strong tendency to disappear through the equalizing of industrial conditions throughout the world.

The United States and Germany, which for a time were England's great market for her manufactured goods, are now rapidly developing the same industries, and are becoming the great rivals of England. Within the United States itself the whole development is shown. New England duplicates old England in more than name. It is little more than a group of towns and cities whose people live by fabricating raw materials, most of them imported, and sending the product chiefly to the West and South in return for the food and raw materials of those newer and less populous sections of the country. The Lower Great Lakes region, which, 50 years ago, was to New England both market and source of supply for food and raw materials, is now becoming her manufacturing rival and turns for her supplies to the yet newer West and to foreign lands. The cotton industry of America, once centered in New England, is rapidly being built up in the South; and all kinds of manufacturing is going on in greater and greater quantities beyond the Alleghanies, so that the North Central States are coming to resemble New England as New England has come to resemble old England. Every state and every country desires manufacturing industries (sometimes unwisely), and they are increasing in every state in the Union, and in almost every foreign country. Lastly, but by no means the least important, comes the emigrant to even up the population physically and complete industrial similarity, so far as it pertains to the labor supply. Before the adoption of our new immigration law, more than a million have sometimes come in a single year to help do the hard and heavy work of mine, foundry and factory. Even with the present restricted immigration there is no reason why in time this country shall not become as fully peopled as is Europe.

This growing likeness in industries and population is accompanied step by step by the cessation of trade in those articles for which the necessity ceases as America comes to produce a product previously secured in Europe. A few decades ago most of our iron and steel was brought from England. Now we export it occasionally to England. The import of textiles, chemicals, and other manufactures is falling off in consequence of American production. The large trade in sub-tropic fruits and dried fruits from Mediterranean countries has almost entirely ceased through the development of identical industries in California and Florida.

Difference in resources. The third basis of trade, that arising from difference in resources, is one of increasing importance and is one which man affects but little, a fact which will become of greater and greater influence the more fully we adapt our use of each section to its resources. The chief of these differences are those of topography, soil, moisture, nearness to sea, and temperature.

Differences in topography give rise to a trade which will endure. The products of the well-used mountain and of the well-used plain must forever be different. The rough, rocky and steep lands cannot be tilled; but they are the natural home of the forests, of wood and tree products, and of the mining and quarrying industries. The full utilizing of mountain countries means therefore minerals, wood, nuts, fruit, water power, paper, and the possibility of printing and publishing and the manufacture of varied light imported raw materials through water power. But the mountain needs the agricultural products of the open plain, grain for bread, animals for meat, wool and cotton for clothing, and the many other products of agriculture, which can be paid for with mountain products. Such is the trade that does now and may for centuries pass between the prairies of west Canada and the glacial regions north of the St. Lawrence, between hilly New England and Appalachia and the level West, between Switzerland and Hungary or Argentina.

Soil differences also make trade. Along the banks of the Mississippi, in southeastern Iowa, are glacial sand plains in the midst of the fertile black prairies of the corn belt. The sand plain, too poor to grow corn, just suits melons and sweet potatoes, which the farmers grow in large fields, and peddle in wagon loads across adjoining counties, or ship by train loads to adjacent states to be bought up by people who can grow corn, but who cannot, on their richer, heavier, more valuable lands, grow good melons or potatoes. This example is typical of the vast trade that is now developing between the sandy districts in the Atlantic plain and elsewhere, and the rest of the United States. Though the most conspicuous, this soil difference is but one example of many others.

The differences in moisture give us the humid and the arid lands between which there is a great and growing trade. Beyond the bounds of cultivation in all countries are the sheep and cattle ranges, where sparse population has two or three products to sell, and must buy most of its food from more favored farm lands, and must secure from the manufacturing towns all the other products that are to be purchased in the store. In the irrigated oases of the arid lands, dried fruit is produced most easily; and it is already being sent from these favored spots in Australia, in Argentina, in Chile, in

Europe and in the United States to the more humid districts, which can with ease produce other products for exchange. This exchange of dried fruits and animal products for grain and manufactures is world-wide and seems to be as enduring as the variation in rainfall, the distribution of people, and the ability to transport with ease.

The shore lands and the inland region have an enduring trade in the fish, of which the rocky and untillable cold coast has at present a great wealth, enabling it to command in exchange the products of all other climates.

Temperature as a basis of trade is the most fundamental, the most widespread, and, for the future, the most promising of great and yet greater performance. No exchange of culture, no equality in education or skill, no emigration of peoples evening up density of population can change the temperature and make tropic fruit grow in the land of arctic fur, or cotton grow in the land of spring wheat. If America becomes a second Europe, Manitoba will have a lively trade with Texas, because Texas can produce cotton and other sub-tropic products, which the short summer forever bars from Manitoba. Florida and other southern lands will send their oranges and vegetables to the northern lands of frost when the latter's agriculture is frost-bound; and the North will send in return its wheat, the red apples from its hills and the myriad products from its mills. Examples in miniature often permit us to see the tendencies of the time more clearly than larger and more complicated examples. Thus the Canary Islands, snugly fixed on steamer routes in the frost-free waters of the warm Atlantic, have within a few decades developed an export of over 200,000 tons per year of bananas, tomatoes, and potatoes, mostly to the English market.

THE FUTURE COURSE OF TRADE. This north-south trade is the trade of the future.[1] It gives the things we cannot ourselves produce, and is needed to round out the economic life of northern and southern lands alike. Foods make the most important class of

[1] Trade between the temperate lands and the tropic and sub-tropic lands is already significant as witness the four leading imports of the United States in 1924:

	Million Dollars	Percent of Total
Cane Sugar	363	10.1
Raw Silk	327	9.1
Coffee	248	6.9
Crude Rubber	174	4.8

commodities from tropic and sub-tropic lands. Northern peoples want their cane sugar, cacao, coffee, rice, spices, bananas, and other fruits; their cocoanuts, Brazil nuts, palm nuts, tapioca, and many minor foods. We of the temperate climates want, for our mills, their raw materials, rubber, Manila hemp, jute, henequin and other fibers; their cabinet and dye woods; their rattan, gums, palm oil, and other forest products. In exchange for these the northern lands are sending machinery, clothing and all kinds of manufactures and some foods, such as wheat and potatoes. This is a natural trade.

At the present time the great bulk of our commerce depends upon differences in the stage of industrial development—east and west trade—but the future is indicated by changes now in progress. The greatest rates of increase are taking place not along east-west lines, but in the trade of temperate with tropic regions; and, if the

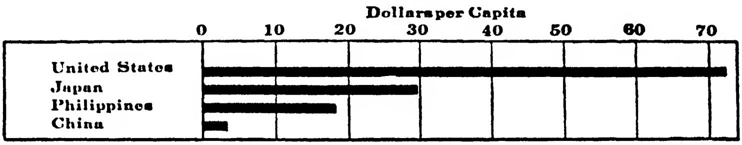


FIG. 249.—China's per capita foreign trade is at present insignificant.

present rates of increase in this traffic continue throughout this century, it will far surpass that on the east and west lines. The east and west trade will probably not decline in absolute quantity, but will become relatively and gradually less important as the world's commerce multiplies itself manyfold, as it inevitably will if its present tendencies continue.

SIZE OF COUNTRY AND VOLUME OF FOREIGN TRADE. Foreign trade, depending thus upon natural laws, modified by man's aid and interferences, is of varying importance in different countries, with the general tendency to be least important in large countries and most important in small countries. China peacefully and successfully ignored the foreign world for many centuries, because she is a world within herself, reaching on the south to the latitude of Havana, on the north to the latitude of Newfoundland, producing cotton, rice and wheat, and reaching westward across semi-arid and arid pastures to the deserts of central Asia. The world could give her nothing that she did not produce. She therefore scorned the world. Petroleum, cheap cotton cloth, modern machine manufactures and new machinery have tempted the Chinese to buy, and their foreign trade is increasing, although it is still less than five dollars per person. The foreign trade, however, of a country like Uruguay, a little fertile cattle and sheep ranch, is $80 per person, among the highest in the world, because Uruguayans produce essentially one class of articles, with which they must buy everything else which a civilized people consumes. Small countries like Switzerland, Belgium and Holland, with almost no variety in climate, and small variety of resources, have a relatively enormous foreign trade. So does England. So would New England, if we had the figures of commerce that cross her southern and western boundaries. But most of New England trade is with other states of the Union, and disappears without statistical record in our vast domestic commerce, which is said to be more than twenty times as great as our foreign commerce. If all Europe were but two nations, corresponding to the United States and Canada, most of her astonishingly vast foreign commerce would disappear, because the commerce of England or Germany with west Europe and Russia would be like that of our northeastern with our southern and western states. Our great area and variety of resources give us a smaller per capita foreign commerce than that which is shown by the countries of Europe, especially such small countries as Denmark or other western European countries.

To see commerce in its extreme development we should look at the Falkland Islands, a wind-swept sheep-range and whaling station with an area of 4,600 square miles, and a population of 3,400 people, whose foreign trade is about $4,400 per person per year. This surpasses the little French colonies of Miquelon and St. Pierre —a few thousand fishermen and ship outfitters on two barren rocks in the cold Gulf of St. Lawrence, who import and export each year the enormous total of about $700 for every person in the colony. In contrast to this the per capita foreign trade of the United States is over $70, and that of Great Britain about $200 per year.

CHAPTER II

THE WORLD HIGHWAY—THE OCEAN AND ITS CARRIERS

To understand world commerce we must first know the part played by the ocean. The nation that does not touch the ocean is like a house that is not upon the street, and some of the bitterest strifes of history have been for the possession of bits of coast. Once a nation has reached the sea it has possessed itself of a part of the world highway that reaches everywhere and belongs to each and all who own even a tiny strip.

THE FREEDOM OF THE HIGHWAY. It is an adage that ocean transportation is cheaper than land, but it is difficult for the landsman to realize how much ocean carriage differs from land carriage in cheapness and in the freedom of competition. This freedom is chiefly due to the same cause which produces the greater cheapness of transportation, namely, the fact that the ocean carrier must furnish only the vehicle, while nature furnishes the roadway, and, in some cases, even the motive power—wind. Upon the railway the cost of the vehicle is an insignificant part of the total cost of service. The important thing is the expensive roadbed and right of way.

THE FREEDOM OF THE TERMINALS. Every city with access to the sea, whether it is large and well situated commercially, or insignificant and poorly located, has a desire for world trade. Often the desire of important cities for trade is so keen that they bid for ships by getting harbors and docks ready for them, and providing facilities for unloading and for taking on fuel. Accordingly, the place for the ship to unload is usually found with comparatively small expense to the ship. If the steamship company cannot find terminal facilities to suit it in one port, it can change to some other port, the freedom of the sea permitting it to go with perfect ease.

THE TWO TYPES OF OCEAN SERVICE. This freedom of the highway and of terminals results in a great variety of traffic methods, but the whole of ocean commerce may be divided into two large classes. 1. The line traffic, with which every one is more or less familiar, carries the passengers and mails and certain kinds of freight. It corresponds to the express and fast freight business of the land. The line service is in the public eye and achieves a degree of attention which is much beyond its relative merits. 2. Charter traffic; vessels operating as single units, like any huge

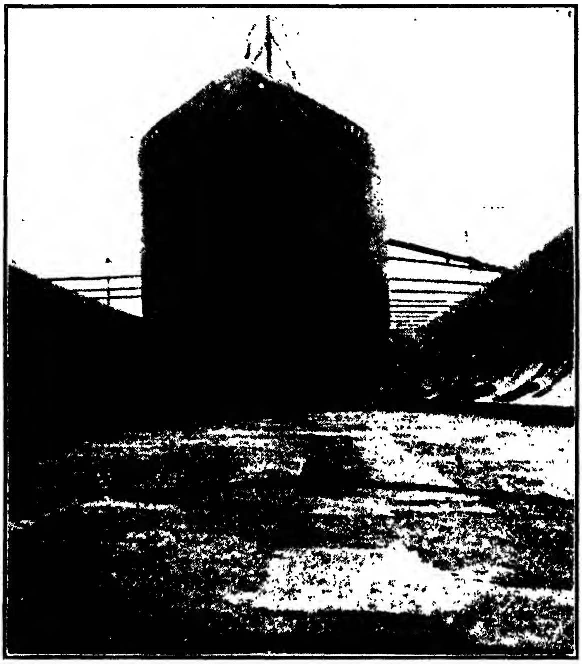


FIG. 250.—A tramp steamer in dry dock shows how nearly cubical she is—about 81 percent.

moving van that is for private hire, handle the larger part of the ocean's freight. It is an individual matter entirely between the shipper and the ship owner. The business is not heralded by expensive advertising, fine engraving and handsome cuts distributed throughout the five continents. All this publicity is costly. The individual ship, which is known as a charter ship, or more commonly as a "tramp," is on the list of some shipbroker or brokers who secure a freight for her on commission, and she goes about her work unnoticed by the traveling public or by the headlines of the newspapers. She is reported only in the maritime columns of the business journals, and is watched only by those whose business it is to know about her travels. But she carries a large proportion of the world's freight.

The tramp vessel that is free to go when work offers, and to lie in port when it does not offer, has a distinct advantage over the line vessel, which must go on a certain date, full or empty, must maintain a schedule and make sailings to ports of call, which in themselves are often unprofitable, but which are necessary, since a line vessel must maintain a reputation to establish relations with shippers and form a clientele. The ambition of the liner is regularity and reliability; the ambition of the tramp is cheapness.

THE CHARTER OF TRAMP VESSELS. The freedom of the sea makes competition easy, but it is especially easy among the tramp vessels. When a great line is established, full competition can only take the form of another great line, which involves much capital and careful organization. Competition in the tramp service requires merely another ship. It does not even require that the owner shall be a successful manager. He may rent his vessel out to another, who has the necessary acquaintance with the trade, or he may secure a manager who will receive a salary or commission. Any person who has the necessary two or three hundred thousand dollars can go to any one of the scores of shipbuilders and have a tramp steamer built in a few months. He can have a ship built on part borrowed money, the builder taking a lien on the ship; and when she goes to sea she will go mortgaged. Or, if the newcomer should desire to engage in the ship business and does not care to wait for the ship to be built, there are numerous ship-brokers who will sell him one within an hour. The owner of this single ship is then in a position to compete in the world's freight market, and can take service on any sea, in any country and from hundreds of ports. The ocean is a world ocean; the ship market is a world market; the charter traffic is a world traffic; and the ocean rate a world rate. If there is grain in volume in the Black Sea the ships go there, and the same is true of India, Australia or South America. Wherever freight offers, there the ships may go and do go.[1]

THE TRAMP TRAFFIC. This tramp steamer, which may be built and owned by anybody, and which may sail in all seas, and carry

[1] "Here is the *Olaf Nordsen* of Stockholm, Sweden (in New York harbor). She is about 8,000 tons and a heavy broad thing, with a short funnel, and two stumpy masts rigged with derricks. She looks a seaworthy ship

the products of any or all countries is a remarkably free agent. It is to be had, however, only by those persons who can afford to load a whole ship; and that is about the only limitation upon the character of produce that is carried by the tramp vessels. First in the class comes grain; then we have sugar, cotton, ores, coal, nitrate of soda, lumber, china clay, petroleum and many other bulky raw commodities. Only occasionally some manufacturer ships enough heavy goods, such as steel rails, locomotives and agricultural machinery, to fill a vessel, in which case he almost invariably charters a tramp. The regions producing the tramp freight and the regions consuming the same are widely scattered and embrace every important country in the world. For example, grain is shipped from our Pacific coast, our Gulf and Atlantic ports, from Argentina, from Australia, from India, from the Black Sea ports, from Egypt and from Baltic Russia. A further analysis of the origin and destinations of prevailing charter commodities would show that we have indeed a world problem. There are hundreds of ports with freight for tramp vessels and there are thousands of ships scattered about the world to do this work.

Management of tramp vessels. The proper bringing together of the ships and the freight is a world puzzle, compared to which the game of chess is simplicity. The ships must move around the world in such a way that the freight is all carried and that the ships that do the work have as few empty voyages as possible, and keep constantly employed.

The successful adjustment of this complicated situation is one of the results of the development, first, of the ocean cable, and within recent years of the wireless telegraph. Practically every ocean-going vessel now carries a radio outfit and is seldom out of touch with the world for very long. Lloyd's agency in Great Britain, with its branches throughout the world, reports every observed movement of more than 30,000 vessels; maritime associations in commercial ports do the same work; so that the ship-

and probably is. The Scandinavians are a hardy race of seafarers and know good ships. We will hail the man hanging over the stern and ask him when they left home.

" 'A year ago,' he answers in broken English. 'We go to Vigo in Spain, den to Italy, den to Tunis. After dot we vent to England, den come here.' She wouldn't have much speed, maybe ten miles an hour, and it would take time to travel all the distances she has been. And unloading cargo is a slow business in Spanish and North African ports."—From *New York Times*, June, 1924.

owner can easily know not only where his own vessel is, but where the vessels of his rivals are.

It is necessary, however, that in this work watch must be kept not only upon vessels but upon freight. Most of the cargos consist of products that depend upon harvest and commercial conditions. If there is to be a good or bad grain harvest upon the Pacific coast or in the Argentine, tramp shipowners must know it and place their ships accordingly. The differing times of ripening of the various crops in the different producing regions and other particular seasonal demands make each port or district have its busy season and its off season. Accordingly, the manager of the tramp vessel has a number of problems to consider as he guides his ship through the maze of world commerce. The cable and radio which enable Lloyd's to report the movements of all vessels, also report the condition of crops in foreign countries, and enable the managers of the ships to maintain almost as good control and knowledge of their ships as does the chess player of the men on the board before him.

The manager of the tramp steamer must consider more than one cargo when he makes an engagement to perform a certain voyage, for it is necessary that his ship be discharged in a place where freight for the next trip is not too far away. Otherwise he may have a long voyage in ballast, making cost without income. The result is that the probable second voyage affects the rates for the first. The manager seeks an engagement which will release his vessel near good prospective freights and he avoids engagements that take him into barren seas. Accordingly this master of applied commercial geography scans the world's horizon for prospective wheat crops or other freight supplies toward which he can work his ships with a chance of securing freight.

The tramp freight rates. It is a fact that if a vessel cannot make good earnings it usually pays better to take low earnings rather than nothing. The consequence is that when freight is scarce the rates may go down not only to a point where there is no profit but below this, because each manager reasons to himself: "If I cannot make profit, it is better to operate at least at cost; if cost cannot be made, it is better to operate at a moderate loss rather than to undergo a greater loss by tying up to a pier and allowing the ship to rust in idleness." The result is that ocean freights may go to great depths; and, conversely, they may rise to great heights, for when the freight is plentiful and the ships are scarce the only limit to which the rates may rise is set by the maximum that the shippers can afford to pay to get a particular cargo carried. Thus a tenfold increase in rates came within a few months after the outbreak of the World War in 1914, and discarded old tubs of vessels were hastily overhauled and put into service, while new ones were still more hastily built. After the war idle ships rusted and rotted by the hundreds in many ports.

The method of making rates and securing cargoes for ships, and ships for cargoes, is best described by the relation of some common incidents of everyday occurrence. A Liverpool shipowner had a steamer in the Mediterranean loaded with jute, which she was carrying from Calcutta to Dundee. The owner desired another cargo for the steamer at the end of the voyage. Knowing that there was nothing in Dundee he communicated with his agent in Newcastle, and himself made inquiries among the shippers of Liverpool. The Newcastle man suggested a cargo of coal to Hamburg, but it was declined; and the owner sought the aid of his correspondent in Dumbarton, but the iron trade of Dumbarton was not promising. Meanwhile the days were passing, the vessel had reached Dundee and there was nothing provided for her. The Liverpool man was himself the correspondent of a London firm of ship-brokers, who telegraphed him at this juncture that they had offers of a shipment of German coke to go from Rotterdam to Santa Rosalia, Lower California, and of another of Cardiff coal for Buenos Aires. The first the shipowner declined, as being only suitable for a sailing vessel, and because of news from across the Atlantic he allowed the second to go to a steamer then lying at Antwerp. Three days before this he had cabled to his New York correspondent a description of the steamer, offering her services to carry grain to the United Kingdom at a certain rate and saying that she could load after a certain date or between certain dates. As New York freight was dull, the firm in that city telegraphed their Boston and Philadelphia agencies. At the same time a Chicago grain exporter decided to export 150,000 bushels of corn, and telegraphed to his agents in New York and Philadelphia to secure offers of transportation. The representatives of the Chicago exporter and the Liverpool shipowner bargained face to face in the New York Produce Exchange. Offers were, however, made at the same rate by the New York representative of the owner of a ship then off Rio Janeiro with a cargo of Chilean nitrate bound for New York, and also by a Philadelphia broker who sought future employment for a vessel then in the Red Sea with a cargo of Java sugar for Philadelphia. The Liverpool owner was informed of this competition, and still having nothing for his steamer he cabled that he would charter his ship for threepence (six cents) less per ton, or, for the same rate, he would take freight to continental ports as far as Copenhagen. He added to his cablegram the word "range," which means in cable code that he would send the ship to the Delaware Bay with the understanding that she might be ordered to New York, Philadelphia, Baltimore, or Norfolk to load. This offer secured the freight, for the representatives of the sugar ship and the nitrate ship having more time at their disposal preferred to take chances rather than cut rates. The steamer, which, pending negotiations, had proceeded to Newcastle to coal, departed thence in ballast for the Delaware. Meanwhile the Chicago exporter found that railroad conditions made Norfolk the most convenient port to deliver his corn at the appointed time. When the steamer reached the Delaware Breakwater (just inside Cape Henlopen), the captain received telegraphic instructions to go to Norfolk. There he loaded a full cargo of corn, and, as the final destination of the corn was still undecided, he sailed to the Channel port of Falmouth for orders. There he was instructed to proceed to Copenhagen, where the corn was discharged. The vessel was now ready for another contract which the agents had been trying to arrange since the day they learned of the final destination of the corn cargo. Wireless telegraph is perfecting the control of the absent shipping by enabling the course of a vessel to be altered in mid-ocean.

THE COÖPERATION OF TRAMP TRAFFIC AND LINER TRAFFIC IN WORLD COMMERCE. This tramp traffic bears a very fundamental relation to world commerce because it carries the heavy commodities—the raw materials and food—without which the manufacturing city and the manufacturing state as at present constituted could not exist. The era of world commerce in its present sense may properly be said to have begun about the middle of the nineteenth century, when Great Britain began the heavy importation of food and the wide export of manufactures. At this time came the steamship, and lines were established between Europe and America, and between Europe and all other countries, and between New York and the West Indies and Colon, and from Panama to San Francisco and Chile. These two types of ocean service work together like freight trains and express trains. The tramps handle the trade of vast quantity; the liners handle the trade of high value and the shipments of small size and great number. The lines, therefore, serve the greater number of shippers. They serve the multitude who cannot fill a ship with one consignment, and among manufacturers there must be thousands of small shipments of finished goods to one that requires a tramp to handle it. The manufacturing state may depend upon the thousand ships that bring food and materials, but there is an equal dependence upon the 300 big liners that carry to market with greater speed the myriad small consignments of manufactured exports. Conversely a raw material producing country like Argentina depends largely upon tramps to take its exports and upon liners to bring its imports of valuable manufactured goods.

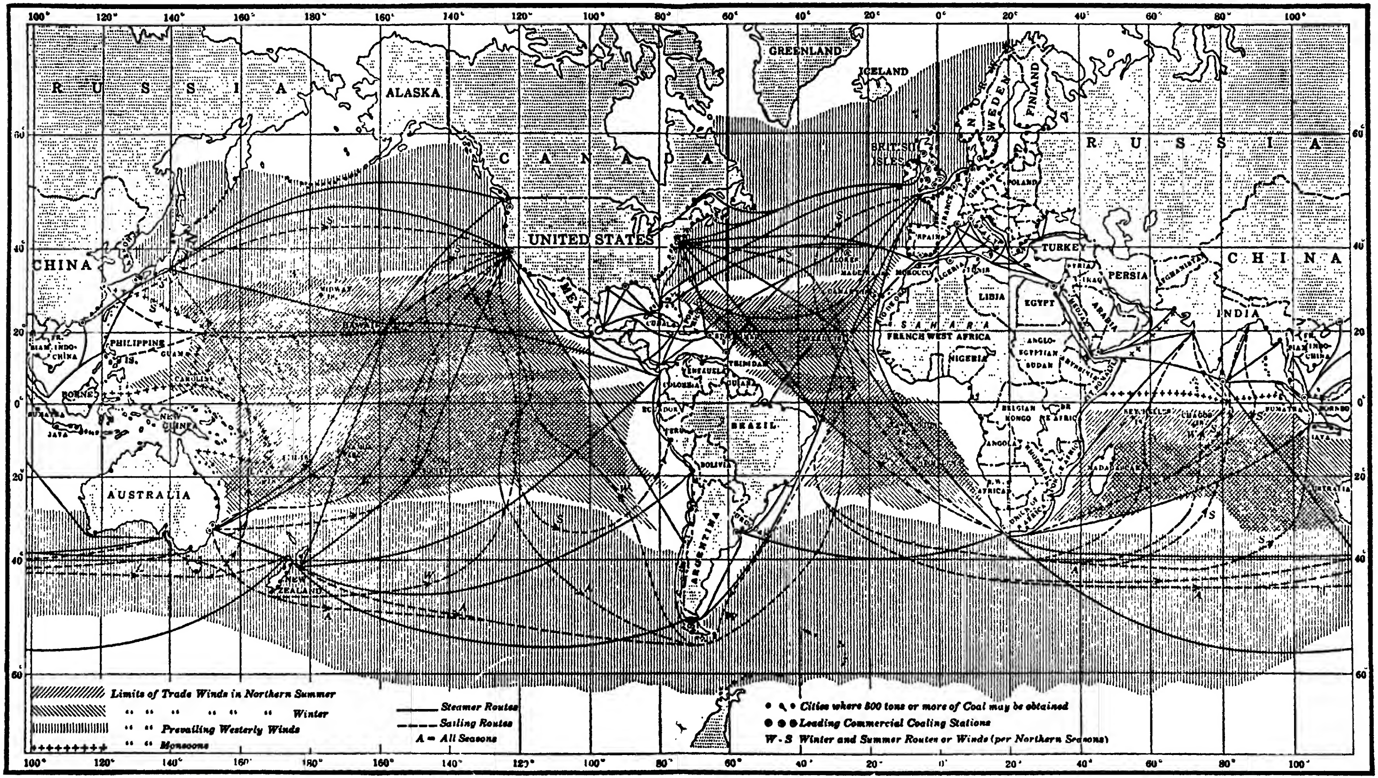


Fig. 250a.—Principal world trading routes, steam and sail. (From *The Ocean Courier* by J. Russell Smith, courtesy of G. P. Putnam's Sons.)

CHAPTER III

THE TRADE ROUTES OF NORTH AMERICA

The internal trade of the United States is vast; the country is almost a world in itself, so great is the variety of natural resource. Not since the founding of the Republic has there been any tariff to interfere with the full development of regional specialties. This great, unmeasured domestic trade is favored by nature.

The surface and contour of the North American continent offer easier paths for commercial routes than those of any other continent except Europe. Most of the habitable areas are comparatively near to, or easily reached from healthful coasts and suitable harbors. The tropic section is the only exception to this, and the tropic is of far less importance than the temperate section.

The center of gravity in North American industry, population and commerce is, and will long continue to be, in the southeastern temperate region, the region comprising the Atlantic slope, the basin of the Great Lakes and the Mississippi Valley east of 100° W. This section is especially favored for transportation within itself and for access to the sea. The slightly sunken coast line affords numerous good harbors, with value increased by a moderate tide. Inland waterways are afforded by the Great Lakes, the Mississippi, the St. Lawrence, and the rivers and bays of the Atlantic Coast. There are few mountain obstructions, and the interior offers a most remarkable combination of conditions favorable to easy transportation. The Mississippi Valley is almost level, opens broadly to the Gulf and further has the phenomenal advantage of almost imperceptible passages to the Lake Basin, to the Atlantic slope and to the areas draining into the Hudson Bay and the Arctic Ocean. The problem of getting out to the Pacific, although of considerable difficulty, is easier than crossing the Alps or the chief mountains of Asia or South America. In Mexico and Central America the mountains are more difficult and the plains less hospitable. Excellent climate and abundant natural resources in the temperate sec-

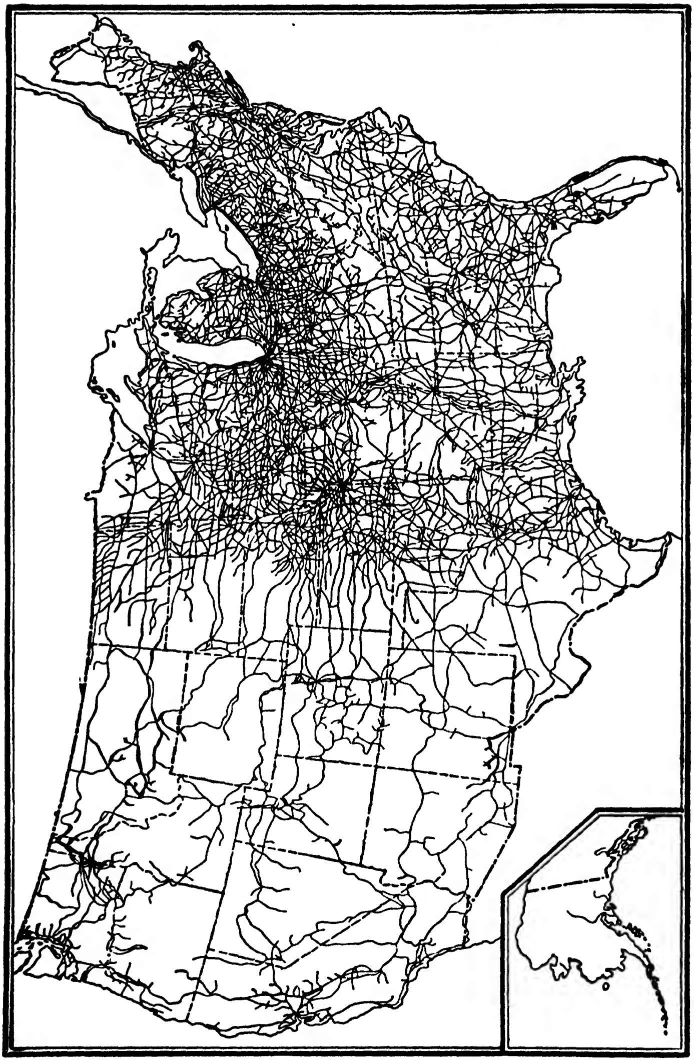


FIG. 251.—The railroads of the United States in 1924. Note the relation between rainfall and railroads, which are a close index of human activity. As an example of the influence of one climatic factor, compare the population of the states marked arid, with that of some large Eastern city or state.

tions complete the conditions necessary for the development of trade routes unrivaled in the size of their commerce.

We have strangely failed to utilize all our advantages, especially our waterways, of which President Roosevelt in a message to Congress said: "Our river systems are better adapted to the needs of the people than those of any other country. In extent, distribution, navigability, and ease of use they stand first. Yet the rivers of no other civilized country are so poorly developed, so little used, or play so small a part in the industrial life of the nation as those of the United States. In view of the use made of rivers elsewhere, the failure to use our own is astonishing, and no thoughtful man can believe that it will last." These resources consist in 25,000 miles of river now used to some extent; 25,000 miles that might be improved; 2,500 miles of largely abandoned canals and 2,500 miles of bays and sounds that need connecting by canals. The waterways have languished and the railroads have thriven because we have been an individualistic rather than a social people. The individual or corporation could make a fortune from a railroad, while the river, free to all, merely interfered with the monopoly of the railroad interests and favored the shipper rather than the carrier. The most conspicuous exception to this is the Great Lakes, a utilized waterway upon which, however, the railway companies run many boats which merely become extensions of the railroads. Before the coming of railroads, this country, like many others, was dependent upon rivers to an extent now little known. Thus the Ohio and Mississippi Rivers were the first great avenues of trade, travel and settlement in the country west of the Alleghanies, which they commercially dominated till 1850. But these streams were not adequately improved and the Great Lakes were; hence they dominated the commerce of the last half of the nineteenth century as the Mississippi dominated the first half.

Influences of the great lakes in making routes. The primary routes of the continent are those connecting the continental interior, the upper Mississippi Valley and the Great Lake Basin, with the Atlantic. Curiously enough, the main thoroughfare to this region is not by way of the St. Lawrence with its great estuary, nor by the navigable Mississippi, but through the low plain connecting the Hudson Valley and Lake Ontario. On the south navigation from the distant Gulf of Mexico was practically shut off until the steamer came (1812) and on the north it is still shut off by the Niagara Falls and the rapids of the St. Lawrence save for boats carrying about one-fifth as much as the Lake boats. The Ohio Valley frontiersman, in the day before the steamboat, took his flatboat load of produce to New Orleans, sold it, sold the boat because it could not be got upstream, and walked home with his silver dollars. His few import goods he bought from another flatboat that came down from Pittsburg, the end of a long wagon journey from the Atlantic. The Mohawk River, flowing out through the only complete break to be found in the Appalachians between Maine and Alabama, gave the key to the Lake commerce.

The completion of wagon roads across the state of New York about the beginning of the century was followed by the building of the Erie Canal in 1825, the first extensive canal in the United States. The tapping of the lakes by this canal was revolutionary for the commerce of the West. The fact that the St. Lawrence drained the waters of the lakes was now of no avail. The Erie Canal drained their commerce into the Hudson and it made commerce. A barrel of flour, which before this had consumed its profit in paying wagon freight for a hundred miles, could now be taken from the lakes to the sea for a tiny fraction of the former prohibitive freight. A large territory in the heart of the continent was given commercial possibilities, because the new route made possible a commerce with Europe by way of New York. Lake shore points throve, having access to the sea through the canal. They also became the bases for the starting of railroad lines into the corn belt states a few years after the Erie Canal had virtually made the Lakes into a commercial arm of the sea. The building of railroads to the West was most easily accomplished along the open route followed by the Erie Canal. This was a profitable place, too, for the building of a railroad, because here were already in existence the traffic-breeding centers of population that had grown up in the territory enriched by the canal that had made cities in the wilderness.

The Great Lakes thus have dominated the development of trade routes in the railway era. Along their shores are the greatest interior populations and trade. The lake freight rates, which have been and are but a fraction of land rates, were a freight attraction that gave any lake port commercial command of the territory behind it. The lake shores have, therefore, always been magnets to the railway builders. Whenever possible these men have brought their lines to the lakes at some point or points so that they might ship east by boat and get a share of the water-borne lake traffic, going west. Consequently the Great Lakes have been the deciding factor in locating at least one terminus of most of the railroads of the central West. The trade routes of this region may now be likened to a section of a thick cable woven of many strands which are untwisted and spread out fan-like at both ends. The lakes, with their steamship lines and the competing and auxiliary

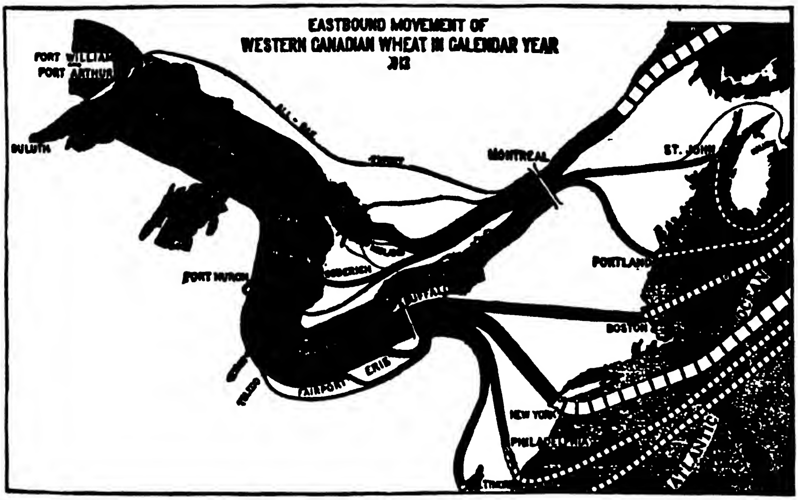


FIG. 252.—The Great Lakes dominate the distribution of Canadian wheat. From *The Story of Wheat*, Butler. (From *North America*, published by Harcourt, Brace and Company.)

railways that follow their shores, make the central or compact section of the cable. The loose ends are represented by the many lines of railway that converge at the western lake ports, and by the other lines that diverge from the eastern lake ports to the Atlantic coast.

WESTERN ASSEMBLERS OF LAKE TRAFFIC. Chicago is at the tip of the Lake that reaches farthest into the corn belt. All routes from the East to the vast American northwest were compelled, in rounding Lake Michigan, to pass this point, which naturally became the greatest railway center in the world. Cleveland, Toledo, and Milwaukee had less commanding positions and grew less rapidly. Duluth, at the head of Lake Superior, is the gateway to a territory that, although much later in its development than that around Chicago and much less favored by climate, causes a large and increasing volume of freight, both outgoing and incoming. Port Arthur and Fort William, Canadian cities on the western shore of Lake Superior, are sister cities and also rivals to Duluth, sharing with her the forwarding trade to and from the spring wheat country to the westward.

Once the railways have brought their grain, lumber, and ore to the lake ports, water transportation renders a great service. From Duluth, Port Arthur, and Fort William on Lake Superior, from Milwaukee and Chicago on Lake Michigan, and from Toledo on the Maumee near Lake Erie, a vast fleet of steamers and barges

FIG. 253.—Iron-ore dock, steamer, railroad terminal and ore storage at a Lake Erie port.

busily and cheaply carry freight to and from Cleveland, Buffalo, and even Montreal on the east. But the railroads because of their greater speed are also busy with the east and west traffic. North of the lakes, between the lakes and with many lines south of the lakes they keep up a constant competition with the lake vessels, and, in the winter months when the lakes are frozen, they must carry all the freight. The railroads also get at all seasons the vast amount of high-class freight for which there is need of haste. Thus, meat, one of the greatest, if not the greatest single product in value in the whole Lake basin goes eastward chiefly by rail from the great packing centers of Chicago, Kansas City, Omaha, and Sioux City. The eastbound grain from these same markets gravitates toward the Lake steamer, since speed and temperature are not so important in its transit.

THE TRAFFIC OF THE LAKE REGION. In numbers of tons per year the traffic through the American and Canadian canals around

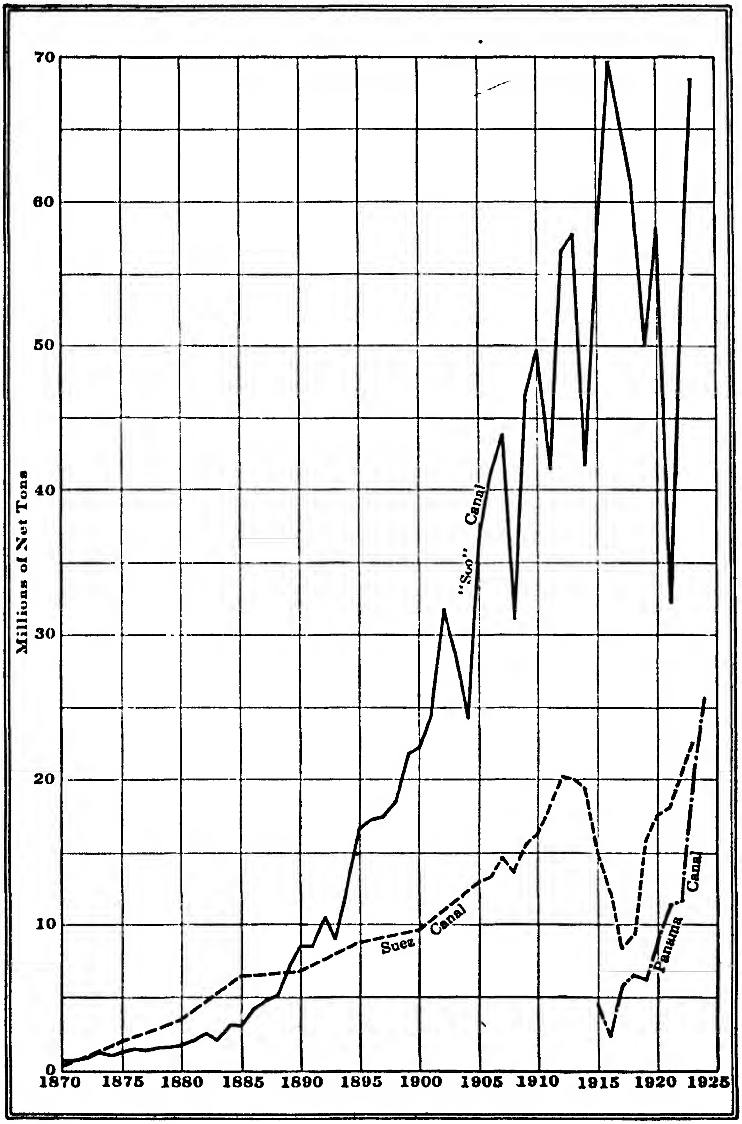


FIG. 254.—Canal tonnage at Suez, the "Soo" and Panama.

the rapids at Sault Ste. Marie at the eastern end of Lake Superior far outranks that passing through the Suez Canal. The tonnage of freight passing Detroit is as great as the combined foreign trade of New York, London, and Liverpool, although it is of far less value per ton.[1] The enormous shipments of iron ore are the largest single item. Shipments of lumber, coal, and grain also assume great proportions. In 1923 it was estimated that 69 million vessel tons passed through Detroit River carrying 92 million tons of freight worth one billion dollars.

Before the World War millions of tons of coal were carried from the southern shores of Lake Erie to the upper lakes at a freight rate of 30 cents per ton. The ore rate was commonly 65 cents from Duluth to Ashtabula, near Cleveland, and grain was carried nearly 900 miles from Chicago to Buffalo for 41 cents per ton. The lower rate westward was due to the competition of the many vessels for the relatively small return freight. In the season of 1924 the wheat rate from Chicago to Buffalo varied from one and one-half cents to five cents per bushel of 60 lbs.—a competent rate. In 1923, 78 percent of the traffic through the Sault Ste. Marie Canal was eastbound. Important articles in this total of 91.3 million tons were iron ore 59.2 million tons, wheat 283 million bushels, other grain 87 million bushels, flour 10.4 million barrels, copper 60,000 tons; westbound, 16.7 million tons bituminous coal and 1.7 million anthracite.

The lake steamers are a highly specialized type. They are just as deep as the builders dare make them to pass through the 21-foot channels that have been dredged in the shoals between lakes. The deepening of these passages by the United States government has aided the shipbuilder in a rapid increase in the size of the boats. In twenty-five years the capacity of the largest has gone from 3,000 to 12,000 tons.

The vessels are built with many hatches for fast loading in which gravity is the chief factor. In unloading the bulk cargoes especially of ore or coal, clam shell grab buckets, some of them of 15 tons capacity, reach into the bottom of the ship and grasp minerals as human hands would scoop up sugar. Ten thousand tons of ore

[1] The Welland Canal at the other end of the Lake, with about one-twentieth as much freight, shows the limiting influence of shallow draught, 14 feet as compared to 21 in the channel at the Lime Kiln Crossing below Detroit.

have been loaded in thirty-nine minutes and 10,000 tons of coal unloaded at Duluth in fifteen hours. These factors of economy explain why the Lakes draw the traffic and why the Lake cities have grown.

EASTERN DISTRIBUTORS—CANADIAN GROUP. From the Lake basin to the Atlantic there are many routes to tidewater between the Gulf of St. Lawrence and the Chesapeake Bay. On the north the St. Lawrence with the port of Montreal offers an economical route

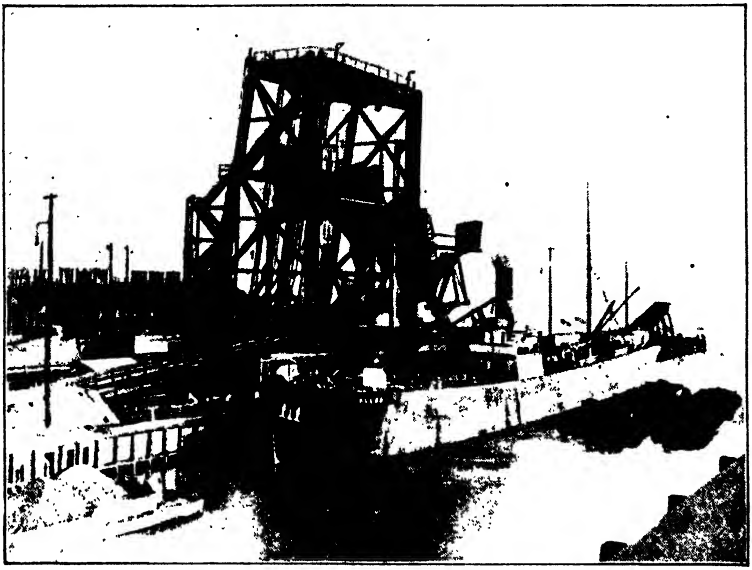


FIG. 255.—The carload of coal is being dumped as easily as a bowl of sugar. (Pennsylvania Railroad Co., Philadelphia.)

now that 14-foot boats can pass through the Welland Canal around Niagara Falls. Montreal is also fed by the transcontinental railways running both north and south of Lake Superior. Millions of bushels of yellow grain come by rail or by combined rail and water haul to Montreal's huge elevators, making her the greatest wheat exporting city in North America.

Unfortunately for a general all-the-year use of the Montreal-St. Lawrence route (400 miles shorter than via New York) the river is closed by ice from December 1 to May 1. Great railroad bridges cross this river at Montreal to give the railways an outlet at ice-free Atlantic ports, chiefly New York, Boston, Halifax, St. Johns,

N. B., and Portland, Me., the latter cities being the chief winter ports for the Montreal steamer lines.

EASTERN DISTRIBUTORS—AMERICAN GROUP. At the east end of the Lakes Buffalo holds a position as traffic distributor, corresponding to that of Chicago and Duluth as traffic assemblers. Vessels of 14 feet only can pass from Lake Erie to Lake Ontario, but Buffalo can be reached from any of the four upper lakes by vessels of 20-foot draft, and with a carrying capacity that exceeds the average reached by the carriers on the ocean itself. Eastward from Buffalo traffic is shared by a dozen railroad tracks connecting it with Boston, New

FIG. 256.—Canal locks of the nineteenth-century (Erie) canal, and the twentieth-century (Barge) canal, Waterford, N. Y. (Courtesy Funk & Wagnalls Co., New York.) (From *North America,* published by Harcourt, Brace and Company.)

York, Philadelphia and Baltimore. This multiplicity of roads from Buffalo has been steadily increasing in efficiency, adding new tracks and cutting into the proportion of traffic carried by the now rather neglected Erie Canal.[2] The state of New York has spent over 100 million dollars in rebuilding the canal to a 12 foot depth and constructing new locks so that it can carry 1,000 ton barges and enable the port of New York to continue as the metropolis of Lake traffic. The service of the Erie Canal is not to be measured in tons actually carried any more than we measure the value of a policeman by the number of arrests he makes. Every spring for many years the grain rates on the railroads went down when the canal opened because

[2] The canal is carrying only about 2 million tons of freight a year, in spite of its fine facilities. Forty years ago it was carrying nearly three times that much.

the canal gave free competition on a cheap highway. Whenever the canal reduced the rate the railroads had to meet it. Thus the canal has reduced the rate on nearly all the hundreds of millions of tons of freight that have passed from the Lakes to the sea in the last hundred years—a service of incalculable value. This fact explains the bitter fights that the railroads have so often made to kill the canals.

It is interesting to speculate on the probable results of the success of the rival plan to improve the St. Lawrence and the Welland Canal, making that route even cheaper than the New York Barge Canal.

To the south of the Buffalo routes three other trunk routes of great commercial importance connect the Lake shore and the Ohio Valley with the Atlantic ports between Norfolk and New York. The traffic on these east and west routes from the Atlantic Coast states to the western plains is the heaviest railroad traffic in the world, and comprises in the main the eastward movement of raw materials and food—grain, flour, lumber, ore, copper, meat, and cattle foods in exchange for the westward-moving manufactured articles and imports in almost infinite variety. The heaviest single item going west is coal, chiefly the superior grades from Pennsylvania and West Virginia.

This rather surprising number of routes to and from the Great Lakes is due to the remarkable topography of the basin of this group of lakes. They lie at the very top of the continental mid region, *upon its very roof*, a reservoir and water transport system on a level plateau. By the digging of a mere canal at Chicago the waters are diverted to the Mississippi. The four southern lakes are so nearly on a level with the general surface of the country, that they can be approached by railway at almost any point suitable or desirable for the landing of vessels. Hence, the multiplicity of routes to them and from them.

Between the Chesapeake Bay and the Gulf there are no railroads of the first magnitude going inland from the Atlantic because there is no inducement to take export goods across the mountains to this corner of the continent. The region of the lower Ohio has sufficient natural outlets toward the Chesapeake, the Lakes, or the Gulf. Charleston, Savannah, and the lesser south Atlantic ports are fed by the local railways and the navigable rivers in the Atlantic plain. This limitation of hinterland gives them a prospect of permanently small size in comparison to that attained by ports having good connection with the center of the country.

THE SIDE DOORS OF THE CONTINENT. This great sheaf of east and west routes bound together by the Great Lakes, and reaching into the center of the continent, has really included more territory than it can hold. As the result of transitory rather than permanent conditions of settlement, it has, in grasping for the vitals of the continent, overreached and placed itself in unstable equilibrium by taking trade that can, with the improvement of routes, go more easily by the side doors to the south and to the north—the Gulf of Mexico and possibly Hudson Bay.

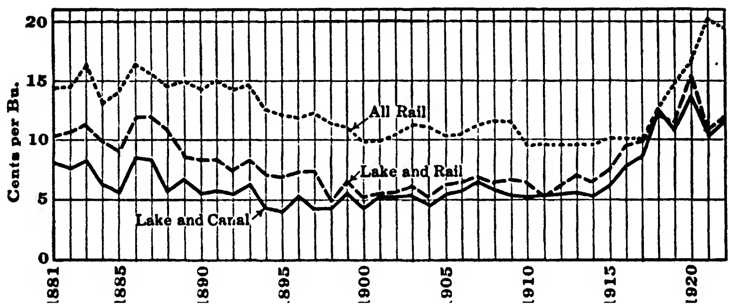


FIG. 257.—Water transportation is a controller of railway freight rates.

The Mississippi River with its boats or the possibility of boats has rendered in its field a rate control service almost identical with that of the Erie Canal. The Mississippi Valley with its natural outlet toward the Gulf has created, first, New Orleans on the great river near its mouth, then at the sides of the valley, Galveston, Mobile, and Pensacola,which have become important with the building of the railways from the productive districts to the northward. These are all cities of the second class, but they are all at the ends of promising lines of trade to the upper valley. Each also has a rich local territory in the cotton belt. Mobile has in addition, Alabama iron and coal, and the navigable Warrior River which permits barges from Mobile to come within a few miles of the coal mines. Galveston can command Texas, Oklahoma, and Kansas grain. Although the routes to the Gulf ports at present are drawing but little freight from beyond the Ohio and Missouri Rivers, their trade is growing and in the course of the coming decades these routes will be extended to the North, and perform a more important part in our foreign trade particularly with South American and Oriental ports. As the population and industries of the United States grow more like those of Europe, the commerce of the Central States will be relatively less with Europe and the East and more with the tropics. The opening of the Panama Canal is another strong factor helping to change the commercial front of the Mississippi Valley from the Atlantic to the Gulf. The lower Mississippi Valley, with vast undeveloped resources, also has great industrial changes before it, so that it is possible that by 1950 the Gulf routes may equal in commercial importance those that connect the Great Lakes and the Ohio with the north Atlantic. These changes are already in evidence and are progressing rapidly. Nature is with them.

This does not mean that we shall see any decline for the eastern roads. Under present normal conditions they are and must be congested, crowded, overburdened with a traffic that results from the great growth of commerce which has come to stay. New trade will go to the Gulf. For example, the wheat trade of Kansas City is already greater than that of Chicago, and Kansas City is distinctly in Gulf rather than Atlantic territory. The distance from Kansas City to Chicago is 458 miles and the wheat rate 17½ cents per hundred; to New York, 908 miles farther, it is 40 cents if for export; from Kansas City to New Orleans, 880 miles, and to Galveston 851 miles, and the rate to both is 30.5 cents for export wheat and 41 cents if for domestic consumption. Thus the American railroads favor export traffic.

The production of vast exports far beyond the western end of Lake Superior has presented a problem for transportation and has caused much hope of a new route.

TO EUROPE BY HUDSON BAY. The high freight rate on wheat from West Canada to the shipping ports at New York and Montreal has raised great hopes of utilizing the Hudson Bay route for grain export. Port Nelson, on the western shore of Hudson Bay, at the mouth of Nelson River, is 100 or 200 miles nearer to Liverpool than is New York, and 1,400 miles nearer than New Orleans. The new Hudson Bay Railroad, which in 1924 was reported to be complete to within 220 miles of Port Nelson, will make the spring wheat region around Edmonton 400 miles nearer to Hudson Bay than to Port Arthur, on Lake Superior. It is estimated that the rail and ship route to Europe, via Hudson Bay, will save the West Canada grain grower from six to seven cents a bushel on his wheat.[3] (See map, page 763.) The advantage of this route in distance is modified by the winter ice, which closes the passage to the Atlantic for the greater part of the year, and may possibly prevent any extensive use of it.

THE TRANS-CONTINENTAL LINES. Between the Pacific Coast and the more populous East lie the Great Basin, the Rocky Mountain plateau, and the Great Plains, now crossed from east to west by eight or nine railways. They are commonly known as the "Trans-Continental Lines," although, with one exception, they lose their identity at the middle of the Mississippi Valley, which may really be considered their eastern end. They here serve as feeders to the eastern routes described above, which forward the freight from any and all of them to the Atlantic coast points. In the competition for the trans-continental trade, the northern and southern routes are more favorably located than the central; and the most southerly route, the Southern Pacific, has, in some respects, the best location of all, and in other respects the worst. This route, having its termini at San Francisco and Los Angeles in the West, and at Galveston and New Orleans in the East, has the shortest land carriage, but it has the disadvantage of crossing the most arid part of the United States. Travelers commonly call it desert. From Galveston and New Orleans the route is in reality continued to New York by regular lines of steamers operated by the same company. This combination of railways and steamship routes secured much California trade with the East before the opening of the Panama Canal. The northern routes, Canadian National, Canadian Pacific, Great Northern, and Northern Pacific, with their termini on Lake Superior, utilize the cheap water transportation of the Lakes, operate steamers to Buffalo, and have regular traffic arrangements with the railways from that point eastward. The Canadian Pacific also has steamers from Atlantic tidewater to Europe. The northern routes are also shorter than the lines that cross the central or widest parts of the United States as may be seen by reference to a globe.

The development of transportation facilities across the Great Plains region has been most rapid. The California gold discoveries

[3] "There seem to be two certainties: one that the rivalry of the new route (if successful) will almost or quite bankrupt the great Canadian Pacific Railway by diverting half its freight, and the other that the Canadian plainsman is bound to have it." (From *North America,* by J. Russell Smith.

fixed American attention on the problem of crossing the plains. The first regular transportation service was the "Pony Express," small packets of letters and valuables carried by relays of galloping horsemen. This was succeeded soon after the gold discoveries of California by wagon trains that set out from St. Louis, Kansas City, and Omaha for New Mexico, Utah, and California. The first of the railways was the Central and Union Pacific, opened in 1869 from Omaha to Ogden and San Francisco. This was a government enterprise built for the trans-continental trade at a time when the buffalo and the Indian still held possession of the plains. It was greatly needed to unite the widely separated East and West and was partly paid for by Government money, as people with private capital were unwilling to make the venture, predictions of failure being heard on every side. Within seven years Colorado, with its mining camps a thousand miles beyond Chicago in the region served by this new railway, had been settled, organized as a territory and admitted as a state. This state, with its quick prosperity, depended entirely upon the Union Pacific to connect it with the world markets, and was more important to the road than was California with its sea outlet.

The number and striking appearance of the trans-continental railways, when shown upon a map, tend to give an exaggerated impression of the part that they play as through carriers of freight. The strictly trans-continental traffic, aside from passengers and mail, is not large.[4] The chief service of these routes is as carriers of the freight produced along the lines, or of coast traffic consigned to interior points. The greatest activity in trans-continental road building is to be found in the North, where there is enough rainfall to mitigate the desert conditions so common in the territory of the southern lines. In Canada, especially, is construction going on vigorously, with two new lines north of the Canadian Pacific in the new wheat country of the northwestern plains.

TRAFFIC OF TRANS-CONTINENTAL ROADS. There is no reason to think that the new lines will be any more exclusively trans-continental carriers than the old. There is, however, a large traffic of an essentially trans-continental character. Thousands of carloads

[4] The prohibitively high cost is shown by the wheat rate of thirty-five cents per 100 pounds from Logan, Montana (111° W.) the traffic divide on the Northern Pacific to the Pacific or to Duluth (1,055 miles). Either terminus of this road is thousands of miles from the price-setting market at London.

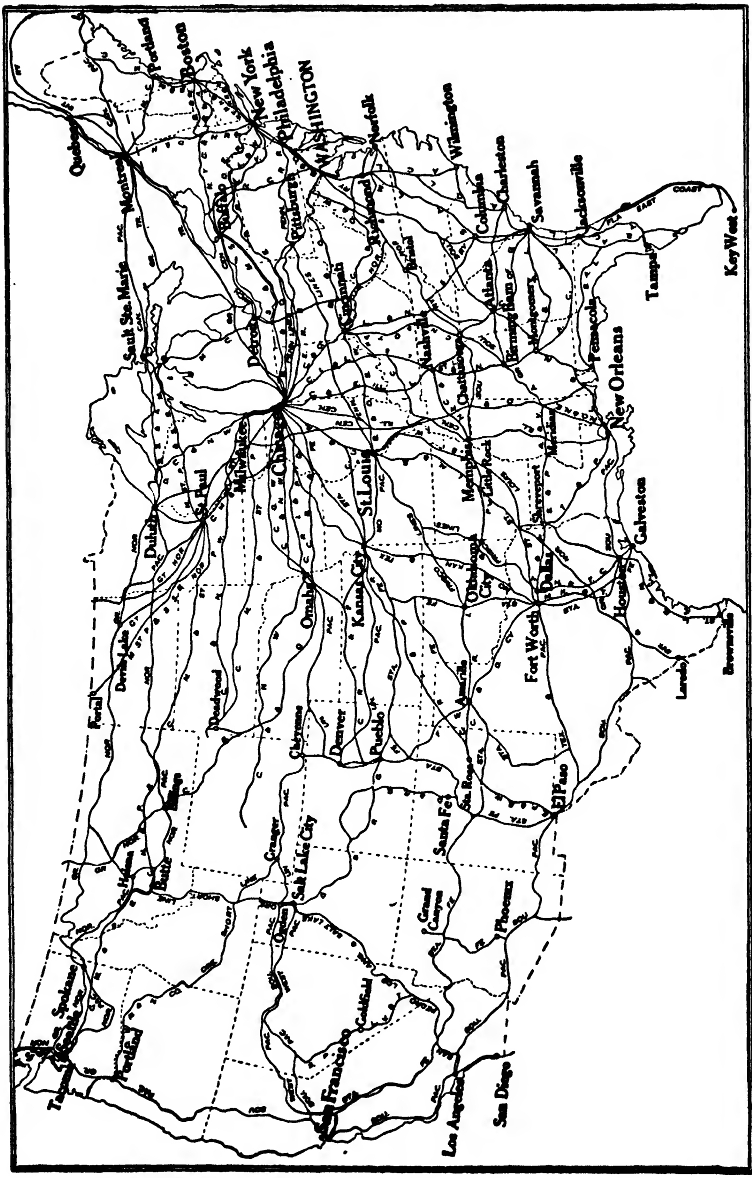


FIG. 258.—Map showing leading trunk railroad lines in the United States.

of oranges, peaches, apples, and grapes with some dried fruit are annually carried from points west of the coast range to points east of Chicago and even to the Atlantic coast cities. Manufactures of great value are taken from the manufacturing east to the essentially non-manufacturing Pacific coast. There is also considerable overland shipment of Oriental teas, mattings, and silk, but the heaviest traffic across the Rockies is the lumber, chiefly from the state of Washington. This traffic is increasing rapidly, for Washington lumber is becoming common not only in the Mississippi Valley but also east of the Alleghanies. The efforts of the railroad managers to get return freight for their lumber trains have caused the shipment of a large amount of exports to the Orient via Pacific ports. In this way cotton has been exported from Texas to Japan via Seattle when its more natural route was by way of the Panama Canal.

The people of the mid-region of the trans-continental railroads are great traffic producers. They are almost exclusively engaged in agriculture, mining, or lumbering. They are far from their markets and their sources of supplies. They sell much and they buy much, so that a single farmer's family in the region of the Great Plains is reckoned by some railroads as contributing $500 a year income to the company. This explains their diligent labors to get settlers on their lines.

THE ROUTES OF THE PACIFIC COAST REGION. The trade routes of the Pacific states are simple. The centers of population are near the coast. Aside from the southern coast settlements, and the northern lumber towns, California consists essentially of a long valley extending to the north and south, opening at San Francisco Bay and drained by the Sacramento and San Joaquin Rivers. A railway net spreads over these valleys and the lines follow the rivers to the sea at San Francisco. In the south the coast range is low and it has not been difficult to build railroads which pass out of the San Joaquin valley and reach the sea at Los Angeles, the port and center of a populous and prosperous district, and also at San Diego. The ocean trade of Los Angeles grew like a mushroom between 1910 and 1923, the largest share of it being with the Gulf and Atlantic coasts (see Table of Ports, page 770).

In the northwest the chief productive regions (aside from lumbering) are the Columbia and Willamette Valleys, which also furnish routes for railways to Portland, Seattle and Vancouver. The

Columbia is also navigable to the eastern boundary of the state of Washington. The great excellence of Puget Sound for the development of good harbors and ports, combined with the richness of its immediately adjacent territory, and the shorter route to a rich interior, marks it as the site of the coming commercial and industrial metropolis of the Pacific Coast of all America.

The nearness of the Pacific Coast population to the ocean causes the Panama Canal to be easily effective in stimulating trade, which with its raw products, is so dependent upon the markets of populous regions.

Between Vancouver in southern British Columbia and the Yukon Valley is a mountainous region with unclimbed peaks and valleys unthreaded by world or local commerce. In latitude 54° 20′ near the southern point of Alaska where the Skeena River flows from a defile in this mountain mass, one trans-continental railroad, the Canadian National, reaches the Pacific at the lonely little town of Prince Rupert. Beyond this, in Alaska, the arctic interior of the continent has been invaded mainly by the dog sledge and the human pack carrier. The Klondike gold fields lying upon the upper Yukon on both sides of the Alaska-Canadian boundary were at first reached by the trail over the mountains near the coast of South Alaska where a short but fearful journey separated sea and river navigation. Within two years after the important gold discovery on the Klondike (1897), a railway, beginning at the harbor of Skagway, had crossed the mountain pass and connected the steamer on the fiorded coast of south Alaska with the brave stern-wheel steamers that risk the shifting sands of the Yukon. But this river is open only in the summer months and must be *entered* from St. Michaels, across a part of the Bering Sea. The lower river route to the Klondike is hundreds of miles longer than the more direct one, over the mountain ranges that separate the upper Yukon from the Pacific. The Alaska Railroad, built and operated by the United States Government, now connects Seward with Fairbanks, nearly 500 miles north on the central Yukon.

The possibilities of travel in the interior of Alaska are being greatly improved by the domesticated reindeer, which has been introduced by the aid of the Government. This work animal is perfectly adjusted to North Alaskan environment where it can also furnish meat and milk. It will be a great aid to prospectors and miners in the search for minerals in which Alaska and northern Canada seem to be promising.

Seattle and San Francisco are the chief trade bases for the vessels which carry almost the entire trade of Alaska. Alaska sends gold and copper, fish (mostly salmon) and furs in exchange for the great list of foods, clothing, and supplies, needed by white men in a cold land, not well suited to agriculture.

THE TRADE ROUTES OF MEXICO. The trade routes of Mexico are, in part, a continuation of those of the southwestern part of the United States. The great majority of the Mexican people live upon the plateau enclosed by the eastern and western Cordilleras that nearly parallel the two coasts until they meet a short distance south of the city of Mexico. Two main railway lines from the United States enter this plateau by the easy northern ascent. These are the National of Mexico, an extension of the Santa Fe from El Paso through the Central Plateau to Mexico City with numerous side lines, and the eastern division of the same connecting at Laredo with the International and Great Northern. Two other lines, from Tampico and Vera Cruz, climb the steep escarpment from the Gulf Coast. The northern routes carry an active overland trade with New Orleans, St. Louis, Kansas City, and Chicago; but a larger and more valuable trade goes to the Atlantic ports of the United States and Europe by steamers from Tampico and Vera Cruz. The imports comprise the great variety of supplies and machinery used in a mining and ranch country that has little manufacturing of the factory type.

There is an isolated railway system on the flat plains of Yucatan. Three small lines, converging at Progreso, serve to collect the Yucatan sisal crop for shipment from that port.

The Pacific coast of Mexico is inadequately supplied with trade routes, many of the smaller ports having only mule trails to mines in the interior. The trade of that region is naturally with the Atlantic, from which it is profoundly barred, as the western Cordillera is high and abrupt, making railroad building difficult. A number of lines have been projected, but the only one completed was in 1902 when the trains first crept down from Guanajuato on the plateau, to Manzanillo, at the seacoast. Since that time an American company, the Kansas City, Mexico & Orient, has started to build a line from Kansas City to Topolobampo, a port near the lower end of the Gulf of California. This line was begun in several places but never completed.

A number of years ago a branch of the Southern Pacific was built south from Tucson, Arizona, to Guaymas on the Gulf of California. Beginning in 1905 it was pushed southward along the Gulf through Mazatlan to Tepic, giving the west coast its first through trade route. Further progress was interrupted by the revolution of 1910. In 1925 the last hundred miles from Tepic across the mountains to Guadalajara [5] was under construction, with the expectation that the line would be completed in 1926, giving Mexico City direct railway connection for the first time with the west coast states of Sinoloa and Sonora, and providing a third main line from the United States to the plateau.

Mexico has, in the Tehuantepec Railway, a most efficient short trans-continental line connecting Puerto Mexico, on the Gulf, with Tehuantepec, renamed Salina Cruz, on the Pacific. This road was built by the Mexican government on one of the routes once cherished as a site for an Isthmian Canal. The road has been put in good order and the termini improved for the transfer of freight from ocean to ocean.

THE CENTRAL AMERICAN ROUTES. With the possible exception of western Mexico, Central America is the most unfavorable part of the North American continent for the development of trade routes. It is in the zone of tropic rains, tropic forest and low, malarial coasts. Nature puts such difficulties in the way of man that no explorer has ever traversed the whole length of Central America. The unwholesome climate of the lowlands has caused Central American population to seek the plateau along and between the double mountain range that makes the continental divide. It so happens that this plateau is much nearer the Pacific than the Atlantic; some of it was settled from that ocean, and at the end of the nineteenth century, all the capitals of Central America, with one exception, had their connection with the outside world by way of the Pacific, in spite of the isolation of that coast. This isolation has been greatly modified by the coasting steamers that since 1848 have plied between Panama and San Francisco. San José, in

[5] To reach Guadalajara from Tepic the railroad must cross abruptly the chief mountain range of North America, besides spanning a series of deep canyons (called barrancas), a route for years pronounced impassable by railway engineers.

Costa Rica, was the first Central American capital to transfer its commercial allegiance from the Pacific to the Caribbean upon the completion of a railway to the east coast at Port Limon; it now has a railroad from San José to Puntarenas on the Pacific. Guatemala City, which has for years had railroad connection with the Pacific, has recently been reached by a Caribbean railroad. It is also possible to go by rail from Guatemala to Mexico City. The other capitals have railways to one ocean or the other, except Tegucigalpa, in Honduras, which has only a cartroad from Fonseco Bay upon the Pacific. Central Nicaragua also has a partial outlet to the east by the steamers, which at some seasons navigate the San Juan River from Lake Nicaragua to the sea at Greytown. Other Central American railways are in contemplation or building. In considering the Central American trade routes and their prospective development, it must be remembered that the population of each of the political divisions consists of a few thousand white people of Spanish race and a few hundred thousand Indians, many of whom are more or less tinctured with white blood.

THE ISTHMIAN CANAL AND THE TRADE ROUTES OF NORTH AMERICA. The opening of the Panama Canal between the Caribbean and the Pacific has caused a number of commercial readjustments and affected many of the trade routes of the continent. The changes in traffic movement, however, are not so much in traffic actually diverted from one route to another as in new traffic that has resulted from increasing industry. As time goes on the routes from the northern Mississippi Valley eastward will decline in relative importance, while those to the Gulf increase. The routes from the continental divide westward will be stimulated by the increase of local traffic that must be called into existence by a cheaper ocean rate to the Atlantic.[6] This will be quite as true in Central America and Mexico as in Canada and the United States. The same force that increases the traffic of existing railways from the Pacific coast to near-by points will cause the construction of many other lines, furnishing routes for traffic that does not yet exist.

[6] A short haul to the sea and a short cut through the Panama Canal to Europe has made the port of Vancouver a recent big shipper of wheat from the Prairie Provinces of Canada. The water rate on wheat from Edmonton to Liverpool by way of Vancouver and the Canal is ten cents a bushel cheaper than the rate from Edmonton to Montreal and thence to Liverpool. The wheat export of Vancouver, 572,000 bushels in the 1920–21 season, had grown to 53,000,000 bushels in 1923–24.

These advantages of the canal to the railroads will develop with the passage of time; the immediate result has been the loss of some through trade by the trans-continental lines.[7] Our railways must now change their scheme of things to an arrangement whereby they gather the commodities within a continent's interior and lay down the assembled bulk at the nearest port, be it Atlantic, Pacific, Lakes or Gulf, to be forwarded by water to its ultimate destination.

FIG. 259.—The Mississippi—a wasted waterway. It will probably be used much more than it now is as freight costs rise and we develop a national organized system of transportation. Looking south from Alma, Wisconsin. Railroad tracks, water tank, Mississippi stern wheeler, log raft, tug. Wing dams—a device much used in Europe to narrow the current, deepen the water and also make the water dig the channel deeper. (Courtesy H. Burgess, Corps of Engineers, U. S. Army.) (From *North America*, published by Harcourt, Brace and Company.)

WATERWAY IMPROVEMENT IN UNITED STATES. The United States needs more facilities for transport, as shown by the freight congestions that clog our railroads in times of exceptional prosperity. The increasing land values that accompany our increasing population make railroad building increasingly costly. The experience of Europe has clearly shown the advantage of extensive expenditures on canals and river improvement, and there is a growing sentiment

[7] One of the reasons given for the receivership of the Chicago, Milwaukee and St. Paul Railroad in 1925 was loss of through traffic to ocean-going vessels using the Panama Canal.

in the United States in favor of the improvement of our waterways. At present they are in an astonishing state of neglect. Some experts say that they really cannot compete with railroads. Others point out their neglect is due largely to the deliberate refusal of the railroads to coöperate with the waterway. We must remember that the first object of a railroad company is to make dividends. If after that it can serve the country, well and good, but none of us will invest in a railroad unless it can make profits. This makes it clear that our waterways have not had a fair test as to their possible services as an integral part of an organized, national transport service. The creation of such a service has been nobody's business save for a short time during the World War, when the use of waterways made interesting innovations. The Mississippi River is one of the finest natural waterways ever possessed by any people. It is 1,156 miles from New Orleans to St. Louis and thence 697 miles to Minneapolis and 406 to Kansas City. There is no steamboat line running the whole length of the stream, and except for coal barges and rafts it is very largely neglected at a time when we need new facilities and it is known that railway transportation is several times as costly as water transport. St. Louis, served by twenty-four railroads, and receiving 3 million loaded cars per year, and Kansas City, served by thirty-nine railroads, are connected by 406 miles of navigable river which for years was almost entirely unused. Then it was used for a few years by the United States Railroad Administration, which was trying to make a national transport system.

The waterways can only become effective when effort is made to have through routing of freight and this the railroad companies have usually refused to do as a part of their diligent (and from the dividend standpoint, wise) policy of thwarting the development of water transportation. Another necessity of success with waterways is the necessity of uniform and far-reaching system in the construction of locks and the maintenance of depths. The pork barrel system of waterway legislation so prevalent in the United States has put locks of varying sizes on the same stream, made a stretch of good navigation here and there that connected nothing with nothing and leaves to us such monuments as the canal at Muscle Shoals on the Tennessee River. In 1908, 12,000 tons of freight passed through it at a cost to the government of $4 per ton for repairs and maintenance and $7.50 per ton for interest (at only three percent) on the cost of installation. It may be that this democracy will permanently display insufficient intelligence to do this great work and that the pork barrel is here to stay. On the other hand, granted systematic construction and compulsory through routing of freight by the railroads, the waterways of the United States have a busy future.

The possibilities of the Mississippi River are enormous. The expensively improved and busy Rhine is a suggestive example. At the head of the navigable eastern branch of the Mississippi, the Ohio, is Pittsburg, the capital of coal, iron, and glass, with the astonishing traffic of 150 to 200 million tons a year. Since 1920 the railroad congestion has driven the Pittsburg steel manufacturers back to boats and the Pittsburg district had 22 million tons of freight in 1922. These figures become more significant when it is remembered that the United States has never yet produced 5 million tons of cotton or 35 million tons of wheat in one year. The total world export of wheat was 22 million tons (1923) and the entire world's crop of wheat is about 80 million tons a year. The Chicago Drainage Canal gives connection with the Great Lakes, and the Mississippi itself flows through the heart of the corn, oat, meat, and hay belts and reaches at Minneapolis the edge of the spring-wheat country and the greatest flour-milling center in the world. The continued neglect of such a waterway is an almost inexplicable waste of resource. We need less triple tracking of coal, wood, iron, and life-wasting railroads and more construction of resource-saving waterways for which the geographic conditions of the country are so favorable.

CHAPTER IV

THE TRADE ROUTES OF EUROPE

The trade of the different European countries with each other is of great extent and closely resembles the trade of temperate North America. Each of these continents has, in the region of middle temperature facing the Atlantic, a large territory with tens of millions of manufacturing people buying food and raw materials. In America this manufacturing region reaches from Chicago to the Atlantic, and from Canada to the Maryland boundary, and in Europe, from Berlin to Warsaw, Vienna, the Alps, and the ocean. Farther in the interior lie the grain- and meat-producing plains, in the north are water power and forests with their wood and paper output, in the south the land of fruits and early vegetables. Europe has only a small corn belt and almost no vestige of a cotton belt, but has instead a great extent of potato-, barley-, oats-, and rye-belt in her mid region.

PHENOMENAL NATURAL ADVANTAGES. In the ease of her exchange of these foods and raw materials for manufactures, Europe has been favored more than North America, more than any other continent. Irregular coast lines make short and easy communications between the interior and the sea—the cheapest of all highways. Here Europe is supreme. Africa and South America resemble solid blocks; and even the United States, with its favorable location, its splendid routes, and an area nearly equal to that of Europe, has but 5,200 miles of sea coast, while Europe has 20,000. Hence, it is natural that the greatest trade routes of Europe should be water routes, and that its railway mileage should be relatively low.

Trade is further favored by the location of the inland seas that indent the European coast. In the north, as in the south, a succession of seas penetrates to the very center of the continent. The only comparison would be the American Great Lakes if they reached farther inland and were navigable at all times by ocean vessels. The Mediterranean and the Black Sea extend the advantage of the ocean 50° eastward from western Spain. This may properly be called the most magnificent system of inland waterways in the world. Its waters give ocean transport to a dozen independent countries and many colonies. Through the navigable rivers of

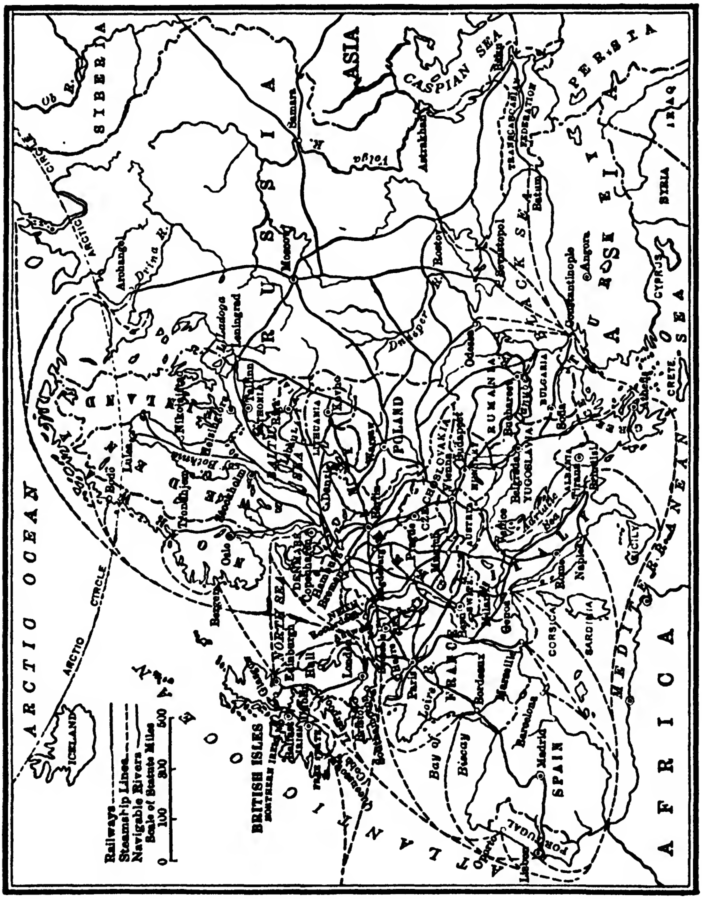


FIG. 260.—Trade routes of Europe.

south Russia and the great Danube, it reaches far into the heart of Europe. The North Sea and the Baltic are almost equally favorable for northern Europe. Between these northern and southern seas, Europe is but a great peninsula, fringed with a succession of smaller peninsulas, each having the particular commercial advantages of such a position. For commercially advantageous location, Greece, Italy, Iberia, Scandinavia and Denmark fall but little below so many islands. France faces two seas, Russia three, and Great Britain is an island kingdom. Farther than this, Europe possesses no large isolated plateaus, and it is well supplied with navigable rivers. The pronounced climatic and economic differences between the different sections of Europe have been a further basis for the development of a large trade between the European countries.

Two sets of routes. European commerce has developed two sets of commercial routes: first, the heavy traffic routes, which are chiefly water routes; and, second, the fast traffic routes, which are chiefly overland routes. The distinction between the two cannot always be sharply drawn, and the commerce of the first sometimes uses parts of the routes of the second; but, broadly taken, there is a distinct division. In each group there are two classes, primary and secondary, or trunk lines and branches. Most of the trade routes radiate from the populous industrial region of northwest Europe to the less populous regions in the northeast, east, and south.

Two great heavy traffic trunk routes are furnished by the southern and northern seas—the sea routes skirting southern Europe to the Black Sea and northern Europe to the Gulfs of Finland and Bothnia and the White Sea. The secondary heavy traffic routes, the feeders to these main water routes, are the navigable bays and rivers and the railroads, which, like the rivers, run in most cases toward the sea, and carry inland products down to the ports. In the north of Europe the drainage is simple, the country is open, and the building of railroads to the ports is much easier than it is in the south where the mountains come so much nearer to the sea.

The great southern route. From Gibraltar to Constantinople, the southern route is poor in the branches that navigable rivers furnish. There are two navigable rivers of third-rate importance, the Ebro and the Po, in addition to the second-class Rhone. The Po is practically choked with mud at its mouth—a condition which is usually found in rivers flowing into tideless seas, such as the Mediterranean.

The mountain wall of the Alps shuts the Mediterranean away from the waters of the land, but the low shores of the Black Sea permit that body of water to drain much more than its proportional share of Europe. It receives the Danube, a river draining the very center of Europe, and navigable throughout most of its length. In recent years it has been made an international highway; and a canal, that has been cut through its swampy delta, avoids the dangers of its multitude of broad and shallow mouths, and permits the entrance of ocean-going steamers, which ascend to the Rumanian ports of Braila and Galatz, there to take the grain cargoes that have come down in barges through the Iron Gate from the plains of Hungary. A more direct route for this important traffic, which is often bound for the lower Rhine Valley, would be directly up stream and overland or through shallow canals, but the cost of land or small-barge transportation is too great in comparison with the river-sea combination.

The Black Sea traffic is further enriched by the steamers on the Dniester, the Dnieper, and the Don Rivers, and by the south Russian railways. In times of normal trade these help to assemble the Russian wheat and corn at the ports of Odessa, Kherson, Nicolaief, Taganrog, and Rostof, where the tramp steamers congregate in hundreds. Within the Mediterranean there is traffic between two distinct economic districts—a food-importing district and a food-exporting district. While Italy, France, and Spain are chiefly agricultural countries, they are also manufacturing countries and must import to some extent both food and raw materials. The east Mediterranean region, comprising the Balkan states, the Danubian states, Russia, Asia Minor, and the Caucasus, is essentially in the raw material producing stage. Grain and other agricultural products are the chief exports, and to these, the east end of the Black Sea with ports at Poti and Batum adds ores and petroleum exports. This gives the basis for a lively exchange of manufactures from the west for the wheat, corn, rye, and oil of the east Mediterranean.

THE GREAT NORTHERN ROUTE. The northern waterway of Europe, terminating at Leningrad and Uleaborg, is favored by receiving more navigable rivers than its southern counterpart. Two of these are the Rhine and the Elbe Rivers, which must be classed as of the first magnitude if measured by the commerce that they carry. The Elbe carries down to Hamburg the products of central Germany and of Czechoslovakia. It is also connected with the Danube by canals. The Rhine has with great labor and expense been made and kept navigable from the dykes of Holland to the waterfalls of Switzerland. Other contributions of freight to the western and northern seas are supplied by the Tagus, the Garonne, the Loire, the Seine, the Weser, the Oder, the Vistula, the Niemen, and the Duna, as well as the canals which thread the plain of north Europe from the west of France to central Russia. The gentle topography and easy drainage of north central Europe thus give many avenues to the sea, and make possible east-west waterways, especially in Germany, that duplicate to some extent the service of our Great Lakes.

Especial emphasis should be laid upon the valleys of the Elbe, the Rhine, and the Seine. The Rhone Valley, also reaching the center of France, is like them. Each contains a navigable river with two lines of railway following it. Each has at least one great commercial city at its mouth—Marseilles by the Rhone, Havre by the Seine, Hamburg by the Elbe, and Antwerp, Rotterdam, and Amsterdam within reach of the mouths of the Rhine. These last are the termini of the greatest of all the inland European trade routes, because the Rhine Valley is the greatest industrial region on the continent, and has the most efficient and extensive river transportation in addition to the busy railroads.

The northern route is bifurcated, the lesser branch passing out in the open sea around the coast of Norway and into the White Sea, which, despite its Arctic location, has in its port of Archangel a heavy shipper of lumber and grain, some of the latter from Siberia. The ports of Norway add their contingent of lumber, also iron ore, granite, and fish.

THE WORK OF THE HEAVY TRAFFIC ROUTES. The heavy traffic routes of European commerce, skirting the continent, and fed by the secondary routes [1] enumerated above, are served by a multitude of coasting vessels, both steam and sail, large and small, giving access to every port of Europe and to every country except to Switzerland, Czechoslovakia, Austria and Hungary; Switzerland has Rhine boats, Czechoslovakia has Elbe and Danube boats, and Austria and Hungary have Danube boats. It is by ship that the heavy freight of Europe is carried; the traffic in which economy of cost is more important than economy of time—the wines, fruits, and oil of Spain, France, and Italy; sulphur from Sicily; dried fruits from Greece; wool from Turkey; grain from Hungary and

[1] According to United States consular reports, "nearly" nine-tenths of the freight of the Magdeburg district of central Germany is carried by the Elbe.

the Black Sea; petroleum from the Caucasus; sugar from Germany; wood from Scandinavia and Finland; grain from Baltic Russia; British coal; Belgian cement, glass, and iron; and the machinery and the heavy manufactures of Great Britain, Germany, Belgium, and France.

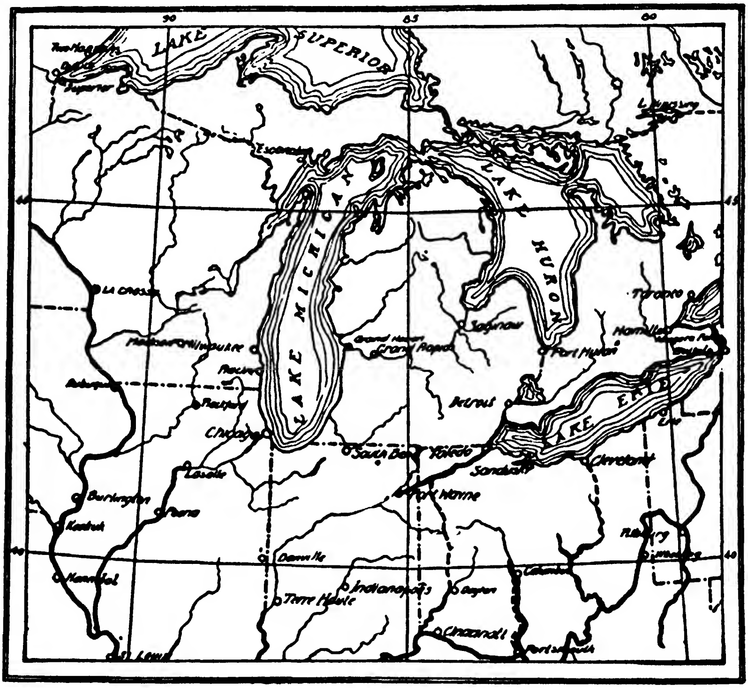


Fig. 261.—Navigable waterways in the North Central plain. Compare with Fig. 262. (After J. Paul Goode.)

A quadrangle, the corners of which are at Belfast, Berlin, Vienna, and Marseilles, roughly includes the manufacturing region, which is either the origin or destination of most of this water-borne commerce. It is a region threaded by canals and navigable rivers giving to every capital except Berne and to almost every manufacturing city of importance the advantage of barge transportation to and from the seaports, thus affording very cheap rates on such industrial fundamentals as coal, iron, wood, stone, ore, cement, cotton, grain, and heavy manufactures. The efficiency, the importance and the function of the heavy traffic routes is better shown by some of the more extreme cases. Regular lines of steamers carry freight from Hamburg and Rotterdam to Mediterranean and Black Sea ports. The writer has seen, on the quays in Antwerp, iron bridges that had come by Rhine boat from Düsseldorf, and were en route to Rumania by the next Black Sea steamer. There are even lines plying between such extreme points as Constantinople and Odessa in the south and Leningrad in the north.

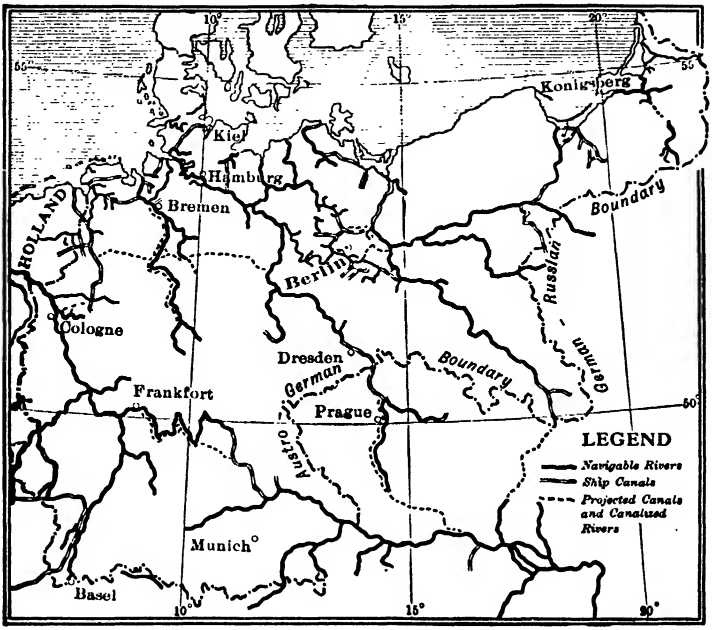


FIG. 262.—An area of the German plain equal to that shown in preceding figure. (After J. Paul Goode.)

UTILIZATION OF TRANSPORT RESOURCES. The manufacturing region of northwestern Europe has the most fully developed transport system in the world. It is a labyrinth of canals and the rivers have been improved at great expense. In an area of 800,000 square miles a billion dollars have been expended in waterways. This, however, is the trifling sum of $2 per acre and it has paid many times over in the increased ease and cheapness of commerce.

The results of deliberate effort are shown by the upper Rhine navigation. In 1893 this river was navigable only seventy days between Mannheim and Strassburg, but owing to the deepening and care of the river by the governments of Baden and Alsace-Lorraine it was navigable for 356 days in 1910. Few people realize the enormous volume of traffic that the Rhine normally carries, the pre-war traffic having been about 58 million tons of freight yearly. The pre-war total for Germany of 118 million tons of inland water-borne freight was about six times the United States total of 19 million (exclusive of the Great Lakes traffic). The total waterways of Russia are estimated at 57,000 miles, Germany, 11,000; France, 7,800; Austria-Hungary, 4,000; England, 3,900; Holland, 3,200; Sweden, 3,100; Belgium, 1,400.

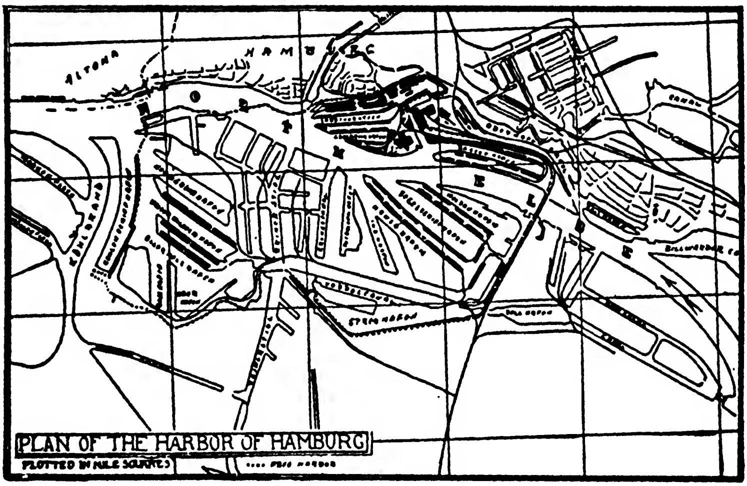


Fig. 263.—A big city on a narrow river must dig many docks. This harbor of Hamburg is typical of many European harbors. (After J. Paul Goode.)

The efficiency of Europe's water routes and the important part that they perform in her commerce is shown by the comparatively small railway mileage. Europe has 20,000 miles less railway than United States, although the area is slightly larger and the population is four times as great. The railways are not necessary where there is such a wealth of waterways so well utilized as those of Europe. Europe has no such problem as that presented by the transportation to the sea of the vast traffic that seeks an outlet from the American Great Lakes. If she had, her railway mileage would be much greater. Conversely it is easy to see that the access of ocean steamers to the Great Lakes at all times would remove the necessity of thousands of miles of railway track. The great railway mileage of America is a record of achievement, but also an admission of continental handicaps.

While Europe far exceeds North America in the utilization of waterways, its railways have not attained the same superiority. The many independent states of Europe form a bar to such a thorough organization of railway traffic as exists in the United States, where uniform regulations exist over wide areas, enabling the railroads to perform wonders in transportation that have not been elsewhere duplicated.

THE VOLGA AND THE CASPIAN. In the class with the great water routes of west Europe is the Russian inland system comprising the Caspian Sea and the Volga River. This is the nearest European counterpart to the American Great Lakes. It fully equals it in length, but the commerce is by no means so vast, even though the river and the sea stretch from the heart of Russia and Russian industry far into the confines of Asia, and offer an excellent avenue for the heavy trade that arises in districts with heavy products and with reciprocal needs. In the northern part of the Volga's course its navigable western branches drain the manufacturing and commercial regions of Moscow and Novgorod. The northeastern branches come down from the lumber regions. The main course of the river traverses a grain-producing and, in its lower courses, a pastoral region. On the Caspian, an important petroleum district lies at the point where the Caucasus Mountains project into the sea. Steamers pass from the coast of Persia to the heart of Russia and connect with canals that go on to the Baltic. There are fisheries in the Caspian, and fish and petroleum are shipped upstream in exchange for lumber, grain, and manufactures.

THE FAST TRAFFIC ON OVERLAND ROUTES. The water routes that surround western and central Europe afford an excellent basis for the heavy commerce upon which industry rests. But these cheap and therefore important routes are slow, and in a region so populous and so advanced in industry there is a large traffic that requires the most expeditious routes—the railroads. Passengers, mail, and valuable or urgent freight use these routes. For through traffic of this character there is a well-organized system of railway trunk lines performing a service which is quite distinct from that of the heavy system with its feeders. The fast traffic routes connect the great centers of population, and the quickest time is therefore often made over somewhat circuitous routes that happen to pass a number of large cities. The configuration of the country sometimes helps population centers to locate the fast traffic routes of Europe with some disregard of distances.

PARIS AND LONDON AS RAILWAY CENTERS. Paris is probably the greatest railway center of Europe, but London may properly be taken as the starting-point for the fast railway service that connects all the capitals of central and western Europe. The British capital is the starting-point for an enormous mail and passenger movement. The city is the center of the British railway system, having direct and very fast connections with Edinburgh, Glasgow, Liverpool, and Cardiff, and a fast mail route to Cork, Ireland, where the out-going steamers take the American mails with some saving of time. A link in the Cork mail route is the Irish Sea steamer service, in which the fastest merchant steamers in the world ply between Dublin, Ireland, and Holyhead on the Island of Anglesea, off the coast of north Wales.

There are several routes from London to the continent with quick and frequent service, and the time tables of continental railways advertise the London connections with their lines. The continental routes spread out to the south and east of London like a fan. Paris is reached by a combination of railway and Channel steamer, over one of four routes: Southampton-Havre, Newhaven-Dieppe, Folkstone-Boulogne, or Dover-Calais, the last being the most used. From Paris the southwestern route passes Bordeaux and Madrid and ends at Lisbon. Another line runs southeast from Paris and divides north of Lyons, one branch going down the Rhone Valley to Lyons and Marseilles; the other, going southeastward, passes through Mt. Cenis tunnel to Turin, Genoa, Leghorn, Rome, and Naples. This is the usual route for passengers between London, Paris, and Rome. A route nearly parallel to this is the Oriental mail route from London via Harwich-Flushing (steamer), the Rhine Valley, Basle, the St. Gothard tunnel, Milan and Bologna to Brindisi. The Oriental mail thus leaves London several days later than the steamer which finally gets it at Brindisi. The region lying between Vienna and London is populous, highly industrial, and so well covered with a network of railways that it is possible to traverse it in many directions. Several regularly followed routes connect the British and Austrian capitals. The Danube Valley is usually entered from the Elbe Valley by way of Dresden or Berlin, or from Frankfort or

Strassburg in the Rhine Valley. From Vienna this southeastern route extends, with regular express train service, to Budapest, Belgrade, Sofia, and Constantinople. A branch of this route (completed in 1916) runs from near Belgrade to Salonica and Athens, making the Greek seaport of Piræus another port for the Oriental mail.

The last of the routes starting from London goes to Berlin by way of the Rhine mouth ports and Hanover, and it also extends to Warsaw and Leningrad. It is the mail route from Russia, and to some extent for Germany also, to England, and America, because the train is faster than the ship and this rail route makes its final connection with steamers at Southampton or Cork.

THE TRADE ROUTES OF RUSSIA. There is across Europe one east and west route of much importance and greater promise—that of the Asiatic express. Although it might be said to begin at Madrid or Lisbon, Paris is the real beginning and the place from which the Russian and Asiatic express trains start. At Warsaw the route divides, the northern arm going to Leningrad, the southern to Moscow, eastern Russia, Siberia, and China. This is the route of promise. The heavy mail from west Europe to the Orient is to be reckoned as the first capture of the new trans-Siberian Railway from the slower circumcontinental steamers. As the vast and fertile plain of Siberia is settled and developed, the chief avenue of its economic and intellectual life will be along the railway running east from Moscow, and this trade route will in all probability far outstrip all other European trade routes in the rate of increase in its traffic. This is the more certain because this route differs from all others in that there is no water competition for the larger part of its territory. The only possibility of a water route to western Siberia is by the River Ob. The river itself is very favorable for navigation, but it has not yet been established that vessels can safely visit the mouth of the river to carry away the freight that river steamers might bring down. At best, the Arctic will keep it closed except for a few weeks in summer, when a fleet of steamers might make a rush for the accumulated freight. On the southern side also Siberia is closed from the Indian Ocean by the deserts and plateaus of central Asia and by the great distance. These circumstances serve to emphasize the importance of the land route to the Baltic, the nearest open sea, and the real goal of the greater part of Siberian commerce.

The traffic over the western part of this route is increased by the contribution of a railway from Turkestan and central Asia. This branch separates from the main line east of the Volga, crosses the Ural at Orenburg and connects at Tashkent with the central Asian system, giving the most direct route to this part of the Russian domain.

Russia has two other routes to her Asiatic possessions, both connecting with the western end of the trans-Caspian Railway system. The monopoly of the Volga route was broken by the trans-Caucasian Railway, connecting Batum on the Black Sea with Baku on the Caspian. Steamers finish the connection with Russia proper by way of the Black Sea, where steamers link Batum with Odessa, Sebastopol and Taganrog on the Sea of Azof, whence railways run to Moscow and Leningrad. In 1899 Baku achieved direct rail connection with Moscow through the completion of a line along the north slope of the Caucasus to Rostof on the Don. This affords a quicker and more direct route to central Asia, and one that is more secure in case of war with a foreign power. As long as connections depended upon navigating the Black Sea, a foreign navy might at any time interfere with that part of the route.

Eastern and Asiatic Russia are as much the frontier of Europe as the Great Plains and Rocky Mountain States were the frontier of the United States in 1880. The economic relations of the two regions are similar. Geographic separation between Europe and Asia is purely imaginary, and is the result of political conditions arising from the absence of means of communication. The extension of modernized European trade routes into northwestern and central Asia will eventually weld the regions into one economic unit in the same way that the trans-continental railways of the United States have brought the West into commercial relations with the eastern states.

Commerce on these Russian-Asian railways has the same basis for growth that has produced such a valuable traffic on the east and west railroads of the United States. They connect the manufacturing cities of west Europe with the cattle ranches, grain fields, and farms of the more sparsely peopled lands of Russia's almost unsettled territory in northwest Asia.

Scandinavian routes. The Scandinavian peninsula is like the rest of Europe in being served by a secondary route of steam railway giving quick connection with the other capitals of Europe.

Express trains between Berlin and the Scandinavian capitals of Stockholm and Oslo are ferried across the Baltic. Commercially this peninsula is an island depending for its outside communication absolutely upon the sea, which envelops it so favorably for commerce.

CHAPTER V

THE NORTH ATLANTIC ROUTE

The greatest of all ocean trade routes is that crossing the North Atlantic and connecting the two most commercial continents. To a person who has not given attention to the geography of the north Atlantic it might seem that this ocean possesses a multitude of trade routes. Yet there are certain geographical conditions producing a surprising similarity in the path followed by all of the ships going across this ocean from North America to northern Europe.

GEOGRAPHICAL FACTORS. The greatest factor leading to the use of this common path is what the mariners call "the great circle line." This can be best understood by examining a globe, the only map that is accurate for large areas. By it one sees that in high latitudes the shortest line between any two points equidistant from the equator is not on the parallel running due east and west, but along the arc of the circle passing through both of the points in question, and dividing the earth into two equal parts—a great circle. The farther apart the two points in question are, and the farther from the equator they are, the greater is the poleward curve of the shortest line between them. Consequently, there are almost no straight east and west routes upon the charts to be followed by the mariner. He is forever following curves, because he is, of all men, the one who is most directly concerned with the fact that the world is round.

It is rather astonishing to discover that the positively shortest air line from Sandy Hook to Liverpool passes directly overland through New England and Canada west of Nova Scotia. The more closely ships can approach this great circle line, the shorter is their voyage; consequently, as soon as it is possible all vessels leaving New York abandon their eastward course and swing northward along the line of a great circle, the exact point for this turn varying with the seasons. At all times of the year the vessel must proceed eastward, sometimes hundreds of miles, before it is per-

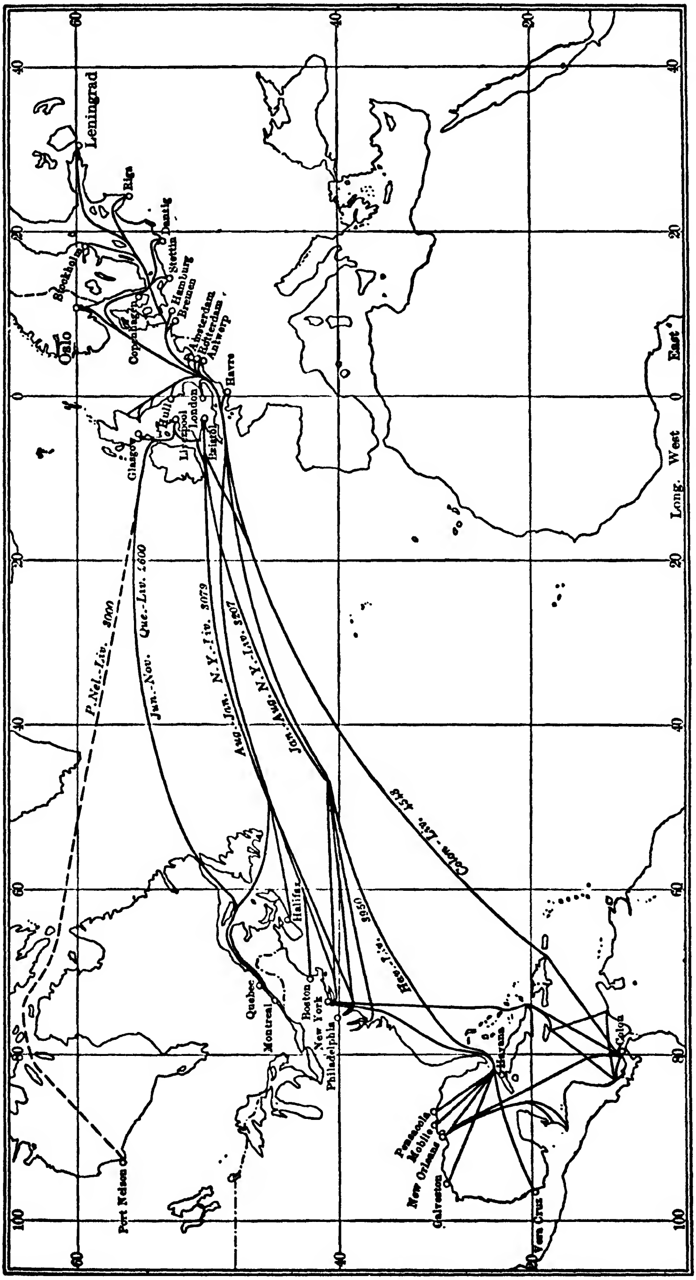


Fig. 264.—North Atlantic Trunk Route.

mitted to turn to the north. Only by this means can the navigators avoid the worst dangers of the Newfoundland coast and the fog banks. The great circle swing makes the vessels from New York, Halifax, and Montreal approach each other before mid-ocean is reached and sail along within sight of each other. For a part of the year, often less than half, the St. Lawrence steamers make an exception to this by going north of Newfoundland.

An examination of the globe, or a photograph of part of it, shows that the east coast of the United States, of which we often think as extending from north to south, really lies so near east and west as to be practically a part of the great circle line from the Georgia coast to Scotland; so that the ship from south Atlantic ports follows the coast and takes the same trunk route as those from the north Atlantic. This same principle goes even further and gives to the vessels from the Straits of Florida, that is to say, the vessels from the Gulf ports of the United States and Mexico, identically the same path across the north Atlantic.

In the process of a shipping controversy, the Liverpool Steamship Owners' Association once declared "that all vessels crossing the Atlantic to this country (Great Britain) from ports in North America take practically the same route from 60° west longitude." As a consequence of this fact, Norfolk is an important coaling station for the ships from Gulf ports. Even Nicaragua is almost within the territory of this same north Atlantic route, for it is but 323 miles further from Greytown to Liverpool via New York than via the shortest possible route. It is thus plain that the north Atlantic route is a great trunk route with a string of branches for the different ports from St. Johns in Newfoundland to Havana, Tampico and Vera Cruz in the tropical Gulf.

It is, therefore, exactly in accord with these basal facts of location that there has arisen a trans-shipment trade at New York and New Orleans by which the products of the West Indies and Caribbean countries are being forwarded to Europe by the great trans-Atlantic liners, and return cargoes come by the same route.

It is a working out of the narrowing longitude of high latitudes that causes Quebec and Montreal, which we are inclined to think of as being far in the interior, to be nearer to Liverpool than are New York and Boston; the same is true of trading posts located far in the center of the American continent upon the western shores of Hudson Bay—a fact interesting to speculate upon in connection with Canada's new railroad being built from the wheat fields of the Prairie Provinces to Port Nelson on Hudson Bay. Port Nelson is nearer to Liverpool than is New York.

The north Atlantic route has the great advantage of being entirely devoid of islands with the exception of Sable Island—the so-called graveyard of the Atlantic—east of the Maine Coast and a few small rocks on the Grand Banks. So universally are these skirmish posts of the continent dreaded that the route for the

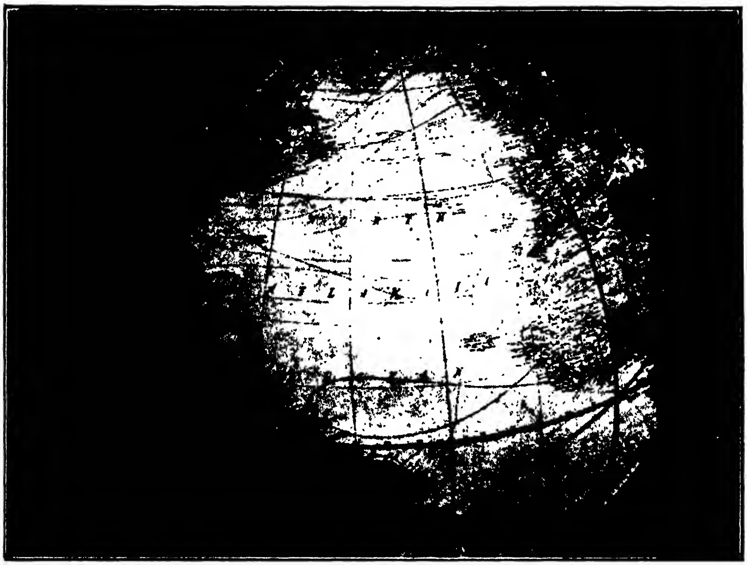


FIG. 265.—Globe showing narrowness of North Atlantic and cause of location of North Atlantic trunk. (Photo E. Stirling.)

trans-Atlantic steamers aims to interpose 60 miles of clear water between the ship and these destroying landspecks. This is the more necessary because of the mingling together of the Arctic current and the warm Gulf Stream which produces well-nigh continuous fog on the Grand Banks. The handicap resulting from these difficulties is well-illustrated in the St. Lawrence River, one of the feeders of the Atlantic route, where the narrow and rocky channel has been frequently the scene of great disasters and where at the present time ships must often tie up during the night. One result of these dangers is an insurance rate often several times as high as that for open sea voyages.

The icebergs, afloat for half the year in the region of the Grand Banks, are a greater menace than a group of islands.

Another dangerous part of the route is Cape Hatteras, which really projects into the Atlantic and, with its long strings of sand bar reaching out to sea, must be rounded by hundreds of vessels from the south. In the temptation to save distance, many a good ship has ventured too near these bars and met her end.

WINDS AND FUEL SUPPLY. The north Atlantic, a region famous for its storms and strong winds, was, in the sailing vessel epoch, a route where some wind could always be had. The ship was never becalmed, and the record of the zone of calms shows this to be a matter of importance, although it was often necessary in the winter time to make a great detour to the south to avoid the steady winds from the west. This was particularly the case in the colonial times when ships were small and rigging was ill equipped for headwinds. In those days it was common for the ship to return from Europe by way of the Canaries and West Indies and beat northward along the Atlantic coast.

In the present epoch of steam no route equals the north Atlantic in the abundance of the supply of fuel. Eastern America and north Europe are producing 95 percent of the world's coal and on both continents this supply is admirably distributed for the supply of steamers. On the American end there are four distinct fields: east Canada is supplied by Nova Scotia; the Middle Atlantic States from Pennsylvania; Chesapeake ports from Maryland and the Virginias; at New Orleans and the other Gulf ports there is Pennsylvania coal, carried down the Mississippi River in barges at minimum cost; and Mobile has Alabama coal under equally favorable circumstances. The European end has a distribution of coal that is not less complete. Southern and western England with the ports of Bristol and Liverpool are supplied from the rich fields of Wales and Lancashire; Glasgow almost overlies the coal-fields of western Scotland. On the east lies Newcastle, synonym for coal; Antwerp and Rotterdam, the great ports of the Rhine, are in reach of Rhine-borne coal from Westphalia and Belgium; Hamburg and Bremen receive their coal very cheaply as return cargo in ships which carry sugar to England, and German coal can also come on barges from the Rhineland. Another fuel supply that should be mentioned is the oil of Texas, Kansas, and Oklahoma in the lower Mississippi Valley. This is now used to a considerable extent and will continue to be a favored fuel as long as petroleum remains plentiful and cheap.

TRAFFIC. The North Atlantic route began as one over which fishermen sailed to the Grand Banks and emigrants left Europe to start new homes in America; the emigrant traffic, which was the first over this route, was one of the greatest until legislation checked it. In the first 10 years of the twentieth century, more emigrants by far landed from trans-Atlantic steamers than had succeeded in reaching America in the two and one-half centuries preceding the year 1850. It is also the greatest travel route of the world and the greatest freight route, and consequently the route possessing the largest, fastest, and most complete ships that ever floated.

It is upon this route that have occurred the fiercest fights for international supremacy. Here in the middle of the nineteenth century occurred the great Anglo-American duel between the rival American and British lines, the Collins and the Cunard. In this struggle the American line was the faster, but ultimately victory was not to the swifter. The Cunard has now outlived the Collins line by more than half a century and the British marine has largely replaced the American. The last thirty years have seen an equally keen competition among the English, the German, the French and American lines, which are here rendering the best ocean service for both freight and passengers that the world has ever seen.

The north Atlantic traffic has always been of a dual nature. The emigrating European has been finding a home, and the manufacturing European has been finding raw materials. This has given to the passenger and freight traffic a continual condition of unstable equilibrium. There are more passengers moving west than east;[1] there is more freight moving east than west. Thus, there are, with the exception of certain short seasons of the year, unused passenger accommodations on the steamers setting out from America, and there is seldom even a temporary respite in the movement of empty freight vessels from Europe for American cargo. America has been sending raw materials in great bulk—cotton, wheat, corn, meat, lumber, copper, petroleum and cattle foods—and receiving manufactures of much smaller bulk. This was true in

[1] The westbound emigrant traffic is not now so pronounced as it was before the United States passed its restricted immigration law.

the first days of the Virginia colonists' settlement when they were saved from starving by the fortunate discovery that the people in the home country would pay them for shiploads of savory and bulky sassafras bark, with which the early colonists at Jamestown were able to purchase bread, clothing, and necessary manufactures which they could not themselves make. The medicinal virtues of sassafras bark were found to be largely imaginary, and the trade fell away to be followed by an unending succession of tobacco

Fig. 266.—At Bush Terminal, Brooklyn, one company operates piers with freight sheds where steamers load and unload; warehouses across the street for storage; cement structures at left where many manufacturers rent floor space with heat and light and power. Circulation is furnished by freight cars, trucks, wagons, barges, and belt conveyors. (Courtesy Bush Terminal Co., New York.) (From *North America,* published by Harcourt, Brace and Company.)

ships, grain ships, and lumber ships; and, in the last decades, American manufactures have added a new class of traffic, chiefly bulky products of wood and steel. Now, as always, the return freight is of much smaller quantity and of higher value, so that many of the ships go out fully laden, and most of them come back with partial cargo, and many with no cargo whatever except worthless ballast.

This traffic in ballast, which makes a load valuable for its weight only, has brought us hundreds of thousands of tons of sand and stone of less than no value; but the necessity of carrying something has caused the Atlantic ships to bring at times coal, iron ore, iron, chalk, china clay, and such bulky freight from

Europe at minimum cost as ballast substitutes. This ballast traffic is not now so imperative because the newer ships have water tanks which they fill and empty with their own engines at practically no cost; but a voyage without cargo must nevertheless always be a loss.

The traffic future promises that our freight movement will not increase so rapidly as it has in the past. America, with her increasing population and her great mills, is using more and more of the raw material, has less and less for export to Europe. The fact that we are establishing manufacturing industries means also that we have a lessening demand for European goods, so both upon the side of production and on the side of consumption there is a prospect of lessened dependence of America upon Europe, and relatively lessened demand for commerce upon the north Atlantic trunk route. The heavy emigrant traffic has probably been permanently checked, but there is every indication of the steady growth of travel between the two continents.

Ports. One of the accompaniments of the nineteenth century revolution in world commerce has been the changing of seaports. Seaports have changed in two ways. The first of these changes has been the physical renovation and rebuilding of the ports and deepening of harbors and channels to accommodate the enlarged steamship and the consequently enlarged trade. The second and yet more important change has been the shifting of the centers of distribution through the relative decline in the importance of the old, and the rise of the many new centers. These changes have been of greater influence in the north Atlantic than in any other of the world's great routes.

The great increase in trade during the quarter century before 1914 has produced a multiplication of the lines of vessels, and consequently a great breaking down in the centralization that arose in the distribution and collection of the traffic to and from a few great ports which had been monopolizing it. There was a time when London and Liverpool almost monopolized the line traffic between Europe and America, but other cities rose to the position of claiming their share from America direct rather than through the intermediate ports. Liverpool saw Bristol rise to the south of her, Glasgow to the north of her, and Belfast across the Irish Sea. London has seen the rise of Antwerp, Hamburg, and Havre, which ports in turn have established coasting lines and have snatched from London a part of the distributing trade of Scandinavia and Russia. But this was not the end. The establishing of coasting lines was scarcely complete at Hamburg and Antwerp, when the same process went further, and yet another set of rivals arose. There sprang up a direct trans-Atlantic connection that gave to Hull, Copenhagen, Stockholm, Leningrad, and Bordeaux the ability to get some of their goods without dependence upon either the new intermediaries, Hamburg or Antwerp, or the old intermediaries at London or Liverpool.

A similar development has occurred on the western end, where New York, while growing steadily in the annual amount of her traffic, is proportionally losing trade to her rival ports like Montreal, Boston, Baltimore, New Orleans, Galveston, and Norfolk.[2] At present nearly all of Canada's commerce with Europe passes through the port of Montreal when the St. Lawrence is open, and through Halifax, St. Johns, N. B., Portland, Me., Boston, and New York in the winter months when the St. Lawrence is frozen.

But with all the multiplying of lines and of services there is no multiplying of routes, only another straw is added to the mighty

[2] American shipping ports handled nearly 126,000,000 tons of freight, exclusive of coastwise commerce, during 1923, according to a survey of water-borne traffic, made by the U. S. Shipping Board's Bureau of Research. Mor than 55 percent of this total passed through six ports, New York, Los Angeles, Baltimore, New Orleans, Philadelphia and San Francisco.

Leading Ports of the United States (1923)
(Million Tons of Merchandise)

	Total	Foreign	Inter-coastal	Non-contiguous
New York, N. Y.	27,615,448	21,275,288	5,876,689	463,471
Los Angeles, Cal.	11,495,456	2,788,021	8,623,036	94,390
Baltimore, Md.	8,341,435	6,617,605	1,552,681	171,149
New Orleans, La.	8,290,350	7,216,287	907,774	166,289
Philadelphia, Pa.	7,870,339	6,242,662	1,549,169	78,508
San Francisco, Cal.	5,740,421	3,012,857	1,472,063	1,255,528
Boston, Mass.	3,604,190	3,024,811	511,817	67,562
Buffalo, N. Y.	3,336,361	3,336,361	....	....
Galveston, Tex.	2,893,178	2,823,497	58,193	11,488
Port Arthur, Tex.	2,854,822	2,797,554	50,474	6,794
Norfolk, Va.	2,126,105	1,958,685	119,434	47,986
Seattle, Wash.	1,949,665	990,128	547,888	411,649
Portland, Ore.	1,719,120	1,232,791	473,600	12,729
Newport News, Va.	1,499,517	1,465,627	5,459	28,431
Cleveland, Ohio	1,403,781	1,403,781	....	....

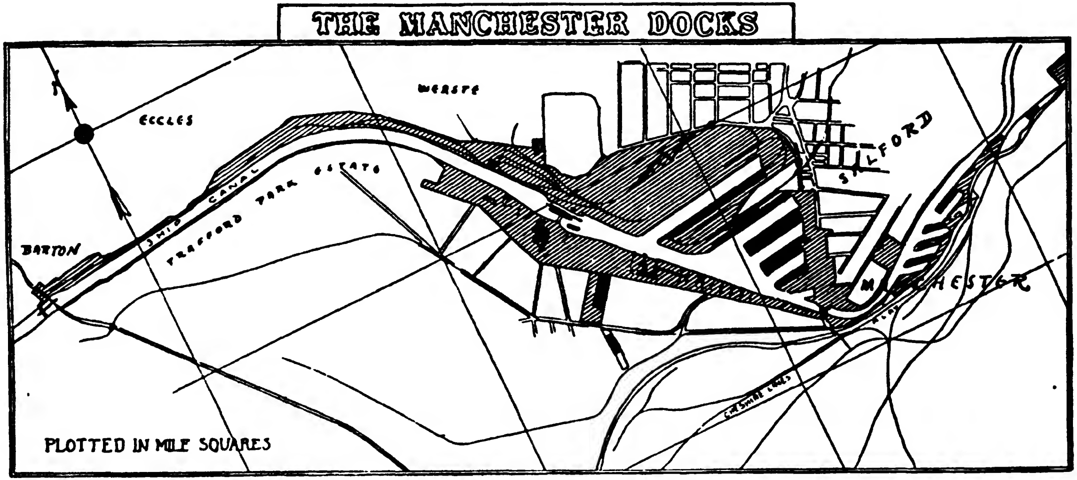


FIG. 267.—The port of Manchester was made at the end of a 35 mile ship canal, new factories arose near the docks, and Manchester had a significant growth in commerce and industry. Commerce is more systematically promoted in Europe than it is in the United States. (After J. Paul Goode.)

sheaf of tracks bound together in the mid-Atlantic but spreading at the ends to include Finland and France, Newfoundland and Yucatan.

The rising of new services from new ports has apparently had no influence on the growth of trade in the old. The ports of Europe are steadily increasing in traffic and are chronically and almost universally out-growing themselves and making new facilities. In Antwerp, Belgium, the harbor authorities have gone into the fields beyond the city and laid out a great new harbor. When completed the port will have 30 miles of solid stone quays, and 800 acres of freight sheds.

Manchester, tiring of what were considered high freights to and from Liverpool, built a ship canal 35 miles long and a harbor. It gave the desired low rates by direct ship and then by the railroads that competed with the ships. The year the canal was opened (1894) its traffic was 686,000 tons and in 1923 it had increased to 5,364,000 tons. Its effects upon the location of industry are seen in the rise of a flour-milling industry and a grain import that rose from 15,000 tons in 1894 to 500,000 tons in 1923.

By dint of sheer expenditure London has passed Liverpool and become the premier port of Great Britain. London is not a seaport city—she is 55 miles up the little Thames River—but the river has been deepened and developed until large ocean vessels now come within a few miles of the British metropolis. One-third of all the traffic in and out of the British Isles flows through the London docks, which have grown until they now cover four square miles. In developing England's largest port the harbor authorities have already expended $50,000,000 and in 1925 were starting to spend an additional $20,000,000 for improvements, including a new entrance lock 1000 feet long, a new dry dock, and elaborate electrical machinery for loading and unloading.

CHAPTER VI

THE TRADE AND TRADE ROUTES OF ASIA

GEOGRAPHIC HANDICAP TO ASIATIC TRANSPORTATION. Asia is old. Asia is in an infancy in which the old peoples, gripping the tools and mechanisms devised in the west, are starting forward to the rebuilding of their old continent, and to the rediscovery of world power. She is the seat of ancient civilizations and of the oldest extended commerce; yet that commerce has always been handicapped by geographical hindrances which will tend to impede her new trade as well. The continent of Asia is five times as large as the United States. Its mere size divides its different parts by enormous distances. The conformation of the land has presented other barriers more prohibitive than distance. There are no large inland seas reaching deep into the land mass, as in Europe. There are no rivers flowing from the great central region, and trade must depend upon land transportation. Deserts and mountains add difficulties that have been well-nigh insurmountable and have limited the commerce of this section to small proportions. The heavy commerce of Asia, like her dense population, has been dependent upon the great rivers and river plains of the south and east; and here only has there been trade in the food supplies and the heavier articles that are typical of present-day commerce. The rest of Asia may yet be said to lie undeveloped, awaiting means of transportation except where the Russian railroads have made a beginning.

THE IMPORTANCE OF ASIATIC RIVERS. The Yangtze is the greatcst of the river thoroughfares by which the commerce of Asia has been supported. Running from west to east through the heart of China it has nearly a thousand miles of waterway for ocean steamers and much more for native boats. The Yangtze is the great commercial artery of China for two reasons. First, because it has navigable branches flowing into it from north and south, and a far-reaching system of canals that open up great tracts of territory. Second, because there are tremendous populations dependent upon these waterways. The rapids of the Yangtze gorges are still a great hindrance to up traffic; but the river gives the western province of Szechwan, with its many millions of people, a better outlet

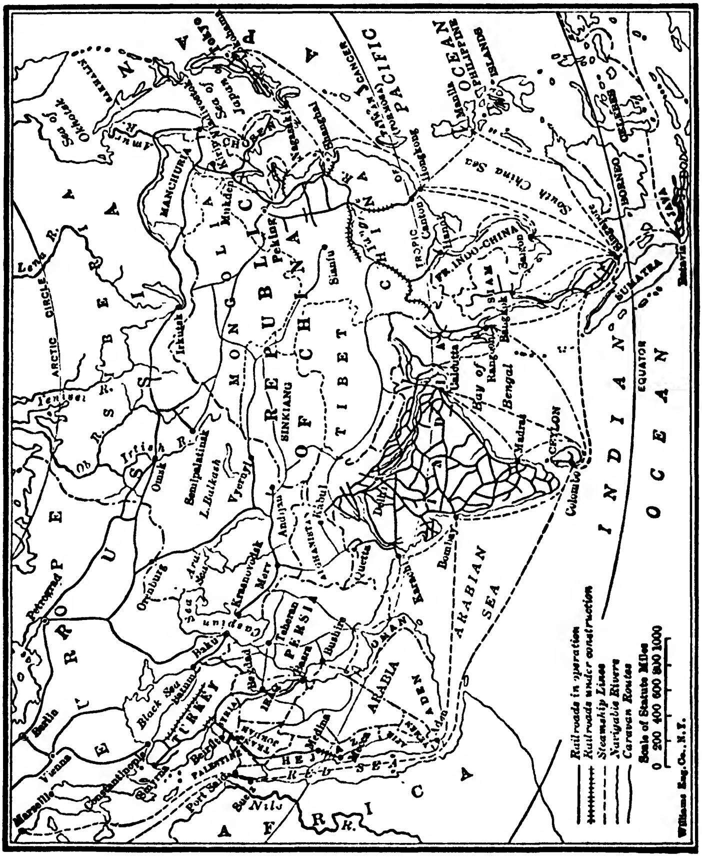


Fig. 268.—Trade routes of Asia.

than the state of Ohio had in 1810, when all agricultural produce had to be sent to New Orleans by flatboats which could not return. The Chinese are able, by arduous human labor, to tow their boatloads of freight up the rapids. It is plain why Shanghai, the gateway to this great valley, is one of the great ports of Asia and of the world, and is destined to greater growth. It is both the New York and the New Orleans of China, with two-fifths of its foreign trade.

In south China the Si or West River and its canals perform the same function as the Yangtze, but for a smaller area, having its metropolis at the great port of Hongkong. In north China the great Hwang River is useful for navigation only for short stretches because of the vast quantities of loess mud it carries. The metropolis of its wide valley basin is Tientsin on the Pei River, which acts as the port for Pekin, with which it was connected by one of the first railroads in China. The only other river of importance is the Liao, which is useful to shipping from Newchwang to some distance north of Mukden.

In Indo-China and Burma the settlements of trading people are all on or near the navigable rivers Mekong, Menam, Salween, and Irawadi, which are served by both native craft and European steamers. Thus Rangoon, at the mouth of the Irawadi, Bangkok near the mouth of the Menam, and Saigon on the delta of the Mekong became the great rice-exporting ports of the world. They also export much teak timber that has been floated down stream.

In India the seats of ancient empire and trade were the rich valleys along the navigable courses of the Ganges and Brahmaputra, and in lesser degree along the Indus. Here are the historic names. The British Administration in India has improved these rivers and built railroads through their valleys so that Calcutta and Karachi, the ports near their mouths, are growing in population and commerce along with Bombay, one of the leading ports of Asia.

Caravan routes. With the slight exception of the navigation of the Tigris, the commerce of the remaining and by far the larger part of Asia, was, until the recent railroad building in Asiatic Russia, dependent upon the land caravan. The entire north is shut off by the Arctic ice; and in the other three directions cyclopean difficulties present themselves to the caravan drivers. On the south a vast wall of mountain and plateau under various names reaches from Asia Minor to Tibet. On the west are the wide and often arid steppes leading into the remote east of Europe. In the center the deserts of Turkestan Mongolia, beset with mountain ranges, connect Tibet with the Arctic wastes of east Siberia. For thousands of years the caravan has contended against these obstacles, using horses, mules, donkeys, yaks, and men as pack animals in the mountains, camels in the desert, and wagons and sledges on the flat plains. These traders have traversed astonishing distances. The men of Pekin and Turkestan have for centuries been familiar figures at the Russian fairs of Nijni Novgorod.

The caravans from China to the west and northwest have been chiefly the caravans of the desert, following the routes of the desert, which comes down to within less than a hundred miles of Pekin, reaches northward nearly to Lake Baikal, southwestward to Tibet and westward to the Caspian Sea. This region is much like the arid region of the United States, having oases and irrigation settlements here and there, but the desert stretches of Asia are much greater in area and often more complete in aridity than those of the United States. Across this waste China has for ages had a caravan trade, and the camel has been a familiar sight in the streets of Pekin since before the birth of any European nation.[1] The most important branch of this overland trade was that with and through Siberia, the routes from Pekin and Hankow combining and reaching Lake Baikal by way of the desert station of Urga.

The Chinese caravan route next in importance passes up the Hwang Valley, across Chinese Turkestan into Russian Turkestan. At Hami in longitude 94° east the route branches, the southern arm crossing the high ranges via Kashgar and the northern going to Tashkent via Kuldscha.

A third route of lesser importance connects Chengtu, the capital of the rich province Szechwan on the upper Yangtze, with Lhasa and Tibet, while a fourth connects Yunnan, a mining city in southwest China, with Bhamo in upper Burma.

The routes that center in Turkestan are, or were, before the coming of the Russian railroads, continued to Europe by a direct route from Tashkent to Orenburg at the end of the Urals, and by a more southern route via the Caspian and Black Seas to Constantinople and south Russia.

The commerce that must traverse these enormous distances on pack animals over mountain, desert, swamp, and sand plain has pressing limitations of high freight rates which exclude anything but goods of the highest value—luxury goods, metal work, silks, cloth, skins, leather, rugs, tea, and spices. The most important of these routes, the one that passed through Siberia, had tea as the chief

[1] The base for this camel trade is constantly changing. As railways are built westward in China, old caravan routes are surrendered and the camel train makes its start from the new end of the line.

article of its commerce. The overland tea cargoes traveled by a variety of means. At Lake Baikal that route reached a well-watered country and the camel returned to his desert. The mud of Siberian spring-time stuck fast the wagon wheels of commerce, which in that region was therefore carried on almost exclusively by means of sledges over the dependable snows of the Arctic winter. Therefore, the tea rested where the spring thaw caught it and proceeded westward when the next snowfall again permitted the movement of goods. Such were and to this day yet remain the only means of commerce and travel in vast areas of central Asia. Naturally the consumption of the goods from the outside world is light where such conditions prevail, and the inland settlements have always been essentially independent.

The day of the trans-continental caravan is on the wane. At best it is a poor, weak rival of the poorest railway; and, wherever they compete, the caravan station becomes the embodiment of hard times and decay. The first great falling off in the overland trade came with the establishment of steamship service connecting the newly opened ports of China with Odessa, and the new railways reaching thence into the interior of Russia. The region west of the Ural Mountains could be supplied with Chinese tea and silk more cheaply by the Yangtze junks and the new water route than by the old routes, which had then no territory left but the domains of Asia. This territory was soon invaded by further improvements, and the Trans-Siberian and the Trans-Caspian railways are becoming the trunk lines for the trade of interior Asia and the caravan is reduced to being their distributor and feeder.

THE TRANS-SIBERIAN RAILWAY. Russian Asia now has industrial conditions similar to those that prevailed in 1870 in the region between the Missouri River and the Pacific coast of the United States—a wide region, partly arid, partly fertile, not thoroughly explored and possessing a sparse population destined to rapid increase through the increased immigration fostered by pioneer railways, along which every station is the starting-point for wagons or pack trains en route for settlements scores or hundreds of miles away. The nomadic herdsmen of the black earth Siberian steppes are now being replaced by the peasant immigrants who have come to raise grain. The wandering trapper of the great forest zone to the north must, when he exterminates the fur-bearing animals, as he is rapidly doing, become a lumberman and help supply the wants of the prairie dwellers to the south. The commercial and industrial life of the new Siberia depends and will depend upon the Trans-Siberian Railway and its numerous branch lines, most of them still to be constructed.

At present the Siberian river systems furnish the most efficient lateral lines of communication with the railroad which crosses them. The flat plains make easy navigation. As early as 1900 there were 119 steamers and 358 barges upon the wide-reaching branches of the Ob, while the Amur serves a large portion of eastern Siberia. The Russian government built the railroad with light and temporary first construction, which must be pretty thoroughly rebuilt before the line can handle much heavy traffic, or develop branches. Thus far the traffic has not reached the stage where branches are necessary. The main line is a stretch of prodigious length through the black earth plains west of Lake Baikal between the forest on the north and the arid land on the south. The long winter season and the ease of sledging enables the grain-growing peasant to haul his crop in for great distances. Sometimes the settler converts his crops into meat, kills his animals and sledges their frozen carcasses 100 miles or more to the railroad. The unremitting frigidity of the Siberian winter gives several months for this work.

It is easy to overestimate the importance of this road as a carrier of through freight that goes from ocean to ocean. In this field it must play a comparatively small part and that part will be limited to passengers, mail, and what, in the United States, is called express matter and very urgent or very valuable freight. In this class will be the silk of China and Japan and possibly tea, but with this latter commodity the sea route can make a powerful competition in the seaport regions of Russia.

Other freight, the common agricultural and industrial articles, comprising over 95 percent of the total commerce arising within a thousand miles of any sea, can be more advantageously handled by the ships that go through the Suez Canal. It should be noted in this connection that many of the agricultural products and all of the grain of the Pacific coast of the United States were until 1899 carried to the Atlantic around Cape Horn in preference to paying the railroad freight across the United States. The railway from Leningrad to Port Arthur is twice as long as that from San Francisco to the Atlantic seaboard and this fact will of necessity make the Trans-Siberian line valuable chiefly as a local rather than an inter-oceanic freight carrier.[2]

The functions of the completed Trans-Siberian railway as a purely commercial carrier of freight, particularly heavy freight, would be more clearly seen if the line were considered to be in two separate sections, with the division line not far from Lake Baikal. This lake marks the end of the great Eurasian low plain. To the eastward the railroad plunges into a mountainous country and crosses the continental divide after passing many mountain ranges requiring expensive construction and high cost of operation, which tend to produce a natural freight divide. Consider the western section as attached to the European railway system and the eastern as a feeder of the Pacific commerce, and we would see the parts in their true significance as outlets running from the closed center to the free circumference of the Eurasian land mass. Western Siberia will look toward Europe, whence the western part of the Trans-Siberian line will bring the imports and take the exports of these provinces. Practically independent of this will be the developments on the other end of the railway system. This territory will find cheapest transportation on the Pacific Ocean, and the Pacific termini of the Trans-Siberian line will be the gateways of import and export for the mining and agricultural regions along the eastern sections of the railway. Such in fact is the case already. The road starting from the Pacific ports as a base was built largely with American machinery and supplies, equipped with American rolling stock, the towns are described as resembling American towns, and the farmers on the Ussuri are using American reapers and plows. It is Manchuria, not Siberia, that is sending flour into the mountains of the upper Amur country.

THE TRANS-CASPIAN RAILWAYS. One can see the Trans-Siberian railway in the economic rôle of two different commercial outlets by comparing it with the Trans-Caspian railway in the central Asian provinces. There one-half of a Trans-Asian railway has been made by the extension of the European transportation system to the backbone of Asia—to the mountain wall separating Russian and Chinese Turkestan.

[2] Questions of military operations and requirements are not here considered because they must so often be conducted with reference to conditions other than those purely economic or geographic. Politically, the railroad will have tremendous influence as a through carrier of emigrants, passengers, and mail and as a distributor of the Russian language and thought.

The first link in this chain was the railway connecting Batum on the Black Sea with Baku on the Caspian Sea. Steamers from this point and also the Volga connect with Krasnovodsk on the eastern shore of the Caspian whence the newly completed line passes Merv, Bokhara, Samarkand, and reaches Andijan in farthest Fergana, with branches to Tashkent on the north; on the south to Kushk on the Afghan border. A more direct connection with Russia is the new line from Orenburg, at the end of the Urals, to Tashkent, the northern terminus of the first line. This is one of the old caravan routes that gave an outlet to central Asia before the Trans-Caspian railway caused it to be almost deserted.

Trans-Caspia, Bokhara, Turkestan, Fergana and Kiwa, the territories served by these new lines, compose an 800-mile stretch of arid and, in part, desert country, irrigated in places by the streams that flow from the high and snow-clad mountains to the east and south. The habitable sections are comparatively small, but fertile. The climate is good, the agricultural products rich and varied. Cotton, cattle, sheep, grains, forage crops, fruits and vegetables of the temperate zone have enabled these oases to support a population as dense as that of agricultural western Europe, and with the coming of the railway, the sluggish caravan trade was quickly succeeded by a lively commerce. The ability to reach the European markets led to a great increase in the production of cotton,[3] and the dried apricot, which had been produced for local use from time immemorial, suddenly found a great market in Russia, making much traffic for the new railroad.

Possible new railways across Asia. A direct rail route from Europe to India by way of the low passes of Afghanistan is one of the future possibilities. The branch line of the Trans-Caspian from Merv to Kushk on the Afghan boundary is not far from Herat, and separated from it by the easiest pass in the entire mountain system between Armenia and Mongolia. On the southern side the railway system of British India has been pushed upward past

[3] Within two decades after the railway was built, cotton became one of the most important money crops from the irrigated fields of the oases. The product, however (950,000 bales, pre-war average), was insufficient for the needs of Russia, and there is small possibility of its large increase because of the very limited areas for which it is possible to secure water. Before the war one-fifth of the irrigated land of Turkestan was in cotton, and the Russian government was trying to double this by arranging for an outside supply of wheat so that the wheat lands of Turkestan could be put to cotton.

Quetta to Chaman on the Afghan boundary near Kandahar. There are no serious engineering difficulties in the way of connecting the two railroad systems and commerce would be. much increased by another radial outlet to the vast landlocked mass of central Asia. Political jealousy is the only reason that the connection between these two national roads now so near together has not been made. They are both military roads, and were not built for economic reasons. Therefore, the caravan still connects India with Russia, and no one can predict how long international jealousy will block the railroad demanded by jostling trade.

Recent railway building in eastern Asia has also given rise to plans for another spectacular trans-continental system. Yunnan, the capital of the rich mining province of southwestern China, was reached in 1910 by a 450-mile French railway from Haiphong on the Gulf of Tonkin. The shortest route from China to British India lies through Yunnan, the distance from Canton to Calcutta by this route being 1,600 miles, compared with 4,000 miles by sea through the Straits of Malacca. The Yunnan line would form an important section on the great trunk railway now assuming shape across southern Asia, which will link Canton with the European system by way of the Trans-Caspian through Russia, or the Bagdad Railway to Constantinople. Of this great trunk railway, fully 5,000 miles in length, about 3,500 miles are either already in operation or under construction; and the greater part of the remainder of the distance has been surveyed and projected.

"The main line of this route, as at present existing, runs from Karachi, on the Arabian Sea, across northern India to Assam. From that point it forks into two branches, both of which impinge upon Yunnan. The more northerly branch reaches Sadiya, on the border where Tibet, China, and Burma meet. Sadiya is less than 400 miles distant from the upper navigable waters of the Yangtze, but the other branch referred to is more likely to form the main route through Yunnan to the east. It leaves the existing line about 150 miles north of Mandalay and runs to Bhamo on the Chinese frontier. From Bhamo, or from Kun-lon, on the same frontier, to which a third branch runs from Mandalay, the British government has the right to extend the lines through Yunnan and to the Yangtze River." [4]

Central Asia affords the possibility for another great railroad—

[4] From the *National Review*, a Chinese-British publication.

to traverse the Hwang Valley and penetrate the deserts to Hami and Kashgar in eastern or Chinese Turkestan. This road, which is now under construction as far as Sian (or Singan), the capital of the province of Shensi, would be the eastern counterpart to the Trans-Caucasian and Trans-Caspian lines of Russia; the resources along the route are promising, but the connection with the Russian systems would be improbable, as there are few commercial reasons to make it profitable to surmount a mountain range whose lowest passes are higher than the highest peaks of the Alps. This route from Pekin to Kashgar, followed by camels for thousands of years, passes the coal-fields of the provinces of Shensi and Kansu and the entire route is a promising though unprospected mineral region. In the upper Hwang province of Kansu is the westernmost extension of Chinese agriculture and an important wool-producing region. The habitable part of Chinese Turkestan [5] is a succession of small oases along the foot of the central mountain range, and, like the oases of western Turkestan, depending upon the melting snows for life.

THE BAGDAD RAILWAY ROUTE OF WESTERN ASIA. An Asiatic project of present importance for international trade is the railway connection between the Mediterranean and the Persian Gulf through a region of wool, dates and minerals. This was one of the most important international routes in the days of the medieval caravan trade between Europe and the Orient, before the discovery of the sea route to India. (See Chapter XII, Part II.) Revived as a railway project, the Bagdad Railway, through the enthusiasm of Germany and the subsidies of Turkey, was built nearly the whole length of Asia Minor before the World War, and has since been completed nearly to the upper Tigris. A line of railway is already in operation between Bagdad and Basra, 70 miles up the river from the Persian Gulf. The completion in the future of the missing sections in Mesopotamia will provide western Asia with a through route from Constantinople across Asia Minor to the rich and fertile flood plain of the Tigris and Euphrates, once the seat of mighty empires. It has lain waste for several centuries since the Turkish

[5] F. Younghusband in his book, *Among the Celestials,* reports that Chinese Turkestan has settlements of from 6,000 to 60,000 people with unused agricultural land and a great abundance of agriculture products, among them wheat, which was cheaper than in India. The total population of Eastern or Chinese Turkestan is probably two or three times that of New Mexico.

conquests.[6] In 1913 an English-built dam and a reconstructed irrigation canal were opened to service, through a concession granted by the Young Turk Government which was then in control at Constantinople. During the World War Mesopotamia was conquered by British troops and has become an independent state, the kingdom of Iraq under a British mandate. The valley is as good as it ever was and will make a home for millions. Some of the canals of the ancients only need repair. Added interest is being taken in Mesopotamia because of the recently discovered and very promising oil fields near Mosul. The English, anxious for a source of cotton under their own control, are also looking to these hot valleys for a future cotton supply. All of which will add to the importance of the new railway.

Persia possesses a little of the Mesopotamian lowland, rich, oily, irrigable, accessible to ships. This small section accounts for the leading exports of Persia, petroleum, cotton, and dates from the bank of the great river, shipped by steamer from Basra and the Persian Gulf.

Basra is the outlet for only a small corner of Persia. Most of the country consists of high arid plateaus; the population lives in densely peopled irrigation settlements surrounded by vast arid pasturelands, over which nomads follow their flocks. Skins are a natural export. This is also a natural setting for the rug industry in both tent and town.[7] The main trade route of Persia is a highway running southwest from Teheran to Bagdad. The northern part of the country is more easily reached from Batum by the Trans-Caucasian railway, from which a branch has been built as far as Tabriz. On the eastern side a branch line from Quetta and

[6] The large and prosperous community, depending upon one irrigation canal for its very life, was a particularly easy victim for the Turk in the exercise of his genius for misrule. The farmer depending upon rainfall had at certain times certain crops that could be taken, but it is reasonably easy to keep enough to save life. The herdsman may get out of sight with his flocks, as the age-long strife of Bedouin and Turk attests, but the band of Turks at the head of the irrigation canal held over the heads of the irrigationists the power of life, death, and all exactions. Hence the desolation and unused possibilities of Mesopotamia.

[7] The Oriental rug is a nice adjustment to geographical conditions. It is highly valuable and can stand the high cost of long caravan journeys from inland points in west Asia. The wool is furnished by the flocks living on the scanty pasturage of the semiarid lands. The weavers live in densely peopled oases where they divide their time between household manufacture and tilling their irrigated lands.

the Indian railway net comes a little way over the border. Thus the whole plateau of Iran, consisting of Persia and Afghanistan, is still served by the caravan or the wagon road.

When nearly all Asia passed into the possession of colonizing powers these countries remained independent, suffering from grievous oppression and misrule and devoid of railroads because neither England nor Russia dared annex them for fear of war with the other.

Most of Arabia is desert, so absolute that it cannot be crossed between Damascus and the Indian Ocean. So far as known but two white men have made the journey from the Red Sea to the Persian Gulf since Roman times. Arabia is practically devoid of both trade and trade routes. The pious desire of the Mohammedans to visit Mecca has made it for centuries the objective of a vast travel and has resulted in the only railway of Arabia which, starting at Beirut, passes Damascus and follows parallel to the coast south and southeastward to Medina, whence it may some day be extended to the Holy City.

THE IMPORTANCE OF SOUTHEASTERN ASIA. The emphasis that has been placed in this discussion upon the long and plodding caravan routes or the half built and imposing railway projects of Siberia, central Asia, Asia Minor, and Mesopotamia, should not be permitted to cause any one to overlook the fact that the commercial center of gravity of Asia lies in China, Japan, and India and the countries of Indo-China lying between them. Vast Siberia and Asia west of the Indus are empty lands, with scarce 50 millions of people. Most of this part of Asia is too dry or too cold for great communities, the exceptions being a strip across Central Siberia and occasional small and scattered areas elsewhere. It is a land in the main much like our arid west, where half the area of the United States has less people than some eastern states. Southeast Asia is soaked in summer by the monsoon rains and there are the crops and the people. In India and southeast of a line running from Calcutta to Harbin in Manchuria live half the people of the entire world. Theirs are the trade routes of a commerce that is to be stupendous. Newchwang, Tientsin, Shanghai, Canton, Hongkong, Singapore, Calcutta, and Bombay are the termini of great and growing routes. Fortunately, most of the people tributary to these ports live comparatively near the sea and their transportation problem is physically simple.

INDIA, SIAM AND THE MALAY PENINSULA. The Indian railway system is already well laid, the British government having built a carefully planned network of lines which in 1923 totalled 27,000 miles. There were in addition 4,500 miles of Indian state lines. The ports of India are growing in population and commerce. Calcutta is the world's greatest jute exporter, ships a large proportion of the Indian tea crop, and is the port of entry for the greater share of the imports. Karachi is a grain port. In Madras and Bombay we have cities that depend chiefly upon the railroads that center there. In this respect Bombay is a nineteenth-century city, a railroad city, and its location near the districts of wheat, cotton, and oil seed production has made it, like Calcutta, one of the leading ports of Asia. Commercially it is a city of the West, dependent upon the railways built by the British but in the large shipments of essential oils it shows its dependence upon the cheap labor of a densely peopled land.

Burma and Siam, long dependent on their rivers, now have a few railways, the principal line of Burma running from Rangoon to Mandalay and on up the valley of the Irawadi nearly to the borders of Tibet. The Northern Line of Siam runs from Bangkok to Chiengmai near the Burmese frontier. In 1909 Britain increased her sphere of influence in upper Siam by 17,000 square miles at one sweep, and in consideration thereof arranged for a loan whereby Siam could finance (and the British build) a railway from Bangkok down the Malay Peninsula to Penang, and thence to Singapore on the Strait of Malacca. Singapore is now the great world port for the shipment of crude rubber grown on the plantations of the Far East, and has in addition large exports of tin, spices and copra.

CHINA STILL IN THE MAN-POWER STAGE. The commerce and transportation methods of China have been well described by a recent careful observer.[8]

"If we look back to the seventeenth century we find our ancestors making use of methods of transportation, manufacture and agriculture which differ only in a minor way from those now used in China. . . . The horde of junks, large and small, which ply the waters of the canals upon the eastern plains, carry millions of tons, both of native and foreign goods, each year. . . . Along the river banks at nearly all of the large cities of eastern China there is a mass of

[8] "Transportation in Interior China," by Eliot Blackwelder, in *Journal of Geography*, Nov., 1911.

junks and smaller boats so densely packed that the traveler is moved to wonder how each owner ever finds his own boat. The bare masts make a veritable forest around such great cities as Hankow and Canton. As is well known, these junks are used as permanent habitations by thousands of families who spend most or all of their lives in these movable homes. The internal traffic carried on by means of the junks is enormous in volume but has never been reduced to figures. When the wind blows in the right direction, the skipper of the junk hoists the familiar sail strengthened with bamboo slats. But at other times—and these probably seem to the

FIG. 269.—Canals in 718 square miles of Chekiang province, China. Each line represents a canal. (From F. H. King, *Farmers of Forty Centuries.*)

poor coolie all too numerous—the boat must be dragged or 'tracked' by the crew wearily tugging at the long hawser made of thin twisted strips of bamboo. . . .

"On land two vehicles are most in use for both freight and passenger traffic—the cart and the wheelbarrow. The carts are small cumbersome affairs, very heavy in proportion to the loads they carry. This heavy construction has probably been adopted because the roads are so bad that a lighter cart would be shaken to pieces. In western countries local or general governments build and maintain the principal roads, but in China this is not the practice. . . . Among the mountains, pack-animals and men afford almost the only means of transportation. Carts are available locally in the broader valleys, but they cannot cross the rugged passes from one valley to another. . . . The idea of doing anything for the common good seems utterly foreign to Chinese thinking. Thus it happens that instead of improving roads so that large vehicles may be used and drawn at a fair speed, both the vehicles and the speed are adjusted to the inexorable demands of roads, which are usually as bad as they could possibly be.

"The great popularity of the wheelbarrow in China is probably due to the fact that a vehicle with one wheel can more easily take advantage of the best parts of the road than one with two; furthermore, it requires no draft animals. The freight-barrow used by the Chinese has a capacity of 600 to 800 pounds, and, like the cart, is a very stout, heavy machine. It is made of wood throughout. There is no more characteristic noise in China than the incessant squeak which arises from the ungreased axles of the wheelbarrows in town and country. The barrow is not always a one-man vehicle; often a donkey or a mule is hitched to the front of it, after the manner of a plow; and when the wind is favorable the thrifty coolie not infrequently rigs a sail to aid him in his weary struggle wtih a load which always seems much too big for him. . . .

"There are coal mines in Shantung (one of the eastern provinces) whose entire output goes by wheelbarrow to cities and towns 50 to 100 miles away. In the case of coal, the rapid increase of the freight charges limits the sale to a small district. More valuable commodities are often carried much farther . . . low grade commodities such as coal, building stone and grain, cannot now be carried any great distance from their sources, on account of the excessive expense of coolie and cart traffic. . . . In 1900 a severe drought destroyed the crops in Shen-si province and soon reduced 3 million people to starvation. More than a third of these actually perished for want of food. And yet, at the same time, bountiful harvests were gathered in the eastern and southern provinces. . . . The coal from Shan-si, carried on donkeys or coolies, is doubled in price every 15 or 20 miles, and so can have only a local market. For this reason one sees the peasants of the great Yellow River plain burning corn-stalks for fuel in their cooking stoves and making no pretense of heating their houses during winter. Coal is beyond their reach now, but with railroads they might have an ample supply at $2 or $3 per ton."

Railroad building in China. The railroad will not drive out entirely the cart and the barrow, the donkey and the coolie-porter. For the present it will merely supersede them in long-distance hauling. In time, however, the multiplication of branch lines will release millions of human freight carriers, who can turn their attention to production, while engines take care of the transportation.

China seems to be in political upheaval. When it will end no one can foresee. Some observers predict that, given freedom from civil war, such as was devastating parts of China in 1925, the next twenty-five years will see more railroad building there than in all the rest of the world put together. Dr. Sun Yat Sen hoped to be instrumental in building 60,000 miles of railroad during the decade 1910–20, thus giving his country a complete network of main lines. This vision was shattered by political chaos in China and worse political chaos—the World War—in the western world. In 1924 there were in operation a little over 7,000 miles of railway in China proper, in addition to about 2,000 miles in Manchuria. The most important of all the Chinese railway lines probably will be the great north and south trunk, which is to connect Pekin with Canton in South China. The northern part of this trunk from Pekin to Hankow on the Yangtze River (about 754 miles) is already in operation, but from Hankow to Canton part of it is still under construction. Most of the other lines now operated in China start at ports such as Tientsin, Tsing-tao on the Shantung Peninsula, Shanghai, or Canton, and run westward along the river valleys. In the north the Chinese railway system connects with the Manchurian and Russian railroads.

China must make readjustments. China is on the eve of an industrial revolution whose effects may well be more far-reaching than any of her late political revolutions. Her newly found dependence upon world markets, after centuries of isolation and self-sufficiency, is already bringing about more rapid changes than did the introduction of the factory system in England. Twenty years ago her foreign trade was but little over one dollar per capita; in 1922 it had risen to nearly five dollars per capita, a remarkable total increase when we consider her more than 300 million people. China is passing rapidly out of the domestic stage and is now taking millions of dollars worth of cotton goods and yarns, rice, machinery, metals, tobacco, illuminating oil, and every variety of manufactured goods. The rest of the world is taking from China her raw silk, beans and bean cake, oils, raw cotton, tea, and various Chinese wares. Much of China's raw material goes to Japan.

When the Chinese are enabled to get at all their wonderful resources, utilize and transport them, still more surprising trade readjustments will follow, and China will enter an era of industrial and social problems more pressing than any nation has yet experienced. With the factory comes unemployment, a new thing of which the Chinese are already beginning to complain. Rapid railway building will give rate wars and the freight advantages of competitive points. This is the force that has done more than all else to pile up western populations in unwieldy cities, separate them from their food supplies, and increase the cost of living. The Chinaman who can live by the household system on his patch of ground, will, like the New England farmer, often find that he cannot do so if he goes over to commercial agriculture with its freight charges and the limitations of crops to those that can be shipped. Yet China is getting railroads apace, the railroads make freight differentials, the freight differentials make cities, and the cities increase the cost of living by inflicting wastes which the richer West is with difficulty able to endure. The suddenness of these changes will make them especially hard on a people with such a low standard of wages and such an undeveloped sense of united action for the common good.

Transportation in Japan. Japan has had an unusual opportunity to develop water transportation—a string of narrow islands with rugged interiors, that force the people to live near the coast, and the coast well supplied with harbors suitable for the much-used coasting vessels. This ease of communication has aided in the quick spread of western knowledge. The transformation of Japan from a hermit nation with closed ports in 1854 to a world power defeating the army and navy of Russia in 1905, and now using every western scientific device, is one of the marvels of all times. There has been nothing like it in human history. It tells much of Japanese quickness, keenness, adaptability, energy and power to imitate. The old hand industries have been laid aside or assisted by the machine industries. Japan has reached the stage where she is beginning to import raw materials and export her labor supply in the form of cheap manufactured goods. At the same time Japan has built up a world-encircling merchant fleet and a large foreign trade, with the United States as her best customer (42 percent of the Japanese exports in 1923).

Japan's railway building has kept pace with her industrial and commercial development. With only 73 miles of railway in 1880, she had constructed 3,600 miles by 1900, and over 7,000 miles by

1923, most of it government-owned. Nearly all the important cities on the islands are connected by railway and ferry, while a seven-mile tunnel under the straits between Honshu and Kiushu (to be completed in 1928) will still further unify the transportation system. There is fast steamer service to the Japanese railway system on the peninsula of Korea, which connects with the Trans-Siberian through Mukden and Harbin, and with the Chinese roads by way of Newchwang. With her coasting steamers, ferries, and network of railways, Japan probably has the best and most modern system of communications in the entire Far East.

CHAPTER VII

THE MEDITERRANEAN-ASIATIC ROUTE

THE LANDS AND PEOPLE SERVED BY THIS ROUTE. This great trade route connecting America and Europe with Asia by way of the Mediterranean and Red Seas is the route through the heart of the world. It passes through the heart of the world in several senses: First, in point of land mass served by it. The world is often shown divided into two hemispheres, one of which is called the land hemisphere, with its center in western Europe and including practically all of the eastern hemisphere except Australia and nearly all of the western hemisphere. The major parts of this land hemisphere are connected through their midst by this great route and its main ramifications. An examination of the globe shows how great a part of the world it reaches. Asia itself comprises more than a third of the land surface of the earth. With Europe and Africa, which are a part of the same land mass, it comprises much more than half of the earth's land; and by one of the fortunate circumstances of geography, this route pierces the middle of this land hemisphere and practically circumnavigates the vast irregular continent sometimes called Eurasia—much the greatest block of land in the world—and receives branches from all of the numerous indentations that cut its southern shore. The vast size and mountainous interior of these lands reduce land transportation to insignificant proportions and turn all traffic toward the sea.

In a second respect this route may be said to pierce the heart of the world, because it reaches lands containing most of the world's population. For Asia the total is over 800 million; for Europe it is 400 million; for Atlantic North America it is nearly 100 million, and Africa contributes enough to raise the total of the people served by this route to well over 1,300,000,000—an astounding figure. The total population of the world is about 1,700,000,000, so that the Mediterranean-Asiatic route serves more than three-fourths of the world's inhabitants. The only large masses of popu-

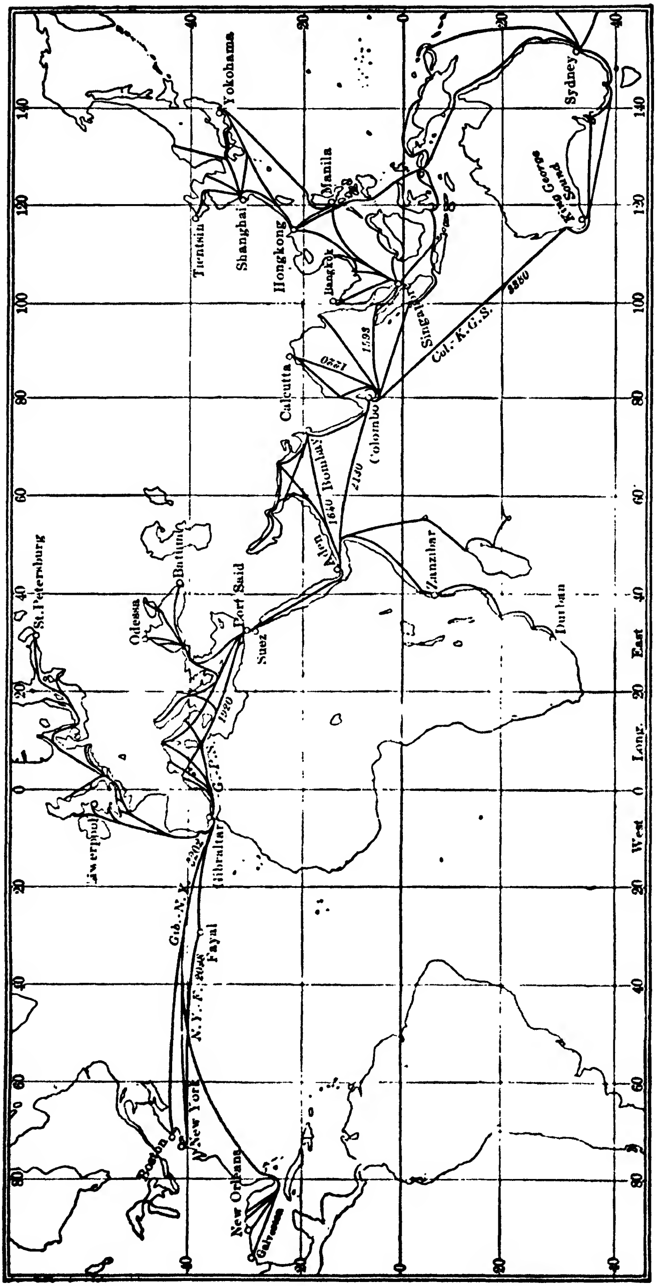


Fig. 270.—Mediterranean-Asiatic Route.

lation that are not reached are the savages of Africa and the fifty-odd millions of South Americans, so that the Mediterranean-Asiatic route not only reaches the major part of the world's people, but a still greater proportion of the world's civilized people. It connects with two great types of Western civilization, as represented by Europe and America, and the Orient, with its older civilizations of India, China, and Japan. Along the route is found every stage of industry from the most complicated and mechanical in America and Europe or the most elaborate hand manufactures of India and the Orient, to the crudest producers of crude raw materials such as the salt gatherers on desert coasts.

History of this route and its trade. The route, in that it includes an artificial ship passage from the Mediterranean to the East, is a creation of the most modern civilization; but the trade is older than the Pharaohs, for the trade is that between the West and the East, regions which have, since before the dawn of history, differed as they do now in the general conditions of life and production. The silks, perfumes, spices, and other costly products of the tropics and of Asiatic skilled hand labor have for fifty centuries come out of the Far East and sought Europe. This destination has been reached over a multitude of routes from the Trans-Siberian sledge route in the frozen north to the galleons which rounded the Cape of Good Hope. Between these two extremes the route of this traffic has shifted, and with every shift it has made a new epoch in history. There were times when it came to the north of the Caspian Sea, through south Russia and Poland into east Germany; again it sought the same route to the Caspian and passed into western Europe through the Danube Valley. For a time it went to the south of the Black Sea across the Bosporus and made Constantinople the commercial mistress of Europe. A yet more southern route is that connecting the Persian Gulf and the northeastern end of the Mediterranean where the city of Antioch grew into prominence. In the sixth century it made great the desert cities of Baalbeck and Palmyra. The region around Suez has had its share of the traffic in ancient times. Caravans have sometimes crossed the short Isthmus of Suez; at other periods they have even reached the Nile Valley below Cairo. From 1500 to 1840 nearly all of this traffic passed around Africa in sailing vessels. About the middle of the nineteenth century the Peninsular & Oriental Steamship Line had its origin in steam services which gave a mail route from England to India through the aid of separate lines of steamers running from Great Britain to Egypt and from India up the Red Sea to Port Said. The portage where the Suez Canal now gives a through passage was then a busy place. At times 3,000 camels were employed to carry a $2,000,000 cargo of a single steamer across the isthmus.

The opening of the canal in 1869 made a great revolution in trade, not only in the route it could follow, but in the type of vessels to be used. Because of the uncertain and weak winds of the Mediterranean and the yet more uncertain winds of the narrow, rocky, and dangerous Red Sea, these waters have ever been unfavorable to the sailing vessel. On the other hand the long route around Africa had never been profitable for steamers, in competition with sailing vessels. In 1870 the opening of the canal, therefore, meant both a new route and a new type of vessel, to be built for the Suez Canal trade. The traffic rose slowly at first, but it has, however, risen steadily, and has now reached enormous proportions, so that the canal company which was at first ridiculed as a hopeless investment has become one of the best dividend payers in the world.

The supply and distribution of fuel along the route. The Mediterranean-Asiatic Route is admirably supplied with coaling stations for the vessels that follow it and is fairly well supplied with coal. The route may properly be described as being double at both ends. In the West it has its main feeders in Europe, but an important part also on the Atlantic coasts of America. In the East, after rounding the continent of Asia, the greater division turns to the northwest toward China and Japan, while another and smaller branch goes to the southeast to serve Australia. There are coal fields at each of the four termini—eastern United States, Great Britain, Japan, and Australia, but the middle part with its thousands of miles of length is peculiarly barren of coal. Australia sends coal at times to every shore of the Pacific (including California), and Singapore at the southern end of the Malay peninsula is supplied with both Australian and Japanese coal. A little is also sent thither from the meager production of Bengal, and occasional cargoes of Welsh coal reach that distant point. All coal ports from Colombo, Ceylon, westward are regularly supplied from the fields of Wales. The price of coal at these ports bears little relation to the distance that the ports may happen to be from the source of the coal. This arises from the fact that as the tramp steamers carry the coal from Wales to the coal port, the rate is decided not by a consideration of mere distance but by the prospect of obtaining a profitable cargo when the coal is discharged. Consequently, coal is cheap near good sources of freight and it is high when freight promises to be scarce. It thus happens that although the distance from the coal fields is twice as great, coal at the eastern end of the Mediterranean is little, if any, higher than at the western end because the western end of the Mediterranean produces little freight of the kind that is shipped as full cargoes in the tramp steamers, while the eastern end, with Egypt and particularly the Black Sea with its millions of tons of export grain in normal times, produces such freight in great abundance, so that the coal vessel discharging at Port Said is nearer another cargo giving profitable employment than is a vessel discharging at Gibraltar or Algiers. Consequently Port Said is a coaling station of greater importance for commercial ships than any other one port in the Mediterranean, although Gibraltar and Algiers are important stations and Malta is sometimes used Aden, which lies exactly on the route at a very convenient place for the taking on of coal, has the misfortune to lie between two deserts producing little but salt, so that the coal at this point is high, and as a coaling station it is only used by those vessels which are compelled to do so. The next coal station, and one also of admirable location, is Colombo on the southwest shores of Ceylon on the road toward the Malay Peninsula, the point of Asia which all ships to the Orient must round. Exactly on this point is Singapore, a port of admirable location for a coaling station and also with cheap coal supply, due to the fact that comparatively near it lie the rice ports of Burma and the sugar ports of Java and the Philippines, so that vessels coming with coal from Australia, from Japan, from India, and even from Wales have excellent opportunities to secure return cargo.

It is interesting to note that this port of Singapore is purely a creation of the present Mediterranean-Asiatic route. In the sailing vessel days that strait was of little importance. The vessels from India sailed south across the Indian Ocean; those from China and Japan came down the China Sea and through the Sunda straits separating Java and Sumatra. Under these conditions of ocean transportation the straits of Sunda were the gateway to east Asia, and Batavia, lying almost at the mouth of the strait, was the great port. With the coming of the steamer passing westward to the Suez route, all this was changed and the Strait of Malacca, between Sumatra and the Malay Peninsula, became the gateway to the Far East. Nearly a century ago a British subject who could foresee the future had the daring to calmly seize the then unsettled island of Singapore which guarded this passage and then await instructions from home. His commercial and strategic foresight have been well indicated by the progress of the last half century, which has made a great port on this island, and put the naval officer's statue in the central square which bears his name. During this time the port has become the greatest port of the region, a great British fortress, and a great commercial coaling station for the shipping of the world.

Other coaling stations of importance are Hongkong and Shanghai, conveniently situated on the Chinese shores.

There is no iron-clad rule by which a shipowner decides the actual coaling practice to be followed by the captains of his ships because it becomes a new business question with each voyage. If the ship can make its owner more money carrying much freight and little coal, it will do so and stop at frequent intervals for more coal. If such stopping is desired no long route in the world equals this one for coaling opportunities. A vessel can sail over it from the remotest port in the Gulf of Mexico to ice-bound Vladivostok in east Siberia without ever being compelled to carry coal for a voyage longer than that between Aden and Colombo, a distance of less than 2,200 miles. The vessel from the Mexican Gulf, if it so desired, could get coal at Norfolk, or Bermuda; the vessels from New York occasionally in times of great stress of freight and high rates call at Fayal or St. Michaels in the Azores about 2,000 miles out from New York, and thence onward the succession of ports is continuous. The leading ones actually used by the various lines are Gibraltar, Algiers, Port Said, Aden, Colombo, Singapore, Hongkong, Shanghai, and Yokohama or Moji.

The coaling question may sometimes assume another aspect to the shipowner. If freight rates are low and the amount of freight scanty, for the two usually go together, the cost of stopping at coaling ports may make it unprofitable. In every case there are port dues to pay, usually a high price for coal; there is always loss of time, and usually quarantine expenses, pilotage, and the possibility of quarantine delay. For these costs there are in times of low freights no compensating returns and it will therefore pay the steamer to carry as much coal as possible from the original port, as in cases where vessels are known to have steamed without stop from Great Britain to Japan. This is, however, unusual, although the reduction of the stops to two, one each at Singapore and Port Said, the best ports, is not uncommon. The fuel supply for this route in the near future may be considerably modified. At present the abundant coal supply of China is not mined enough for export and the steamers are using inferior Japanese coal in Chinese ports. It is probable that the magnificent supply of China may in the near future materially alter the coal supply of Oriental ports.

Another change of much greater possible extent is gradually coming about through the increasing use of oil as a fuel, either in steamers, or in motor-driven ships with engines of the Diesel type. Of the 62 million tons of vessels which made up the world's shipping in 1923, 16 million tons were oil burners, while in 1913 only about 1½ million tons burned oil. For the ocean vessels which use this fuel, the Mediterranean-Asiatic route is particularly well supplied. Eastern America and Mexico produce one-half of the world's petroleum and supply western Europe. The oil fields of Russia, Rumania, Persia and Mesopotamia are adjacent to and midway along the route. Very promising fields are being developed toward the other end of the route in Burma, the Dutch East Indies, and British Borneo. As long as the petroleum supply remains plentiful and cheap, an increasing amount of it will be used for ship fuel.

A TRUNK ROUTE. Of all the world's ocean routes the Mediterranean-Asiatic is the trunk line par excellence. This comes about from its length and its location between the two northern and the two southern continents of the eastern hemisphere, which it serves by numerous lateral branches, finally reaching in the west the United States, where its termini include the widely separated points of Galveston and Boston. The indented coasts of Europe and Asia furnish from every great gulf and sea a branch to the main trunk route. In this respect it is quite the peer of any railroad system and in its structure bears considerable resemblance to the Pennsylvania Railroad—probably the best located railroad with regard to traffic in the whole world.

Traffic. The traffic upon this great route, which almost circumnavigates the world, is as varied as the peoples and lands which it reaches. For convenience the traffic may be considered in six different groups. While two of these groups are confined to a single continent each, and in that respect have certain local aspects, their trade is international.

First—the traffic of the Mediterranean waters. The Mediterranean itself is about 2,000 miles long; and, including the Black Sea, it is nearly 3,000 miles from Gibraltar to the most remote indentations of Soviet Russia. This may properly be called the most magnificent system of inland waterways in the world. Its waters give ocean transport to a dozen independent countries and many colonies. Through the navigable rivers of south Russia and the Great Danube, it reaches far into the heart of Europe. From prehistoric times it has been the scene of busy commerce. Before the days of the compass its many islands favored navigation from landhead to landhead and it is thus possible to traverse its whole length with reasonable safety by keeping in sight of land. In the present epoch of steamers it is busier than ever. A good example of this is the great Italian Steamship Co., which possesses over 100 steamers and serves some seventy-five ports on the Mediterranean system. These disbursers of Italian produce and collectors of Mediterranean goods gather products at Genoa and Naples to be sent across the Atlantic in ocean steamers belonging to the same company. This is a common system in European commerce and in the Mediterranean. It is also done by the French lines assembling at Marseilles, and, to a lesser degree, by the Spanish, the Russian, and other steamship companies.

This Mediterranean traffic is between two distinct economic districts—a food-importing district and a food-exporting district. While Italy, France, and Spain are great agricultural countries, they are also manufacturing countries and must import both food and raw materials. The east Mediterranean region, comprising Hungary, which reaches navigation through its river ports on the lower Danube, Rumania, the Balkan states, Turkey, and Russia, is normally in the raw material producing stage. Grain and other agricultural products are the chief exports, and to these, the east end of the Black Sea adds ores and the petroleum exports of Batum. This gives the basis for a lively exchange of manufactures from the west for the wheat. corn, rye, oats, and oil of the east Mediterranean. This trade was sadly injured by the World War, but is slowly recovering.

SECOND—TRAFFIC BETWEEN WESTERN EUROPE AND THE MEDITERRANEAN. Great Britain and the other countries adjacent to the North Sea use great quantities of the sub-tropical orchard and garden produce grown along the shores of the Mediterranean proper, from Spain to Asia Minor inclusive. Chief among these products are wine, oranges, lemons, figs, raisins, and early vegetables. These edibles in great quantities go to the northwestern countries, and the heavy populations of the manufacturing districts adjacent to the North Sea also are accustomed to use large quantities of the grain, ore, and other raw products from the Balkan and Black Sea region. The return cargoes in this trade consist in point of bulk primarily of coal of which over 20 million tons a year pass from the Welsh fields to the Mediterranean ports. The next in bulk are the forest products of Scandinavia which are in great demand in the populous and essentially timberless Mediterranean. In point of value these bulky articles are rivaled by the machinery, cottons, and other manufactures of Great Britain, France, Belgium, and Germany.

THIRD—THE TRAFFIC BETWEEN THE EAST INDIES AND THE ORIENT. The term East Indies—following the British classification—includes India itself, the mainland to China; also Singapore and the adjacent islands. Here is a large traffic and one which promises to continue its growth, for it has a firm basis in economic conditions. Japan has become a rapidly increasing importer of food and raw materials. Chief among these imports are cotton, rice, and sugar, all of which are produced in south Asia; the cotton in Hindustan; the rice in Burma, Siam, and Indo-China; the sugar in Java, the Philippines and other scattering localities. In return for these commodities Japan sends coal as far as Singapore, and manufactures (chiefly cotton goods) to all the countries mentioned. As Japan increases in industry, and China with her vast population follows in her wake, this trade between temperate Asia and tropic Asia promises to largely increase.

FOURTH—TRAFFIC BETWEEN NORTH AMERICA AND THE MEDITERRANEAN. This is, in its present routes, a new trade. There was a time not long ago when direct steamer lines from north Europe to America took from Europe the products of all parts of the world, including the Mediterranean. To a limited extent this practice of trans-shipping at Liverpool or London the products of Italy, Spain, Greece, and Turkey, still continues, although between 1890 and 1925 it has been greatly modified by the establishment of new lines of steamers between New York and Marseilles, Genoa and Naples. The process has gone even further and the desire for direct shipment has caused lines to be established between New York and Constantinople and the Black Sea, thus avoiding the trans-shipment of eastern Mediterranean goods at western Mediterranean ports, and thus carrying one step further the universal desire for direct communication between producer and consumer. It is natural that an essentially agricultural country like the United States should have much more trade with the manufacturing countries of the western Mediterranean than with the agricultural Black Sea region, although we send at times large shipments of agricultural machinery to the Black Sea ports.

FIFTH—TRAFFIC BETWEEN EUROPE AND THE EAST. This is really the first and greatest of them all. In its beginning and down to comparatively modern times this trade was chiefly an exchange of European bullion for the silks and other luxuries of the East. The easy transportation of the steamship era has added to it commodities which before were unthought of. The region of the Persian Gulf now sends to Europe dates, wool, hides, and oil, as well as Mohammedan prayer rugs. The port of Karachi in northwestern India is famous for the shipment of wheat and grain grown in the valley of the Indus to the north of it. Beyond is Bombay, which sends to Europe cotton, wheat and a great variety of oil seeds from which are extracted scores of the higher grades of oil known in the paint and drug trades. Beyond is Colombo in Ceylon, which, along with Calcutta, has of late years begun to export tea. From Calcutta also comes the world's supply of jute shipped chiefly to Dundee for the manufacture of gunny-sacks to be used throughout the world. Indo-China, which may for this purpose be considered to include Burma, also has its staple export—rice, which is sent in shiploads to all parts of the world, especially to Bremen and London, the great rice markets. Singapore is the assembling point for the world's crude rubber, a shipper of tin, and a great spice center. It is also the junction point for many steamship lines, and has an import and export trade of about $500,000,000 a year, greater than that of many nations. From Java come annually about 1½ million tons of sugar. The Philippines send sugar, Manila hemp, copra and cocoanut oil. China and Japan are the main factors in the world's supply of raw silks and join India in competing in the tea supply.

In return for this varied supply of raw materials and peculiar manufactures, western Europe (chiefly England) is sending railroad iron, locomotives, all kinds of machinery, cotton goods, clothing, preserved foods, and manufactures and supplies in innumerable variety.

SIXTH—TRAFFIC BETWEEN NORTH AMERICA AND EAST ASIA. This was, until a very recent date, very much like the trade from the Mediterranean in that little of it was handled by vessels passing directly between the trading countries. London was the great market from which we received the products of all Asia, and the returning European vessels carried some American goods, although much of the American supply of goods imported from Asia was paid for with European manufactures, which in their turn were paid for by our exports to Europe. About 1900 direct lines of steamers were established between New York, India, China, and Japan. The experiment was instantly successful and the lines have continued, with the addition of others from the Gulf ports. These vessels carry cotton, petroleum, wood, and iron manufactures, tobacco, cotton cloth, and miscellaneous manufactures. Illuminating oil was formerly so much prized by the Chinese that it filled quite the half of all the shipping from the United States to China, but there is a growing demand for our textile machinery, iron and steel products, locomotives, chemicals, dyes and textiles. The return cargo is much less bulky and many of these vessels return with Philippine hemp, Java sugar, Singapore rubber and tin, or East Indian rice.

CHAPTER VIII

THE NORTH PACIFIC ROUTE

THE COMMERCIAL NEWNESS OF THE PACIFIC. The Pacific Ocean is the last of the great oceans to become of interest to the world at large. The Atlantic and the Indian have been repeatedly traversed by the representatives of western civilization since the year 1500, but during three-fourths of the period that has elapsed since that date the Pacific has remained a region unknown; and to this day there are in its vast expanse many uncharted islands. When the eastern coast of North America had already produced commonwealths strong enough to declare their independence, the central Pacific was just being explored by its first great navigator, Captain Cook, who lost his life there at the hands of the savages who had never before seen a white man. About 1806 Oregon received its first white settlement, but as late as 1840 a man of international reputation stood up in the United States Senate and ridiculed the idea that the Pacific coast of what is now the United States could ever be of value. It is from the middle of the nineteenth century onward that the Pacific has risen swiftly to the important place it now holds in the attention of the civilized world. In 1846 we annexed California. In 1848 came the gold discoveries in California and the making of a new commonwealth there promptly followed. Three years after the California discoveries the gold cry went up from Australia and there was a rush to that corner of the Pacific. In 1854 the ports of Japan were opened to the world; fifteen years later our first trans-continental railway was completed to the Pacific coast; and since 1850 we have had continual interest in the north Pacific fisheries.

Since 1890 the intensity of interest in the Pacific has increased. In 1894 came the Japanese-Chinese War, which signified that there was an Asiatic power. In 1897 the Alaska gold discoveries were made. Upon the first of May, 1898, Dewey's guns announced from Manila to the American world that there were such things as the Philippine Islands. We have annexed Hawaii, have watched

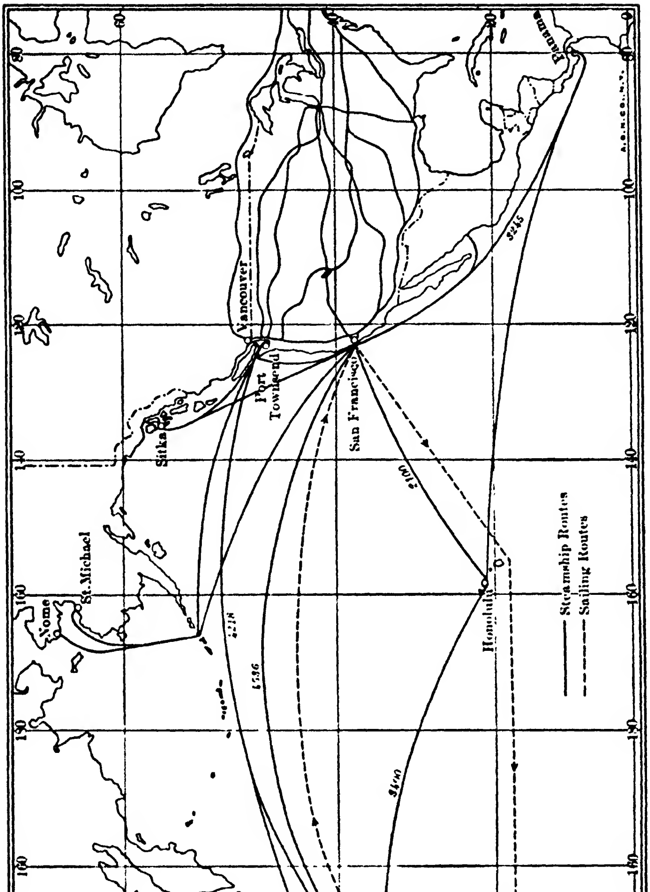


FIG. 271.—Routes of the North Pacific.

the Russian advance to the Pacific, and the resulting Russo-Japanese War. Meantime, all the leading powers of Europe have been striving to gain a foothold in China, the mysterious Celestial Empire that has proved so inviting to the exploiting and trading nations. And the United States dug for a decade at the American isthmus to create the Panama gateway to the great Pacific, which was opened in 1914.

THE STEAMER TRACKS. All the recent interest centers around regions which are directly connected with the north Pacific trade route. This route is like the north Atlantic route in that the great circle factor is of much importance in locating it, and widely separated regions are brought by the factors of geography to use one and the same great route. The great circle factor is of much greater importance on the Pacific than on the Atlantic, because the regions of importance upon the two ends of the route are in virtually the same latitude; the distance is so much greater that the amount of the northern deviation of the great circle line is consequently increased. There is no part of the world upon which the Mercator map works greater distortion. The American-Asiatic cable route via the mid-Pacific islands of Hawaii and Guam to Manila is far from the direct line, but was so placed to be on American soil. Instead of America and Asia facing each other across a wide ocean, a globe shows that, because of the great width of the Pacific, the west shores of America and the east shores of Asia are practically a continuous straight line. This revolutionizes the ideas which one must get from looking at a flat map. The steamer that attempts to pass directly from the ports of Puget Sound to Yokohama will wreck herself upon the rocky shores of the barren Aleutian Islands. Consequently the route is not a true great circle, but is flattened out to the southward from it, so that the vessels may avoid the Aleutian Islands, in sight of which they pass. From San Francisco it is possible for the vessels to make a true great circle up near the Aleutian Islands. The effect of the great circle becomes yet more perplexing when the attempt is made to apply it to the route from Panama to Yokohama. The direct line between these two points goes northwestwardly through the Caribbean Sea, Yucatan, the Gulf of Mexico, Texas, Wyoming, Vancouver Island, the Alaska peninsula and thence southward to Japan. A steamer compromising with these hard facts skirts the shores of the American continent until southern California is reached, and then crosses the north Pacific Ocean in the latitude of southern Canada. San Francisco is therefore much more nearly upon the actual short route from Panama to Yokohama than is Hawaii, which we are accustomed to think of as being exactly in

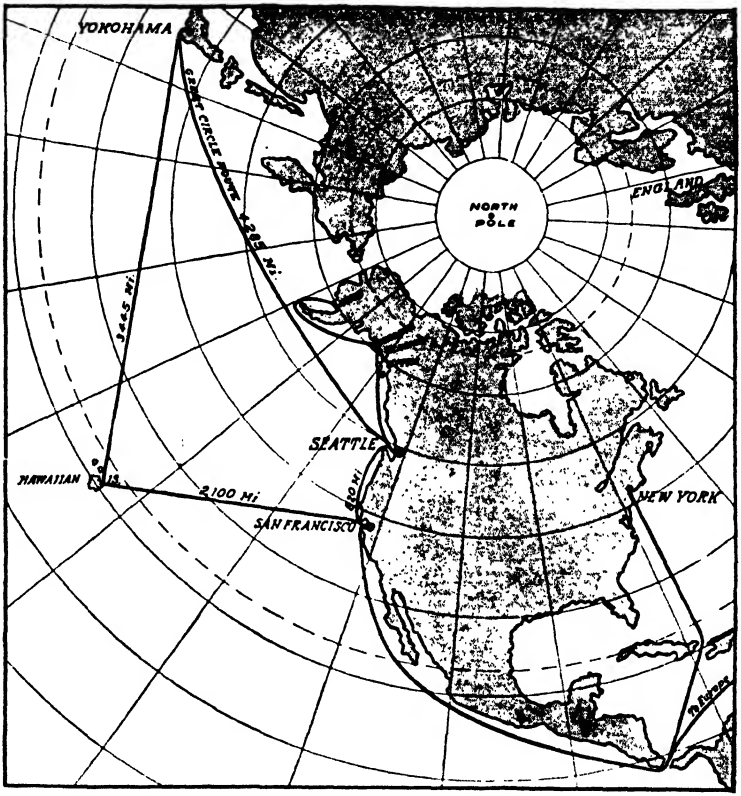


FIG. 272.—Most of our maps make us forget that the world is a sphere, and they hide the real directions that places are from each other—especially places in high latitudes. The north Pacific distances are a good case in point.

the path. To stop at San Francisco would require a deviation of but 114 miles from the shortest possible steamer path and the deviation to Hawaii is over 300 miles. The one point that commercially commands the north Pacific route is the main island of Japan, for upon it is the great port of Yokohama, where practically every vessel crossing the north Pacific stops. Here every thread of this great commercial cable is focused to a single point. This spot is exactly on the route and is a great coaling station, being thousands of miles from any other port to the eastward which can have rendered service to the steamer. Manila is the last port of call for the steamers passing from America to Asia; Yokohama is directly on the route to it; and the Chinese ports of Hongkong and Shanghai are almost invariably sought by the same steamers on the out voyage.

Owing to the storms of winter there are times when vessels do not go so far north as in summer, but they never go far enough south to prevent their reaching Yokohama as their first port. The importance of the trade of the Hawaiian Islands causes the port of Honolulu to be visited en route by steamer lines making for San Francisco, although this detour costs these vessels about 800 additional miles of steaming. The vessels from Puget Sound to Asia do not touch Hawaii.

Coal supply and winds. Upon most of the great trade routes there has been a sailing-vessel epoch, which has been gradually giving way to the advance of the steamer. There has been less of this upon the north Pacific than upon any of the other great routes, chiefly because most of the traffic has arisen since the epoch of the steamship, and, furthermore, because it is essentially steamer rather than sailing-vessel traffic. This part of the ocean, however, is well supplied with the natural conditions for sailing vessels. North of latitude 35° there is a good westerly wind blowing steadily eastward from Asia. The westbound vessel beats southward immediately upon leaving an American port; and when the trade-wind zone is reached, turns westward and sails before this wind for thousands of miles until near the coast of Asia; then a deviation may be made to reach the desired ports.

The coal supply upon the route is fairly satisfactory, but the great length of the voyage requires that a steamer shall give up a comparatively large proportion of her space for coal purposes. There is practically none taken en route. Fortunately the Japanese coal, lying as it does part way between Asia and America, is admirably located. A vessel a thousand miles out from the Chinese coast takes on Japanese coal very close to the point of its production. Unfortunately there is no satisfactory supply thus far in California, and most of the American coal comes from the region adjacent to Puget Sound. Some Japanese and more Australian coal is imported at San Francisco, and for many years before the opening of the Panama Canal cargoes of coal in sailing vessels regularly came around the Horn from Atlantic ports of America and occasionally from Wales.

TRAFFIC. The first part of the north Pacific route to attain modern importance was the link between Panama and San Francisco in the early days of the gold epoch in California. Many thousands of men engaged in producing nothing but the precious metal of coinage required a relatively great movement of commodities to supply their every want. For a time the returns of gold production were so great that it paid to produce nothing in California, but import everything from other parts of the world. While the pioneers crossed the continent in stage coaches and wagon trains, sailing vessels flocked around Cape Horn with supplies, but this route was so slow and so long that means of communication across the Isthmus of Panama were promptly established; steamship lines were running from New York and San Francisco to Panama (and also to Nicaragua) several years before the opening of the Panama Railway in 1856. Over this route there was a lively trade, which increased steadily until the completion of the Union Pacific in 1869 furnished speedy railway communication with the eastern centers of population.

The north Pacific route has rendered its greatest service as a new road between the West and the East—a new rival to the old routes across Asia, around Good Hope and through Suez. Before the first trans-continental railway was opened in 1869 there was a steamer line from San Francisco to Japan and China. This original line has been followed by a half dozen more. These numerous steamers carry outward a much greater amount of cargo than they bring on the return voyage from Asia. A comparison of staples easily explains the reason. America exports coarse cotton cloth and gets silks in return; coarse lumber is exchanged for lacquerware, raw cotton for silk, canned goods and flour for drugs and essential oils, heavy machinery and petroleum for matting, Oriental art goods, and fire crackers.

The lack of freightage balance upon this trade route has led to some peculiar movements. Vessels going out to the Orient are in a sad plight for return cargo, so that many of the sailing vessels going to China and Japan from the north Atlantic ports discharge their cargoes (chiefly oil) in the Oriental port, cross the north Pacific in ballast and return to the north Atlantic with a cargo of grain secured at Puget Sound, Portland, or San Francisco Bay. Shortly after 1900 British line steamers continued their voyage from Great Britain to Japan by crossing the Pacific to Puget Sound, loading there with grain and other American produce, and returning to Liverpool by way of China, Japan and the Suez Canal, before the Panama Canal was opened. Since the opening of the Panama Canal it is common for vessels to go around the world and such line service is regularly advertised.

HAWAIIAN TRAFFIC. The Hawaiian Islands have a place in the traffic of this route much greater than their area would indicate. The Hawaiian staple is sugar, the crop now averaging about 600,000 tons a year. Hawaiian sugar went around the Horn until the opening of the Tehuantepec Railway. Much of it now reaches the port of Philadelphia by way of the Panama Canal, although some of it goes to the near-by ports of the Pacific mainland, which are also importing bananas, pineapples, and other tropical fruits from these islands. The frequent service from San Francisco gives that city an even greater importance as a base of Hawaiian supply than as a market for Hawaiian goods.

ALASKAN TRAFFIC. To the northward there is an additional stream of traffic, to supply the mining industries of Alaska. Vessels pass both from San Francisco and Seattle, although the latter, because of its nearness, has a larger trade and a route which lies largely within the shelter of the achipelagoes that skirt the shores in this region. The Alaskan ports of Juneau and Skagway are located on the mainland not far from Sitka, while Seward is the coast terminus of a 500 mile railroad from Fairbanks in the heart of Alaska. Another interesting bit of traffic is that arising from the salmon fisheries which dot the American coast from the mouth of the Columbia River to Bering Sea.

PROSPECTIVE TRAFFIC. The prospects are for great increase of traffic along the north Pacific route. Every region adjacent to it is, in the modern sense, in its economic infancy. With their development will come trade. Japan is just entering upon a manufacturing epoch in which, like England, she must import both food and raw materials. There has already been a large trade over this route in carrying to Japan the machinery necessary for the development of these industries. This traffic will continue, with, of course, changes in the number and character of the commodities comprising it. In Manchuria is to be found the only underpopulated part of eastern Asia suitable for the support of a large population, and its settlement will be one of the movements of the near future. Adjacent to it are over 300 million Chinese who have lived thus far by agriculture and household industries in a region whose coal and other mineral resources are probably unexcelled. People are necessary to a great world market and China has the people. During the last ten years, amid civil wars and political chaos, her commerce has increased threefold. When her foreign purchases average only $10 per capita, she will be buying commodities worth between $3,000,000,000 and $4,000,000,000 a year. Any such awakening on the part of a people must mean enormous traffic over this route.

It is generally recognized throughout the United States that the whole Pacific coast region of this country and British Columbia is capable of great development. The growth of trans-continental railways to connect it with the East has completely reversed the prophets of the sixties, who asserted that the heavily subsidized Union & Central Pacific Railway would never have sufficient traffic to make it pay. The rapid increase of these lines can be taken as a prophecy for Pacific trade, for every trans-continental railway has some kind of trans-Pacific steamer connections as its western terminus, and the incompleted lines in both Canada and Mexico have contracts for new Pacific steamer lines to follow the common track to Asia.

Prospective port changes. This great multiplication of railways and Pacific steamship lines is cutting into the early predominance of San Francisco in this trade. This port had the first trans-Pacific steamship line and the first trans-continental railway; and, naturally, in that period she had no rivals. The present leadership of Puget Sound as the American gateway for the traffic of the north Pacific route does not mean that the San Francisco is actually declining or is likely to actually decline in the amount of trade. It means that other trade is arising elsewhere and that San Francisco will have a smaller territory to serve, but, within the smaller territory, a steadily increasing traffic.

Upon the Asiatic side Yokohama, Kobe, Shanghai, and Hongkong promise to remain the great ports, while Manila at the terminus will have a steadily increasing trade. The northern ports of Tientsin, Newchwang, Dairen, and Vladivostok which are now supplied chiefly by coasting lines from the greater ports, must eventually, with the development of Asiatic railways, have traffic sufficient to merit direct communications, as have the newer ports upon the American side and upon the north Atlantic trade route.

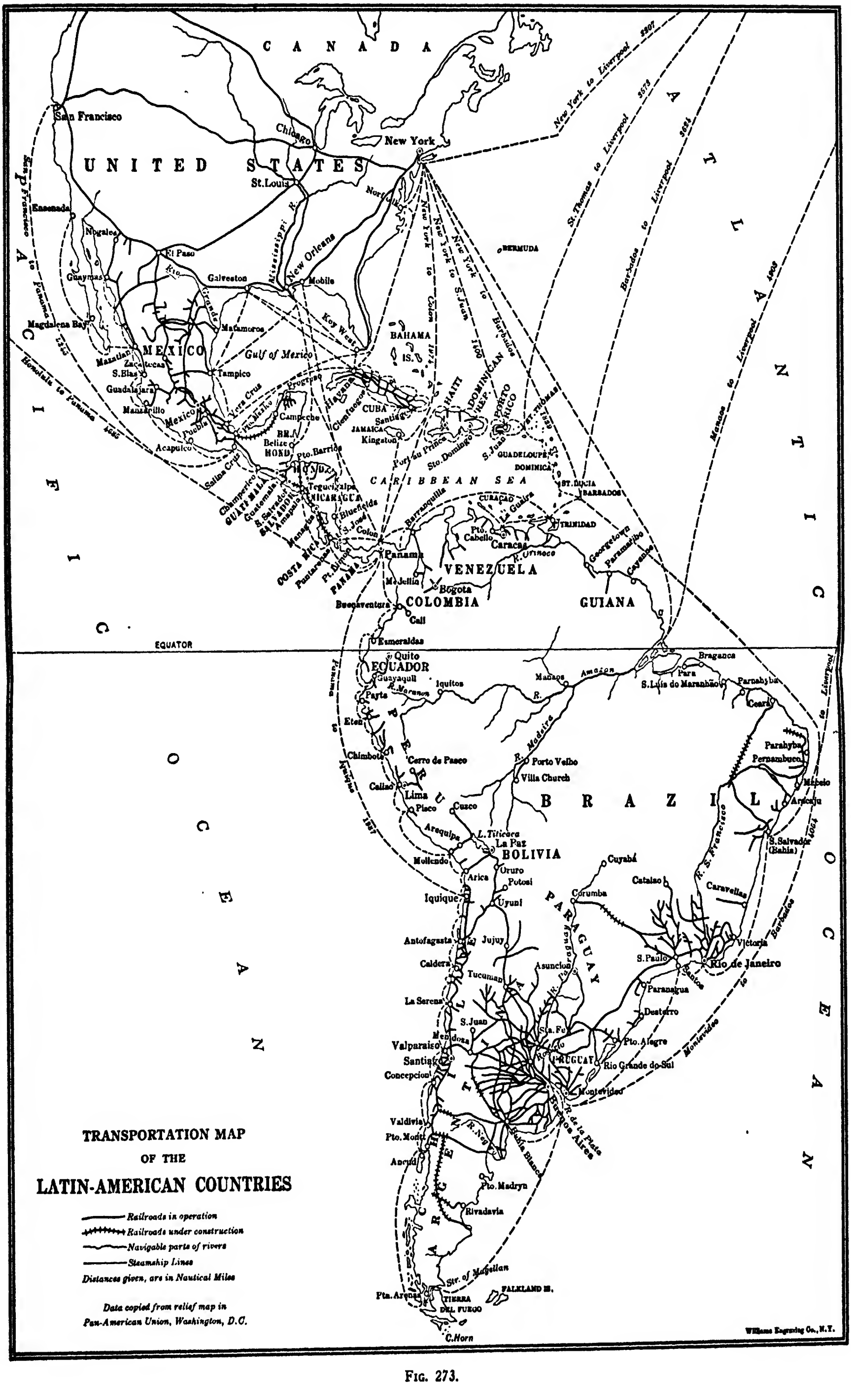

TRANSPORTATION MAP
OF THE
LATIN-AMERICAN COUNTRIES
Railroads in operation
Railroads under construction
Navigable parts of rivers
Steamship Lines
Distances given, are in Nautical Miles
Data copied from relief map in
Pan-American Union, Washington, D.C.
Williams Engraving Co., N.Y.
CANADA
UNITED STATES
ATLANTIC OCEAN
PACIFIC OCEAN
EQUATOR
San Francisco
New York
Chicago
St. Louis
New Orleans
Galveston
Mobile
El Paso
Key West
Gulf of Mexico
MEXICO
BERMUDA
BAHAMA IS.
CUBA
HAITI
DOMINICAN REP.
PORTO RICO
JAMAICA
CARIBBEAN SEA
New York to Liverpool 3207
St. Thomas to Liverpool 3578
Barbados to Liverpool 3624
Manaos to Liverpool 4903
Panama
VENEZUELA
COLOMBIA
GUIANA
ECUADOR
PERU
BOLIVIA
BRAZIL
PARAGUAY
URUGUAY
CHILE
ARGENTINA
Rio de Janeiro
Buenos Aires
Montevideo
Valparaiso
Santiago
Lima
Bogota
Caracas
Str. of Magellan
FALKLAND IS.
TIERRA DEL FUEGO
C. Horn

FIG. 273.

CHAPTER IX

SOUTH AMERICAN TRADE AND TRADE ROUTES

GEOGRAPHIC BARRIERS TO COMMERCE AND ROUTES. The geographical conditions of this continent have opposed the development of commerce and commercial routes, and South America to-day rivals Africa in the extent of its commercially unpenetrated land mass. Like Africa, it forms a solid block of land with a somewhat regular coast line and a consequent dearth of good harbors, making poor facilities for the commerce of the sea to connect with the commerce of the land. When the land is attained, the trader finds access to the interior is difficult because a mountain wall surrounds the greater part of the continent. The Andes extend without intermission along the entire western coast. Upon the east the highlands of Venezuela and Brazil, although not so high as the Andes, bear much the same relation to a large part of the Atlantic side of the continent.

Further than this, it is difficult to reach the plateau because of the inhospitable nature of the coastal plain lying between the base of the plateau and the sea. From Guayaquil, 3° south of the equator on the Pacific side, around the northern and eastern parts of the continent to southern Brazil, the shore plain (nearly continuous) is almost uniformly forest clad, low, hot, and marshy, infested with insects, and subject to malaria, yellow fever, and other tropic diseases. This is a constant barrier to the growth of prosperous maritime cities and a hindrance to the conduct of commerce with the interior.

As a result, the ports are usually small cities, limited strictly to the purely commercial operations necessary to the handling of imports and exports. Another and usually much larger city is commonly nearby on the more healthful plateau. It is in reality another part of the same economic community. The city is merely divided and only that part remains on the natural shore site which absolutely cannot go up to the more wholesome hills. La Guaira is the port for Caracas, ten miles away in the mountains. Santos is the great Brazilian coffee port, but São Paulo forty miles inland on the plateau is the real center of the region. Rio Janeiro is an exception to the rule in that it is a large city, but Petropolis on the heights twenty-five miles inland is the place of residence for the leading citizens of Rio Janeiro, including the official representatives of foreign governments. The situation in Santos was long graphically described by a local saying that the inhabitants were vitally interested in, and talked about three things—the price of coffee, the rate of exchange for the fluctuating Brazilian currency, and the yellow fever which was rife upon the low and unwholesome coast until 1905 when the advancing science of sanitation practically conquered the disease. The climate of the coast has been a great drawback to the settlement of the continent by Europeans. If the eastern coast of North America had presented so unfavorable a front to the colonists the progress of settlement and trade would have been delayed many decades, perhaps a century; for the reputation of the land might have been made by its coast, and colonization discouraged.

The coast of South America has still further drawbacks for commerce. The Pacific shore plain from northern Peru 6° south latitude to 30° south is essentially rainless and desert, except where irrigated by snow-fed streams flowing across from the Andes. The only South American coasts offering ready access to European colonists lie between 30° and 40° south latitude and include the agricultural region of Chile and the southern states of Brazil, Uruguay and a part of Argentina. With the exception of the coffee plateaus near the tropic in Brazil, these are the only parts of the continent in which extensive colonization has occurred and where the European races outnumber the colored races. In many of the tropic American countries there is but a small percentage of white people, the great bulk of the people being the aborigines or, as in central and northern Brazil, negroes and mixed races.

THE APPARENT ADVANTAGE OF RIVERS. The interior of South America, although cut off by the plateau, consists of a vast plain to which three great, navigable rivers give entrance, and apparent solution of transport problems. The Orinoco, the Amazon and La Plata drain valleys whose extent and fertility are only equaled in the temperate zone by the Mississippi and the Yangtze. But owing to the floods, forest, malaria, and other disadvantages of the torrid zone, civilized communities have been able to avail themselves of only a part of one valley, that lying along the southern or temperate part of the La Plata system. No large tropic valley in South America has yet been settled in any modern sense. They have been explored more or less, some of them have settlements here and there, but practically all the land is in a state of nature.[1]

A CONTINENT OF SHORT TRADE ROUTES. As a consequence of the natural conditions outlined above the commercial life of the continent, with a few exceptions, passes along a number of short routes that connect the centers of population near the coast with the common highway, the ocean. With the single exception of the rubber gatherer's boat on the upper Amazon, there is no South American counterpart for the long caravan routes that traverse the deserts of Africa or the plains of Asia; no counterpart for the long-drawn Trans-Siberian Railway; no trans-continental railway lines like those of North America; no daring schemes like the Cape-to-Cairo Railway of Africa. In mere weight of difficulty, however, the Andes Mountains are the greatest single barrier that modern commerce has assailed. Lacking long routes, South American commerce gravitates by many short feeders to the ocean, the one great highway of commerce. Owing to the unorganized internal transportation conditions and the lack of routes for assembling and distributing, the continent requires for its commerce many more ports than does North America, Europe, or Asia. There is a regular service between Europe and ten ports on the Atlantic and Gulf coasts of the United States. On the coast of Chile alone there are a dozen ports to which the European steamers advertise a service. Until the recent completion of the Longitudinal Railway of Chile most of the trade and travel was by coastwise vessels. Other coasts are equally rich in places at which ships stop, although many of them are far from being satisfactory harbors. For every little port there is an inland route or routes, but many of them are as insignificant as the little-known ports they serve.

FOREIGN TERMINI OF SOUTH AMERICAN TRADE. All South American routes alike have Europe and the United States upon their

[1] Astonishing proof of this emptiness is furnished by the explorations of Mr. Sauder of England who plunged into the wilds of Goyaz and followed his compass to Manaos, about 1,000 miles. He found only an empty land and no traces of the terrible and gigantic savages in which all Brazil believed. Mr. Roosevelt's journey (see *Through the Brazilian Wilderness*) does not differ greatly in its economic findings.

other ends, yet these regions are from 2,000 to 6,000 miles away as vessels go. At the same time there is almost no trade with Africa just across the south Atlantic in one place but 1,600 miles away. Regions have nothing to exchange unless there is a dif-

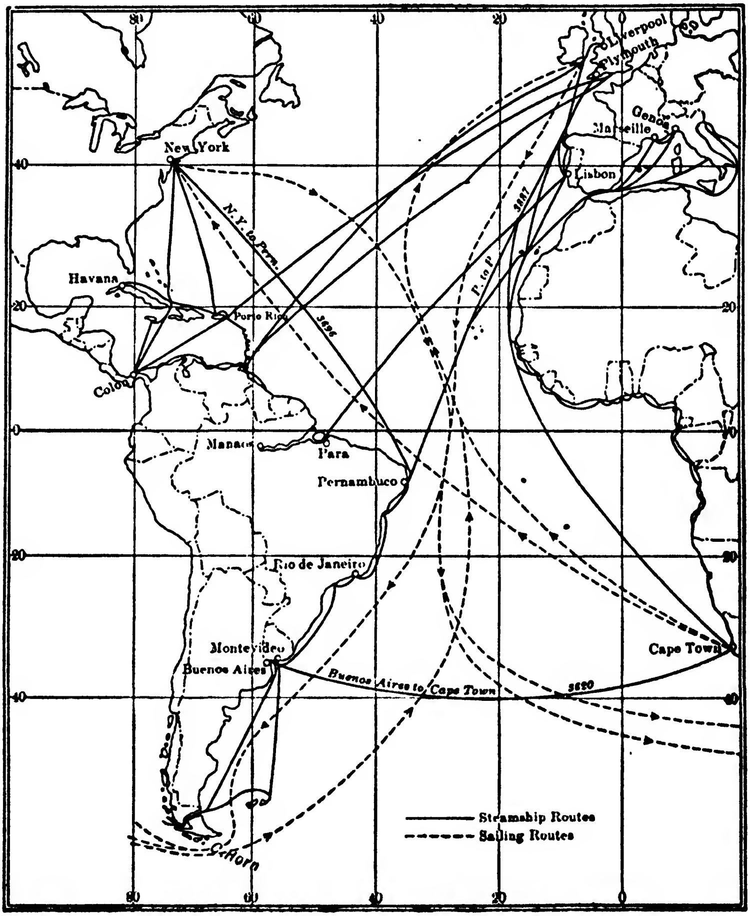


FIG. 274.—The vessel tracks of the Middle and South Atlantic.

ference in production and wants. This the two continents lack. They lie in similar latitudes, under approximately similar climatic conditions; there is no great difference in density of population or stage of cultural development. The economic basis for the exchange of products does not exist; therefore there are no trade routes. The whole trade in the south Atlantic is that passing between the temperate zones and the tropics and that passing between a manufacturing region and a region producing raw material. "Down to the sea and away to the north" might well be its motto.

THE CARIBBEAN SEA. This body of water, called by the Germans the American Mediterranean, is practically surrounded by continental shores or strings of islands, and lends itself naturally to skirting voyages.

The Caribbean countries, being alike in climate and resources, have almost no trade among themselves. Most of the commerce is with the United States and Europe. Nearly all of the many steamer lines make a circuit of several ports. The lines from Europe usually enter at Barbados or St. Thomas (both important coaling stations), while those from New York often enter between Cuba and Haiti and call at La Guaira, Puerto Colombia, near the mouth of the Magdalena, Colon, and Kingston. Direct lines of steamers go from New York to Havana and San Juan, also from New Orleans to Limon and Puerto Cortez, and other Central American ports.

THE GREAT ROUTE OF THE COLOMBIA. In the north, the Magdalena River resembles in its service a trunk-line railway. The river itself is the trunk; and, in addition to its navigable branches, several short lines of railway are among its feeders. The river mouth is choked with sand but the two ports of Cartagena and Savanilla are connected by short railways with their river ports, of which Barranquilla on the Cartagena railway is the more important. The river steamboats are of the flat-bottom stern-wheel type used on the Mississippi. The total length of navigation on the river is 900 miles and on the branches 215 miles. Rapids at La Dorada, 592 miles from Barranquilla, make it necessary to use a railway for fourteen miles, after which boats are again used. The lower valley is a green and almost uninhabited tropic forest. The chief centers of Colombian population, agriculture, and mining are on the interior plateaus drained by the Magdalena, from which the short lines of railway and numerous pack trails make connection with the river steamers. At some rainy seasons these pack trails become impassable even for mules; and at best everything that is carried to many interior towns must, if it weighs over 100 pounds, go in sections on the backs of mules.

Consequently the imports of many parts of Colombia, comprising as they do the whole list of goods required by a modern community from hoes to pianos, trolley cars, engines, and mining machinery, still call for most skillful crating and packing, often in knock-down form. This extraordinary amount of care was one of the reasons for the great increase of German trade over the British and American in the period just before the World War. The Germans want commerce and are willing to cater to it. The English have had it so long that they do not feel the necessity of making such effort. The Americans are in the main so profitably employed with the domestic trade that it is only an exceptional firm that cares to make the effort.

The river Atrato, draining a deep valley to the west of the Magdalena, is navigated almost to its source; but the commerce of this marshy and exceedingly unwholesome valley is served by one or two small steamers setting out from Cartagena.

Colombia pays for her small import with coffee from the plateaus, gold and platinum from the mountains west of the Magdalena, and gums from the lowlands, bananas from the northern coast, where an American owned steamship line calls for them at Santa Marta, and hides from all inhabited parts of the country. Colombian industry and hence her trade have often been in a depressed condition due to the ravages of destructive wars waged by rival chieftains in their attempts to gain control of the custom-house, the chief objective of revolution in many Spanish-American countries.

THE ROUTES OF VENEZUELA, THE NORTHEAST COAST, AND THE LESSER ANTILLES. The center of Venezuelan population is on the cool plateau around Caracas, where there are some highways and several short railways united into a system reaching the seacoast at the ports of La Guaira and Porto Cabello. The territory served by these ports is of comparatively small area, and is limited to the highlands east of Lake Maracaibo, and north of the Orinoco Valley; but commercially this district outweights the rest of the country just as the Ontario region of Canada outweights the rest of the Dominion.

Venezuela with its plateau population is strikingly like Colombia in its commerce except that its centers of population are nearer the sea and do not have to depend upon a long river to reach a port. The asphalt and oil of Lake Maracaibo district replace the gold of Colombia as a natural asset easily accessible for export.

The longest trade route of Venezuela is that furnished by the navigable Orinoco. Steamers can ascend for a thousand miles and sometimes small ocean-going vessels go as far as Bolivar, but European and American goods are usually transferred to local vessels at Port of Spain, Trinidad. Not long ago the entire river service consisted of one steamboat, and the great plain of the Orinoco with its millions of acres of grass and forest is still practically unused by man.

For a long time the heaviest commerce in this region was furnished by the asphalt from the island of Trinidad, adjacent to Venezuela but under British control. No product could be more conveniently placed for export than the asphalt of Trinidad Lake. This unending supply is located so near the sea that an overhead cableway less than a mile in length carries it from its original location to the hold of the ocean steamer. Tramp vessels carry it to American ports, to Europe, and to almost all parts of the world. Both cacao and sugar from Trinidad now exceed in value the combined export of asphalt and petroleum.

The Guianas, like Venezuela and Colombia, belong to the commercial circuit of the Caribbean. The fine English mail steamers from Southampton enter the circuit at Barbados, a great port of call where branch lines connect with the lesser Antilles to the north and with British Guiana on the south. This branch line handles most of the mail and package business of British Guiana, leaving the sugar for tramp steamers. From Barbados the Royal Mail steamers go to Trinidad, the ports of Venezuela, Colombia, Colon, Jamaica and thence with passengers, mail, and bananas to New York where they receive cargo brought across by the fast trans-Atlantic liners and retrace their way to Southampton by the same West Indian and South American ports visited on the out trip. The Dutch subsidized mail line makes a similar circuit between Amsterdam and New York via the Guianas, Venezuela, and the lesser Antilles. Other lines make the Caribbean circuit from France, Canada, and New York, so that the transportation facilities are good.

THE TRADE AND ROUTES OF NORTH BRAZIL. From the Orinoco to Bahia, 13° south, there is a succession of ports, each the outlet for small coast settlements. Along the whole length of this coast, approximately 2,000 miles, there is but one route to the interior, the Amazon. This river and its branches afford a magnificent system of inland waterways running through a region almost entirely covered with forest and at certain seasons flooded many miles back from the streams. This valley, which might rival or double China in population if it were utilized, has a forest so exuberant that man has thus far used only a few of its by-products, sarsaparilla, nuts, and rubber. The sickly population probably numbers less than one to the square mile. Although some Brazil nuts and cacao are exported, the principal industry is rubber gathering. While rubber growing now belongs more to the cultivated plantations of the East Indies than to the wild equatorial forest, the gathering still goes on and high prices for rubber at the tire factories in Akron, Ohio, bring prosperity to the Amazon valley. Its three ports, Para at the mouth, Manaos 860 miles up stream, and Iquitos 1,100 miles beyond in eastern Peru, have a busy trade when rubber is high. For the number of people involved the trade of the Amazon is heavy and, upon its import side, varied. During the days of good rubber price the people of the tropic settlements produced little but their exports; and imported from the Portuguese farmers in the mother country surprising quantities of fruits, vegetables, and other products of agriculture. Steamers from England, calling en route at Portugal, regularly go as far up as Manaos, 15-foot boats to Iquitos and some of the branches are also served by steamers.

There are many streams in the Amazon system that could be made navigable by the use of American "snag boats" such as are constantly employed in pulling lo[illegible] [illegible]d other obstructions out of the Mississippi River. Some au[illegible]rities place the possible navigation of the Amazon Valley at 15,000 miles, but the part at present navigated is far below that. Thousand[illegible] of miles of navigable waters are now given over to the crocodile [illegible]d the occasional canoe of the native. Ecuador, Peru, Bolivia, and Colombia have trackless eastern territories in the Amazon Valley from which they have been cut off so absolutely that the Peruvian governor sometimes goes out to his post at Iquitos on the upper Amazon by way of Callao, the Panama Canal, and thenc[illegible] to New York, Lisbon or Liverpool before taking a steamer for [illegible] the Amazon River. The Amazon receives the commerce [illegible] [illegible]le regio[illegible] in eastern Bolivia, since the completion of the [illegible] [illegible]portant improvement on the whole system, 200 miles of railway [illegible]nnecting the navigable lower Madeira with its Bolivian branches above the 18 cataracts. It is estimated that there are 3,000 miles of navigable rivers in the Bolivian plain, a region that has been greatly isolated because of the separation from the Pacific by the Andean wall and from the Atlantic by the Madeira Falls.

The region between the Amazon and Rio Janeiro is an exporter of sugar, cotton, tobacco, cacao and hides. Here the negro and the mulatto predominate. After the Amazon, the next in length among Brazilian inland trade routes is that from Bahia to the upper course of the San Francisco River. Bahia is the center of an important coast district and the terminus of a railway 300 miles long connecting with the steamers on the San Francisco above the falls that break its lower course as it descends from the plateau. This inland waterway is navigable for about 700 miles, but the rainfall, the population and the commerce of the upper valley are slight. The greater part of the commerce of Bahia has its origin in the coast districts. Pernambuco is another important port of a coast section much like that about Bahia.

THE RAILWAY NET OF THE COFFEE STATES. The greater part of Brazil's foreign trade originates in the two ports of Rio Janeiro and Santos, the chief ports of Brazil and the ocean termini of the trade routes over which passes Brazil's leading export, coffee. Brazil's rubber district and her coffee district are farther apart and more thoroughly separated physically and commercially than the Washington wheat country and Alaska. The Brazilian coffee district occupies a broad plateau and has a railway system which has developed into the best railway network anywhere in the tropics outside of India. It has outlets at the two ports, Rio and Santos. These roads also carry the Brazilian manganese ore; and the traffic on the Santos line has made it necessary to double track the road from the port to the inland metropolis, São Paulo, which is a city European in population as well as in appearance, being largely inhabited by thousands of recently arrived Italian immigrants. The extremities of this Brazilian railway net reach by devious routes points as far apart as Cleveland and Columbus, Ohio, are from Philadelphia and Baltimore, and one line now goes all the way to the upper Paraguay. As this plateau produces more than half of the world's supply of coffee, and as the United States is the greatest coffee-consuming country, the commercial relation between that country and Rio and Santos is heavy, though one-sided. We import Brazilian coffee by the tens of shiploads, but export to Brazil by the shipload, so that the balance of our trade is very much against us. (United States imports from Brazil, 1923, 213 million dollars; exports to Brazil, 51 million dollars.) On the other hand, we export to Europe much more than we import, while Europe manufactures the kinds of clothing and luxuries required in Brazil, so that the result is a curious triangular trade whereby Brazilian coffee goes to the United States and the United States pays for the coffee with cargoes of agricultural produce and manufactures sent over the North Atlantic trade route. Europe, in turn, pays for the American cargoes by sending shiploads of manufactures to the Brazilian coffee growers. This peculiar traffic movement has long been recognized, steamship lines have been organized to follow the lead of economic conditions, the vessels making triangular voyages between Rio Janeiro and Santos, New York, Liverpool, or Manchester. Rivaling coffee in bulk though not in value is the coal import of about a million tons, chiefly from England.

SOUTHERN BRAZIL. If we remember that Buenos Aires is in the latitude of Norfolk and that Rio is in the latitude of Havana, we will be better able to appreciate what southern Brazil is—a land with possibilities much like those of our own cotton belt. The chief new things that are happening there are corn and meat. American packing plants have arisen at Santos and other Brazilian cities, and the list of Brazil's exports had in 1923 an order that will surprise those who have not watched the changes come: coffee, 216 million dollars; sugar, 14 million; raw cotton, 12; hides, 11; cocoa, 9; frozen meat, 9; oil-producing seeds, 9; rubber, 8; tobacco, 6; maté, 6.

THE RIVER PLATE VALLEY. Various European lines call at the small ports of agricultural South Brazil, Paranagua, Porto Alegre and Rio Grande du Sul; but the River Plate or La Plata Valley is the next trade route of importance on the east coast. Here one of the great rivers of the world, under the names La Plata, Paraná and Paraguay, offers an open route far into the interior. Ocean steamers ascend in large numbers to Rosario, 230 miles above Buenos Aires. Commodious river steamers ply regularly from Buenos Aires to the ports of Paraguay.[2] From Asuncion, small

[2] The dependence of Paraguay upon this river is thus depicted by an American Consular Report: "Paraguay is shut in on the west, north, and east by hundreds of miles of thick, almost uninhabited forest country. On

steamers wind through the swampy forests to Cuyaba, 680 miles to the northward in the heart of the tropics. By this circuitous route the Brazilian governors used to go out to their posts at Cuyaba, the capital of the remote and sparsely peopled state of Matto Grasso, which is larger than Great Britain and France. This wild, little known, semi-arid highland has until recently had only a few settlements and no industry except a few diamond mines and cattle ranches. The commerce of the upper Paraguay is correspondingly light.[3] From Paraguay to the ports of Argentina and Uruguay there is a lively traffic in maté, hides, oranges, vegetables, and other sub-tropical produce sent to the colder lands down stream. The one railway of Paraguay running south from Asuncion has been extended to connect with the railways of Uruguay and southern Brazil.

THE ARGENTINE ROUTES. The fertile plain of Argentina to the west of the lower Paraná and La Plata is low, level, healthful, of easy access to the sea, rich in sheep and cattle, wheat and maize, and possesses the best railway net in South America. The foci of these lines are the ports of Buenos Aires and Rosario. Their advantages can only be appreciated when we speculate upon the advantages that would result if Winnipeg and Chicago were seaports. Rosario has such a good harbor that grain sacks slide by gravity down chutes from the warehouse on the bank to the steamer in the river. Westward from longitude 64° west, the rainfall is insufficient for agriculture and the network of railways gives way to a handful of lines going directly across the plains to the irrigated districts at the foot of the Andes. Several roads lead to the north-

the south the greater part of the outlet is barred by swampy land, practically without population. From the day of its discovery to the present time the country has had only one artery of exit and entrance, the Paraná River. Both the Paraná and the Paraguay are difficult rivers to navigate. They are shallow and full of sand bars and other obstructions, and in time of drought become so low that even ships built especially for the service are frequently delayed for days. To this inaccessibility may be largely attributed Paraguay's backwardness; not directly, but indirectly, for its isolation has made immigration of progressive people and adoption of progressive ideas very slow." To this should be added the influence of a tropic climate on man's energy.

[3] Recently an industrial railroad has been built eastward from Corumba on the upper Paraguay to connect with the railway net of Brazil. Most of the work is being done by Jamaica negroes and the enterprise is European; the financial magnate, an American. This new Brazilian railroad across to the Atlantic cannot be expected to carry much through traffic in competition with river steamers.

western province of Tucuman, the sugar producer, 900 miles from the Atlantic ports. The trans-Andean line, finished in 1910, shortens by many days the winter journey between Buenos Aires and Santiago, which had previously required a steamer journey through the Straits of Magellan because the mountains could not be crossed. It also makes possible a Pacific outlet to the important fruit and wine industries of Mendoza and San Juan, sub-tropical Argentine provinces at the foot of the Andes, much nearer the Pacific than the Atlantic. A second trans-Andean line from Tucuman to connect with the Antofagasta-Oruro line is in process of construction, to be completed in 1926. There is little reason to expect it to do a trans-Andean business.

The wheat-growing and stock-raising industries have extended to the south and southwest. Railway extension has followed those changes, and the new southern port of shipment, Bahia Blanca, is rising in importance like a new Galveston. Already it is the center of several railway lines from the wheat district to the north and there is prospect of the early completion of a line across the plains to the lake district in the southwest where the ranchers have now taken up all of the cool Patagonian Plains as they have in Alberta. The more abundant rainfall in the vicinity of the Andes south of 40° south produces some forests and excellent pasture.

The Paraná Valley and the Argentina plains are agricultural in the American sense. They are exporters of grain and animal products. They began commerce as a pastoral region, exporting such valuable produce as hair, wool, hides, tallow, and bones. Fifty years ago experiments proved that Argentina could grow wheat; less than thirty years ago she began to export the heavy surplus and is now an important factor in the world's supply. Of late years corn and flaxseed have also entered the list to a lesser degree. Meanwhile the production of animal produce is in no wise diminished. Here, in this remote corner, where animals were so cheap as to be slaughtered for their hides, tallow and bones, the great firm of Liebig began then to make meat extract, a product requiring a minimum of transportation. Of late years refrigeration has made possible a large export of meat from this district and the cattle at times are even carried the long journey to Great Britain alive. Here is a rival of the United States having as many sheep and over half as many cattle and an insignificant home market. These ports export in most cases to our market, Europe, the same things we export to it. Hundreds of steamships loaded with grain and meat annually make this voyage. The return cargo of manufactured goods fills but a portion of the ships; others take coal, which is by all means the bulkiest import of the region, Great Britain alone sending over two million tons a year to Argentina; and so cheap are the out freights that even bricks are carried from Europe to the southern hemisphere.

Although commerce is predominantly with Europe there is a basis here for American trade. We are importers of wool, skins, and hides, and since Argentina has become an agricultural country, she is an importer of agricultural machinery, in the manufacture of which we lead the world, so our steamship lines to Argentina, although less numerous than those of Europe, are prospering.

The southern part of eastern South America takes part in another triangular vessel movement. Argentina exports more in bulk and value that she imports. South Africa imports much more in bulk than she exports, so the vessels that discharge at Cape Town, finding no cargo there, often swing across the south Atlantic to the mouth of the La Plata, load a return cargo for Europe, and join the great procession northward bound along the coast to Cape St. Roque where the Europe- and America-bound ships separate.

South of 40° south latitude, South America has no important trade routes. It is a region which but a little while ago was called Patagonia, and was left as the unchallenged and unexplored domain of wandering natives, but is now very rapidly being converted into sheep ranges to the great sadness of the persecuted native who had erstwhile lived largely by hunting wild guanaco, a sheep-like animal. The only port of importance that has yet risen in this region is Punta Arenas on the Strait of Magellan, the base of supply and export for hundreds of miles of coast exporting the products of sheep ranches and some gold mines.

THE CHARACTER OF THE PACIFIC COAST DISTRICT. The western or Pacific side of the continent, because of the narrowness of its plain, and difficulty of travel in its slope, has a multitude of small and often inferior ports. In 4,000 miles there are but six railroads that cross so much as one range of the Andes; only five railroads reach the plateau, and only two cross it to the east slope. Few coasts are so devoid of back country. There is not in this whole length of the continent even a second-class navigable river and only in part of Chile and in western Ecuador is there any valley worthy of mention. The agricultural region of Chile lying between 30° and 40° south consists of a long narrow valley between the Andes and a low coast range in which frequent breaks give access to the ports of the Chilean coast. The valley resembles exceedingly the valley of California and chief of the ports is Valparaiso, the center of a trunk line railway which will run two-thirds the length of Chile, from Port Montt (latitude 42°) on the Chilean inland sea in the land of heavy rain, to Arica (latitude 18°) 2,132 miles away in the Atacama desert. From Iquique to Arica the line is still under construction. Numerous small feeder lines connect the main trunk line, called the Longitudinal, with various ports and interior towns. It will probably be a long time before commercial needs can make the northern half of the road economically profitable.

South American minerals support governments. In the arid coast plain of northern Chile, the port of Iquique is the terminus of a short but very important railway that connects the nitrate refineries with the seacoast. Iquique shares with Antofagasta the largest nitrate-shipping business in the world. In addition to nitrates, Antofagasta, the great copper port, ships copper, silver and other ores, making a total mineral export from this desert region of over a million tons a year.

The mineral wealth of this west coast seems destined to the support of dynasties. During the third quarter of the nineteenth century the Peruvian government lived and grew reckless on the income of the guano deposits of the Chincha Islands. At the present time the Chilean administration similarly subsists on the nitrate taxes. During the colonial period the Spanish monarchy had similar support from minerals. Within less than 30 years after the discovery of America the hardy Magellan had rounded the continent of South America and the Spanish conquerors shortly established an empire along the Pacific shores of South America, whose exports almost alone supported the Spanish monarchy for two centuries and a half and made it the dominant power of Europe. This trade was peculiarly one-sided. It consisted of the exchange of authority and regiments on the one side for gold and silver on the other. The Spanish conquerors found great stores of precious metals in western South America; and for many years continued the supply by compelling the natives to work the mines, whose produce was carried back to Spain in the royal galleons.

In 1575 Sir Francis Drake, the English explorer and buccaneer, entering these harbors, found heaps of gold and silver and piles of wheat lying practically unguarded upon the wharves, awaiting the coming of the Spanish king's tribute ship, the only ships ever before seen in those waters. In 1923 nitrate and copper made up 80 percent of the value of Chilean exports and she had in addition valuable shipments of iodine and iron ore (600,000 tons).

There is an interesting triangular trade by which central Chile, agricultural like California, feeds the desert miners and gets paid in manufactured goods from Europe and America.

THE ANDEAN RAILROADS. North of the Tropic of Capricorn the conditions of the eastern side are again repeated, and the district of greatest population shifts from the coast plain, as in Chile and Argentina, to the plateau, as in Brazil and Venezuela. This Andean highland, the highest plateau outside of Asia, runs at an elevation of 8,000 to 14,000 feet through Bolivia, Peru, and Ecuador and sinks to the enclosed valleys of Colombia where the Cauca River basin east of Buenaventura has an elevation of 3,300 feet. The plateau is enclosed on the eastern and western sides by the Cordilleras of the Andes, which present a front that is very high, uniform, and difficult of ascent. Over this barrier the trade routes must pass. South of the equator there are numerous trails established by the Incas and followed by trains of llamas and mules since the Spanish conquest. Within the past forty years several railroads have, by fearful effort,[4] been built to the plateau and have become the chief means of communication with the sea.

The port of Antofagasta, in northern Chile, is the ocean terminus

[4] The difficulties of Andean railroading are illustrated by the first trans-Andean line that was formally opened April 5, 1910.

"The tunnel is 12,000 feet above sea level, between Valparaiso and Buenos Aires. Heretofore winter travelers have been compelled to go round by the Strait of Magellan, a cold and stormy voyage of fourteen or fifteen days. The tunnel project after being twice abandoned was finally accomplished by an American syndicate organized by W. R. Grace & Co., of New York.

"On the Argentine side the railway tracks are brought up the mountains by a series of 'rack sections,' or zigzags, as far as the first tunnel, called El Navaro, which is 5,325 feet long. Then, by a steel viaduct, they cross a tremendous gorge to the second tunnel, which is 15,195 feet long.

"On the Chile side the mountains fall so rapidly that it was necessary to build a series of screw-shaped tunnels describing a corkscrew 27,840 feet long and dropping 2,762 feet in that distance. The aggregate length of the several tunnels is eleven miles." (*Philadelphia Ledger*, April 6, 1910.)

Note the gradient in those tunnels.

of the longest of the plateau railways. A line between 700 and 800 miles long crosses the desert of Atacama and climbs to the plateau of Bolivia, which it traverses in a northerly direction to Oruro and La Paz where it connects with the steamers on Lake Titicaca.

This lake was attained many years ago by the Peruvian line that connects the Pacific port of Mollendo with the lake port of Puno. The lake was already navigated by steamers before the railroad reached its shore, the steamers having been carried up in sections on mule back. The steamers cross the lake to the Bolivian town of Chililaya, which along with Oruro, for years the terminus of the Antofagasta line, was the base of caravan trade to La Paz and other plateau points. Sometimes as many as a thousand pack animals could be seen at one time loading goods for the mines and settlements across the plateau. The Peruvian railroad extends northward from the lake and to Cuzco, the ancient Inca capital, a little way down the slope toward the Amazon. This railroad and the one to Antofagasta carry a limited amount of freight that is destined for, or comes from, the eastern slopes of the Andes, but the chief dependence of the railways is upon the mineral and pastoral products of the highlands. Large plains (mostly arid) are covered here and there with salt and borax; at other places they have flocks and even native crops of barley and potatoes. The historic Potosi mountain of silver and tin has never been worked by scientific methods, yet the plateau is one of the important tin districts of the world. Copper, gold, and other minerals seem to be abundant and their exploitation has but begun. Tens of thousands of square miles of mountain pasture support the llama and alpaca, while the sheep of Bolivia and Peru outrank in number those of leading American sheep states. Arica in northern Chile also has a railroad to La Paz and the plateau.

Peru has another plateau railway extending from Callao past Lima to Huancayo. This railroad taps the important mining district of Cerro de Pasco on the high plateau. A few years ago Cerro de Pasco ores were being carried on mule back a distance of ninety miles to Oroya. This railroad was built by an American in the days of Peruvian guano prosperity, at a cost of $200,000 per mile through the terrible Andes, which, like the Mollendo road to the southward, it crosses at an elevation greater than that of Pike's Peak or Mt. Blanc. But the mineral resources of the plateau are great enough to warrant such effort.

The Peruvian coast, like that of north Chile, has several short lines. They serve the coast settlements and sugar plantations in an arid plain where 1½ million acres are irrigated with Andean snow water and unfortunately but little more may be irrigated later. The westernmost point of Peru has an export of petroleum. All Peruvian ports import wheat, flour, butter and lard.

THE ECUADOREAN RAILROAD AND COMMERCE. Still another Andean railway is in Ecuador. This country possesses a fertile and well-watered plain between the mountains and the Pacific. Here is the port of Guayaquil, the gateway to forests producing palm nuts and cacao; but the truly equatorial climate causes the center of Ecuadorean population to be in the enclosed plateau about 40 by 300 miles lying between the ranges of the Andes containing the world-famous volcanoes Cotopaxi and Chimborazo. Here nearly a million people lived until near the end of the first decade of this century, entirely cut off from all communication with the commercial world, except by a pack trail descending from the 10,000-foot plateau by perilous ledges and crossing swamps that often become impassable in the rainy season. A 350-mile railroad has at last been constructed by American capital from Guayaquil to Quito, the capital. It opens no new trade routes, but revolutionizes the methods and commerce of an old one. It makes possible, for the first time, the participation of these people in world's commerce. This road practically annexes to the commercial world a new province containing a million people. Their commerce is likely to be of limited extent because they live in the temperate zone climate of the high plateau where the country is so rough that there is small likelihood of their having any surplus of wheat, corn, or beans to send any farther than to their neighbor of the tropic plain, if perchance they can compete even there with temperate zone foods. Their exports are, therefore, likely to continue largely of hides and wool, a little rubber from the eastern forests, and minerals of which the country claims considerable store. The imports comprise the whole list of manufactures and supplies needed in a modern city and in a surrounding farming district.

THE ROUTE TO WESTERN COLOMBIA. The northernmost Andean trade route connects the Pacific port of Buenaventura, in Colombia, with the enclosed valley along the upper course of the Cauca River. This stream is a branch of the Magdalena and therefore drains into the Caribbean, but the mountains of central Colombia cut it off from the Atlantic by a high plateau and convert the valley into impassable narrow canyons with tumultuous waterfalls. The Pacific is reached by the passage of a single range of the Andes less than 6,000 feet high, hence nearly all commerce to and from the valley passes over the trail from Buenaventura on the Pacific to Cali on the Cauca, where the traffic divides to go up and down the valley. New railroad extensions were built in this section between 1921 and 1923. This valley differs from all the other regions within the Andes and tributary to the Pacific in being low enough (3,000 to 3,500 feet) to be thoroughly tropical in its production and trade.

THE PANAMA CANAL AND ITS EFFECT ON TRADE ROUTES. Until the opening of the Panama Canal the heavy commerce of South America depended upon the Magellan route around Cape Horn. Steamship lines from Europe or New York had regular services down the east coast, around the Horn, and as far north as Peru or Ecuador. Now this is divided into two sets of lines, the easternmost of which stop at Buenos Aires and the westernmost of which stop at central Chile. These lines carry outward a general assortment of manufactures, machinery, clothing and the supplies for raw material producing countries. The return cargo on the western side consists predominantly of nitrate of soda from northern Chile and, to a limited extent, of sugar and cotton from Peru, copper, silver, and gold ores from various points along the coast, and tobacco, hides, and miscellaneous agricultural products. Much of the mineral export of the west coast goes to Europe and America in tramp vessels, many of which come across the south Pacific with coal from Newcastle, Australia.

The opening of the new outlet toward the north has changed the direction of the commercial current, steamship lines by the score have rearranged their itineraries, and tramp freighters by the hundreds and thousands, mostly nitrate ships and ore ships, pass through the Canal in a steady procession. The west coast of South America is now as favorably placed for world trade as is the east coast. The land routes of western South America have their termini from 2,000 to 8,000 miles nearer the markets of the north Atlantic. This advantage gives a reduction in costs and a speedier delivery of goods that is stimulating the industries and extending the railroads and trade routes of the Pacific side of the continent.

In the Andean region of Bolivia and Peru the opening of the Canal promises to materially affect the Pacific routes by extending them a little down the eastern slope. The extension of railways and mining on the plateaus will intensify the present demand for the sub-tropical and tropical food supplies produced in the fertile valleys of the eastern slope, and desired on the plateau, a fairly populous region of temperate climate. Pack trains now supply La Paz and other plateau towns with lowland produce. Industrial development will give efficient railway service from the Pacific to the plateau, and, coupled with the greater demand for agricultural products of the east slope, will be the ability to transport engineering supplies and extend the plateau railways into the lower country. Such extensions are a part of the plan of each of the three Andean roads of Bolivia and Peru and even of others that have not yet left the Pacific plain. Abundant water supplies will furnish electric power if it is required, many streams passing through 10,000 feet of descent in a short distance.

The communities of the eastern Andean slopes are chiefly occupied with feeding the miners of the plateau and receiving through it the factory produce brought up by rail from the Pacific ports. From Bolivia to Colombia there are no transcontinental routes worthy of the name. Here, for thousands of miles, the continent is still utterly uncrossable except by the hardiest of exploring parties proceeding at some risk of life.

CHAPTER X

THE TRADE AND ROUTES OF AFRICA AND THE GOOD HOPE ROUTE

THE NEW AFRICAN COMMERCE. Although Africa was circumnavigated before America was discovered, the sinister title of "Dark Continent" has stood into this very decade for the mysterious continent, devoid of commerce, but filled with the hidden dangers of the venomous unknown. African commerce has been thought of in terms of beads and savage barter, but now no continent is changing more rapidly. Old "Darkest Africa" is lightening fast. Its present commerce is relatively small, but a much more active future is promised as a result of the new transportation routes now being opened in all directions. African railroads and steamboat lines are being pushed much faster than commerce actually warrants because colonial governments and the colonizing powers in Europe are building lines into the wilderness to subdue territory in the hope that commerce will come later. Trade trails are being cut through the thickest jungles, and immense areas have been opened for cultivation and colonization. The frontiers have been pushed back until but a comparatively small part of the continent is unreachable by white men.

Africa remained a closed continent until the end of the nineteenth century because the climate is usually bad for Europeans and because geographical conditions made the interior hard to reach. The regular coast line possesses very few good harbors. The continent generally is a plateau with abrupt descents toward the sea and a level interior, in some parts flooded during the rainy season. The great rivers, which in Europe, Asia, and America offer easy navigation far into the interior, in Africa come tumbling down toward tide level, blocking the navigation. These falls may make wondrous power some day, but for the past they have kept the continent closed. In the tropic sections the coasts are usually low, swampy, malarial, and unwholesome, almost prohibiting land transit to the interior and giving to the explorer and newcomer a most unfavorable idea of the entire continent. Only at the extreme ends of the continent have we had a coast along which human beings could prosper and white men live in any approach to comfort. Fortunately there also was the Nile, the one river which, despite its ten

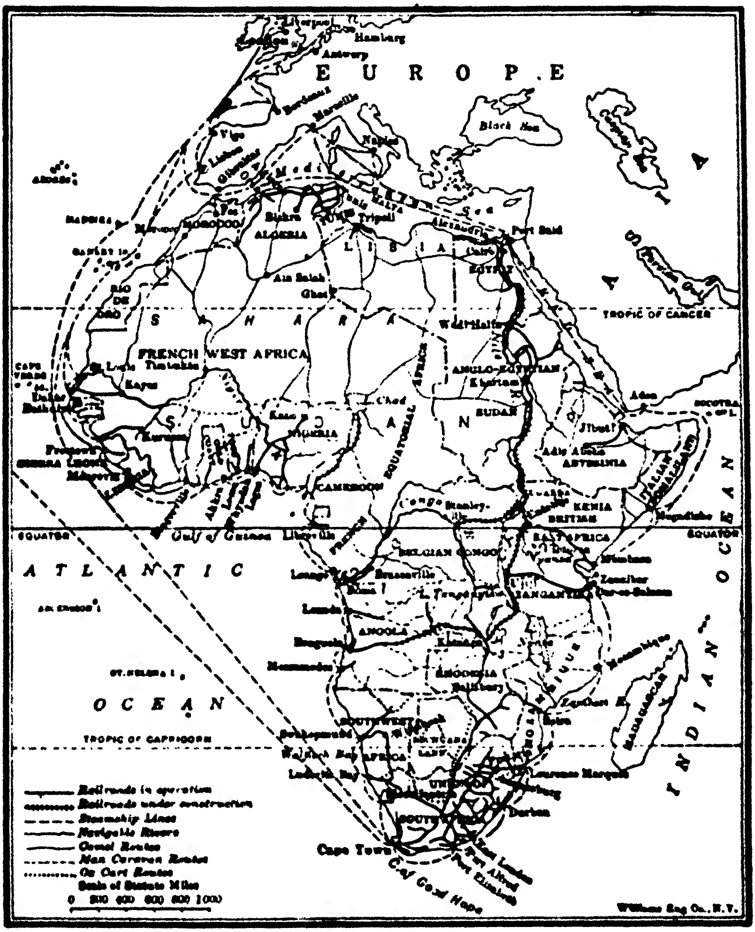


FIG. 275.—Trade routes of Africa.

cataracts, has erstwhile been of some service to navigation and has in its valley sheltered one of the oldest and most historic civilizations.

The commercial zones of Africa. The continent is further divided along east and west lines into five distinct economic zones, within each one of which the similar economic conditions of the people have not permitted extensive exchange, and between which the natural barriers to travel and transit have been almost prohibi-

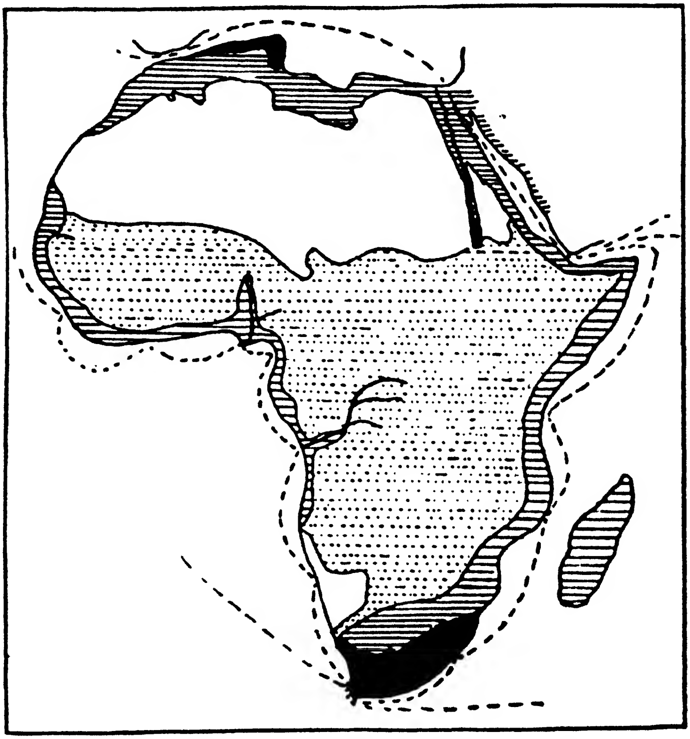
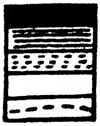


Fig. 276.—The trade zones of Africa. (After Robt. M. Brown.)



Regions of large commerce.
Regions of important commerce.
Regions commercially undeveloped.
Desert or unproductive regions.

tive of any kind of communication, except that carried on by the exploring expedition. The best of these five regions, the temperate extremities of Africa—Barbary States and the Cape region—have not offered a favorable base for African development because they have a semi-arid climate and are cut off from the extensive and torrid interior by the two remaining economic (or uneconomic) regions, the Kalahari desert in the south and the vast stretches of the Sahara in the north. Despite the blistering blank of the deserts that have cut off the temperate and sub-tropic ends from the tropic middle there has been a limited trade across the wastes to the very large region comprising tropic Africa. In its eastern reaches the arid part of south Africa has more rain than Sahara, and east of the mountains the trade winds give good rainfall for there is here no moisture-blocking land mass like Arabia.

THE TRANSPORTATION METHODS OF THE OLD AFRICA. Three distinct methods of transportation have prevailed in the different parts of Africa. Wagon trains drawn by oxen have carried trading expeditions from the cape to the Zambezi River; and the well-known caravans of the Sahara have kept up a feeble trade between Morocco and the Mediterranean ports on the one hand and Timbuktu, Lake Chad and other Sudan points on the other. The interesting and picturesque "ship of the desert," the camel, and the camel caravan, have been much emphasized in the education of the youth of western civilization, and it is therefore easy to overemphasize their importance in world commerce. Statistics of the Sahara caravan trade, which sets out from Algiers, Tunis, and Tripoli, indicate that it amounts in the twentieth century to but little over half a million dollars annually.

Central Africa has the third and least efficient means of transportation. Between the Sudan and the Zambezi the meager commerce, until recently in the hands of Arabs and negroes, has been borne in canoes or by caravans of men, because the climate was fatal to beasts of burden. Some ivory, rubber, skins, palm nuts, and other products of high value were carried to the coast by these laborious means, and bartered for European goods brought by the vessels that traded along the coast.

THE PARTITION OF AFRICA AND THE RECONSTRUCTION OF THE ROUTES. Excepting Egypt, Barbary, and the Cape, all of which are in the sub-tropical extremities, the commerce of Africa was too small, its prospects too unfavorable, to tempt the colonizing powers of Europe till late in the nineteenth century. Then came the scramble for African possessions: as nations began to stake off their homesteads others rushed in before it became too late. The whole central region of darkness was quickly divided; and a new era in African commerce began.

The European powers have annexed, divided and traded land, and reconstructed the map. Now the European pioneers, explorers, capitalists, and colonizing governments have begun the laying out of railroads and steamship lines to replace the feeble means otherwise provided.

Naturally the easiest way to begin was to send good steamers to the coast. The ocean must ever be the great thoroughfare of African trade. No other continent promises to be so absolutely dependent upon ocean commerce, for Africa has less prospect than any other continent of developing manufacturing and agriculture

Fig. 277.—A central African freight train (of carriers) waiting to be loaded. (H. L. Shantz, United States Dept. Agr.)

that will supply her own needs, and therefore will have greater dependence upon other continents whose products she can get only by trade across the sea which skirts her even coasts. The coasting steamers of England and other European countries have already well attended to Africa's ocean routes.

Scores of African coast ports are now regularly visited by European steamers and the continent is regularly circumnavigated in both directions. From this base the attack upon the land has begun. From important ports railroads are being or have been built inland to tap the navigable lakes and rivers, and pierce the very heart of the continent with the steam-driven freight carriers of civilization.

Victoria Nyanza, Tanganyika and Lake Chad are no longer names of mystery. These lakes, like the Congo and Niger Rivers, have steamboats on them; and the London daily papers are only a month old when they get to Lake Albert Nyanza.

THE LEADING AFRICAN RAILWAYS. The most important railway systems of the continent are the Egyptian and South African. The Egyptian line to Khartum and hence south and west to El Obeid in the Sudan, connects with steamers on the upper Nile which continue the service to the boundary of the Uganda Protectorate, 5° north latitude. The new transportation facilities carry the products of the Nile Valley to Alexandria, are stimulating Egyptian industry, and steadily increasing the commerce of Egypt, which has already given Alexandria the heaviest commerce handled by any port of Africa. It is a rather surprising fact that even in Egypt highways are little used and that the donkey and camel are the chief means of carrying produce to the railroad and the steamboat.

The South African lines are making greater industrial changes than are the Egyptian railways. Egypt has always had its Nile, but South Africa has had only its veldt and its oxen. The railroads which are so necessary are going in many directions to develop a constantly enlarging frontier. Cape Colony, Natal, the Transvaal, and Orange River Colony are a pastoral and mining region, resembling some parts of the western United States and having an area a little larger than Texas and New Mexico. This region is in the early stages of ranching and agriculture, is being rapidly settled and has an expanding railway net. The backbone of this railway system, the trunk line running north from Cape Town, has been pushed steadily northward. In 1910 it was far beyond the Zambezi and more than half way from the tropic to the equator. At the present time (1925) it has been constructed through Elisabethville in the Belgian Congo as far as the waters of the upper Congo River at Bukama. It has five side lines to the east coast, terminating at Port Elizabeth, East London, Durban, Lorenco Marques and Beira.

These roads carry down to the sea the wool, hides, and mohair of the ranchmen on the arid plains and the gold, diamonds and copper from some of the world's greatest mines. In exchange comes a great variety of European and American manufactures needed in the mine, farm, repair shop, and home. As is the case with most such regions the leading classes of imports are iron and steel (including machinery), clothing, and food.

CAPE-TO-CAIRO RAILWAY. These two British railway systems of north Africa and South Africa are the backbone of the Cape-to-Cairo railway project, which will get its first through connection by the use of steamships on the lakes and upon the Nile for several degrees in equatorial Africa. The all-rail route was found to be practically impossible where the tremendous inundations convert large areas of the upper Nile valley into a condition which is neither land nor water, but an impassable tangle of aquatic vegetation that baffles all man's land or water vehicles. In its modified form the route can be completed easily, but with the original plan it could be built only by selecting a new route in equatorial regions.

This impressive enterprise was the dream of Cecil Rhodes, an empire builder. It will be built, but as a carrier of through traffic its prospect is not bright. It will be 6,850 miles in length and about four-fifths of it is now in use. The only road to which it can be compared is the Trans-Siberian, and Africa needs such a line far less than Asia. The Cape-to-Cairo line does not tap a landlocked, remote continental center. When completed, it will be a very long railway paralleled the whole way by the open sea from which it is easily accessible and with which it cannot compete in freight rate, if perchance it can in speed.

There can be no better indicator of its probable traffic function than an examination of the traffic on that part of the Cape-to-Cairo line which already reaches nearly 3,000 miles from Cape Town into the tropics of the upper Congo. This road has already five side connections tapping it from the south and east and the completed line will probably have as many more. The chief function of the Cape-to-Cairo line will be to connect a number of shorter lines that come inland from the various eastern ports. There is surprisingly little freight passing from Cape Town to Johannesburg and Pretoria, on the southern one-third of the present line. These cities receive most of their imports through the side railroads from Delagoa Bay (Lorenco Marques) and Durban, a tendency which will leave the completed Cape-to-Cairo line no more through trade than exists on the line from Bordeaux to Odessa. The side lines which will break the hope of through traffic are being constructed in advance of the through lines, as was the case with the line from Beira. In Tanganyika Territory (formerly German East Africa) a subsidized railroad connecting the port of Dar-es-Salaam with Ujiji on Lake Tanganyika 772 miles away, was finished in less than contract time. In 1915 by the completion of a railroad from the upper Congo to Albertville on the lake, the whole Congo river-and-rail system to the Atlantic Ocean was linked up with the Indian Ocean. Another such system across Africa will result when the 585-mile line from Mombasa to Lake Victoria (the Uganda Railway) is joined to the Congo. A railway is projected[1] from Stanley Falls on the upper Congo to the African lakes, so that this district may be able in the near future to export its produce either east or west.

Large areas in this east African region, now coming into the European commercial zone, are high, with a climate dry enough and cool enough to be free from many tropic disadvantages, and Europeans are now beginning to colonize here in the hope of producing cattle and other agricultural produce in large quantities. The plateau near the Uganda railroad is 5,450 feet high at Nairobi and European ranchers have taken up more than a million acres of land. In Katanga, the southeastern part of the Belgian Congo, a few white colonists are settling in an area estimated to have forty million acres (five times the size of Belgium) suitable for white colonization. The traffic possibilities of the central African railways may therefore be great.

WEST AFRICAN HIGHWAYS. West Africa shows an amount of railroad building that is likely to be surprising to any one who has not followed it closely.

In southwest Africa (formerly German) the railways run from Walfish Bay on the Tropic of Capricorn to Windhoek, 237 miles from the coast and to Tsumet, 359 miles from the coast. The Ger-

[1] There is a mighty difference between the seriousness with which we can take the projection of railways in Tropic America and Tropic Africa. Many of the American governments are poor, weak, corrupt, and properly devoid of credit. They cannot build roads or operate them; private enterprise must therefore build them for profit and then endure the disturbances of civil wars. The African colony represents the firm hand of Europe and abundant credit. The European government backs up its colony; the colonial council dominated by Europeans uses the colonial credit revenues to build and operate a railroad at a loss or no profit in the hope of building up the colony. Thus the British East African Protectorate has spent over $30,000,000 in building the Uganda railway from Mombasa to Lake Victoria, without expectation of any income from it in the near future. In Latin America a ruling dictator will grant concessions (franchises) for railway building and the concessionaries try to tempt private capitalists to build the line. Meanwhile the railroad is "projected."

man activity resulted in the construction before the World War of 1,000 miles of railroad in this African colony where the rainfall is so slight that the chief dependence of commerce will be upon copper and other minerals. A road has now been built across 700 miles of desert to connect with the Cape-to-Cairo line, and may be considered a part of the South African railway system. At present its traffic is slight.

In Portuguese Angola, in 10° south latitude, the Benguela railway is being pushed eastward to connect it with the Cape-to-Cairo line, 1,200 miles away. Its immediate object is to tap the famous Katanga Copper district, but as yet it has not covered half the distance. From Loando and Massamedes in the same colony railroads are being pushed eastward, and the colony has 818 miles of road open for traffic. At present coffee and rubber are the chief exports and textiles the chief import.

THE CONGO RIVER ROUTE. The Congo River is at present the longest and the greatest central African highway. A score of steamers ply between the seaport of Banana at the mouth, and Matadi, less than 100 miles inland, where a 250-mile railway connects with the steamers of Leopoldville, on Stanley Pool above the numerous falls. The commercial changes of the new Africa can be easily inferred from the effects of the railroad from Matadi to Leopoldville. The journey used to require 20 days, with great loss of life. The freight rate was £2 per load (human carrier) of 65 to 75 pounds, about $250 per ton. The journey now takes two days and the freight rate is $3 per ton. From Leopoldville eastward the Congo is navigated for 1,200 miles to Stanley Falls on the equator. Here another railroad connects with several hundred miles of navigable waterway on the upper river, giving steam service 2,250 miles from the sea. A railway is in operation from the upper Congo, to Lake Tanganyika, with its steamboats, and other lines are projected from Stanleyville below the falls to Lake Albert Nyanza, and from Stanleyville to the rich copper deposits in the Katanga region of the Upper Congo. There are over one hundred steamers and barges on the Congo above Leopoldville and a 246-mile pipe line has been laid from Matadi to Leopoldville to bring crude oil for their use.

The commerce of the Belgian Congo ($175,000,000, 1920) is large for Africa, and shows a rapid increase. The total imports and exports were twenty-five times as large in 1900 as in 1887, and ten times as large in 1920 as in 1900. The chief exports are copper (nearly half the total), palm nuts and palm oil, gold, copal, and ivory; the chief imports are cotton cloth, machinery, and a varied list of foodstuffs.

THE TRADE AND ROUTES OF THE GULF OF GUINEA REGION. Railroad building and the opening of trade routes are going on quite as rapidly in the jungle-clad region of the equatorial forests and the Gulf of Guinea, the late haunt of the slave, as in the less humid and more wholesome southern region. The natural riches are great; the population is large; and the whole district, except the small territory of Liberia,[2] is in the hands of energetic colonizing nations with strong governments and abundant capital.

Cameroon, formerly a German possession but now belonging to France, has 359 miles of railway leading back from its principal port, Duala. In the large British territory of Nigeria which joins it, much more extensive commercial development is in progress. Akassa, the chief port, has several hundred miles of navigable lower Niger adjacent to it, with government steamers and barges upon it; and, from the head of navigation, the government has completed a 400-mile narrow gauge railroad to Kano, in the Sudan, 900 miles (4 days) from the sea. Kano is a trade center and commercial metropolis for the caravans which come from the Sahara and from around Lake Chad. The Sudan is one of the least known but apparently the most populous and promising parts of tropic Africa. Geographers report cities of 60,000 to 100,000 people, who are, for Africa, industrious; and the climate and the country are suited to live stock. A transition region (grassland) between the desert to the north and the jungle to the south, it is said to be good for cotton growing. It is Africa's land of promise, with a cotton area in Nigeria alone five-sixths as large as that of the United States, and the British government is not neglecting it.

West of Nigeria is the French colony of Dahomey with the port of Kotonu, which has 226 miles of railroad going northward into the interior. Next comes Togoland where the port of Lome has 204 miles of railroad tapping its hinterland. West of Togoland is the British Gold Coast Colony, which under the leadership of white men mainly from Great Britain, has developed a new and valuable

[2] Liberia was established under American auspices in the administration of President Monroe as a free state, a refuge for freed slaves. It has been almost swallowed up by the encroachments of Britain and France and was recently saved from what threatened to be final absorption by the intervention of the United States.

tree crop agriculture. From less than 6,000 tons in 1905, the output of the cacao plantations has risen to 160,000 tons in 1922, with an export value of $28,000,000. The Gold Coast now produces from one-third to one-half of the world's cacao crop. Its principal ports of Sekondi and Akkra are the bases for 275 miles of railroad, and have excellent jetties, piers and storehouses.

Between the Gold Coast and Liberia is the French colony of Ivory Coast, where an energetic French administration has constructed 230 miles of railway (1924) and plans to continue the line north to the Niger River. Liberia, with no ambitious Europeans to urge improvements, has no railroads and its 20 miles of highway were only recently built. West of Liberia is British Sierra Leone with an excellent harbor and coaling station at Freetown (44,000), the most important seaport in west Africa. The railway mileage of Sierra Leone totals about 338 miles.

The rapidly growing export of the whole Guinea coast, a century ago known all over the world as a seller of slaves, consists primarily of palm oil, palm kernels, cacao, peanuts and other oil seeds, mahogany, a little rubber and other gums, and a significant beginning of cotton and tin. The imports are chiefly cotton goods and the varied list of modern manufactures now desired even in primitive lands.

THE WEST AFRICAN ROUTE TO TIMBUKTU. Alas for the myths of geography, Timbuktu, with its jingling rimes, typical of remoteness, has become a commercial reality of steam and rail and telegraph; and its safe steam route to the sea has sadly cut into the traffic of the tedious caravans that had for ages wended their way from one oasis full of robbers to another on the long journey to the Mediterranean coast. To reach the region of Timbuktu in the French Sudan, three far-reaching trade routes have been established from French West Africa. The chief port is Dakar with five lines of European steamers calling. From Dakar a railroad 165 miles in length connects with Saint Louis at the mouth of the Senegal River, a stream which has been much improved for navigation so that steamers now ascend in the rainy season to Kayes, 570 miles. Kayes in turn is the western end of a 344-mile railroad to the navigable upper Niger, on which steamers run to a point 150 miles below Timbuktu, where the river becomes choked with flying sand from Sahara. In 1923 this route by way of St. Louis and the Senegal River was partially superseded by a new railway running direct from Dakar to Kayes and hence by the older route to Bamaka on the upper Niger. Still a third railway 366 miles in length runs from the port of Konakry in French Guinea to Kurussa on the upper Niger and to Kankan 46 miles further.

The Algerian Railway system has already crossed the Atlas Mountains; but, if continued across the Sahara, it will be for political and military, and not for commercial purposes; and it is not likely to play an important part in the economic future of the Sudan. French publicists are, however, strenuously urging the construction of a line to Lake Chad, the Sudan and beyond.[3]

The trade of Senegal differs from that of the other colonies to the east of it in that peanuts comprise the bulk of the export.

THE BARBARY STATES. The trade routes of north Africa are simple. The Mediterranean Sea serves as the highway in the first instance for most of this region of the desert's edge. In Algeria, the largest and the richest of the colonies of France, and in Tunis there are good systems of railway running out from the ports of Oran, Algiers and Tunis,[4] where many steamers call and whence direct lines go to Marseilles, which is one of the great markets for the wheat, wine, olives, wool, and early vegetables from the north of Africa. Several French railroads, largely military in their purpose of construction, have been built across the Atlas Mountains and into the edge of the Sahara in both Algeria and Tunis. This is stimulating the date trade from the oases which had before depended upon the camel. There is a little trade across the desert, employing about 30,000 camels, but it is insignificant for two reasons: the great danger of robbers, and the increasing ease of reaching the Sudan from the South. Morocco also has several lines of railroad running inward from Mogador, Casablanca, Rabat, and Tangier to inland places such as Fez. Where the rail route stops the caravan route begins.

[3] "The control of Cameroon by France thus makes French territory in West and North Africa continuous from the Mediterranean to the Congo and from the Atlantic to the Egyptian border. A great opportunity is thus offered to France to develop unhampered the many schemes for linking up the Congo with the proposed Trans-Sahara and other proposed West African railways."—*The World Remapped*, R. Baxter Blair, 1924.

[4] The whole of this region is very promising as a field for future mineral development, excepting coal. For instance, railroads in southwestern Tunis bring to the port of Sfax hundreds of thousands of tons of phosphate rock from low-grade deposits of vast extent. Bedouins who want some money often come here and work for a while.

MINOR LINES OF TRANSPORT. Africa has of course many minor trade routes and some railroads that do not merit consideration among the leading routes. For example, there is a very long list of little stopping places on the west coast of Africa where the European steamers get the mahogany, rubber, palm nuts, and ivory which the natives assemble by any and all means in their power.

At several points on the east and west coasts are short lines of railway reaching inland from coast ports. Some of them may become routes of importance. One of the more promising ones runs 485 miles from the port of Jibuti in French Somaliland opposite Aden to Addis Ababa, 8,000 feet high on the Abyssinian plateau. Lying wholly in the tropics, its capital in the same latitude as Panama and its southern border barely three degrees from the equator, the greater part of Abyssinia has a temperate zone climate, and it can grow many of the temperate zone crops. Thus it has the basis for a future trade with the tropic regions so close at hand.

In conclusion the two main facts should be kept in view—that the main problem for African trade is in every case the establishment of rail outlets to the sea; and, second, that the interior has important isolated waterways which it has been the first problem of the railroad builders to tap and develop.

The almost feverish activity at railroad building in tropic Africa and European dependencies in Malaysia in comparison to the lethargy that prevails in similar independent American regions is interesting evidence in support of Mr. Kidd's [5] thesis that the enterprises and governments of the Tropics must be dominated from the temperate zone.

The African trade, like that of South America, is served in different sections by different sets of steamship lines. This is very properly so, not only because of distance, but because of the different commercial requirements of equatorial savages in breech cloth and imperial British in broadcloth at Cape Town.

SOUTH AFRICAN CONNECTIONS. The first trade region in point of age and present importance is that of British South Africa, served by several lines of splendid steamers working in unison and giving service from Liverpool, New York, London, Southampton, and the Continent. The liners engaged in the South African trade pay no heed whatever to all the rest of Africa, but steam directly from Europe and America to Cape Town and usually skirt

[5] Benjamin Kidd, *Control of the Tropics*.

the coast to Lorenco Marques, stopping at Port Elizabeth, East London, and Durban.

TROPIC WEST AFRICA. The trade of tropic west Africa is served by a number of lines of steamers that skirt the coast from the Sahara to the Kalihari desert. The number of ports visited is indefinite, some of the lines going all the way to Walfish Bay and others attending to the needs of various smaller sections of the coast. These steamship lines make of Liverpool, London, Hamburg, Antwerp, Havre, and Marseilles the great depots of west African trade; and, from and through these ports, America and the rest of the world do most of their trading with the African coasts. Liverpool specializes in mahogany logs and divides the rubber with London and Hamburg, Antwerp gets the ivory, and Marseilles is the leader in palm oil and peanuts.

EAST AFRICA. The trade of the east African coast is served by several lines of European steamers—English, French, Italian, and German—that come through the Mediterranean. A line of smaller steamers connects with dozens of steamers a month at Aden, and runs up and down the coast to Zanzibar, an important trading center and the capital of an island producing the bulk of the world's cloves. A steamship line runs from Zanzibar to Bombay and practically all of the commerce of the coast is carried on by a few thousand East Indians. Like west Africa, the chief imports of east Africa are textiles, metals, foods, and liquors, and the exports are hides, rubber, copra, spices, and, most recent of all, the copper of Katanga, most of it shipped from Beira in Portuguese East Africa.

THE GOOD HOPE ROUTE

Separated from, yet attached to, the trade of Africa is the Good Hope route. This is the oldest of the great ocean trade routes. It is practically co-eval with the history of America, and the commercial history of this contested route is told in the colonies and peoples that are now to be found in South Africa. The Portuguese discovered and for a time monopolized the route, and their decayed colonies still exist to the north and west of the Dutch settlements. When the Dutch had triumphed over Portugal they rejoiced in the monopoly of the commerce of the Far East. In the seventeenth century this trade was carried on almost ex-

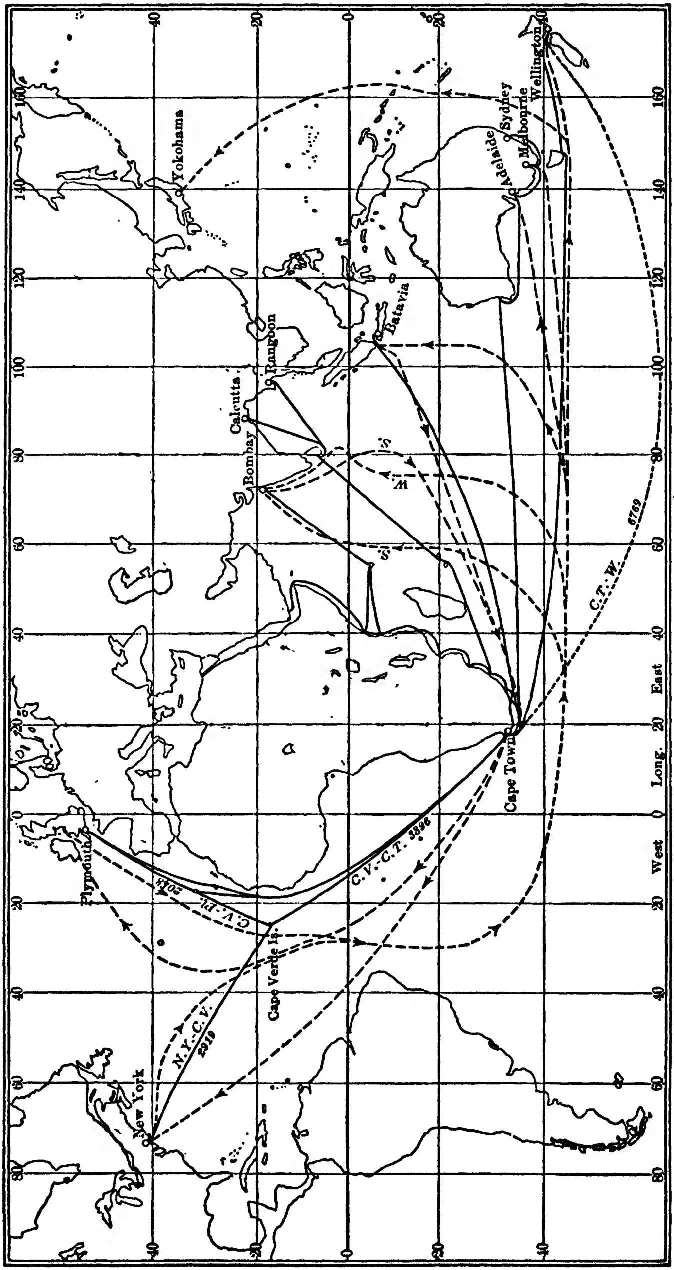


FIG. 278.—The Good Hope Route.

clusively by the way of the Cape of Good Hope, where the Dutch made settlements that served as a half-way post and victualing station for the ships bound on the long and tedious voyage to the Indies. Then followed a century of commercial and naval struggle between Holland, France, and England, with the triumph of England. Her ships became the predominant ones rounding the Cape. She won and yet controls the colonies which had their start as the Portuguese and Dutch half-way posts on the route to India, and her people drove the Dutch back toward the Portuguese.

The Good Hope route is really a group of routes rather than a single route and actually narrows to a single track at no place in its prodigious length. The nearest approach is just below the point of Africa, where for a short distance the steam and sail tracks are brought near each other. It is at least threefold beyond that point; and, like the Mediterranean-Asiatic, it has double termini from the eastern and western shores of the north Atlantic—the English Channel and the New York Bay. Beyond the point of Africa one branch turns to the north and follows the east coast of Africa, another goes to the East Indies, and a third directly to the south shore of Australia.

The steamer tracks in the Atlantic go so nearly north and south that there is little great circle curvature noticeable; but the great circle route from the Cape to Wellington, New Zealand, cuts off 750 miles from the distance between the same ports via Melbourne. Unfortunately, the great circle reaches a latitude of so much ice and bad weather that it is not much used as a route.

SAILING VESSEL TRACKS. The Good Hope route passes over a part of the world containing great expanses of ocean and comparative barrenness of land, giving sea voyages of great length between the isolated land areas. In this respect it differs radically from the Mediterranean-Asiatic route. The great distances from the Cape of Good Hope to Europe or America, or to any other lands, have combined with the favorable winds of the Atlantic and Indian Oceans to make this route the last great stronghold of the sailing vessel. Indeed, until quite recently it has been declared that this was a stronghold from which steam could never displace sail.

This prediction has, however, been disproved by the great improvement of the steamer and its adoption within the past fifteen years for a part of the trade of every important division of the globe, including the various subdivisions of the Good Hope route.

The peculiar location and windings of the sailing tracks are explained in terms of the prevailing winds. For the sailing captain the quickest way is the shortest, regardless of actual distance; for the steamer captain the shortest way is usually the quickest. Or, putting it in another way, the steam navigator being practically independent of wind and current, thinks in miles and goes from point to point and headland to headland in nearly straight lines. The sailing captain thinks in days. If the vessel makes 30 miles a day by the direct route and 100 miles a day by the circuitous route where the winds are good, he makes a great detour and saves time. The peculiarities of wind and current often make detours advisable. In fact, it is almost invariably true that the steam route and the sail route between two points differ in location, and if they do happen to agree one way they are apt to differ on the return, for it is uncommon for the sailing vessel to go and return over the same track. All of these sailing peculiarities are admirably illustrated on the Good Hope route with its double sets of crooked sailing tracks. To understand them one must know the main facts of the wind systems.

In the Atlantic north of 25° or 30° north latitude, depending on the season, the wind, except when disturbed by cyclonic storms, is normally from the west at all seasons, and from the southern edge of these westerlies, down to the vicinity of the equator, the trade winds blow uniformly from the northeast. South of the equator the trade winds are duplicated, but blowing this time from the southeast. Near the latitude of Good Hope the prevailing westerlies are again reached. They blow here with great force ("roaring forties") and sweep unimpeded around the world.

The trade winds blowing from Spain toward Brazil make it necessary for a vessel from New York to go nearly across the Atlantic with the westerly wind before turning into the trades in company with the European contingent, which has had a very direct sail. The southeast trades can be crossed at best advantage by taking a right-angle course, close to the coast of Brazil, and proceeding southward into the prevailing westerlies before which the vessel rides as far as possible before turning northward to her destination. A glance at the map shows that the combined result of the northern and southern westerly winds is to give the track from New York to Good Hope the shape of a rough letter S reversed.

Vessels rounding Good Hope from the east hug the coast as closely as possible to avoid the west winds, and if bound for New York they have a direct course going with one trade wind and at right angles to the other.

The Indian Ocean has a different wind system, with a peculiarity in it. In the winter it is like that of the Atlantic, minus a northern zone of westerly winds. In the summer the northern (northeast) trade wind is reversed, and blows toward Asia as a strong southwest wind called the monsoon. These winds make it necessary for the winter vessel from Good Hope to Bombay to creep around by Ceylon to get in a position to cross the northeast trade wind at a right angle by going up the coast of Hindustan. When the summer monsoon begins, the out-going vessel from Bombay must take the same track as the in-coming vessel in winter, for in no other way can she utilize the southwest monsoon which sets squarely toward the coast.

The coal supply upon this route was unsatisfactory, both in the supply along the route and the conditions for transporting it thither, until after Natal began to supply good steaming coal at Durban. This former lack of coal was another factor helping to explain the late survival of the sailing vessel preëminence there. Vessels starting from Great Britain or the United States did not approach another coal-producing country until Australia was reached, full half way round the world from the starting-point.

Traffic. The maps clearly show that this is a long route for any of the Asiatic traffic. The opening of the Suez Canal, with its short-cut connection, was a great blow to the traffic of the Good Hope route, which, before that time, had almost had a four-century monopoly of the trade between Asia and the West. The growth of the Suez traffic cut into the Good Hope traffic, but the great expansion of commerce during the past fifty years has caused a rejuvenation of the commerce which passed to and around the Cape. Australia and Africa have risen from the ranks of outposts of civilization to states producing and consuming freight by the millions of tons.

The traffic of South Africa is a very peculiar one in the world's trade. Regions of sparse population and comparatively recent settlement are usually producers of large quantities of raw material and consumers of manufactures, which comprise a much smaller tonnage. Such has been the commercial history of practically every country in the New World; but, owing to the scanty rainfall, which precludes extensive agriculture in South Africa, and the great predominance of gold and diamond mining among the industries there, South Africa imports lumber, grain, flour, machinery, and general manufactures, and pays for them in such valuable commodities as gold, diamonds, ostrich feathers, wool, mohair, hides, and skins. The old saying that "good goods come in small packages" here holds true, so that a vessel carrying a cargo to South Africa faces the almost inevitable prospect of going away practically empty. The Cape is therefore a scattering point for vessels in ballast seeking freight. Some go west to South America, others pass to Bombay for grain and cotton; to Rangoon for rice; to Java for sugar; or to Calcutta for jute.

The largest traffic movement that passes the Cape is the trade of Australia. Despite the existence of the Suez Canal and the splendid German and English steamer lines which reach Australia by that route, the bulk of Australian commerce follows the cheaper open-sea route around Africa, which is after all but 1,000 miles longer. Only the mail, passenger, and a limited freight traffic are taken by the lines on the shorter, but more expensive Suez route. The cargo steamers, of which there are many, find it more profitable to follow the ancient way discovered by Da Gama than the new one dug by De Lesseps.

A third traffic division passing South Africa is that in the sailing vessels, which still set out from Europe and the United States for east Asia. This traffic out-bound is very largely composed of refined petroleum, which is consumed in astonishing quantities in India, China, and Japan. These vessels commonly enter east Asia waters by way of Sunda Straits, between Sumatra and Java; and return by the same route, although there are times in winter when the dangers of the China Sea are avoided by a detour, taking the vessel around the continent of Australia before it turns north to reach Asia. A common return cargo for these ships is East Indian sugar or rice.

Upon the whole, the traffic and the consequent vessel movement upon the Good Hope route are peculiarly one-sided. Much (in tons) goes out and less returns, and at every turn the ships leave this route and go seeking cargo to return to the north Atlantic by some other route.

The traffic of the Good Hope route has limitations upon its future. There are not at the present time 20 million people in South Africa and Australia combined. Owing to the limited agricultural resources of these British colonies the population will not grow rapidly. That of Australia is almost static. Any trade to east Asia cannot be expected to pass around Africa indefinitely with the present decline in the use of the sailing vessel. The trade of the Good Hope route is therefore largely limited to such part of the Australian and African traffic as will continue to use it in preference to some other route, as Panama and Suez. This trade from the regions now containing 20 millions must naturally be vastly less than that of the Mediterranean-Asiatic route, which has upon its lines a population sixty times as numerous but with far fewer commercial wants than the inhabitants of the British colonies in the southern hemisphere. These people are, and will continue to be, among the heaviest per capita traders, while the Asiatic peoples are and will long be among the lightest.

The future of the American trade with South Africa and Australasia is particularly bright, because these British colonies are in the same stage of industrial development as parts of the American West. We have had experience with their kind of physical problems, our agricultural machinery is adapted to their kind of land, as our mining machinery is adapted to their mines, and there is every reason to expect a continued and increasing trade in American machinery and supplies for the development of these new lands, while our mills and tanneries are increasingly dependent upon their wool and hides and skins.

The fact that South Africa has not been equipped by nature to start off as a great grain grower by extensive agriculture does not prevent her from having room for considerable areas under irrigation and possibly for grain growing without irrigation if improved varieties of grain are used. The same developments can extend Australia's production.

CHAPTER XI

THE TRADE AND ROUTES OF AUSTRALASIA AND THE SOUTH PACIFIC

A WATERY DESERT. The South Pacific and Indian Oceans are a realm of waters, almost a world of waters, a saline, watery desert in which Australia and New Zealand are but little more than oases, and one of them, Australia, is largely desert. Compared to this wet desert the world's dry deserts are but insignificant scraps. The Pacific is classed as one of the oceans, but it is almost as large as all the rest of them combined. It is more than twice as large as the Atlantic and has an area estimated at 70 million square miles—four times as large as Asia, ten times as large as North America, more than one-third of the entire surface of the globe—one and a third times the area of the entire land surface of the world. Its width along the equator between the mainland of Asia near Singapore and South America is practically half the circumference of the globe and nearly four times as wide as the North Atlantic. Nor is the Indian to be classed among the minor oceans.

Australia and New Zealand are the dominant and almost the only commercial factors in the South Pacific and Indian Oceans.

THE ROUTES OF AUSTRALIA. The problem of Australian routes is fundamentally different from that of Africa. There is no populous rain-drenched interior, with mighty rivers tumbling with the power of Niagara over the margins of a continental plateau. About all that can be said in a commercial way of much of Australia is that it is on the map. It is an immense arid and semi-arid stretch with a good eastern margin and a fair southwestern corner. Large tracts in the central and western parts have never been crossed by any explorer, and many explorers have perished in attempted explorations. The agriculture is practically all east of the Pacific watersheds except a little in south Australia and a few irrigation settlements; and by the time the western boundary of New South Wales is reached the desert becomes practically absolute and even the hardy sheep herder must give up.

The most spectacular route in all Australia is the Transcontinental line running over a thousand miles across the desert and connecting the railway systems of South Australia and Western Australia. It was built by the Federal government because obviously no other agency would undertake such an unprofitable enterprise through hundreds of miles of uninhabited and unproductive arid waste. Another route for the transmission of ideas, not goods

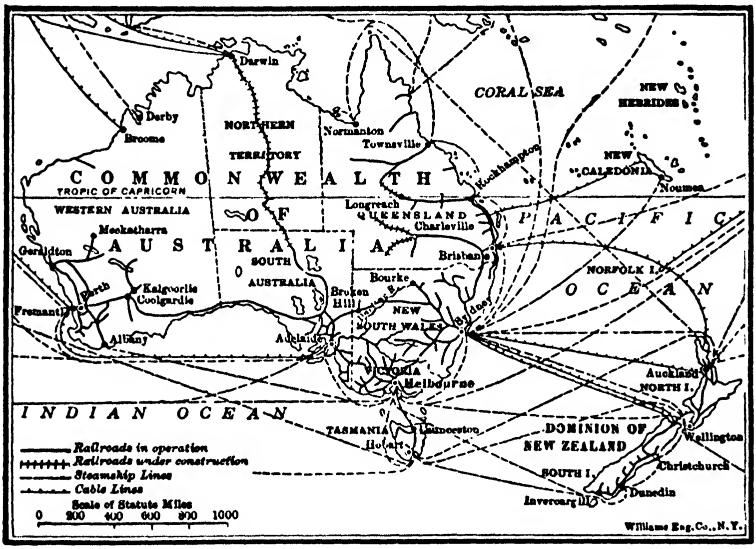


FIG. 279.—Trade route map of Australia.

—the desert telegraph line erected at great hardship across the center of the continent to the north shore—connects there with the Asiatic cable system and Europe. The proposed[1] railroad over this same route, of which 477 miles has already been built northward to Oodnadatta in South Australia, is also a political, not an economic, expedient. The next most spectacular thing is the pipe

[1] The Commonwealth Government has pledged itself to build a railway connecting Port Darwin on the north, the port of the Northern Territory, with the railway system of South Australia. It is estimated that this railway expenditure will amount to about $50,000,000. This Northern Territory has about one-sixth of the total area of Australia. Except for the small settlement at Port Darwin, it has scarcely any white population, most of it being an empty wilderness.

line which carries water from the mountains back of Perth (west Australia) many scores of miles eastward into the desert to the new town around the gold diggings of Coolgardie.

After passing through a stage in which mineral production was paramount in Victoria and important in New South Wales, these two states have grown into great pastoral regions. Both have developed excellent railway systems, 5,000 miles in New South Wales and over 4,000 miles in Victoria. Their ports, Sydney with nearly a million population, and Melbourne with over three-quarters of a million, have a surprising concentration of the population of the two colonies—at the present time one-half of all the people being in these two ports. This seems to be a condition common in newly settled regions, and a duplicate is found in our Pacific coast. The good harbor seems to get the start; the railways are built there; trade centers there; and this advantage of an early start gives no other place a chance to make a beginning. In Australia the additional political advantage of their being colonial capitals is also an important factor in letting the ports monopolize the trade of large states.

Adelaide (population 255,000) stands in a like relation to the best section of South Australia and its railroads are practically a continuation of those of Victoria.

The almost unsettled Queensland, with its long coasts, has more ports and far less railroad mileage. The chief port is Brisbane, a city of 210,000—over one-fourth the population of the colony—which does much of its trading through Sydney, with the assistance of coasting steamers which do an important trade in Australia. The whole northern and northwestern coast is scantily inhabited, and the trade of west Australia is chiefly gathered at Perth (with its harbor at Freemantle), which has a railroad to the gold-fields in the desert.

AUSTRALIA'S TRADE CONNECTION WITH THE REST OF THE WORLD. Australia is practically at the other side of the world from the United States and Great Britain, and is at the end of all routes that reach it—the European mail route that comes down from Ceylon where it leaves the Mediterranean Asiatic route, the smaller branch line that threads its way from Singapore through Toures Strait to Brisbane and Sydney, the freight lines that pass Good Hope, and the steamer lines from the Pacific coast of the United States and Canada.

From the standpoint of traffic the Good Hope route far outweighs all others. Australia sends over this line to Great Britain wheat, frozen meat, wool, hides and skins,.butter, gold and copper. In return for these staples come British machinery, cotton goods, woolen goods and a whole list of manufactured articles that are required by a highly civilized agricultural community doing but little manufacturing. By far the most valuable export is wool—sometimes making up half of the total—followed by wheat, butter, meats, hides and skins, a decreasing amount of gold, and an increasing amount of other metals. Consequently, the Australian imports of lumber, wood, and bulky manufactures sometimes make more tons than the export; and the vessels in Australia are in straits for out-freight. This situation is mostly found in the port of Sydney, which is due to its being the terminal port for nearly all vessels going to Australia, and the natural end of a voyage. Fortunately for the vessels seeking profitable employment, Sydney has the great advantage of being near the Australian coal-fields at Newcastle but 60 miles away. This lack of other export freight has placed Australia in a position to ship coal from the east coast as a ballast substitute. It is carried to Java, Singapore and even East Indian ports, where rice is secured. Sailing vessels take coal to Hawaii, a sugar-exporting island, or to San Francisco, where wheat is secured, or to Chile, where it is exchanged for nitrate of soda, thus permitting vessels to circumnavigate the world.

The traffic from New York over this route to Australia fills many ships a year and is largely composed of lumber and wood manufactures, iron and steel goods, agricultural and other machinery, leather goods, and a host of miscellaneous small articles. We import but little from Australia except wool; and, as we get much of that via the London auctions, the vessels that carry American produce out usually join the Sydney fleet that goes cargo hunting.

NEW ZEALAND. New Zealand, long narrow islands with a row of good harbors, exceeds Australia in the simplicity of its inland routes. Invercargill, Dunedin, Lyttleton, Wellington, Napier, and Auckland—all have short railways to the farms and ranches. It differs from Australia in that it has a much better rainfall, making luxuriant pasturage. Hence it has become the world's largest exporter of dairy products—butter, cheese, and condensed milk. Otherwise it is a smaller edition of Australia in its exports and imports, which are predominantly with Britain, which is the place where half the property of British Australasia is still owned, the natural market for the products and the place that most Australasian families still think of as the old home.

Some steamers go directly to New Zealand from New York and Great Britain, but they usually stop en route at Melbourne, and some continue the journey from Sydney to Wellington. There are good inter-colonial steamship lines between the various Australasian ports.

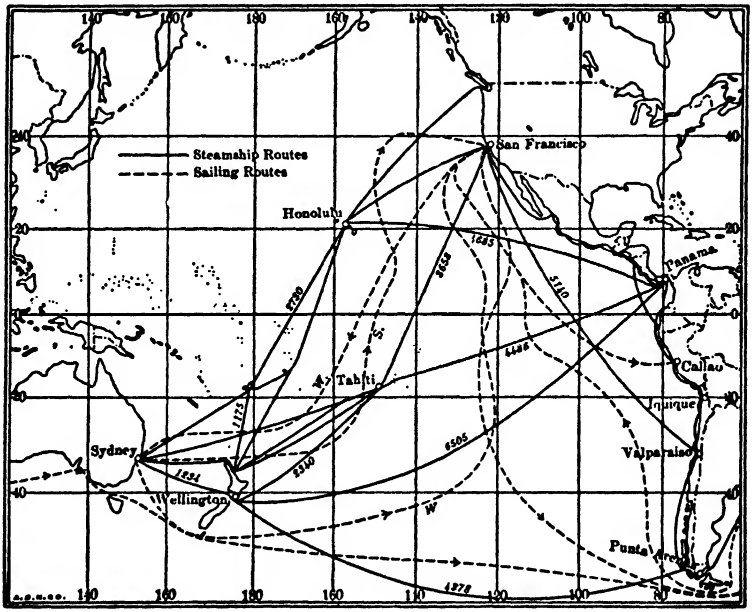


FIG. 280.—Routes of Southern and Eastern Pacific Ocean. W—winter. S—summer.

THE ROUTE ACROSS THE PACIFIC. Although Australia and New Zealand are upon the edge of the Pacific, their commerce has surprisingly little to do with that ocean. As a result of its enormous size the rather surprising fact develops that the Pacific Ocean is practically not crossed by any important trade routes—they skirt its shores. (A globe is necessary for correct impression.) We have already seen in the account of the north Pacific trade route how that route follows the shores of the American and Asiatic continents from Panama to Singapore. The trade of South America follows down the Pacific shore to creep out of that ocean through a hole in the mountain wall—the Straits of Magellan. The Australian coal ships swing across the southern margin of the ocean to the nitrate ports and then follow the shore. Even the route from Australia to Panama, in taking advantage of the great circle, swings so far to the southward that it passes between the islands of New Zealand and follows much nearer the edge than the middle of the ocean. Some scattering vessels—chiefly sail, go with Australian coal ballast into the north Pacific, but the only trade route in all this great ocean that may really be said to cross it, is that connecting Australasia with the Pacific coast of North America.

The ports of Vancouver and San Francisco are connected with Australia and New Zealand by several lines of steamers. Two of these call at Hawaii and one at Tahiti, in the Society Islands. This is at present the quickest mail route from Australia to Europe because it uses the fast trains of America and the north Atlantic steamers, but the commerce is feeble both in fact and basis, since California and Australia are alike in products, race, density of population, and climate, and there is almost no cargo for the mail steamer to carry northward, and but little to go southward but lumber.

WINDS AND FUEL SUPPLY. In most parts of the ocean the Pacific is well suited for the sailing vessel. In its northern and southern parts the trade winds blow as in the Atlantic, and to the north and south of these wind areas are the same zones of the west wind. The working out of the leading south Pacific vessel tracks shows most plainly the effect of these winds. The winter route from Sydney to San Francisco, for example, goes to the south of New Zealand and nearly 2,000 miles east of it before turning northward into the trade winds. By this deviation the vessel can pass through the southern trade winds almost before the wind and take an approximately right-angle course across the northern trade-wind zone. The summer route between these same two ports shows the effect of the same winds, but also shows that the zones have shifted somewhat to the north with the movement of the seasons. The fact that the trade winds always blow away from the coast of lower and southern California makes it necessary for all sailing-vessel tracks into San Francisco to make a wide detour to the north to avoid the trades and come in before the west wind.

The two great defects of the Pacific as an ocean for the easy development of sailing routes are the large zone of calms in the equatorial region west of South America, and the ferocious storms of the Cape Horn region. The sailing-vessel route from San Francisco to Callao in Peru is a striking example of the influence of the doldrum or calm zone, to avoid which the vessel passes nearly 2,000 miles to the west of its destination and more than 1,000 miles to the south of it to get the proper angle to sail across the trade winds and entirely avoid the zone of calms, in which the vessels idly drift for days together. There have even been cases of whaling ships which have started from the southern hemisphere to make the northern whaling season and have entirely missed it by floating for months like seaweed in the doldrum calm.

The winds around Cape Horn blow with a force rarely met elsewhere, and almost continually from the west. In addition to this, snows and storms are of exceedingly frequent occurrence, and it is by no means uncommon for vessels to spend ten, twenty, or even thirty days in almost the same spot, beating vainly against the wind which will not let them round the cape from the Atlantic into the Pacific. This accounts for the fact that the sailing vessels regularly go to Australia from the Atlantic by way of Good Hope and return by Cape Horn, and there are cases of vessels that have tried to get into the Pacific around Cape Horn, and after vain effort have given it up and gone eastward before the west wind to reach Chile or California. In the early days of steamers to Australia, the Peninsular and Oriental Steamship line (British mail) used to send its steamers home from New Zealand by the Straits of Magellan, thus regularly circumnavigating the globe, although no South American freight was sought except that of the Chilean port of Punta Arenas in the Straits. The route was selected because of the greater ease of steaming with wind and current and has now been given up in this period of more powerful and economically operated steamers.

For steamers, the coal supply of the Pacific is better than one might expect from a consideration of the mere factors of size of the ocean and length of the routes. At each of the four corners of the Pacific is a coal-field—Japan, British Columbia, east Australia, and Chile. The central Pacific throngs with unnumbered islands, many of them having good harbors, and about five of them being coaling stations. These are New Caledonia, Fiji, Samoa, and, to the north of the equator, Guam and Hawaii. Of these islands, not one, however, is regularly used as a coaling station by an important line of steamers, the common practice being for the regular vessels to proceed from mainland to mainland without adding to their stocks of coal. But each of the above mentioned coal-producing regions at the ocean's corners possesses important coaling stations for ocean steamers.

THE FUTURE TRAFFIC OF THE PACIFIC. In the future as in the present the mid-Pacific promises to remain a realm little crossed by trade routes and bare of industry or the hope of industry. A vast stretch of ocean lying between New Guinea, Hawaii, and Japan is large enough for a continent, but absolutely uncrossed by any trade route worthy of the name. In this empty sea a new island might remain undiscovered for decades unless some whaler, or some investigating Drake or Darwin chance to sight it. With the exception of Hawaii, the only Pacific island producing large quantities of freight is the French island of New Caledonia, not far from Australia. The exports of nickel and other ores from this island furnish employment for a considerable number of vessels homeward bound for Australia. With these two exceptions, the vast Pacific is bare of islands which are capable of supporting commerce in any large modern sense. The myriads of coral islands are almost uniformly low and comparatively barren. Most of them are unpeopled, and those that are inhabited, produce little but the cocoanut palm. The lands upon its southwestern edge partake of the inhospitality of its middle, for in New Guinea and adjacent islands the cannibals are still eating exploring parties and it is small wonder that about the only vessels visiting these shores are those of the copra-gathering and rum-selling traders. The adjacent part of Australia, Queensland, has only one inhabitant per square mile, including a city of over 200,000 total population; and most of the shore of northern Australia is of no more use to civilized man than is the middle of Borneo, or a section of Amazonian forest five miles from a river, or a part of Canada inland from Hudson Bay—all of which are utterly unused.

CHAPTER XII

THE WORLD CARRIERS AND THE PANAMA CANAL

World commerce has a world mesh of trade routes. It also has world carriers in fleets of tramp ships standing ready to go anywhere that ships can sail or steam, and to pass from route to route as wagons pass from street to street. It also has world carriers in steamship companies whose services overreach any one trade route and render astonishing feats in connecting a commercial community to its world environment.

While we have long since learned to think of railroads as system, we are still prone to think of steamship lines as doing what the early railroads did—merely connecting two places. This idea must be discarded. The law of growth among steamship lines works surely to the development of trunks and branches, a development which has already taken place, although the branches are fewer than upon railroads. The improvement of the steamer and the use of the ocean cable gave the needed regularity, dependableness, and knowledge for the organization of ocean commerce and transportation into a regular and systematic service akin to that of the railroad. The great ocean lines sail with precision and regularity. To secure the supply of freight for these great lines, their managers have been compelled to establish smaller lines to supply and distribute the necessary cargo. The largest trans-Atlantic lines are, without exception, thus equipped at one or both of their terminals. Before the World War, Germany with her systematic promotion of foreign trade, had furnished us the best example of this. The North German Lloyd and the Hamburg-American connected at their European ends with lines running to South America, east Asia, and other distant parts of the world. They also connected with smaller lines plying to the near-by European ports and with steamers on the German rivers. These two German companies carried the same system even farther. Their trunk lines to east Asia were fed at Singapore and other eastern ports by lines of smaller German steamers which traversed the eastern archipelagoes and the Asiatic coasts and rivers, collecting cargo for the trunk line stations of the large steamers bound for Bremen or Hamburg, at which ports it was transferred by the European distributors referred to above or sent on to America by the trans-Atlantic lines of the same companies. The Wilson Line from New York to Hull connects in that city with an enormous fleet of small steamers which thread the coasts of the North Sea and reach all ports of importance in Scandinavia and along the Baltic. Some of the other British trans-Atlantic lines connect with British coasting lines and with the lines to Australia and other British colonies. The French and Italian trans-Atlantic lines are fed by fleets of Mediterranean coasters and trans-oceanic lines at Havre, Marseilles, and Genoa. These steamers call at more than twenty ports and gather freight which is to be transferred at the ends of the route to the next steamer bound for America. Other examples of this systematic trunk and feeder development of ocean service might be mentioned; but they would show no feature differing from the development of the examples cited or from the railroad and its branches except that the ocean service of single companies at times circumnavigates the globe and covers a much wider scope of territory than any railroad system can ever serve.

The company that runs a line on one route only is at the mercy of any local fluctuation in traffic. A strike even might spoil the profits of a quarter; so might a drought or any local uncontrollable disturbance. Then, too, there are seasons in nearly all trades during which the traffic is abundant and others in which it is scarce. Just after harvest time, wheat, corn, and cotton go forward in quantity and the trade falls away to small proportions as the next harvest approaches. The steamship company with many lines can have its annual work evened up by seasonal prosperity in one quarter as dullness comes in another. Instead of having ships half idle on its one dull route, it can shift them to the prosperous route. As the vessels get old and antiquated for the finer routes they can be shifted to a slower and inferior route. The greatest advantage, however, is the picking up of freight for the main lines, just as the branch roads feed a main trunk railroad.

All these forces are welding the ocean carriers into ever-growing systems.

The best example of this wide-reaching world carrier was furnished by the Hamburg-American Steamship Company at the outbreak of the World War. This one company dominated the metropolitan city of Hamburg and connected it with Montreal, Portland, Boston, New York, Philadelphia, Baltimore, Newport News, New Orleans, and Galveston in the eastern United States. It sent steamers to Mexico, Central America, Panama, Colombia, Venezuela, and several services to the Lesser and Greater Antilles. They went to the Amazon, to the ports of central and south Brazil, to Uruguay and Argentina, around to Chile and Peru and up the Pacific coasts of America to the ports of United States. In Europe they circumnavigated the British Isles, and skirted the coast of France, Spain, Portugal, and Italy, to the head of the Adriatic; they went in the Baltic to Russia and Finland and Sweden, and out in the Atlantic to Iceland and North Cape, and on to Arctic Spitzbergen in the summer. In Africa they touched at Alexandria and down the whole west coast as far as the mouth of the Congo. In Asia they served Aden, the ports of Arabia, Persian Gulf, Ceylon, Calcutta, Straits Settlements, China, Korea, Siberia, Japan, and finally—and possibly most remarkable of all—the steamers of this company crossed the Pacific to Portland, Oregon—a grand total of sixty-eight services crossing every ocean, touching all continents and every geographic and commercial zone. Extensions were in contemplation or contracted for. This system will doubtless be restored in time, as Europe recovers from the War, for it is the normal way for ships to work. There are many more examples but none quite so far-reaching as the Hamburg-American system was.

Equally suggestive and almost equally far-reaching is the joint organization of railroad and steamship lines. This practice, common in America, Europe, and Asia, probably reaches its highest development in the Canadian Pacific Railway which operates in connection with its trans-continental railway line a trans-Atlantic service to Europe and a trans-Pacific service to Japan, China, and Hongkong. It also has a steamer line on the American Great Lakes.

THE PANAMA CANAL

Building the canal. Into this complex maze of world routes served by world carriers has come a new factor, the Panama Canal.

It was fortunate for commerce that the chance of nature so nearly cut the earth in two at its middle that we could finish it with canals. The Suez Canal (opened 1869) relieved the trade between the West and the East of a long and wearisome journey around Africa or an expensive portage at Suez. In the western hemisphere the narrow isthmus of Panama connecting the two Americas early became a center for inter-ocean transit, first by mule-trail, then by wagon-road, and finally by railroad soon after the discovery of gold in California. The building of the Panama Railroad in 1849–52 caused a frightful loss of life because of the deadly climate, especially the yellow fever. It was finished only by the aid of Chinese.[1] Later the French, under de Lesseps, flushed with their success in building the Suez Canal through the desert, started to build the Panama Canal through swamp and jungle. They failed, partly because of graft, but much more because of yellow fever and other diseases.

In the short period of less than twenty years that intervened between the collapse of the French enterprise and the beginning in 1904 of the American work on the Canal, the world had entered a new epoch, so far as the tropics was concerned. Yellow fever was no longer a mystery. It was known to be carried from one man to the next by the female of one particular genus of mosquito. Malaria also was found to be mosquito-borne. This knowledge made a profound difference in the methods of the two canal enterprises. Since the mosquito was an enemy he was systematically fought. At the source of every stream near the canal works barrels of crude oil were spread to kill the young mosquito, and every swamp was drained or oil-coated. The forest growth was cut back from the camps and even the tall grass cut down so that the sea breezes might have free sweep to drive the mosquitoes back. All sanitary measures were carried out rigidly by the United States army medical corps, and Panama, which had had one of the highest death-rates in the world, soon had one of the lowest. By the use of steam shovels, high explosives and Jamaica negroes to do the hardest of the manual labor, the United States Army engineers finished the canal in ten years at a total cost of about 400 million dollars and it was formally opened for the use of shipping on August 15, 1914.

[1] It was often said, figuratively, of course, but with a sad basis in fact, that there was a dead Chinese for every tie in the 49 miles of railroad.

Readjustment of ocean trade routes. The Panama Canal has opened a new epoch in the commerce of the world. The swift liner and the tramp freighter have shared alike in the relief afforded by the new route and can now save many days [2] in getting from one traffic zone to the next. While the American isthmus blocked access to the Pacific, that ocean was in a sense a sort of blind alley as evidenced by the tremendous journey made by vessels that went from London to Yokohama and Puget Sound and then turned to retrace their tracks. To-day the short cut home for that vessel is by way of the Panama Canal, thus completing a round-the-world voyage which has become typical. Europe's ships can go eastward to the Orient loaded and return by way of the Panama Canal (see chapter on North Pacific) with cargoes from the west coast of North America. Los Angeles and San Francisco are now ports of call between Europe, New York, and the Orient.

There is no continent, almost no important country even, that has not made a change in some of the routes by which its goods

[2] SAVINGS BY THE PANAMA CANAL

	Nautical miles	Days at 10 knots	Days at 16 knots
Liverpool to Port Townsend	5,666	23.1	14.2
Liverpool to San Francisco	5,666	23.1	14.2
Liverpool to Honolulu	4,403	17.8	10.9
Liverpool to Valparaiso	1,540	5.9	3.5
Liverpool to Yokohama	–694	–2.4	–1.3
Liverpool to Shanghai	–2,776	–11.	–6.8
Liverpool to Sydney	–150	–.6	–.4
Liverpool to Adelaide	–2,336	–10.8	–6.1
Liverpool to Wellington	1,564	6.	3.5
New York to Port Townsend	7,873	32.3	20.
New York to San Francisco	7,873	32.3	20.
New York to Honolulu	6,610	27.0	16.7
New York to Valparaiso	3,747	15.1	9.2
New York to Yokohama	3,768	15.2	9.3
New York to Shanghai	1,876	7.3	4.4
New York to Hongkong	–18		
New York to Manila	41		
New York to Sydney	3,932	15.8	9.7
New York to Adelaide	1,746	6.7	4.0
New York to Wellington	2,493	9.9	6.0
New Orleans to San Francisco	8,868	36.4	22.6
New Orleans to Yokohama	5,705	23.3	14.4
New Orleans to Valparaiso	4,742	19.2	11.8

go and come by sea. Steamship lines by the score have rearranged their itineraries, and the tramp freighters by hundreds and thousands are unloosed from harassing restrictions and free to work their way around the world with a freedom that redounds to the benefit of hundreds of millions of men. The start forward in 1914 to this, the greatest readjustment of all time, was not unlike the general movement that follows the signal of a policeman in a crowded street when he releases two masses of waiting men or vehicles after a parade has passed.

Sources of the new canal traffic. The possible freight which the Panama Canal has made more accessible to the manufacturing regions of North America and Europe lies in four main zones: Pacific North America, Pacific South America, Australasia, and East Asia. Excepting the first, all of these are marginal traffic, traffic that can seek an alternative route. The great question is—What does it cost the ship to go around? To the time charterer the cost of ships in the market enables him to tell to a nicety what they cost—and this cost varies with freight rates, and they fluctuate through hundreds of percents. Thus a ship may be making \$25 or \$250 per day, facts which would make her owner have differing regard for the canal tolls which might cost him \$100 per day for the time saved. The freight rate of \$1.20 per net registered ton for cargo-carrying vessels (less for ships in ballast) amounts to \$6,000 each trip through the Canal for a vessel of 5,000 tons.

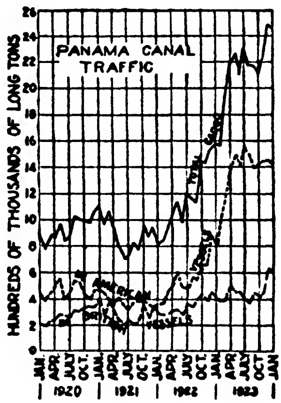


Fig. 281.—The very rapid increase in Panama Canal traffic. (From *North America*, published by Harcourt, Brace and Company.)

There is a pronounced tendency for the eastbound traffic to be in raw materials, while the westward freight consists of manufactured goods. Millions of barrels of California petroleum exceeding the total of all other products, come east by way of the Canal, while there is an increasing movement of fruit in cold storage. The lumber from Oregon, Washington and other Puget Sound ports is one of the important commodities shipped through the Canal. Wheat from the Prairie Provinces of western Canada, instead of flowing to Europe by the lakes and the rivers of the St.

Lawrence system, now may (and does) reach Vancouver by rail and Liverpool by steamer. The trade of New York and New Orleans with Australia also has much distance to save by the Canal. Even greater is the saving from the Atlantic ports to the Orient. The steady procession of nitrate ships and ore ships, mostly tramps, from western South America uses the Canal, but the tramp makes varying use of the new waterway. If freights are high it will be more profitable than when freights are low.

The Panama Canal is now handling a large and growing intercoastal traffic. The trade of the United States Pacific Coast with Atlantic ports had long been compelled to pay high costs for transshipment at Panama, or go around Cape Horn, one of the longest journeys in the commercial world. Fourteen lines are now handling this business through the new waterway and the west coast of America has become thereby a real world empire, instead of an isolated province. New York, Philadelphia and other Atlantic ports have direct shipment to San Pedro harbor at Los Angeles, to San Francisco and other west coast ports. Similarly the liner on the west coast of South America can circumnavigate that continent, coming or going by the Canal as circumstances warrant.

In the first decade of its use the Canal has been used by more than 25,000 ships which have paid in tolls nearly 100 million dollars, or one-fourth the original cost of its construction. In that time the freight carried through it has increased from about 4 million tons to 23 million, and the value of the goods now handled annually is more than a billion and a half of dollars. And in the process of building up that great traffic it has both deprived the rails of business and built up new trade between the cities of the Atlantic and those of the Pacific. When we consider that the Canal has cut the distance from New York to the west coast of South America by almost two-thirds, and reduced the distance to Melbourne, to New Zealand and to Yokohama by about 3,000 miles, it is not hard to understand why we have developed an increase of 233 percent trade with these countries, as against only seventy percent increase with other parts of the world. If the present rate of growth is continued the United States will need to enlarge the present Canal, and it has already secured the right to construct a second inter-oceanic waterway across Nicaragua, should the need for it arise in the future.

CHAPTER XIII

THE TRADE CENTER AND ITS DEVELOPMENT

I. THE DEVELOPMENT OF COMMERCIAL CENTERS

THE ORIGIN OF TOWNS AND CITIES. An examination of the methods and causes of commerce leads to an inquiry into the causes of the growth of cities. Not only does the larger current of international trade always pass from one city to another, but the same condition is also true of domestic trade. Cities and trade are continually exerting reflex influence, the one upon the other, and, to understand the large commercial movements, we must understand the economic functions and origins of the city.

The origin of the town goes back into the early history of the human race—before the days of the first permanent settlements and the first regular trade. There are places in Asia where people still congregate for a temporary residence and season of trade—a temporary town whose people disperse to the four corners of the compass when the market adjourns. The present-day metropolis is but a town grown permanent through regular trade, and large through much trade, and the same laws govern its growth and push it from its village beginning to its metropolitan ending.

The beginning of commerce is a barter between two individuals. Each has a surplus of a particular article and each finds advantage in the exchange of that surplus. The most complex phases of present-day commerce are but the outgrowths of this simple exchange of goods, complicated by the numberless wants of man, the variety in natural resource, the world-wide distribution of industry and the myriad complexities of invention and manufacture.

The rise from barter to money and the expansion of trade to international proportions have produced many institutions. First and most fundamental among these is the trade center or distributing center. Granted riches and neighbors, trading man soon develops so many wants that it becomes inconvenient to visit individually the various people with whom he wishes to trade, and some common meeting place is the result. Many previously isolated individuals now have a place for common activity; some of them a place for common residence; and a market place or fair, a village or a town comes slowly into being. It is interesting to note in this connection that in many European cities this plot of ground where the primeval trading took place continues to this day as a market square, as in Antwerp, Brussels, and many other cities now grown great. It is also to be found in many a small European country town. The normal trading town is, therefore, manifestly and most naturally located in some spot easy of access, some spot with a superiority of access usually due to geographic causes. If the superiority of access is sufficiently great the settlement around this market place becomes a city with international trade, for the market village and the metropolis are alike the products of economic forces that differ only in degree, not in kind.

THE KINDS OF CITIES. In examining into the causes for the growth of commercial centers, one should note the distinction between industrial and commercial causes—between industrial and commercial cities. Examination shows that most cities have both commerce and industry in some degree. The mere numbers of people inevitably produce a certain minimum of trade and manufacture. As a commercial city increases in population some local industries usually spring up. And similarly the growth of a manufacturing city usually develops some commercial activity. But, in the main, the city exists because it is either a commercial or an industrial center, the one activity being only secondary or tributary to the other. In most cases it is easy to characterize the world's leading cities as belonging to one or the other of these classes. For example, Pittsburg, Pennsylvania; Birmingham, England; and Lyons, France, will be classed at once as industrial cities. New York, Liverpool, Hamburg, and Hongkong will be classed as commercial cities. The purest examples of commercial cities are to be met with in the unhealthy seaports of the torrid zone where the conditions of life are so bad that only the most compelling of operations are there performed. Such a city is Port Limon, Costa Rica; Santos, Brazil; and Banana at the mouth of the Congo. Here are centered the strictly port or commercial activities that must be by the water's edge; while all other activities seek better locations.

In some cities the commercial and manufacturing influences become difficult or even impossible of accurate discernment because political reasons have interfered with, or combined with the workings of geographic forces. Where several cities have approximately equal natural advantages, the selection of one of them for a national, state, or county capital will be the deciding factor that raises it far above its rivals. This force has made Paris and Berlin the great cities that they are, and the city of Washington, in a location fixed by statute and without either manufactures or commerce worthy of mention, exists because it is the place of residence for the thousands employed in the administration of the central government of a rich and rapidly growing nation.

The commercial city or distributing center, its causes and some of the influences affecting it, will be considered here. At the present time, students, publicists, and lawmakers are devoting much attention to commerce. It is necessary that there should be a clear understanding of the way in which commerce, and particularly international commerce, is carried on and why it is carried on in certain cities. Without such an understanding, legislation in favor of commerce must sometimes miss its goal and expenditures for the promotion of trade must sometimes be made without results.

The place of transportation in making commercial cities. Some advantage in transportation[1] is the most fundamental and most important of the causes determining the location of a distributing center. It may almost be said to be the only cause for the formation of such centers. For some reason or reasons, a particular place is more conveniently and cheaply reached by many people than any surrounding point; and, as a result, they naturally exchange commodities there. The country store is located at the crossing of roads. There also is the village. In a mountain country the market town is at the junction of two, or, still better, of three valleys. Another favorite location is the end of a mountain pass, or a gap that is a thoroughfare between two valleys. If rivers are difficult to cross, settlements will spring up at the safest ferries or

[1] "New York is the most gigantic product of transportation. This is so because nowhere else in the world is there such a supreme focus of routes by sea and land. London is a close rival to New York, but London has Liverpool, Hull and Bristol as rivals. New York being the gateway and market of the North American continent, and having also one of the finest harbors in the world, has become the world's most important port."—*North America*, by J. Russell Smith.

fords. In a level plain, a town will be near its center, and a focus of roads or railroads in such a plain, fertile and populous, will almost surely make a city. Any one who is familiar with the geography of a peopled area of varied topography can see examples illustrating any or all of these forces.

The head of navigation on a river is a location far more commanding than any of those already mentioned. Here all the trade that goes by the river must be changed from one method of conveyance to another. Here goods are collected from the surrounding country for shipment by water. Here the people who bring the goods buy their supplies. Here also must be merchants, forwarding agents, and the repairers of wagons and ships. A town or even a city arises. It is interesting to note that towns of this class were relatively much more important in 1800 than in 1900. In the first-named year a river offered a much greater relative advantage for cheap transportation. But few localities could support populous settlements without water transport, for the alternative was the heavy, creaking wagon miring in the mud. The cost of carrying goods by wagon was so great that in a short distance it equaled the value of the goods and set a narrow territorial limit to commerce. So a navigable river gave its valley a cheap outlet to the sea, and the river port was a close rival in importance to the seaport. But in 1900 the railroad carried most of the freight which 100 years before depended upon the river. As a result, many places of leading importance in 1800 had in 1900 become insignificant towns. The new means of transportation, namely, the railroad, had built up prosperous cities where under the old conditions cities were impossible. Examples of this shrunken importance may be found in abundance in the basin of the Chesapeake. With its many estuaries there were numerous ports of nearly equal size in 1800, when George Washington's Alexandria was an important and prosperous place. But Baltimore has long been the seaport of the Chesapeake and Alexandria would scarce make a good ward in the rival that now serves her by rail with many sea-borne products.

The railroad train has rushed past the river port to the seaport and the giant ocean steamer has taken the trade. The most commanding location for the commercial city is the safe harbor which is, or may become, the natural outlet for a rich and populous territory. It has in greater degree and in greater extent the advantage that is to be found in the location of all the smaller distributing centers that have been cited above. It is a convenient place for the breaking of cargo. It is the extreme point that can be reached by the most favorable means of transportation and one where operations must begin on a smaller scale and a more expensive method. Here the ocean steamer discharges its freight, which is taken forward to its destination by smaller and more expensive carrying agents—the coasting vessel, the river boat, the railroad, the motor truck, to some extent the wagon, and, in some countries, even the pack train. The great seaport exists because it is a place for the breaking of cargo of ocean ships, just as the country store exists because the boxes and wagon loads of miscellaneous supplies must there be divided up into numerous small packages for the individual consumer.

THE CONDITIONS FOR THE FURTHER RISE OF SEAPORTS. Seaports are the focusing points of the commerce of both land and sea. Much land commerce and nearly all land routes go to and fro between ports and interior points. All ocean commerce is a movement of ships and goods from port to port. What makes a port? Any place where ships can unload in safety their goods upon the land may become a port, but among thousands of such places a few hundred actually do become ports because of their location with relation to adjacent, accessible seats of human enterprise. They rarely become ports because of any production within the port itself. The activity of the port begins primarily because it has particular advantages of access to populous regions and also particularly suitable access to the sea over which the commerce of the regions is to go.

It must be a point as far inland as possible so that the importer and exporter may have the largest advantage of the cheaper freights possible on large ships. Therefore the greater ports are at the heads of bays and gulfs rather than on peninsulas and headlands. The rugged west coast of Great Britain offers many bays and harbors for the shelter of shipping, but none of the small ports on projecting Cornwall displaces Bristol as the leading harbor of the southwest of England, for Bristol is far inland on the head of a bay. In the same way Liverpool, the great port of the west, has grown up on the indented coast of Lancashire, and not on some of the equally safe bays of the projecting coast of Wales. Similarly, Boston and New York are on bays that indent the main land, not on those more easy of entrance but near the end of Cape Cod or Long Island.

Besides easy access from the sea, the great seaport, the international trade center, must have easy access to the land and to the centers of population that it serves. This access is best supplied by a river valley with water transportation on the river itself and canals and railroads that can be built most easily along watercourses. Nearly all important seaports are at, or near, the mouths of rivers, navigable or otherwise, and, in regions having navigable rivers, the largest cities are in locations having the best communication with the interior. New Orleans, on the lower Mississippi, has been, from its settlement, the unrivaled metropolis of the coasts of the Gulf of Mexico. Philadelphia, Boston, and Baltimore were the rivals of New York till the opening of the Erie Canal made the Hudson the outlet for the Great Lakes and of enormous territory in the center of the continent. With this advantage New York has gained a foreign trade exceeding that of all the other Atlantic ports combined. If the break in the Appalachians had been at the head of the Delaware, the Susquehanna, or the James, the location of our great commercial metropolis would surely have been different. The improvement of the railway and the cheapening of rates have caused the Erie Canal to carry a declining proportion of New York commerce, but the level country through which the canal passes is also the most favorable for the building and operation of railroads.

As in America, so in other continents, the navigable river has dominated the growth of seaports. It is not by accident that London and Liverpool are upon the Thames and the Mersey with their canal connections with the interior. Hamburg has outstripped Bremen because the Elbe is navigable even beyond the Austrian boundary, but the Weser gives Bremen only inferior communication with the "hinterland." The Nile has made Alexandria; the Ganges, Calcutta; the Yangtze, Shanghai; and Hongkong, the island distributor for south China, lies directly at the mouth of the West River, the great highway of the southern provinces.

THE COMMERCIAL CITY BECOMES INDUSTRIAL. Being the distributing and supply point for such a region, the port has an excellent supply of raw materials, and becomes a favorable location for the establishment of manufactures. This is especially true of those industries requiring imported raw materials. To industrial development along this line is due a large share of the growth of all the larger seaports of the world. New York is the first city in America in the value of its manufactures.

INTERMEDIARY OR ENTREPÔT TRADE. In addition to and distinct from the in-coming and out-going trade of the dependent and industrial districts, is the commerce of the second kind—the distribution of foreign goods to other foreign countries. Thus London and Liverpool have in the past had a large commerce in articles that did not originate in England and were not intended for consumption in England. London was the largest distributor of foreign goods. The London merchant was a middleman in international commerce; consequently, England gained in riches from this source. But the chief reason for the growth and prosperity of London was not her foreign distributing trade, but the commerce that came to her as the local center of a great industrial population and the commercial capital of the country where the most highly developed manufactures in the world fostered the largest import and export trade. The chief basis of a city's trade under modern commercial conditions is usually to be found in the industrial districts of which that city is the immediate distributor, and not in the business that comes to a city as a commercial intermediary. This intermediary, or distributing trade, national or international, is the second step in the development of a city. The first step is the establishment of many lines of transportation giving connection with the various countries engaging in international trade. These are only built up by local demand and local production.

PORTS FOR RAW MATERIALS AND FOR MANUFACTURED GOODS. One of the changes in the world commerce of the past century has been the pronounced separation of ports into classes. One class is the raw-material port, and another is the manufactured-goods port. The two are steadily growing more distinct at the present time. This has resulted from the vast multiplication of the bulk of commerce—a multiplication which is in turn the result of the numerous industrial changes brought about during the past hundred years by the application of steam and electricity to so many of man's activities. Its commodities have changed from the small-bulk and high-value goods such as tea, silk, furs, spices, and luxury goods to the cheap and bulky raw materials—grain, lumber, petroleum, ore, and the coarser fibers. Spices, for which India was once so important, have gone to the twenty-second (they were tenth in rank in 1911) place in her exports, although we use more of them than ever.

The filling of the channels of trade with the many bulky, cheap, or perishable articles has produced new trade conditions with less dependence upon great ports and distributing centers. Cheap and bulky goods usually go to the best advantage in full cargo lots; and, as the vessel has to depend upon no other freight, it can load

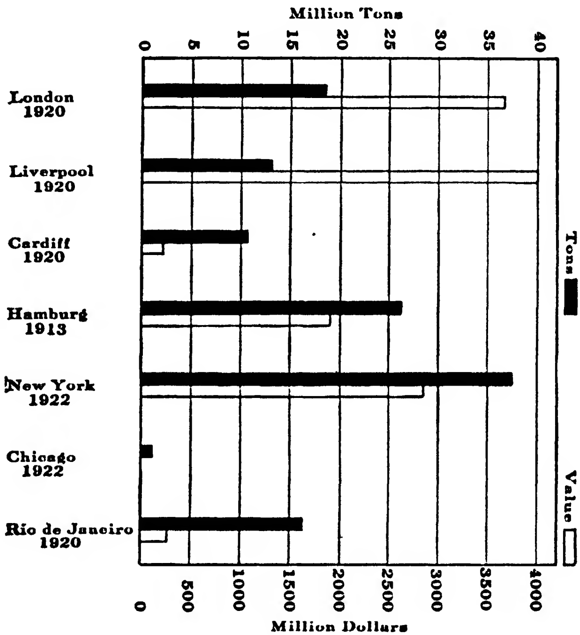


FIG. 282.—Variations in the foreign trades of ports. Comparison of net register tonnage and value of goods. Cardiff is a port for coal and ores, Liverpool for cotton and manufactures. (After J. Paul Goode.)

at any small port near the place of production. It is easy and profitable for a vessel to go to a small port of Florida or Georgia for a full cargo of phosphate or lumber, to a Chilean outport for nitrate of soda, to a West Indian outport for iron or bananas, to Cardiff, Wales, for coal, or to a convenient railway terminus in the Argentine for wheat. These goods may also be imported by a small port for use in local industries that do not require a large population for the manufacture and distribution of the products. A railway, a pier, and suitable warehouses may enable a small town to export or import raw material in bulk. The raw-material port therefore may be, and often is, a small port.

RELATION OF TRADE IN MANUFACTURES TO GREAT PORTS. In contrast to this, only a large city can import or export cargoes of highly manufactured goods. These articles are consumed in small quantities. Much choice is exercised in their selection and purchase by the consumer. The retail dealer must exercise similar care and discretion in the selection of his stock. He can do this best in a great wholesale market where he can go from place to place and take advantage of the competition and variety of stock of many wholesale merchants. This is to be found only in a great city. This gives the city holding the trade in manufactured goods the conservative force that comes of its being known as a market. The trade in manufactured goods therefore continues to cling to the older distributing centers and devious routings long after it is possible to make direct shipments.

The nineteenth-century development has been not so much a revolution as a new growth. The old commerce of 1800, the trade in high-value goods, stays, much augmented, in the old centers; and the new commerce in bulky raw materials goes to them and also directly between small ports. This gives to the trade of almost all ports a one-sided characteristic which has a profound influence upon the ocean-carrying trade. The greater number of the world's ports are either importing or exporting ports, and it is unusual for a port to have an equal share of each.[2]

[2] TRADE OF SELECTED PORTS

(Value in millions)

Ports	Imports	Exports
New York (1923)	$1,775	$1,430
Boston (1923)	340	48
Philadelphia (1923)	215	125
Norfolk (1923)	13	155
New Orleans (1923)	166	346
Galveston (1923)	28	414
San Francisco (1923)	186	157
Detroit (1923)	82	218
London (1921)	£415	£191
Liverpool (1921)	241	286
Hull (1921)	60	31
Manchester (1921)	51	34
Bristol (1921)	36	5

New York, Boston, and Philadelphia, the leading Atlantic ports, adjacent to the greatest centers of population and manufacture, are the cities with the oldest and best ocean connections, and are the leading ports of import. San Francisco, the old gateway for imports across the Pacific, has also excess of imports and is in interesting contrast to the new manufacturing city of Detroit, which has 2½ times as much exports as imports. The ports of the industrially newer and less populous South show the trade in raw materials cut off from the trade in manufactured imports. At New Orleans the exports are double the imports, and at Norfolk the same conditions are visible in an exaggerated degree. At Galveston, the newest of the important American ports, the ratio of exports to imports is about 15 to 1.

Export of manufactures is like the import of manufactures. In exporting manufactured goods there is the same tendency to cling to the old and great port although the tendency is here weaker than it is in the importing of similar goods. The conservative force is the fact that manufactures usually go in small shipments of which many are required to fill a single ship. Add to this the fact that the shipper of goods of this class wishes as fast, frequent, and wide-reaching sailings as possible, and it is evident that he can only get what he needs by doing business through the largest accessible port.

The United Kingdom, being a nation with import of raw materials and export of manufactures, thus reverses the commercial conditions of the United States. Most of her ports (see table) are importers of more goods than they export. Indeed, in several cases they export practically nothing and import considerable quantities of the raw products exported from the small ports of America.

Another way of classifying this same division of traffic is to say that the raw-material port is the tramp-ship port and the manufactured-goods port is the line-vessel port.

2. THE WORLD ENTREPÔT

The natural trade of an entrepôt. One commercial center can at times distribute a certain product or products to most of the peoples of the trading world and, for those products at least, it becomes a world entrepôt. The commodities that lend themselves to this method of distribution must have special qualifications. The goods must have high value, small bulk, and good keeping quality. By having high value the freight rate is relatively insignificant and the long and devious journeys are not a serious handicap. Having small bulk there is not the demand for a whole shipload of them in any one place, and so it is really cheaper to let them wend their way by transshipments through the common distributing center or entrepôt. A second factor of influence is the question of distance. The more remote the origin and destinations of the traffic the stronger is the hold upon this trade of the entrepôt with its organization of routes, ready to serve and hard to duplicate.

The trade that best answers to this description and is therefore best fitted to be handled through an entrepôt is that from the Orient to the western world. For many centuries it has comprised articles of small bulk and high value—spices, drugs, silks, curios, and tea. These were articles consumed everywhere among the western peoples, but always in small quantities. They were produced in a remote part of the world, and it was commercial economy that they should be distributed among western countries from some western entrepôt. The city best fitted to render this distributing service was the one where varied industry had given the most widespread vessel connections. The shifting of this trade from route to route and from center to center is an interesting study of commerce as affected by war, politics, discovery, invention, geographic control, and the economic conditions that resulted from these forces. Owing to this complexity of shifting forces the profits and glory of being the western entrepôt of eastern trade have rested in turn with Venice, Lisbon, Bruges, Antwerp, Amsterdam, and London.

THE RISE OF VENICE AND BRUGES. During the ordered period of the Roman Empire this unimpeded commerce was divided among many cities. After the fall of the Empire in the West, Constantinople, the seat of the strongest European power, became the richest commercial city of Europe and one of the important gateways to the East. Since the decline of the Byzantine Empire some one city has controlled a large share or even had a monopoly of the valuable commerce that passed between eastern Asia and western Europe, and this city has then been an object of envy for the trading world. Venice was the first of the series.

The products of the Orient were brought over the caravan routes through Persia, Syria, and Arabia to the ports of the eastern Mediterranean, whence they were carried by ships to the western Mediterranean. The foremost powers upon this sea were the city republics of Italy. These republics strove among themselves for the eastern trade. These wars were fights to the finish. There were no half-way measures. They were after monopoly, and the fleets of Venice triumphed, but not by accident. Her economic conditions had given her the best fleets and the widest commercial connections, for the city on the tiny islets had been compelled for centuries to carry in ships every article of food and raw material used by her population. Venice used her advantage to monopolize the eastern trade; and, when necessary, preserved her monopoly by armed force. Europe was compelled to purchase from her merchants silks, spices, perfumes, and other Oriental products. Venice flourished, and bedecked herself with her profits and with the treasures of her victims, so that she is at this moment, after centuries of decay, one of the finest show places in all Europe. One of her assets, if not her chief present asset, is the fact that the people of all nations flock thither to view the remains of her grandeur. In the days of her monopoly the Mediterranean peoples dealt directly with her and regular convoys of precious goods were sent across the Alps and down the Rhine to supply the northern countries. Another part of this northern trade went by the sea routes through the Strait of Gibraltar. But, by land or sea, the chief destination of the eastern cargo was the same—the Netherlands. Here was the greatest center of population, industry, wealth, commerce, and shipping connections north of the Mediterranean. Here also was the "center of all trade between Gibraltar and Finland." [3] For four centuries Bruges had been the metropolis of the low countries, lying securely on the canals that connected the Rhine with the ocean. By 1488 the silting up of her harbor and the increasing size of ships rendered the port no longer accessible, and in that year many of her merchants emigrated to Antwerp on the more open Scheldt. Bruges dwindled, but continued of interest down to the early 20th century because she was a medieval city in the medieval shell (wall) undisturbed by the swelling growth that had burst and usually razed the wall of nearly every other walled town of west Europe.

THE FALL OF VENICE. A similar shriveling fate was in store for Venice. Her ships could ride unchallenged on the Mediterranean

[3] Dorn: *Die Haven des Weltverkehrs,* p. 655.

and carry back in triumph the pillars of cathedrals from Constantinople and choice products of the East, if they could be reached at any port upon the Levantine Seas; but Venice could do nothing with the conquering hordes of Turkish horsemen who overran west Asia and interfered with the caravan routes to India. About the same time, Vasco da Gama, the Portugee, discovered the sea route to India; and in 1499 the first merchant ships that rounded the Cape of Good Hope brought Indian cargo to Lisbon. It is said that the news of the discovery of the new route caused stocks upon the Venetian exchange to decline in a day to one-half their former value. In 1504 the blocking of caravans caused the Venetian fleets to return empty and the proposal, two years later, to build a canal at Suez was prophetic but premature by some 365 years.

The rise of Lisbon and Antwerp. Lisbon quickly succeeded Venice as the European entrepôt for Oriental products. The Portuguese government monopolized the spice trade and the profits were 400 percent. Lisbon, however, lacked the requirements necessary for a commercial metropolis. She was not the natural center of a network of local routes that had arisen as servitors of her local industries. She had no local industries of importance; and, as to commerce, she had at best been but the emporium for the comparatively small trade of the Azores, Canaries, and west Africa. While she had been the head station in the sea trade between Venice and the Netherlands, she was but a ship-provisioning place. She lacked the location and the necessary connections for distributing the newly won Oriental products to northwest Europe. Hence, the Portuguese spice importers provided for the distribution of their Indian goods by establishing factories in Antwerp, which had recently succeeded Bruges as the metropolis of the Rhine Delta. While this Lisbon agency business continued, the Flemish manufacturing towns continued to increase in industry and the Flemish metropolis became a market for English wool; for skins, flax, grain, and wood from the Baltic countries; for metals, hardware, glass, and dyes from Germany; for Rhenish and French wines; for Italian brocades; for Spanish fruits; for the products of the Levant, as well as spices from Lisbon.[4] By 1550 Antwerp was the metropolis of Europe, and 2,500 ships lay in her harbor.[5]

[4] *Lehrbuch der Handelsgeschichte*, Richard Mayr, p. 114.
[5] Dorn, p. 656.

THE POLICY AND FALL OF ANTWERP. It appears that in the beginning Antwerp prospered above the other Netherland cities because foreigners were free to come and trade at all times, while at other cities they were under restrictions most of the year. At that period it was customary for the leading cities to have annual fairs, when traveling merchants traded on equal footing with the resident burghers. At all other times the foreigner must deal through a local broker. Antwerp was at all times a free-trading city and thither the merchants of Bruges emigrated, there the traveling traders from all Europe collected, and the city prospered until the sieges of the Spaniards closed it for a time, and the final subjugation by Spain in 1585 drove away all who would not subscribe to the Catholic faith. In one year 19,000 people, including the leading merchants, emigrated, most of them to Amsterdam, for the Netherlands were still the industrial center of gravity of Europe and the Netherlanders were the greatest traders. Amsterdam thus became the new entrepôt for the distribution of Oriental cargoes, for here, as at Antwerp and Bruges, was a natural center for the manufacturing industries of the Rhine Delta and a natural focus of the routes from the northern shores and the southern shores of Europe, from the British Isles, and from Switzerland down the lordly and busy Rhine. In the next ten years—1585 to 1595—Amsterdam nearly doubled in size.

THE PROSPERITY OF AMSTERDAM AND HOLLAND. The Dutch provinces, being still at war with the now united kingdoms of Spain and Portugal, could not import East Indian products from Lisbon. Accordingly, companies were formed for eastern trade; and in 1595 the first expedition brought the products of the Indies direct to Holland. This circumnavigation of Portugal ended her ninety-six years of monopoly of the shipway to the Indies. Holland, like Venice, clinched her advantages. In the first decade of the seventeenth century, the triumphant Dutch navy conquered most of the colonial empire of Portugal; and the Dutch East India Company practically monopolized the trade between Cape of Good Hope and the Strait of Magellan. To monopolize the supply of spices, the Dutch sailed the East Indies looking for and destroying spice trees so the product of certain controlled localities might comprise the whole crop. The merchants of Holland controlled the trade of the Rhine Valley up to Basle, and the old Hanseatic posts had in most cases become their agencies. By 1645 the

Dutch fleets had a practical monopoly of the North Sea fisheries; they were doing most of the carrying trade of Europe; and, during the English civil war, they even carried the commerce between England and her colonies. In Colbert's time it was estimated that there were 20,000 merchant vessels in Europe, and of these the Hollanders owned from 15,000 to 16,000. Amsterdam became not only the commercial but also the financial capital of Europe and of the world.

THE COMPETITION OF HOLLAND AND ENGLAND. The prosperity of Holland brought her into conflict with the rising powers of England and France. In the latter half of the seventeenth century a series of wars with these countries severely taxed her resources. Oliver Cromwell's Navigation Act of 1651 was a direct and severe blow at the Dutch carrying trade, as well as a direct admission that the English could not compete with the Dutch on even terms. By these new regulations only English vessels could engage in the English coasting trade or in the trade with the English colonies. Foreign goods must come to England in the ships of the country producing them or in English ships; and they must come direct, *i.e.*, German or Indian goods could not come via Amsterdam. Further than this, fish that came into English ports must have been caught by English ships. These stringent regulations served to free England from her dependence upon the Dutch vessels, and gradually built up an English marine; but England's position of independence was not exchanged for that of international distributor until her industries made her the greatest exporting and importing nation. For half a century after the Navigation Act was in force Amsterdam was more important than London, and she was a strong rival for yet another fifty years. The Netherlands were the leaders in the textile industries and a potent force in European commerce so long as the system of household labor and hand power prevailed. The age of machinery dawned in England, and with its development came English supremacy. Holland had hands and feet and windmills for driving machines, but England had waterwheels and coal.

ENGLAND'S INDUSTRIAL PROSPERITY. England, free from the wars and disturbances of the continent, and a refuge for many exiled weavers, had the efficiency of her labor first increased by the use of water power. Coal was used in the smelting of iron in 1740; and the abundance of these minerals, the bases of manufacturing industry, enabled England to develop machinery, use steam and lead the world in industry. The continuous and destructive wars of the Napoleonic period kept the industries of the entire continent at a standstill, while those of England were undisturbed and rapidly increasing. English commerce and English riches made unprecedented gains because all parties in the continental conflict were compelled to buy English goods. The maritime independence due to the Navigation Acts became naval supremacy through the wars of the last half of the eighteenth century and the victories of Nelson. By the beginning of the nineteenth century England had most of the eastern colonies that had belonged to Portugal, Holland, and France; and the British East India Company had practically succeeded the Dutch East India Company as the conveyors of Oriental produce. On the basis of the best supplies of coal and iron then available, England had, in a century and a half of undisturbed internal peace, become the country with the greatest industry and the greatest commerce. She had as a result the best commercial connections and had succeeded Holland as the greatest international carrier. She was the first country to develop a good network of steamer lines upon the modernizing of commerce after the peace of 1815. Lines went to the Continent and to the United States, and from the days of the old British East India Company there had been frequent connection with the East Indies. With this equipment of commercial routes the leadership of England and the entrepôt traffic of London were most natural. In this period she called herself the workshop of the world, for which London was the metropolis, the greatest trade center and the distributor of the products of Asia. The star of Amsterdam had set.

Relative importance of entrepôt trade. But the importance of this intermediary or entrepôt trade must not be overestimated, for it has always been subsidiary to the commerce that is essentially local in its origin or destination. This was true of London in 1865 when she was the undisputed world metropolis and it is true in greater degree in the present when her supremacy is passing away. What London has lost and is losing no other single city or country is gaining. The period of the world entrepôt is passing. The later entrepôts have had a less binding grip upon the trade than their predecessors held. Amsterdam's monopoly was less complete than that of Venice. The predominance of London was never so complete as that of Amsterdam, and London will not even have any single successor unless some unforeseen elements reverse the commercial tendencies of the present.

Causes of decline of world entrepôt. Two reasons will largely explain the passing of the world entrepôt. First, the tremendous increase in the bulk of world commerce. The second grows out of the first and is the multiplication of steamship and railway lines which enables many cities to serve as entrepôts for limited areas.

On the question of the supremacy of commercial cities, the future cannot be judged by the past. The mechanical improvements of the nineteenth century have made a new industrial and a new commercial world which must be judged by the new conditions.

The great inventions of the present era have increased manyfold the materials of commerce. These changes have permitted a rapid increase in population in commercial countries and have brought about the settlement of new continents. Wildernesses in North and South America, Australia, and Africa have become civilized lands having wide commercial relations. Where an occasional trading ship loaded with valuables and trinkets made a bartering cruise in 1800, fleets of steamers assembled in 1900 to carry away the coarse bulky staples of international trade; and, in the first decade of the twentieth century, the progress in this direction was more rapid than ever. No city could handle it all if she tried; but, nevertheless, England, especially London, had a strong hold during the greater part of the nineteenth century.

Other nations rise to commercial independence. When Germany, Denmark, France, Belgium, or the United States wanted small shipments of Indian or Oriental goods, it was convenient and financially advantageous to get these goods in England, because Germany, Denmark, France, Belgium, and the United States had regular and frequent connections with England and England had connections with the Orient. After a century of multiplication of commerce, London is still the leader, and richer than ever; but other cities are also distributing the products of the East since they have developed direct connections of their own. Half a dozen British ports have direct lines to the East. German lines go from Hamburg and Bremen, French lines from Havre and Marseilles. There are frequent and regular eastern sailings from Antwerp, Genoa and, once a month, from Copenhagen. New York also has regular connection with the Orient, Australia, Cape of Good Hope, the coasts of South America and the ports of the Mediterranean and the Baltic.

Fig. 283.—The steamer routes of and ports served by the leading Danish steamship company with headquarters in Copenhagen—a rising entrepôt.

As England between 1750 and 1850 established the factory system, built up industrial cities, a foreign trade, and lines of communication, so between 1875 and 1925 have the continental countries and the United States experienced the same industrial revolution and the accompanying growth of cities and of industries. The last and inevitable step in the chain of events has been the establishment of direct communications between the Orient and other ends of the earth to give an outlet and supply for these new-grown centers of industry. The increase of direct connection and the growing complexity of the international trade route net is a pronounced and characteristic tendency of the later decades of the nineteenth century and of the present. England retains her position of independence, but other countries—the United States, Germany, Belgium, Italy, France, and Japan—are advancing toward a similar independence. There is a consequent tendency for each country to raise up its own entrepôt. We can indeed see the progress before our own eyes, for the centrifugal or decentralizing forces continue.

Other cities become entrepôts. Before the World War Hamburg had, in large degree, succeeded London and Liverpool as the basis of foreign goods supply for Scandinavia and the Baltic; but almost before Hamburg was secure in her new trade possession, lines of steamers were beginning to carry the products of America and the Orient direct to Stockholm, to Copenhagen and to the Russian ports. In 1912 a Norwegian company started a line from Oslo to the United States. This trade of Scandinavia and the Baltic is new, but it shows the tendency. Lines from the United States to Genoa have largely displaced trade via Liverpool, and the more recently established lines from New York to Constantinople and the Levant are cutting off the trade to the United States via Genoa and Marseilles. An examination of port connections the world over will show the same conditions of decentralization and growing freedom from a few great ports that has taken place in Great Britain and the continent of Europe. Two examples will suffice to show the tendency.

The increasing trade of the ports of north China adjacent to the Gulf of Pechili makes it profitable for occasional vessels to take cargo direct from America and Europe to ports of Tientsin, Newchwang, and Talienwan. A short time ago nearly all of the trade of east Asia was first laid down at the great entrepôts of Hongkong, Shanghai and Yokohama, for final distribution in small craft. As commercial development on this north coast continues and satisfactory harbors are made, there is less and less dependence upon Shanghai, Yokohama, and Hongkong and more direct connection with the remote bases of supply at San Francisco, Seattle, London, Liverpool, Hamburg, and Marseilles.

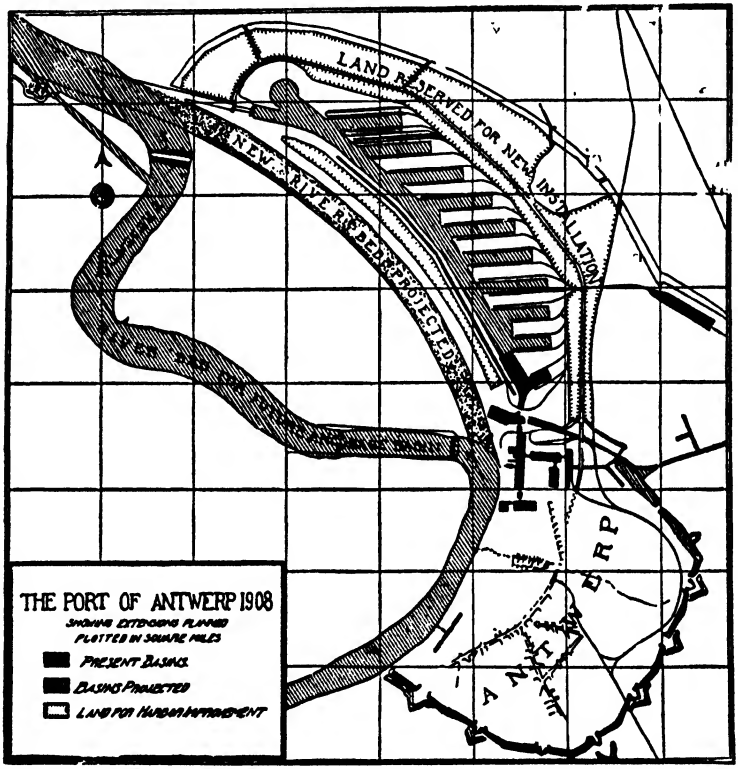


Fig. 284.—Antwerp has outgrown the fortifications put up as defense against Napoleon III and before the war had port plans that are probably unrivaled for comprehensive system. America can show nothing like it. (After J. Paul Goode.)

Another example of this world tendency comes from Australia. For many years the sparse population of West Australia secured the greater part of its European and American goods by the coasting steamers that came from Sydney and Melbourne. The rich gold discoveries so increased the population and trade that after 1898 the west coast began to receive European steamers direct, and is in large measure freed from its dependence upon the east coast cities as bases of supply for European goods.

R[ELATIVE] DECLINE AND ABSOLUTE INCREASE. It must be kept in mi[nd that] decentralization does not destroy the old trade center. The statements concerning declining importance are relative, applying to percentage of rapidly growing wholes, and not in any way to absolute quantities. Commerce was increasing with unprecedented rapidity in the years before 1914 and the new developments, the new trade routes, are made by and for a part of the new commerce. Meanwhile, it is usually true that the particular trade that inevitably belongs to the old center has also increased and, with it, the city's prosperity. It is still a distributing center, greater than ever, but for a smaller territory with increased commercial activity. Antwerp now ranks fifth or sixth among the world's commercial cities, being little more than one of the two chief outlets for the Rhine Valley. But she is about five times as large as when she was the world metropolis, has rapidly outgrown her new walls, and had under construction in 1914 harbor extensions that would shelter several times the ships and traffic of her palmiest world entrepôt days. No less than $70,000,000 will be required to complete her astonishing new harbor, and there is little doubt that the World War only delayed it. London's distributing trade has suffered from the competition of the revived Antwerp, of Hamburg, Bremen, Marseilles, New York, and other cities; but London has millions more of people than she had in 1856 when the first Hamburg trans-oceanic steamship line was established, and she is still struggling to enlarge her harbor. New York handles a smaller and smaller percentage of the foreign trade of the United States, but, as other American cities increase their imports and exports, New York's foreign trade reaches a total greater than that of any other city in the world. The World War tended to raise New York at the expense of European entrepôts. For years Hamburg was absolutely closed, and London nearly so. But the War was temporary while trade forces are perennial and London has regained much of [her] old business for reasons which the following pages exp[lain].

EFFECT OF GRADING GOODS. The question of international distributing centers is not alone affected by routes of transportation and the establishment of direct connections. There are many other factors. One of them is the gradability of goods. In general, it may be said that commodities having such uniformity as to be accurately graded and sold by grade, can be and usually are sent directly to their destination with little regard to the entrepôt, while commodities that cannot be accurately described but must be inspected before purchased are often bought and sold at some convenient intermediate point which has come to be recognized as a "market" for a certain commodity or commodities.

Wheat is an example of the gradable commodities. A buyer is reasonably certain what he will get when he buys No. 1 or No. 2 of a certain kind of wheat, graded in a certain market. Accordingly, ships load in Oregon, Argentina, or the Atlantic coast of the United States or Canada and start toward Europe. The cargo is sold by telegraph, and the captain of the ship learns his destination by radio or by signals as he passes the Madeira Islands, or some point on the English or Irish coasts.

Effect of ungradable goods. Such transactions are impossible with the ungradable articles of which wool and ivory may be taken as examples. The value of these commodities is affected by so many conditions that they must be examined before being purchased. The sheep's fleece is often cut into five or six pieces at the shearing table and the wool bale of commerce contains only one of these kinds. The value of the bale depends upon the skill of the wool baler on the sheep ranch. It also depends upon the breed, the ancestry, and the food of the sheep, which affect the length, fineness, and strength of the fiber. The character of the soil in different localities gives the raw wool a varying proportion of dirt; the heat of the climate and the variations of the seasons give it a varying percentage of grease; a drought and accompanying shortage of food reduces the physical condition of the sheep and makes a weak place in the fiber. The wool buyer needs to consider all of these factors in purchasing. He must, therefore, see and feel of the wool before buying, and a mistake in judgment may cause large financial loss. The wool buyer is a highly paid expert and it has always been profitable for the wool manufacturers of the United States, England, and the Continent to secure a large share of Australian wool (the highest grade of wool) at the London wool auctions, where careful inspection is much easier than it is in Australia.

Ivory is likewise of uncertain value. The age of the animal and the size and the previous treatment of the tusk, are important factors, and an almost imperceptible fracture may nearly ruin an otherwise perfect piece. Ivory is, therefore, sold by auction. The greatest market is Antwerp, the greatest supply coming from the Congo region.

CONSERVATIVE INFLUENCE OF AN ESTABLISHED MARKET. Commodities requiring inspection are not necessarily sold at auction. Private sales may give as firm a hold on international trade, once a city becomes the recognized place to buy and sell certain commodities. The entrepôt has a prop in that peculiar and conservative force—the drawing power of a "market." The drawing influence of an established market causes some cities to handle large quantities of goods which might now be handled to better advantage and with less labor elsewhere. The "market" often holds its trade in this day of direct connections by the force of mere custom and conservatism. Such is the Bremen tobacco market, which began with the establishment of a line of emigrant ships to the United States in 1827. At that time tobacco was almost the only return freight, and Bremen became the greatest European tobacco market. "Bremen is the market for hogshead tobacco, and everybody buys here." Such were the words of a Bremen tobacco merchant when asked as to the cause of Bremen's control of the continental tobacco trade. Later came cotton, rice, grain, and petroleum, and its importance in the rice, cotton, and tobacco trade continued until the World War and may be expected to revive as Germany again gets her fleets and regains her commercial feet. The fact that this city is a great rice market and had good eastern and western steamer connections long caused her to forward to the United States some East Indian rice that might just as easily have gone direct to New York. In comparison with Bremen, Hamburg had better steamship connections and decidedly better interior transportation; but Bremen held the tobacco market and the cotton, rice, grain, and petroleum markets, although Bremen cotton firms have tried to open branches in Hamburg, with the idea that they might eventually move to that city. The Hamburg branches failed just as have the efforts of London wool brokers to sell Australian wools (fine wools) at Liverpool auctions. In the same way Liverpool brokers have failed to sell carpet wools (coarse wools) at London auctions. The cause of these failures may be ascribed to the price-setting function of the established auction or market. In each of the above cases the goods offered in the unusual places were offered at reasonable or even very favorable rates, but the buyers made unreasonably low bids, and later they often paid more for the same goods at the established place. At the unusual place the buyer has the uncertainty of thinking that he might get a better article or more favorable price at the regular market with its larger stocks; so he bids cautiously. In the regular market he knows that here all sellers are bidding for his trade, and he buys. It is a kind of a supreme court of commerce.

EFFECT OF ABUNDANT CAPITAL. The capital of the entrepôt serves as a prop to maintain its hold upon trade that might by existing direct connections go direct from producer to consumer.

The business of the international distributing center therefore increases or decreases with changes in the financial soundness and available capital of the trading countries. The merchants of the great center by having stocks of goods may, in a sense, serve as the bankers for, or partners with the traders of countries where capital is less plentiful. Hence, as capital becomes more plentiful in the various countries, there is less need for and dependence upon the center. The German or Belgian manufacturers may not have the capital to invest in raw materials that must be purchased in South America or Asia in large quantities and weeks in advance, even if such purchases are desirable. Steamship connections make such a trade possible, but it may suit the manufacturer better to buy in London or Liverpool in small quantities as needed. An incident shows how this force works. In the opening years of this century many German woolen mills had established a direct trade in Argentina wools, to the detriment of the British merchants who had previously supplied them. Financial difficulties in Germany brought failure to a number of German mills and reduced capital and credit to others. The direct purchases in South America had to be discontinued and a larger share of the wool supply again came through the centers of abundant capital—London and Liverpool. This case is an exceptional one in a time when the general tendency was toward the increasing financial independence that fosters direct trade, but it serves as a forcible illustration of the influence of abundant capital on the entrepôt trade.

The history of the Liverpool cotton market illustrates this general tendency. Four or five decades ago two-thirds of the American crop went to Liverpool, 2 million bales were often carried in stock, and the world price was fixed in that city. As the American dealers could not afford to store and hold it, they exported it as rapidly as possible, and, in a few months, the whole crop was disposed of.

The continental buyer could not afford to send to America for it all at once, but took advantage of British capital by buying in small portions in Liverpool. But as capital became more abundant in the regions of cotton production and cotton consumption, there was a corresponding decline in the international importance of the Liverpool cotton market. American mills consume a larger share of the annual crop; American capitalists are able to hold the raw product; American speculation and American consumption set the world price. In many cases the cotton spinners of the continent buy directly from America; and Bremen, Havre and Antwerp became rival markets with Liverpool. Some hasty purchases or small purchases are made in Liverpool, but the relative importance of that city has declined; instead of importing two-thirds of the American crop her dealers now handle but one-third and instead of two million they now only carry one million bales in stock.

THE ENTREPÔT PROBLEM IS UNIVERSAL. The restraining influences are but exceptions in a general tendency. The day of the world entrepôt has passed and its place is being taken by an ever-increasing number, so that we now have a score that are as large as was Amsterdam in her distributing prime, each handling as much trade as she did in that day. But the fact remains that of the many, many thousands of towns and cities upon the face of the globe, all but this favored score connect with the great arteries of commerce through some entrepôt of greater or less importance. Therefore, it is plain that the problem of the entrepôt is universal and their number merely serves to heighten interest in them.

New entrepôts are springing up all the time; but they come in response to economic law, not legislative statute or personal or national whim. If these laws had been better understood, the American people would not have been so sure in 1898 that Manila was a good place from which to control the commerce of Asia. Manila is not, and, under any feasible conditions of commerce, cannot be an entrepôt for the trade of America with Asia. It can neither assemble nor distribute the trade of that continent with either America or Europe. It bears almost exactly the same geographical relation to the mainland of Asia that Havana does to the mainland of North America. No sane person talks of Havana's future as an American entrepôt. To make Asiatic entrepôt matters worse, Manila is the most distant port of Asia except Singapore. Some of the lines from America have added Manila to their list of ports; but it is often the end port of the voyage, which naturally takes the ship first to Yokohama, next to Shanghai, then to Hongkong, and finally to Manila. Manila is the metropolis and natural entrepôt of the Philippine Islands. It can be to them what Copenhagen is to the scattered isles of Denmark, what Honolulu is to the Hawaiian group, what Havana is to Cuba—the place where some of their products will be assembled, the place where great ships will unload cargo for distribution by smaller vessels to a hundred smaller ports, roadsteads, and wharves. As the Philippines prosper, Manila will prosper. If the American Congress throttles Philippine industry, it throttles Manila's trade which handles the products of that industry. In any case, traffic that seeks Asia will go to Asia, whether the Philippines prosper or decline. Hongkong, Shanghai and Yokohama are Asiatic entrepôts, but giving way to newer and smaller ones closer to centers of production.

CHAPTER XIV

THE WORK OF THE TRADE CENTER

I. THE BARGAIN CENTER

THE BUYING AND SELLING OF DISTANT COMMODITIES. A city may be a commercial center in two ways—first, as an actual distributer of goods; second, as a transaction center, a place where bargains are made for goods that are elsewhere and which may never be brought to the center. The transactions in C often relate to goods in A to be sent directly to B. The transaction center is the lineal descendent of the eighteenth century distributing center. In the days when the communication of ideas and the carriage of goods depended upon the slow and uncertain sailing vessel, or the equally slow and uncertain means of land conveyance, it was usually necessary to have the goods on the spot before they could be the subject of bargain or sale. However, the steamship, the railway train, and the telegraph have made a commercial world, new in its methods of management as well as in its staple commodities. The telegraph gives instant and constant information concerning stocks on hand, the crop prospects, and other conditions that affect the prospective supply. Standardization either by manufacture or by grading makes it possible for buyer and seller to bargain definitely for commodities neither has seen or ever will see. The steamship gives quick delivery; and, what is of equal importance, it far exceeds the sailing vessel in the certainty of reaching port in a stated time. Commercial transactions of to-day may thus concern commodities in distant places and for future dates; and, although the movement of the goods may be decentralized, it still remains advantageous in a surprising number of cases for the men doing this work to assemble in groups at some convenient center.

ADVANTAGES OF CENTRALIZED BARGAINING. The sales and purchases are made in the center because it is easier to carry on such operations where many buyers congregate, where many compete in the same business, and where representatives of many businesses can serve each other. This attracting force is somewhat akin to that of an auction and it draws those engaged in the bargaining or transaction side of commerce into groups that are often quite irrespective of the location of the commodities in which they deal. This centralizing force operates in local, interstate and international trade. It is usually strong enough to collect into a small district of a city all the firms engaged in the same line of business, provided the business is not of the retail nature requiring scattered location close to its patrons. The steamship agents and brokers of London, Liverpool, New York, and San Francisco are all collected into small districts of their respective cities through which one can walk in a few minutes. The London wool brokers have their still more restricted locality, and two or three small streets are the headquarters for the general produce brokers. The same is true of the leather merchants of New York and the paper dealers of Philadelphia. An hour's walk through the wholesale districts of New York, Philadelphia, London, Hamburg or any of many smaller cities will suffice to give the observer many examples of this grouping of mercantile firms engaged in the same business. This centralization has gone so far that some buildings are recognized as the center for certain industries.[1]

EXAMPLES OF CENTRALIZATION IN BARGAINING. The exchange, of which the stock exchange is a conspicuous example, represents the highest form of this grouping or centralization. There the principal buyers and sellers of a particular commodity actually congregate in a single room to facilitate their work. The exchange method of doing business may be applied to most commodities of which the price may be quoted. London recently had nine exchanges —a stock exchange, a wool exchange, a metal exchange, Lloyd's, the underwriters' exchange, the corn exchange (grain), the coal exchange, the royal exchange (bankers, manufacturers, etc.), the shipping exchange, and the Baltic, an exchange where all commodities are dealt in, especially grain in full cargo lots. New Orleans, Liverpool, and Bremen have cotton exchanges; Louisville has a tobacco exchange; and Leipzig a book exchange. Hamburg has one very large exchange attended by most of the brokers and wholesale merchants of the city. A variety of transactions take place, but the grouping principle works within this general Bourse or exchange,

[1] It is suggested that persons using this book as a text have local studies made in their respective cities and towns.

for there is a steamship corner, a grain corner, a coffee corner, a stocks corner, etc.

By similar centralization the manufactured products of an industrial district are usually sold at some central point to which in many instances they are never sent, being shipped instead directly from the factory to the point of final destination. Manchester is the selling center for the cottons produced in a score of smaller cities and towns in Lancashire. Offices in the business section of Philadelphia sell a large part of the manufactures produced in the mills of the suburbs and near-by towns. The same is true in Boston and many other large cities. Most of the shoes made in eastern Massachusetts are sold in a hundred or more offices located in a restricted area in Boston.

National centers for management of foreign trade. In the same way the transactions of foreign trade are centralized in the commercial metropolis. Decentralization of commodity traffic has been an accompaniment of the growth of the new commerce; but the telephone, the telegraph and the fast mail have helped to keep up the transaction center by putting the selling agent in easy communication with the factories and local centers of the producing and consuming districts in all parts of the world. Sales for the foreign trade or to the distant consumer cannot be arranged easily from cement works located in the Allegheny Mountains of Pennsylvania or Virginia, from the Georgia cotton mills, or from the phosphate mines of Tennessee or Florida. Consequently the selling agencies are in New York, although the cotton cloth may go to China by way of Vancouver Sound, the phosphate is shipped from a gulf port to Japan and the Virginia cement reaches the sea at Norfolk and Newport News, or goes by rail to interior points. The products of the scattered industries of Great Britain are largely sold in London, but tens of millions of pounds sterling worth of the goods thus sold go from the point of production to Liverpool, Hull, Glasgow, Bristol, and other ports for export. Hamburg merchants or brokers sell a large share of the German export manufactures while they are yet in the mill, and the goods in question often go down the Rhine to Antwerp or Rotterdam for shipment. The Paris commissionaire renders a similar service in the French export trade, and in many countries the broker who makes a specialty of selling for many persons or firms brings about an important part of the transactions in foreign as well as domestic trade. There is a general tendency toward the establishment of direct connections between consumer and producer, especially when the currents of trade have become regular and confidence is established; but the markets for the new industries or the new lines of trade in many of the old industries are found through the agencies of the selling center. Here also the new purchaser usually finds it is easier to purchase his stocks, and at all times the individual trader dealing directly has the opportunity to better his condition by selling through the transaction center and getting the advantage of a competitive market.

INTERNATIONAL BARGAIN CENTER. The transactions of the wider international trade are also centralized. London, the last great international distributer, is still a large international seller. With the convenience of telegraph and cable and wireless the London distributing merchant often found that, upon the founding of direct communications between foreign countries, he could continue to make the bargains and arrange other details although the goods no longer passed through London. He knew the conditions of both eastern and western markets, and the direct connections that have sprung up merely enabled him to deliver more quickly by shipping his goods direct. Thus the counting house stayed while the warehouse passed away. By this process, London has come to be a dealer in goods which may never at any time be within 5,000 miles of England. For example, London brokers and London merchants recently had a practical monopoly of the international sales of pepper, Manila hemp, Indian jute, and Burma rice (the chief supply for the world market.) The world's supply of each of these four commodities is produced in a comparatively small region and consumed all over the world. The high value and limited supply of the annual crop would probably lead to disturbing price fluctuations if the central London firms did not act as a sort of regulator. Being in constant communication with their numerous agents in the centers of both production and consumption, having a world knowledge of this particular trade, they are able to conduct business more safely than is the firm in New York or Marseilles, should it attempt to buy hemp, jute, or pepper directly from the dealer in the point of shipment. Under such an uncentralized method no man or set of men would have the knowledge of conditions in the producing and in all of the consuming centers; and it is probable that some one of the several centers of consumption would get too large a proportion of the annual crop to be successfully sold in its established markets; or it might by delaying purchase get too small a supply, producing scarcity and abnormal prices; or again the entire crop might not be purchased and a surplus would be left to disorganize the next year's market. But as it is, the London firms have a geographical location that is central to the consuming regions of Europe and America, and because of their knowledge of the requirements of each section the business is conducted much more evenly. A financial disturbance or failure in Spain or Holland or Sweden might cause the sacrifice of a shipment of pepper that had been purchased and was in transit. The Spaniard, acquainted only with a small local trade, would lose heavily by a sudden forced sale; but, if the London house had charge of the transaction, the shipment in question would be transferred to the next best market, which might be in the United States, in Scotland, or in Russia. It sometimes happens that such sudden changes return to the broker's control goods that can be disposed of to good advantage in some other place where a new and unexpected demand has arisen. The importance of London as a rubber market is another interesting example of the work of the international middleman.

The commodities that are subject to the centralized control of London sometimes go by London, Liverpool, or Hamburg for convenience of trans-shipment to final destination in America or Europe, but they more often go direct. For example, the Burma rice goes in full cargoes from Rangoon to Chile, Brazil, and the West Indies, while shiploads of crude rubber from Singapore go directly to the United States.

The direct shipment does not seriously affect the position of the London firms so far as bargains are concerned. A representative dealer in Manila hemp said that the United States tariff arrangement giving a reduction on hemp imports shipped direct from the Philippine Islands had stopped the old circuitous movement of trans-shipping in London but had not in any way interfered with the London management of the bargaining end.

The influence of capital. The international transaction center requires a central location, a line of business that is carried on in widely separated places, and, in addition, an abundance of capital. Often capital must be more plentiful in the center than in the commercial outposts, for the central management of a distant business operation is at times only possible by the use of capital from the controlling center. In this respect the relationship to the distributing center is again shown.

The London firms can hold the fiber trades only by buying the hemp in Manila and the jute in Calcutta. The rice distributing firms own the cleaning mills in Rangoon and the other ports in Burma. This central control goes further and sometimes takes a lien on the unharvested crops. The white grapes of southern Spain are usually sold in or through London to offset the account of the merchant-banking firm that has, through its local agent, advanced the money necessary for the expensive oak casks and cork packing. An American importer of these grapes bewailed his inability to buy them direct from Spain, but he could not break the hold of the English money unless he had a bank in Spain. He was not a banker; so he got his grapes in London and sent them across on the fast trans-Atlantic liners at little if any sacrifice of time or freights. The long-established use of London capital has given the London capitalist a controlling voice in the sale of many products. For a long time much American cotton was controlled by British firms which advanced money to large cotton factors who advanced it to small cotton factors who advanced it to growers. The growing surpluses of American capital since the World War are tending to make New York a center for transactions of this nature.

CLOSE RELATION TO BANKING AND INDUSTRIAL ENTERPRISES. The distant agents for London firms have brought and are bringing to London a great variety of transactions similar to the above. Further examples may be cited in the Persian wools, the dates of Arabia, and the cabinet woods of Mexico and the West Indies. The details of an actual case will illustrate this class of transactions. A German firm, half merchants and half bankers, has head offices in Hamburg and branches or agencies in many other cities, among them a port in the Tehuantepec region of Mexico. In this port there was a Mexican promoter. He had a concession from the government to cut mahogany in the woods of the interior; he was familiar with the language of the Indians and with the local labor market; but he had no capital. He arranged to get the necessary money from the banker's agent who was acquainted with the conditions and took the risk as follows: first, the promoter was bound to deliver certain amounts of mahogany as collateral for a certain sum of money for which he was to pay a good rate of interest; second, he was to receive the money in monthly installments as the work of getting out mahogany advanced; and, finally, the agent was to sell the wood, thus securing the payment of principal and interest—provided it brought a sufficiently high price. This was of course a part of the risk incurred in advancing the money. When the work was so nearly done that a date could be set for its conclusion and for the shipment of the lumber, the agent informed the head office in Hamburg. The principals entered into negotiations to secure transportation, and finally chartered a British sailing vessel to load a full cargo and proceed to the English Channel for orders. In the meantime, efforts were made to sell the cargo but as no suitable buyer could be found in Germany, it was placed in the hands of a London broker who sold it to a Paris firm who ordered the vessel to proceed to Havre and discharge cargo.

As the trading countries come to possess more adequate supplies of capital for their own use, and when the trade assumes larger proportions, the international transaction center loses, at least proportionally. When the buyer and the seller can manage a transaction without mortgaging the goods in transit to a financier in a third country, there is less need of the services of the broker in the international transaction center. There is accordingly a tendency toward a decentralization of management as well as a decentralization in the actual handling of goods. But the two decentralizations do not accompany each other. The direct movement of goods precedes in point of time the direct management of the business. The latter may be indefinitely delayed. The supplies of capital may remain low, causing dependence upon foreign bankers. Few countries have or promise to have sufficient capital for their own needs. Since the commercial character of the traders in some countries is not reliable, no one dares trade with them who is not fully acquainted with them—which usually means having an agent on the spot, as happened in the Mexican lumber incident described above. The trade of some countries will therefore continue to be largely transacted through the centers in the financial countries, although many products, usually the raw materials, go directly to the ports nearest the points of consumption.

In the United States the industries are conducted upon an unprecedented scale, the mercantile classes are relatively reliable, and the accumulation of capital has been rapid. As a result direct bargaining arrangements have been established, at least for the staples of American trade. There is no single European center for the trade in American grain, cotton, or lumber. American merchants deal directly with half a dozen European cities. Sometimes a London broker succeeds in placing a cargo of American grain or lumber in some other city, but this is unusual and he must divide his brokerage with the agent in the other port. The grain cargoes from the Baltic and Black Sea ports are usually sold by London brokers, although they may go to any continental or British port. The same is true of East Indian teak, West Indian mahogany, and a large share (some merchants estimate it at a half) of the Brazilian coffee that goes to the Continent.

Direct control of distant industries from the bargain center. There is still another stage in this bargain center control, the entrepreneur stage. The capitalists, at first European but increasingly American, actually carry on industries and manage them and sell the product through the headquarters in the capitalistic center. Hamburg is the market for the German coffee plantations of Guatemala; Amsterdam is the chief market for the Sumatra tobacco grown in the East by the Dutch companies. The jarri paving-wood industry of western Australia is all managed in two or three buildings in London. London has thousands of companies doing business abroad, and, if one walks through the business districts and reads the signs upon the office buildings, he can familiarize himself with geographical names in every continent, in almost every country or island with resources to develop and with an adequate capital. New York is following in the steps of her commercial mother, and she is not alone among American cities. A whole floor of a New York skyscraper is occupied by the American office force of a single company operating sugar plantations in Cuba. Perhaps the best single example of this far-flung type of enterprise is furnished by the United Fruit Company, which, conveniently for students, has had its physical operations described.[2]

It should be emphasized that this capitalistic development has but begun. A mere corner of the world, say a half million square miles or one percent of the earth's land surface, has capital to spare. All the vast remainder of the world must depend upon imported capital for the execution of any considerable enterprise, such, for example, as the building of a railroad. This is true of the entire continents of Asia, Africa, and South America, the East

[2] Adams, F. V. *The Conquest of the Tropics,* an eulogy of the United Fruit Company.

and West Indies, Australia, Central America, Mexico, Canada, and most of the United States. There has long been much control of industry in our western and southern states by eastern capitalists. Throughout the nineteenth century the countries of northwestern Europe were the sole exporters of capital, but on account of the World War most European countries have become borrowers from the richer United States.

The borrowing countries are in different degrees of poverty; some are much nearer financial independence than others. Australia and India are much richer than Persia or Central America; but, taking the world as a whole, there is every indication that during the most of the twentieth century a comparatively small proportion of the world will furnish the capital that will be distributed throughout that part of the earth's surface that contributes commodities to world commerce. At the present time the United States is doing the lion's share of the lending, but if European industry revives she will probably resume her activity. One of her present troubles is that she killed off in the World War the generation of young men who should be doing the work.

THE RISE OF INTERNATIONAL BARGAIN CENTERS IN THE UNITED STATES. In recent years Hamburg, Amsterdam, and Paris have been encroaching on the previous supremacy of London, and the World War pushed New York, for a time at least, to the leading position. One of the ways by which this happened was the sale during the war of British foreign investments.

New York's dominance in international transactions is but a natural next step to its previously established dominance in the industries of America. A surprising amount of national and international business is done without leaving New York City. In New York are consummated the deals in Montana and Arizona copper, Oklahoma oil, Maine spruce lands, Georgia pine lands, Susquehanna water-power plants, Virginia railways, Florida phosphates, West Virginia coal, Pennsylvania cement works and the chartering of ships for Galveston cotton. Most of the larger railroads of the country have offices there and those who supply them must also have offices there. The list might be drawn out indefinitely, for there is not a state in the Union that does not have lands, enterprises and resources managed from New York, the bargain center of America.

As this country grows richer and has capital to invest in foreign lands, the office signs of New York become more and more of a gazetteer of the world. The future is suggested by the important place taken by New York in the industries and railways of Mexico and by the Guayaquil-Quito railway which was built by an American company that has its headquarters in New York and did not even list its stocks on the London exchange. Men in this New York office make bargains for steel rails shipped from Pittsburg, for ties shipped from Oregon, for cement shipped from eastern Pennsylvania. New York manages the banana business of the Caribbean countries and the asphalt business of Trinidad and Venezuela, and is striving for a chance to help build railways in China if the Chinese will just be kind enough to work and then let the property be safe for the foreign owner. Other American cities will engage in similar distant enterprises. The era of bargain centers is but begun.

2. THE WORK OF THE MERCHANT OR MIDDLEMAN

FUNCTION OF THE MERCHANT AND OF MONEY COMPARED. Merchants carry on the world's commerce, which consists in buying and selling, and transport agencies do the actual carrying from one place to another. The merchant and money are commercial twins, both called into being when primitive commerce becomes too elaborate for direct barter. While a community and its economic life are so simple that producers can supply themselves with goods by exchanging directly with each other, they use no money, and there is no merchant. But such conditions of simplicity can only exist in a small community having very little social or economic organization. To-day most primitive peoples use commodities produced by men they have never seen. In these cases money (gold, silver, shells, wampum, pieces of leather, checks, drafts, promises, street-car tokens, anything that is agreed upon) serves to transfer the value from one community to another, from one man to another. The herdsman with twenty cattle, fifteen of which are of no value to him if he himself must use them, stores their value in shells or beads, or gold given by some merchant until he can exchange it for furs or weapons. As the money serves to transfer the value of goods, so the merchants transfer the goods themselves and make the link between two producers, each unknown to the other.

KINDS OF MERCHANTS. As trade becomes more extended the merchant cannot himself know both producer and consumer and another class of merchant arises—merchants who sell to other merchants. With the growing complications of society this process is repeated so that in the present international trade goods sometimes pass into the possession of eight or ten different merchants before they reach the consumer. Some of these merchants perform but a small part of the process of connecting the producer and the consumer, for some mercantile operations are divided into sharp and narrow specialties. With all their variety of work the whole group of merchants may be divided into two classes:

(*a*) Those who only sell goods for other people.

(*b*) Those who own the goods they sell.

The man or firm owning the goods is commonly regarded as the real merchant, those who sell for others being usually known as commission merchants, brokers, agents, etc., but their service to society and their part in commerce is the same. The question of the ownership of the goods being sold is a minor detail; the selling is the important part.

THE COMMISSION MERCHANTS, BROKERS AND AGENTS. The merchant who sells goods for other people is a result of widened and well-established commerce. He is to be found in all large centers of domestic or foreign trade, and his chief capital is his knowledge of and acquaintance in the market in which he sells. Some familiar examples are the farm produce commission merchant, the stockbroker, and the real estate agent. In the medium sized and large cities of America and Europe, the farm produce that cannot be sold by the farmer himself [3] is sold by commission merchants to whom the farmer or local dealer has consigned it usually at his own risk. The merchant has no capital involved except the warehouse and necessary appliances for handling the goods. He is acquainted with the local dealers in his particular line of goods, sells the farmer's produce on the best terms he can, and receives his pay in the form of a percentage commission. The stockbroker goes to the stock exchange, and buys and sells securities for his clients on commission (called brokerage). The money broker takes advantage of his knowledge of the money market. Knowing the reliable borrowers and also money lenders, he arranges loans between these parties and receives a commission. People having lands or buildings which

[3] By a needless separation of producer and consumer world commerce has greatly and uselessly raised the cost of living. For a discussion of this point see later chapters in Smith, J. Russell, *The World's Food Resources.*

they wish to sell or rent, go to a real estate agent who finds purchasers or tenants, and receives a commission on the purchase or rental money.

Brokerage or commission transactions are quite as important in international trade as in domestic trade. Every city that is a "market" in international trade, such, for example, as London, Liverpool, Hamburg, Antwerp or Havre, has many brokers who have an international clientele. Sometimes they handle a certain class of articles; often only a single article. Sometimes a firm of brokers has several members and a staff of clerks, and yet deals in but a single article as wheat, rice, cotton, tea or coffee. It is common for the brokers of a city who deal in the same article or articles to form an association for their mutual advantage and for the publication of statistics. London has a Rice Brokers' Association, Liverpool a Cotton Association, a General Brokers' Association and others.

The auction sales of London, Hamburg, New York and other cities are but a species of the commission merchant's work. The work of the international broker or commission merchant is similar to that of the local or domestic broker mentioned above, except that the operations cross international boundaries and are spread over a wider area.

Within the city of London, a business custom has developed whereby certain classes of brokers perform a unique function. They effect transactions between merchants who may be in the same building. This is not because the merchants are unacquainted. For want of a better name, the advantage may be called diplomatic. The Briton explains it thus, an explanation which shows the reason that causes many transactions in all cities to be arranged by third parties. If merchants or their acknowledged representatives should meet daily and haggle over prices, set them, change them, promise, threaten and withdraw their threats, there would be a certain amount of friction and personal hard feeling which is not a good basis for continued profitable business relations. Therefore, they make the transaction impersonal by employing a broker. He goes to the merchant and offers to secure certain goods at a certain price. If the price does not suit, the broker may change it later in the day or he may find another purchaser. But in any case the broker is not responsible; he is but the agent. Whose agent he is, the merchant does not know, for any broker may sell goods for ten or twenty-five or maybe a hundred merchants. He is not the representative of a firm, but rather the representative of impersonal goods, and this impersonal aspect of the transaction keeps every one in a good humor where friction and animosity might otherwise arise. The practice really results in the merchants having fewer regular salesmen employed, and expanding their force when necessary by the employment of the professional free lance salesman, the broker.

THE SELLING OF MANUFACTURED GOODS. The brokerage and public commission business is better adapted to simple and unmanufactured commodities than to the more elaborate manufactured goods that tend to be suitable for particular markets only. With the exception of real estate and stocks, all of the examples cited above were of articles moving from the district of raw material production toward the industrial center—farm produce going to the city, foods and raw materials going toward the manufacturing and consuming regions of Great Britain, the Continent or the United States. In the case of manufactures, which constitute the bulk of European, and a growing share of American exports, the more exacting demands of the market require more organization for successful selling. Goods are often sold on commission, but it is done by a regular authorized agent who is often the representative of but one manufacturer or group of manufacturers, although he sometimes sells for several concerns. The sales agent and the export commission house serve the distant manufacturer just as the commission merchant serves the distant farmer, except that from the nature of the case the factory output is more regular than the farm output. The export merchants to whom they sell are in their turn the great rivals of the sales agent and the export commission house. The export merchant is ever striving to get away from both these bargain center sellers, and by establishing direct dealings with the factory, avoid the commissions of the intermediary.

THE EXPORT MERCHANT. The export merchant performs an important and interesting part in international trade, especially between the manufacturing countries of the north Atlantic and the distinctly raw material producing regions of Asia, Africa, tropic America, and Australia. A firm that buys in Europe and sells in Chile or Australia, or both, covers a wide area. In the selling country the firm does business as a wholesale house which may carry every line of goods required in such a country as Argentina, Chile or China. Distributing branches are established and the area of operations increased until some firms now conduct operations in China, India and Australia; or in China, the Philippines, Australia and one or two countries in South America. So thoroughly and extensively is this business organized that six or seven firms in Manila transact nearly all of the mercantile operations of the Philippines, while similar conditions prevail in China, Japan and South and Central America. A single firm has branches thousands of miles apart and in many Latin-American countries.

The exporting firms have a similarly thorough organization for the purchase in producing countries of the multitude of commodities which they sell in consuming countries.

As England was the first country to have a large export trade in manufactures, many of the export houses dealing with the other continents are English firms whose head offices are yet in London. Although there are, of course, many American, German, French, and Belgian firms also, it is probable that London is still the headquarters for the majority. Originally, London was the place where most purchases were made, including such goods as came from America or the Continent. With the growth of manufacturing in America and Germany, British firms must sell increasing quantities of American and German goods to supply all the wants of their patrons in Brazil, New Zealand or India. As the use of American and Continental goods increased, London became an inconvenient place to make all purchases and the establishment of branches in other manufacturing countries has become common. An actual example shows how it comes about.

A London firm with a business in Cape Colony had been buying some American goods in London and forwarding them. Then the goods were ordered from New York, and shipped by way of British ports. Then direct steamship lines were established from New York, and the London firm opened a branch in New York to attend to the American business. There is almost daily cabling between the Cape Town branch and London to order goods, and between the London and New York houses to decide what goods shall be bought in one country, and what in the other. Otherwise, the two purchasing branches conduct their work independently and London is only the financial headquarters and the purchasing center for British goods. Another typical British firm has its headquarters in London, with a branch in New York, and sells goods in Argentina, having its store and warehouses in Buenos Aires. The London office attends to the purchase of British and Continental goods. Firms with more extensive business often have an American, a British, and a Continental purchasing office. The location of these offices will be New York, London and probably Hamburg, as Germany offers the greatest variety of manufactures. This nearness to the center of production gives the purchaser a better chance to become acquainted with local conditions and to make bargains more quickly and with less cost for cabling, for it is a noteworthy fact that the ocean cable has largely replaced the mails as a means of communication in international trade. Having several purchasing branches it is easier to take advantage of differences in price in the different countries. If prices rise in America, the London and Hamburg offices purchase more heavily. If Germany has an industrial boom and high prices, the New York office may be the scene of greater activity in purchasing.

Contrast between method of shipping and purchasing. It must not be inferred that because the goods are purchased by a New York, Hamburg, or London office, they pass through those cities. When the goods are purchased they are almost always in the factory or the warehouse attached to it, provided they are in existence at all. The New York branch of one international exporting house has upon its books the names of nearly 7,000 American manufacturing firms, from which it may buy goods. In Europe it is the same, and in both continents the goods are sent from the factory to the port of shipment in the most direct and economical manner. Hamburg branches of British and American firms buy iron goods in the Westphalian district below Cologne and ship them by the Rhine boats to Rotterdam or Antwerp where they are put aboard the ocean liners for the final destination. London houses buy Manchester goods which are shipped from Liverpool, Scotch iron ware which is shipped from Glasgow, fine clothing in Paris which is shipped from Havre, laces in Lille or Brussels for shipment from Antwerp. Goods purchased through New York may be exported from Boston, Puget Sound, Montreal, or New Orleans. An extreme case is that of the London firm that, having no American branch, purchased by cable a lot of provisions in San Francisco and ordered them shipped by direct steamer to Hongkong where they were trans-shipped to Singapore, the selling center for this particular firm.

THE POSITION OF AMERICANS IN INTERNATIONAL TRADE. There is in many minds an erroneous confusion of trade and traders. A spurt in American exports may not indicate much change in the nationality of the people doing the business. It may mean nothing but increased purchases by European firms long established in foreign countries. For example, Germans in South America handled much of the greatly increased American export to that continent during the World War. The first trader in the field has a strong advantage over his later rivals. The force that comes from an established trade with regular customers, a good name and wide acquaintance makes it difficult for the new merchant to get started. As a consequence of this advantage of an early start, the mercantile organization shifts much more slowly than the world's industrial or exporting center. The British merchants, the first in the field, have simply bought German and American goods when they became available, and supplied them to their old customers. The German merchant has now gone abroad and is making strong competition with the English, and the Americans have recently begun to compete for foreign trade. The great boom in American exports that occurred after 1900 was not accompanied by a corresponding increase in the work of the American merchants doing business abroad. The merchants of other countries, finding our prices good, bought the goods and sold them again. The development of American mercantile enterprises will come in time, but it is the second step. The first step—the development of the vast domestic resources and the supply of the home market—has thus far occupied most of the enterprises and capital of the American people who, in the main, care and know but little about foreign commerce, or ships.

All this neglect of foreign fields by Americans is quite natural. Our abundant resources and resulting high wage levels have kept our young men at home, while the young men of job-hungry Europe have been compelled to take the low wage and the privation and the isolation of the foreign host. After all, if you can stay on Main Street, or the old home farm, why spend your young life in a hot and malarial little tropic town or trot about the globe with a sample case eleven months out of twelve?

CHAPTER XV

THE BALANCE OF TRADE AND ITS RELATION TO INDUSTRIAL DEVELOPMENT

Definition and significance of balance of trade. Balance of trade is the term usually applied to the difference between the valuation of goods imported into and exported from a country. Owing to the concepts of a discarded theory of political economy an excess of imports is called an unfavorable balance of trade and an excess of exports a favorable balance of trade.

There is such a variety of causes that the excess of exports or imports can have no uniform significance and therefore no significance beyond the mere excess in value of the one over the other. An excess of exports, the so-called favorable balance of trade, does undoubtedly mean some credit abroad. It, therefore, presumably means that the exporting people can meet their current obligations and are therefore solvent, but it will not do to carry the figure on and suppose that upon the average it means riches for the nation or the individuals of the nation having this so-called favorable balance. It means more often a moderate but improving state of indebtedness. Nations are made of individuals. To see the trade balance in its correct light compare it to an individual's financial and industrial condition.

If a rich man retires from Wall Street or London to a fine country estate in Virginia or Surrey and from it sends out annually $3,000 worth of produce and has sent to it annually $10,000 worth of produce, no one speaks of his condition as being unfavorable. He is the envy of the countryside. His neighbors know that he is rich enough to live upon his money so that he can sell few things and buy many. Alongside of him may live a farmer with a mortgage on his farm. He sells $3,000 worth of produce and owing to his heavy interest payments he only has the money to buy back $2,000 worth of produce.

If these two men were types of groups large enough to be called nations, common custom as it speaks of balance of trade would say that the farmer who was laboring against the mortgage had a favorable balance of trade when in reality he is working arduously, selling the eggs he ought to eat, and going without a new roof on his house; and common usage and terms would have it that the comfortable, rich man had a very unfavorable balance of trade. As a matter of fact, he can order and pay for the products of all lands. And so could a nation in his position. The terms favorable and unfavorable balance of trade are at times ridiculous contradictions, if they are meant to convey the idea of national riches. Excess of exports and excess of imports would be much better terms, because they do not have further implied meanings tending to mistaken concepts. Excess of import or of export is produced by too many diffeıent and at times contradictory things to be so simply and categorically defined as favorable and unfavorable.

Relations of money and bullion to the settlement of trade balance. There is a widespread failure to recognize the fact that the balance ot trade is eventually paid, paid in goods and paid only in goods. It seems difficult for the business man or the student to grasp the fact that money, whether gold or bank note or bank check, is always really nothing but a medium of exchange, like wampum, something to transfer property as a piping system transfers water. A piping system is not a drink. Neither is a bank check. Each of them may in a sense *transfer* a drink from A to B. Thus money helps men to transfer property. Money may defer real payments, but it must be got before it can be used and there are but two ways to get it: (1) As bullion dug from the lands of the paying nation, it becomes in its production, goods. (2) Sell goods and get the money from some other nation, as when Brazil sells us coffee and gets money to buy clothes in England and France. Further, the goods given and the goods taken in exchange are of equal market value. Money merely enables our goods and labor to pay debts, to pay for other labor and other goods. The goods given and the goods taken tend to balance each other. Trade between nations does similarly balance eventually except for presents (including the funds of emigrants, including heiresses, bad debts and the losses through unsound investments) and is paid in the produce of the trading lands. This produce may be corn or cloth, coal, iron or gold from the mines, or it may be service in a hotel, a hospital, a school, or a ship. The point is that it is paid in the products of industry, and money has no more to do with it than would money in the following case: Ten farmers may compose a village. They have empty pockets, but each has $1,000 to his credit in a near-by bank. Some busy day they are animated to buy and sell from each other. As one sells, he gets a check. Then having money he buys, and so the business whirls. By noon they have effected transactions among themselves to the extent of $25,000 worth of houses, lands, teams, and cattle and have given fifty bank checks on the $10,000 which has all the morning lain to their various credits in the bank. The bank checks furthermore had nothing more to do with all this business than so many figures on the bank bookkeeper's ledger where they were finally totaled up. The farmers apparently paid with credit slips, but really they exchanged the results of toil. Nations do the same through highly organized and well-nigh invisible financial mechanism for international payment in which gold, except it be mine produce just entering circulation, renders the same service as the bank checks or the figures in the ledger above mentioned.

Other factors that enter into the settlement of trade balances. The keepers of import and export statistics see but a part of the international transactions. There are other factors in international payments than mere import and export, such as the oft-mentioned interest money, the expenses of travelers, the payments of international freights and the properties of emigrants who may be laborers with bundles of clothes or heiresses with millions in securities. The traveler is sometimes a weighty factor; as in Bermuda, for instance, which is thus enabled to import from three to four and one-half times as much value in goods as it exports, and in Switzerland where the traveler sometimes leaves $20 per year for every inhabitant of the country.

The capitalists' or the heiresses' securities are still another confusing factor; if they are bonds they are deferred payments; if stocks which represent immediate ownership, an immediate transfer of title to property from one country to another is involved. In either case the emigrated capitalist or heiress can become the actual user of wealth in a foreign land only through the transference of actual goods from the country where the property is, and the receipt of goods of equal value in the country where the owner lives. Thus an American-British peeress' income of half a million dollars from bonds of a United States corn-belt railroad really means $500,000 worth of American wheat, corn, pork, automobile, or other produce sent abroad from America, for only by selling their produce could the farmers and townsmen who supported the railroad pay their freights from which the railroad company pays its interest, which in turn is the income of the peeress. And unless that $500,000 worth of goods or its equivalent reaches Britain, the owner is no more benefited than Crusoe would have been had he on his fertile (but not financial) isle possessed a

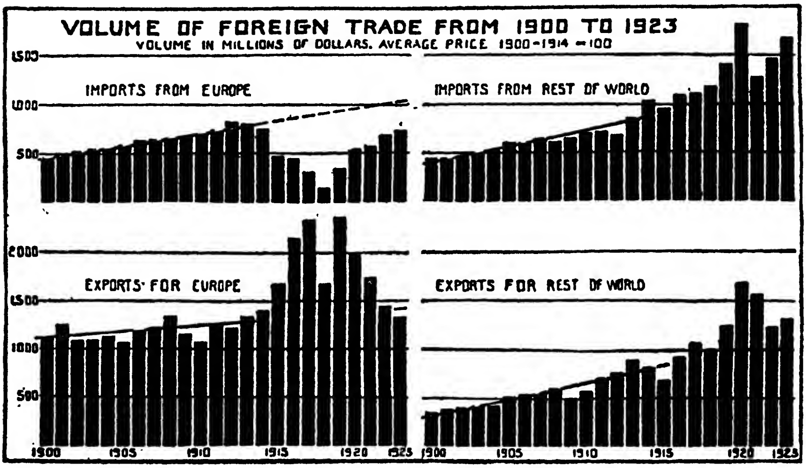


Fig. 285.—The United States is coming to resemble Europe more and more and therefore has less basis for trading with her. (Courtesy Cleveland Trust Co. Business Bulletin.) (From *North America*, published by Harcourt, Brace and Company.)

similar fortune in bonds. A ship loaded with goods purchased with the proceeds of the bonds in the country where the property lay would enrich alike Crusoe on his isle and the heiress on her isle. They both need goods, but documents butter no parsnips.

Payment in goods and promises of goods. The perfection of our commercial and financial organization has made the existence of these simple processes less visible, but it is none the less true that when we go to Europe we pay our way with American goods or the proceeds thereof in government or bankers' promises to pay, while the goods go some other way. It is only in the visibility of the device that we differ from the Esquimo who would come a pauper from his land of barter in the north unless he brought the furs and products which alone permit him to get our money to pay his way during his sojourn in our lands.

Beneath and behind the smooth-running machinery of international financial settlement with its bankers' checks and bills of exchange, is the commodity settlement complicated by the traveler's payments and by the deferred payment of investments; but, with the exception of the transfer of wealth by the emigrant, which is a gift from nation to nation; there is a final balance in the exchanges of goods, or a promise to balance as shown by stocks, bonds, and financial promises. Bullion dug from a mine in the exporting country and entering circulation is here counted goods, because it is a product of industry and a bank note is not counted as goods because it is nothing more than a certificate or receipt for goods like a railroad ticket. This payment of goods, present and deferred, combines with normal industrial development to give us four stages in the evolution of the national trade balance which is the annual record of the movement of goods.

THE STAGES IN THE EVOLUTION OF A NATIONAL TRADE BALANCE. (1) The first is the equipment stage, in which the people of a country are borrowing heavily from the people of some other country to get the means to equip their land for production. During this period the imports exceed the exports. (2) The second stage is the interest-paying stage, during which ordinary wants of import consumption are paid for by exports and in addition other exports are sent out to pay interest, giving the interest-paying stage a surplus of exports over imports. (3) The third stage is the foreign-investment stage, during which the country is sending out food or materials for the building of factories, railroads and other equipment in other countries, still in the equipment stage. Another way of getting this same result is for the investor to take title to property in the foreign country instead of having property sent to him. Thus Cuba may owe United States interest on money invested in sugar plantations. Instead of letting that money come to United States in the form of goods we take title to more Cuban land. During this third stage also the exports are likely to exceed the imports. (4) The fourth and final stage is the interest-receiving stage and the return of investment stage when the loaning country is receiving interest payments in the form of produce and possibly occasional returns of principal. This makes the imports greatly exceed the exports.

THE FIRST—THE BORROWING OR EQUIPMENT STAGE. We can best understand the working of the first or equipment stage in its influence upon trade balances by taking a particular case. Some Americans with $10,000,000 to invest conclude that they will build a new railroad in Mexico or Ecuador (it has actually happened in both). In the beginning of operations, a number of engineers, graduates of American technical schools, enter the "borrowing" country in a passenger train or ship, promptly followed by many boxes of bacon, barrels of flour, and a miscellaneous assortment of provisions and supplies which the Mexican or Ecuadorean customs officials record as imports into Mexico or Ecuador. The line is surveyed and located, and work begins. Carloads of dynamite, trainloads of cement, hundreds of tons of steel girders, thousands of tons of steel rails, hundreds of miles of telegraph wire, millions of feet of lumber in the form of ties and station material, and carloads of provisions for construction camps cross the Mexican or Ecuadorean boundary and are credited as imports. The heavy expenditure for payroll of native laborers who usually do nearly all of the actual work will result in a lot more imports into the "borrowing" country until that one small operation can be traced almost to the ends of the earth. If a number of similar operations go on at the same time; in other words, if Mexico or Ecuador were on something of a boom and foreign capitalists were busy investing there, it is unquestionably true that the imports would exceed the exports at this time. Such is the normal condition of a country that is having a lively experience in the equipment stage of its industrial and financial history. We can see that this equipment stage, with its surplus of imports is, therefore, likely to occur in the most undeveloped regions, and is really the beginning of participation in the world of trade. It will take on added intensity whenever a country experiences a new industrial boom, as occurred in South Africa just after the Boer War, in Cuba just after the Spanish-American War, and in Korea, where, after war with Russia, Japan took hold with a firm hand, so that the trade for 1907 consisted of $8,000,000 exports and $20,000,000 imports.

Canada, especially western Canada, was at that time also, as is well known, experiencing a general industrial and agricultural boom, and a tremendous development in railroad building. These new enterprises were financed quite largely by foreign countries, but the money went to Canada in the form of goods and showed itself in imports worth $351,000,000 while the exports were valued at $227,000,000. Panama, during her Canal-building years, was the most delightful example of all. As a freight forwarder and as a kind of construction camp for the world's greatest piece of equipment she imported almost five times as much as she exported. Any country with abundant and profitable resources but with little capital is likely to enter this first stage.

The wealth of emigrants, always a somewhat confusing factor, is especially so in this stage because of the proportionately greater number of people who transfer their whole fortunes to the new country, a transfer which takes place in the various forms of *goods* and is never paid back because the owner goes along.

THE SECOND OR INTEREST-PAYING STAGE. All this so-called unfavorable balance of trade for the new country looks upon the surface like loss for the nations which send out the goods without return. The people of the supplying country take the immediate return in the form of printed claims on property, usually stocks and bonds of the enterprises for which they have sent supplies. These are really promises to pay and the real return comes when the newly equipped enterprises make dividends and cause the country in which they are located to enter upon the second or interest-paying stage. If some persons in Boston have spent $100,000 in equipping a copper property in Mexico, that property can only make returns on the investment by yielding copper and the copper can only make returns for the people of Boston by causing a certain value in goods to be shipped out of Mexico in such a way as to place those goods or their equivalent in money or other goods at the disposal of the Boston owners. If property in Mexico pays something to the owner in America, something must go out of Mexico to do it. This is a factor toward surplus of exports for Mexico. In addition, ordinary consumption goods are imported and paid for with other exports.

We see this interest-paying stage to best advantage in some rather mature countries whose statistics give us small reason to question their accuracy. Canada is well known to be a tremendous borrower from England and the United States, which have built and yet own most of the Canadian railroads, hold many state and municipal bonds, and own many Canadian ranches, getting their returns in exports, which in 1924 amounted to 1,044 million dollars for all Canada, while the imports were valued at but 797 million. British India, which is almost exactly analogous to Canada in its dependence on foreign capital, exported 1,173 million dollars worth of products in the same year and received in return but 775 million. The Union of South Africa had exports of 344 million dollars and imports of 263 million in 1924, and the entire British Colonial Empire had an export excess or so-called favorable balance of trade. The Dutch East Indies are controlled to a surprising extent by Dutch enterprise, and the trade statistics of 1923 show an unusually heavy balance with an export of 534 million dollars—a figure more than twice the imports of 241 million.

THE THIRD OR INVESTING STAGE. The foreign investment stage is hard to single out, because the activities which place a country in this stage are likely to run side by side with those which characterize the second. The best illustration of this was to be found in the United States, in the first fifteen years of this century. At that time numberless corporation managers were from time to time collecting vast amounts of cash for interest payments which they annually made to the Europeans who held the stocks of American railways, street railways, breweries and manufacturing enterprises. An interesting example of this is the reported instance of the late Queen of Spain, who, during the Spanish-American War, owned a large amount of American Steel & Wire Company's stock and kept it for safety in the Bank of England. While the United States was paying interest money out of the east door to Europe on these vast borrowings of the past, we were sending capital out of the north door, the west door and the south door. Americans have invested hundreds of millions of dollars in Mexico and South America within the last two decades. This process is continuing in Chile, Canada, and in a number of other countries, so that this investment abroad joined with the payment of interest to capitalists of Europe to make our pre-war excess of exports over imports surprisingly large.

THE FOURTH OR INCOME-RECEIVING AND RETURN OF INVESTMENT STAGE. England has more than once been likened to an old gentleman with many money bags which he jealously guarded. Britain has led in the loaning of money to all equipping countries from New Zealand to Saskatchewan, from San Francisco to Cape Town. British ships also carried the exports and the imports alike of the United States and many other countries. She was also a Mecca for American and Colonial travelers who annually left in Europe many millions more than Europeans left in America.

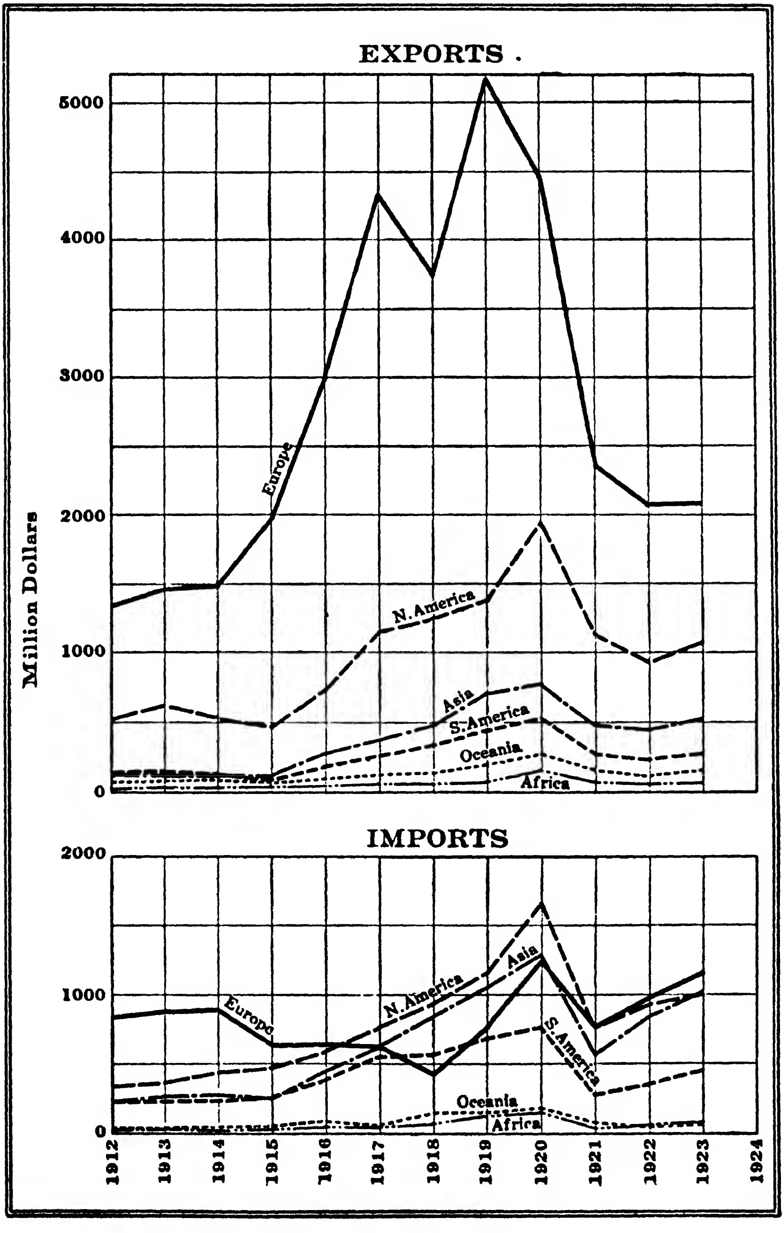


Fig. 286.—United States exports and imports by continents.

Impecunious British aristocrats bartered their titles and high social position (which stayed in England) for the daughters of the new American rich plus a substantial share of the new riches. The net result of all this British investment was shown in Britain's ability year after year, before the war, to import about a billion dollars a year more in goods than she exported. To call that balance unfavorable is ridiculous. At this time also France, Holland, and Belgium belonged in the same favored class of interest receivers, having the so-called unfavorable balance of trade which is really under these conditions a sign of riches.

THE WORLD WAR AS A TRADE BALANCE FACTOR. The foreign trade and the transactions in international finance of the period beginning with 1915 afford a rich collection of facts to illustrate all the principles laid down in the foregoing discussion. The World War was a most remarkable disturbance of international trade and trade balance. It broke all the laws of nations and of God, but it did not break any of the above-mentioned laws of trade balance.

The war had its unbelievably bloody battles, but it was also a war of goods—(*a*) equipment, (*b*) food, (*c*) transport.

(*a*) Equipment. We get some measure of the importance of equipment in this war when we recall that in November, 1914, after the deadlock on the western front and the digging-in of the armies, Lord Kitchener, head of the British armies, announced that the war would last three years. He underestimated it by a twelvemonth, showing that even he did not realize how much time it would take to make the thousands of big guns, the millions of shells, the shiploads of explosives, the tens of thousands of motor trucks, and the other masses of material of which the mere enumeration gets us into figures beyond our understanding. The retailing of these goods in the United States in the post-war years was a continual astonishment as to how so much could have been made.

The United States, with its one hundred million people, its matchless and abundant resources, its machine shops and factory organization spent four busy years making munitions for this war. Every European neutral was equally busy and the warring countries exerted themselves to the utmost.[1]

(*b*) Food. The demand of nations too busy at fighting to work

[1] The fact that so many millions could fight and so many more millions could do war work shows the amazing potential wealth of the world if its powers can be used for constructive work at moderate efficiency.

their land enlarged the wheat fields and corn fields of American farms, and we increased our flocks and our exports of meat as well as grain.

(*c*) Transport. The war was as much a war of transport as it was of men and of munitions. The fleets of motor trucks that ground up the roads of France until they had to be rebuilt time and again came by the trainload from American factories and clogged American ports. The sinking of ships by the submarine put us to feverishly building a navy and created the greatest burst of merchant shipbuilding ever seen. These trucks, these ships, this meat, this bread, these munitions, were all sold to Europe at unheard-of prices, and as a British official remarked to me in the fall of 1917, "You have here in America all the money in the world," and he was not far from right.

Europe had indeed imported and America had exported to the limit, indeed, beyond any limit that the world's financiers had before thought possible. Before the war we had regularly exported a few hundred million dollars a year more than we imported.

Because of the war our balance of trade jumped up to an extent never before seen. Europe imported beyond belief and her exports melted away. She was too busy fighting.

The chart of balance of trade shows how astonishingly Europe bought without sending us goods in return. Instead of sending us goods, as is the habit of trade, they gave us promises to pay at some future time. First, the British and French governments paid for these goods by giving their bonds (promises) to American individuals (bankers). When this had about reached its possible limit, the United States government borrowed the money from the American people (Liberty Bonds) and loaned it to the British and other European governments, which paid for our corn and iron with these credits. The bonds or money never left our shores. It was *goods* that went, and the price was fat.

It was the Liberty Bond that finally pushed up our foreign trade in 1917 and kept it there during 1918, 1919 and 1920. Such unnatural trade without real payment must be temporary. Real goods must follow promise. Unless the debt be forgiven, the Europeans must pay the interest on their bonds and they must some day pay the bonds themselves. To do this they must resume their industries and their trade. They must sell goods to get money with which to pay—if they pay.

That places us in a perplexing position. As a nation expressing itself in legislation, we still have that Napoleonic idea that imports are bad and exports are good.[2] This idea shapes our whole foreign trade policy. Uncle Sam is much like the monkey who reached into the heavy jug and grasped the potato in his fist. He held the potato. He could not get his fist out. He could not lift the jug.

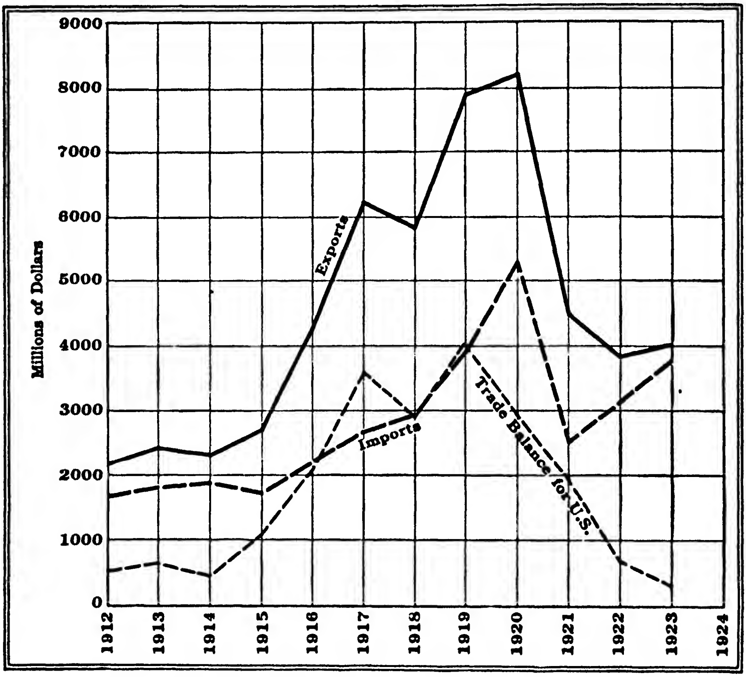


FIG. 287.—United States total trade with the world.

He would not drop the potato; so there he sat, rich (in potato) but impotent to enjoy.

Between 1915 and 1921 we delivered to the world quantities of goods that exceeded the dreams of medieval kings when they told each other fairy tales. We did all this on royal promises to pay. Of course the Europeans can pay us only in goods. These goods they can get to us by one of two ways:

[2] This 18th century idea called mercantilism was held so strongly by Napoleon that he freely permitted England to import grain from the Baltic in 1810–11, thinking that he was thereby injuring her. Really he let England strengthen herself to crush him.

(*a*) Sending their own goods to us, or

(*b*) Sending their goods to third parties who will in turn send us goods.

Trade is the exchange of goods. We have sent them our goods. Now it is their turn to send us theirs. Billions are due us for war debts. Further to increase our prospective imports, the post-war years were years of busy foreign investment by the United States—mines in Chile, plantations in the West Indies, municipal and private loans in Europe. More billions are due us from these sources. The billions must come in goods or not come. The billions are due. Then we put up the tariff to keep them from coming. Then we build up an elaborate governmental foreign trade organization to stimulate exports. We have not yet learned that trade is the exchange of commodities. We are still a nation (as a nation) of economic illiterates. International trade will be interesting to watch for this next fifteen years unless its lunacies bring more war.

CHAPTER XVI

THE INFLUENCE OF GEOGRAPHIC FACTORS ON THE COMMERCIAL POLICY OF NATIONS

Every nation desires the greatest possible measure of independence. There are two kinds—freedom in government and self-supporting independence through variety of industries. Political independence is always menaced by industrial incompleteness and its accompanying commercial dependence which a blockade may convert into starvation to be ended by surrender to the blockading conqueror. As a result of this menace, all the nations of the world desire to establish or maintain as much as possible of the economic independence which alone guarantees political independence.

This economic independence is attained by two means. First, varied industries which use domestic materials and approach completeness in the supply of national needs; and second, an unbreakable chain of commercial connections, which give access to the ports and products of the trading world, thus providing the same necessary goods from foreign sources.

Economic independence through control of the sea. Great Britain offers the one good example of the nation that has rightly felt independent for generations of time because of the unbreakable commercial connections and resultant access to all markets and supplies. For nearly a century these were guaranteed by her policy of keeping a navy as large as the combined navies of any other two European powers. Unfortunately this method involves armed supremacy, and is only applicable to one nation at a time. The supremacy aspect of the situation is only of real value in war. During peace, when all may use the world's highway, the sea, the nations of the world have a close approach to equality in that economic completeness that comes through sea-borne commerce. It is completeness but it is not independence, for all the single lesser nations know that it rests upon the good will of the owners of the stronger navies. But the great advantage of seaports and sea trade makes maritime outlets one of the greatest ambitions of nations.

The World War gave beautiful examples of all these ideas. A single invention, the submarine, all but undermined England's sea-wall. The small nations, Holland, Denmark, Norway, traded as the strong nations dictated. It also showed that no nation can now live to itself alone. China was the last and she has surrendered to interdependence. This serves but to emphasize the importance to any trading people of access to the sea.

Value of access to the sea. Thus Russia has since the beginning of modern times striven seaward from inland Muscovy. When she finally reached the Baltic Sea, she promptly established her capital there (St. Petersburg—Petrograd—Leningrad). Not content with ports on the Black Sea, the White Sea and the cold Sakhalin Channel at the mouth of the Amur, she reached out also for the Persian Gulf, the Yellow Sea and the Sea of Japan, where she came into contact with Japan in the war of 1904. The Soviet government complained bitterly that the creation of the new Baltic states from Poland to Finland was nothing but the jealousy of the great powers shutting off Russia once more from the sea.

Pre-war Germany stood credited by most observers as casting envious eyes on Holland because this small neighbor possessed the mouths of the Rhine, Germany's greatest natural commercial outlet. After the World War reunited Poland was given access to the sea by what is known as the Polish Corridor, although it cut Germany into two parts. Czechoslovakia was guaranteed the use of the Elbe and a German railroad. The Danube, like the Bosporus, is an international stream. Friendly Canada laments that the frozen St. Lawrence makes her naturally dependent upon American Atlantic ports during the winter months. To avoid this dependence, the economically uncalled for Intercolonial Railroad has been built in great detour around Maine so that by this route through the snowy woods, Canada can, if need arises, reach the open sea at St. John, N. F., without crossing American soil. It is also claimed that Canada's good feeling toward England was greatly strained because the mother country acceded to a boundary decision that gave to the United States all the seacoast of Alaska. It should be noted the St. Lawrence carries vast quantities of American produce during the summer months.

Economic independence through varied industry. While sea power as an essential part of economic independence is limited to the nation with a dominant navy, many nations have acted on the theory that they could remain independent by the development of varied industries supported within their own territory. This object dozens of nations are now attempting to attain by protective tariffs that cause the establishment of industries because they give a higher price to the manufacturer who produces and sells within the protected country. The same national end is occasionally sought through the much more honest method of bounties on production. The geographic conditions in which nations are placed cause them to fare variously with their protective tariffs. They have reached a variety of situations in which it is possible to observe the recurrence of phenomena in a way that suggests laws of tariff evolution.

THE BRITISH TARIFF DEVELOPMENT. In tariff developments as in other industrial developments England has been a pioneer. The factory system was first established at a time when a general protective tariff was levied on the products of the factory and the farm and the Napoleonic wars gave a rare opportunity for large sales abroad. Great growth of manufacturing resulted and with it great increase of city population. These city dwellers consumed more food than the English farms produced and the importation of grain that paid a high tariff made the price of food so high that hardship resulted in cities. This same high price made great prosperity for the land owners through the high rents that they could exact from the farmers. Then followed the historic corn law agitation, a strife between a landed aristocracy and the hungry city workers, resulting in the repeal of the tariff and the adoption of the free trade policy. This permitted the import of cheap food which erelong reduced the price of farm produce and so reduced British agriculture. It in no way injured her manufacturing interests because no other country had such supplies of coal, iron, capital, and skilled labor, and consequently there was no real manufacturing rival, except an isolated industry here and there like the silk industry of France.

This situation of British supremacy and resultant free trade continued unchanged for half a century, during which free trade rose in the English mind to the dignity of a virtue—a piece of accepted morality. The opening of the twentieth century saw this position challenged by a strong but unsuccessful agitation for some tariff protection for British manufactures. This resulted from the building up in the United States, Germany, and Belgium of factories that were as efficient as those of Britain, especially as the British, thinking that they owned the seas and the markets tributary thereunto, had been far less keen than the Americans and Germans in adopting improved methods. This foreign competition became the more acute because of the practice of "dumping" in the British market the unsalable surplus of factories in other countries at less than cost. Adjustable tariff to check this practice of dumping has become a common device.

The post-war talk in England about protection has to deal with the unchangeable facts that she must live by importing raw materials and food and that a tariff on either raises the cost of production and of living.

German tariff development. Germany has gone part of the way through the course followed by England. Before her unification, Germany, with many little tariff units, was chopped up into a multitude of local trade units making large domestic trade impossible and causing the continuance in 1870 of the household industry that England had largely discarded in Napoleon's time. Under a general protective tariff she developed between 1870 and 1914 a great factory system and rapidly added to her agriculture a great manufacturing industry. Her cities grew like those of the American West. Berlin matched Chicago in the increase of population. As a result the city populations of Germany cannot be fed from the German fields, so that the protective tariff makes high priced food. The English situation of 1840 is repeated in almost every detail. The corn law fight has been on in Germany since the beginning of this century. A tariff on food means that the German nation of 60 million eats costly bread and meat and the aristocratic landholders, estimated at 300,000 persons, profit by the resulting high rents. As partial pay for this the nation also has the advantage of having a large share of its population living under the better conditions of the country, but the German artisans, like their English fellows of 1845, were on the point of repealing that tariff when the World War broke. The landed aristocracy was slowly losing ground in the contest with the landless millions, and only held its own by a voting system based on the theory and practice that some men's vote counted for more than that of other men.

Holland and Belgium, too weak to be naval powers, too small to have widely varied industries, or many raw materials, and too populous to feed themselves, have low tariffs, approaching free trade, in food, raw materials and manufactures. No other policy seems possible to them. A tariff at any point would embarrass some industry unless levied upon a pure exotic, and it then becomes a mere revenue measure like the English tariff on tobacco or the American tariff on diamonds.

POST-WAR EUROPEAN TARIFFS

A tariff is the greatest single provoker of war there is. There has been a new and bitter crop of them under the operation of that great trouble maker, the Versailles treaty. They should be studied with interest and watched with alarm.

TARIFF DEVELOPMENT IN THE UNITED STATES. The United States is, of all nations in the Western World, best fitted for economic independence through a wealth and variety of natural resources permitting an almost completely satisfying variety in production. The Americans have been but a handful, rioting in the richest abundance and most complete variety of resources to which the hand of man was ever laid. We have been large producers of all important foods and raw materials except rubber, tin and potash, while our supply of cotton, tobacco, petroleum and copper almost verges on monopoly. On this basis of opportunity the protective tariff of the Civil War, laid first as a war revenue measure, produced prompt and surprising growth of manufactures. The protective tariff was then continued as an industrial measure, our factories throve tremendously with the aid of imported labor, and for some decades the United States has been pointed out as the most conspicuous success in the attainment of national independence through varied industry stimulated by the protective tariff. There has been a widespread lack of appreciation of the part that wealth of resources has played in this development.

Within the United States the different sections of the country have furnished an interesting but easily explained medley of opinions on the tariff. New England has wanted a tariff on cloth and shoes to protect her textile mills and shoe factories, but she has wanted no tariff on the raw material, wool and leather, which she did not produce. The wool growers of Ohio have wanted, and generally succeeded in getting, a tariff on raw wool, while the cattle-producing states have desired a tariff on hides. Massachusetts, a coal buyer, has wanted no tariff on coal that she might get it cheaply by boat from Nova Scotia or Wales, while Pennsylvania, a coal producer, has held stoutly for a tariff on coal. Some southern states, exporters of cotton in which they had no rival, and importers of nearly all manufactures, have been thorough free traders until the lumber industry sprang up within their borders, and then their congressmen voted for a tariff on lumber. Many other examples of the origins and changes of tariff attitude in the various sections of the United States might be shown to follow closely upon industrial condition and industrial change.[1]

We have attained our rapid distinction in manufacture while the nation is still an exporter of food and raw materials. As to stage of evolution of tariff policy we are still far behind Germany, although there are signs that we are beginning to approach her condition. While not importing much food, save sugar, tea and coffee, we are using an increasing amount of imported raw material and the cry of "free raw materials" that is now heard is the first symptom of the approach of the American counterpart to the so-called agrarian question in Germany and the corn law agitation in England. If the United States begins regularly to import wheat the tariff question will assume a new intensity through the class conflict between the rural wheat grower and the urban wheat user. Thus far, the meat and grain sections of the country have borne all the pains of the tariff and have been content with party slogans. How the people of Iowa, for example, could do it has been one of the intellectual marvels of my life.

The Orient furnishes two admirable examples of the influence of geographic conditions on national policy in fields other than the tariff.

THE CHINESE POLICY OF ISOLATION. China has persisted in ignoring foreign nations to the great mystification of many Westerners. "Let us alone," was China's expressed sentiment toward all peoples. She was often considered benighted but her policy was probably wise and it was certainly of natural origin. There was little that the world could give her because she was a world in herself. The summer rains of China stimulated agriculture, which availed itself of rich alluvial plains near the sea, while in the

[1] A discussion in one of the meetings of the League of Nations bordered on the ludicrous. The representatives of Belgium (populous and timberless) proposed that the wood resources of the world should be pooled. It was the representative of Canada (scanty of people and rich in wood) who sprang to his feet with instant objection.

north were extensive deposits of fertile loess, the most indestructible of all upland soils. Reaching from the latitude of Havana to that of Newfoundland, her forests ranged from bamboo and oranges, to pine and spruce; her grains from rice to wheat, corn, millet, barley and rye. In the south was cotton; in the center, silk; in the north and west, the wool and hides from the flocks that roamed the 2 million square miles of arid and semi-arid ranges in the provinces. The mines yielded iron, copper, gold, and silver. The careful husbandmen raised pigs and poultry in vast quantities and the fish supply of sea and river was supplemented by fish culture in which the Chinese have led the world. From north to south the grand canal passed between the latitudes of northern Florida and Philadelphia and connected a set of inland waterways vastly better and more used than those of any contemporary nation of 1800 or 1850 or any other date. While the domestic system of manufacturing continued in both East and West, the West had little for China but silver, for the Chinese were far and away the master craftsmen. In 1819 a British publicist lamented the fact that America had in the furs and ginseng of the forest the only commodities except bullion that the Chinese would take in pay for tea which the west desired, and which the western merchants took over the junk side in the Chinese harbors. Naturally China wanted to be let alone by those who had nothing for her and whom she considered ill-mannered. The discovery of petroleum and the invention of machinery, both of which China needs, have given to that country the desire for imports, the basis for a foreign trade, and following that a foreign policy. Along with a foreign policy comes the development of a national sentiment in which China is making great progress. Chinese students who have recently been in American universities did not when in school at home know there was such a thing as *China*. They knew of their own town or district, and the province, but the term China meant no more than Asia. One of the chief things that the Chinese have experienced from their contact with the west, has been the destruction of such central government as they previously had. Out of this chaos, the new economic conditions are raising a new concept, *China*. The idea is being solidified by opposition to the disliked foreigner. It is probable that the idea of a unified China is growing, just as the concept *United States* rose out of separated colonies and finally in the railroad epoch became United States *is* rather than United States *are*

—a grammatical record of a profound change in sentiment made possible by communication. China has telegraph, cheap print and increasing communication to aid her in developing a national concept and organization to deal with the new problems arising from the end of economic independence.

Japan becomes a manufacturing nation. Japan furnishes the second Oriental example of geographic influence upon policy. Like China she had for centuries lived within herself supported by agriculture and household industry. As she approached the limit of possibilities in that direction, western ships visited her shores. Her insular location made easy the infiltration of foreign ideas and foreign goods which her meager resources caused her to desire to import. Japan adopted western learning and western machinery and was seized with the ambition to be a world power. This required armies, navies, arms, railroads, and the mechanical equipment of the inventive west. In the attempt to equip herself with these things Japan realized her poverty, which was intense, alike if she would buy or manufacture at home. Her dense and diligent population could not wring a surplus from the scanty land. There was no surplus of rice, and it is now regularly imported, as are also flour, beans, tobacco, and most of the little meat that they eat, and even phosphate with which they fertilize the fields. To complete the list of her limitations we need but to point out the poverty of factory materials. There is no wool or leather, but little cotton, no rubber, almost no iron, and inferior supplies of coal. Yet the increasing population of Japan must support itself in part by manufacture, or emigrate, or starve. There were no suitable places for extensive emigration, so the demand for manufacturing and the trade in raw materials and finished products was imperative.

Japan becomes possessed of colonies. As the Japanese realized that they must become like England and live by manufacturing, they appreciated the importance to themselves of Korea and Manchuria. They had long imported from these quarters beans, bean oil, and bean cake (for fertilizer), and the trade with these regions promised to be of prime and increasing importance as the country went over to the factory and commercial basis. Korea had unused rice and barley land, promising minerals, and good forests. In Manchuria, corresponding to our upper Mississippi valley and part of the Canadian Northwest, is the finest stretch of unused farm land in the Mongolian world. Manchuria also has forests, coal, and other minerals. These regions would furnish Japan with food, take her manufactures and emigrants, and put her in an independent position resembling that of China or the United States.

Japan's war with China in 1893–94 was little more than a necessary (from Japan's viewpoint) expedition of conquest, and the conquest was provided for in the treaty of peace. Then a coalition of European powers took from her the fruits of the war and handed over to Russia, Port Arthur and the railway, that modern burrowing root of the tree of conquest. Japan, landless, crowded, threatened with suffocation, prepared herself for mortal combat as probably no nation ever did, and when Russia laid hands on Korea, she sprang and fought the Russo-Japanese War, 1904–05, and to the profound astonishment of the world, won for a second time the possibility of a large part of that economic independence which has enabled China to scorn the world and has made the United States unique among the nations.

In the desire for an acquisition of a colonial empire, Japan is by no means unique, she is merely late. Most of the other powers have had colonies or the desire for them for many decades, and the efforts of some nations to get them have been small tributes to human intelligence.

THE REASON FOR COLONIAL POSSESSIONS. Despite many philanthropic protestations, which are rarely believed by the well-informed, the commonest working theory of colonies is the same as that which causes the imposition of protective tariffs, to reserve the home market for the home manufacturer at the expense of consumers. The colony merely enlarges the home market idea through some arrangement whereby the enterprisers of the home country have advantage over foreigners in availing themselves of the economic opportunities created by the colonies. Chief among these devices are preferential tariffs, concessions of lands and other resources, favorable franchises to corporations, and favorable navigation laws.

The dominant idea back of the acquisition of colonies is the securing of markets. Owing to the instinct for national completeness men sacrifice the known mutual advantages of trade, for every nation is glad to sell and chary of buying. Selling abroad is almost always regarded as an economic virtue for a nation. At the same time it is a corresponding or greater virtue to supply wants at home.. Abundant selling and meager buying is the impossible and contradictory ideal for which most nations strive. It is a curious survival of the old economic doctrine of mercantilism. Owing to this preference it is easy for any people to buy but often difficult for the people of one nation to sell to those of another. Hence the strife for foreign markets which can be made absolutely secure only by possession. It is one of the war-making aspects of tariffs. Hence the international scramble for colonies which has caused so many wars in these last two centuries and has resulted in the loss of independence for nearly all of Asia and the speedy partition of Africa by the colony grabbers. No publicist doubts that the Monroe Doctrine is the only force that has for decades prevented the partitioning among the market-monopolizing powers of Europe of all that part of the New World south of the United States.

If nations put no more obstructions in the way of the individual's buying than they put in the way of his selling, and gave all individuals an equal opportunity to develop resources, the desire for colonies would largely die, and the map of the world would look very different from that which now exists. Nations would actually be trying to persuade each other to take possession of certain unruly peoples and give good government and hence permit the creation of commerce for all to share. Such a millennial dream is very far from the existing world condition of rivalry, jealousy and threatened war among colonial powers. On the other hand the mandate system of the League of Nations may bring some such condition to pass much more quickly than is now supposed possible. We are still in the psychology and philosophy of international anarchy.

Japan, like the United States, was very late in having any desire for colonies. Japan had first to abandon the domestic system before she realized any need for markets and colonies, but she then needed them more acutely than any other nation ever needed them, and she accordingly changed her policy with the most astonishing rapidity. In a very short time she became possessed of colonies, the desire for which is a psychological and political response to the economic fact that a nation has emigrating people who need homes, or manufactures for which she desires markets, or both.

One of the most interesting aspects of international relations is the complex of activity and the maze of fictions and pretenses by which nations express and often try to hide the desire for colonies.

THE PROCESS OF ACQUIRING COLONIES. The way nations impelled by these forces gradually absorb weak countries is well illustrated by the fate of North Africa. In 1840 France sent an armed force into Algeria (Turkish territory) to protect her missionaries and from that foothold her power has extended until she owns Algeria, Tunis, and the larger part of west Africa from the Mediterranean to the Gulf of Guinea and the Congo River. There are varying degrees of formality in this. France still tolerates a figurehead Dey or native ruler in Tunis.

Out of the franchise to build the Suez Canal came a French and British influence that resulted before the World War in the practical rule of Egypt by a British agent and a British army.

In 1904, France and England arrived at an agreement (entente cordiale) concerning spheres of influence in the Mediterranean. France agreed to give England a free hand in Egyptian affairs in return for surrender by England of any exclusive interests in the western Mediterranean. Since 1840 France had been gradually extending her control in Africa, and was far on the way toward an absorption of Morocco through the extension of influence over customs, police and banking. The removal of England left Morocco apparently to the mercy of France and Spain. Spain had for centuries held a few towns opposite Gibraltar. In 1905, Germany interfered, alleging that France was aiming at commercial monopoly in Morocco. As a pretext for German interference, German subjects had concessions to build certain public works, especially a mole in Tangiers. She demanded that an international conference be held to determine the status of Morocco. Members of this conference, held at Algeciras, Spain, were England, France, Spain, Germany, Austria-Hungary, Italy, Belgium, Netherlands, Portugal, Russia, Sweden, Morocco, and the United States. This was the full list of the Caucasian colonizing Powers plus Sweden. After long conference the demand of Germany for a share in control of Moroccan affairs was not granted. The police of the country were placed in French and Spanish control, as were also the finances, and the reduction of Morocco went on with quicker pace in the campaigns that were promptly waged against her fiercely independent tribes. Within five years after the Algeciras conference the right of France and Spain to partition Morocco was recognized by treaty. The Mohammedan tribes have made it a task of many costly campaigns. Meanwhile, came that greatest of all bomb shells in the colonial world—Mr. Wilson's phrase, "The self-determination of peoples." Post-war Egypt got into a ferment, England gave her "independence," an artful combination of phrase and gesture which permits the Egyptians to be independent while England still rules them.

This brief account of the passing of north Africa from independence is typical of the modern process of Colonial acquisition in a world where there is not enough land to go around. Middle Africa with its many ignorant, unorganized and weak tribes was merely parceled off by the nations as town lots might be parceled by a syndicate of purchasers—England, France, Germany, Austria, Italy, and Spain, each taking a piece or two, big or little, according to the strength of their hands.

The most refined methods of annexation are through loans and railways. The weak nation borrows, and the interest is not paid. The lender takes possession of the custom houses to collect the interest on the debt and it is very easy for custom house control to spread to the control of the towns and then the country. Thus the United States became the dominant force in San Domingo by common consent when Europe threatened to do it if we did not. By the railway conquest, the undeveloped nation agrees that a railway shall be built in its territory by representatives of some more powerful nation. Such were the Russian railways, across Manchuria to Vladivostok and to Port Arthur. The railways and the workers thereon required protection. The difference between police protection and an army is a line that has never been pointed out. Russian soldiers in great multitudes entered Manchuria, which the whole world recognized in a few years as essentially a Russian province, as Egypt is an English province despite the claims of the new Egyptian government. By the War of 1904 Japan took the rights to some of the Manchurian railways from Russia by force. China was no less dismembered by this change in concessionaires who were really conquerors.

The colonial expansion of the United States is an interesting example of the way an energetic people overflows industrially, commercially and then politically when it has arrived at a relative saturation at home. Despite the pious promises of platforms and Presidents we have overflowed into the Caribbean since 1898 with the steadiness and irresistibleness that characterize glaciers (in books). McKinley, Roosevelt, Wilson, Harding, Coolidge—have *spoken* variously, but they have kept one policy. The forms of this control have been fascinating in their variety. For a good concise account, see Bowman, Isaiah, *The New World*.

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