THE ENCYCLOPEDIA OF HEALTH AND PHYSICAL CULTURE

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EDITOR-IN-CHIEF

A COMPRFHENSIVE GUIDE TO THE PROPER CARE AND COMPLETE DEVELOPMENT OF THE HUMAN BODY WITH DETAILED DIRECTIONS FOR THE PREVENTION AND TREATMENT OF DISEASE

INCLUDING SCIENTIFIC METHODS FOR BUILDING DYNAMIC, POWERFUL HEALTH AND ATTAINING A SYMMETRICAL, BEAUTIFUL BODY

ARRANGED FOR READY READING
CLASSIFIED FOR IMMEDIATE REFERENCE

IN EIGHT VOLUMES

VOLUME II

MACFADDEN BOOK COMPANY, INC.

NEW YORK

1933

Tenth Edition

Printed in the United States of America

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THE ENCYCLOPEDIA OF HEALTH

VOLUME II

BASIC PRINCIPLES OF NUTRITION

Foreword by the Editor

BEFORE we take up in more detail the scientific study of food and nutrition, let us set forth a few fundamental principles regarding human food and the eating habits of man.

FIRST PRINCIPLE: *Instinctive appetite should guide human eating habits.* Any substance which is the result of growth, vegetable or animal, and which appeals to the true instinctive taste of man should prove valuable for human nourishment. Were this not true the human race could not have survived.

Basic Principles of Diet

The scientific knowledge of foods is comparatively new in the world and that knowledge is not yet complete. Without it, man like all other animals, had only instinct, appetite and taste to guide him. With such guidance alone man developed to his dominating superiority and conquered all other forms of life on this earth, which proves that such food instincts were dependable.

The intelligence manifested through natural law is supreme. It governs the growth and development of life and the survival of the race proves the soundness of these natural laws. Primitive man, like all other animals, had no thought-out conception of these laws. They were expressed in him through instincts, hunger and appetite.

When man ignores these guiding forces within him he is very apt to go astray. Civilized man has gone very far astray in his eating habits and has allowed many of his true food instincts to be perverted, destroyed or replaced by artificial or cultivated tastes and habits. These have brought untold nutritional evils, caused a loss of strength and vitality, encouraged disease and shortened man's life.

In the present age modern science is discovering many of these grave errors and mistakes in our eating habits. But no man, not even the most learned food chemist, can yet fully depend upon pure scientific knowledge to guide his food selection and eating habits. We all must still depend very largely on instinctive taste and appetite. But in most people such self-reliance is unconscious, and hence in grave danger of being perverted by the artificial influences of civilization.

As we acquire modern scientific knowledge of food we should also give attention to the cultivation of natural food instincts. Civilized people lead unnatural lives dietetically. They do not eat according to natural law because they fail to regard and develop their natural instincts. People eat when they are not hungry. They use artificial seasoning to disguise the true tastes of food. Instead of regarding the inner voice of instinct (and the call of true appetite), they ignore it and cultivate artificial tastes and food habits that are contrary to natural law.

Instinct and Diet

Though modern food science and industry are doing much to remedy the graver of nutritional blunders, we cannot yet depend upon such science alone to guide us. We have food instincts as do the wild animals and we should see to it that

PHOTOGRAPH EWING GALLOWAY

In all lands food instinct as well as economy play their part in the housewife's choice of foods. This may be said even of such wayside markets as that shown in this scene from Java.

they are developed and allowed to function instead of being perverted and destroyed.

SECOND PRINCIPLE: *Man can be properly nourished only by natural food.* Food that has perpetuated the human race for thousands of generations must be dependable for the nourishment of man. Science has not yet succeeded in making artificial or synthetic food. We are still dependent wholly upon the products of Nature for our sustenance. When we tamper with those products we do so at our peril. If intentionally or inadvertantly some of the essential vital elements needed to sustain life's processes are removed, we have not true food but a defective product that will not sustain the highest form of life and vitality.

Artificial Foods Dangerous

Our foods should be consumed with all their natural elemental constituents. No particle of their elemental value or substance should be removed or destroyed. We should strive to have as large a proportion of our diet as possible composed of fresh unaltered foods in the form in which they are grown. We should make it our business to find out

PHOTOGRAPH EWING GALLOWAY

The roadside market of our clime and time has flourished because of growing appreciation of the flavor and superior quality of foods fresh from their source of production in nearby gardens and farms.

whether any of the changes and processes through which foods are put before they reach us have been such as to impair their nutritional worth and vital qualities. Foods that are so changed should be rejected.

No form of life can be supported wholly upon laboratory products, and man is no exception to this fundamental law. Even if such a thing might be theoretically possible it is yet as far from practical achievement as is a means for human travel to some distant planet. Man must still live on natural food, by which is meant food as provided by Nature, containing all its natural elements and flavors and not doctored or devitalized by man. One would think that the common sense of this principle must appeal to every one capable of reason. Yet when we first advocated this doctrine of natural foods, supposedly scientific writers of that day were by no means in accord with such views.

Food chemists had discovered and classified a few of the more important nutritional elements of food. In their faith in this incomplete and theoretical knowledge they thought they could judge the nourishing and health-building qualities of any food by its mere chemical analysis.

Such a fallacious doctrine played into the hands of those commercial interests that were putting out artificially processed, compounded, preserved and doctored food. How dangerous such products are we now well know, and much scientific evidence has been brought forward to show why they are dangerous. But until that evidence was produced a belief in the superior wisdom of Nature in these matters was our only protection. And it is still the best protection, because people are easily fooled by scientific-sounding arguments in favor of artificial foods, whereas anyone should be able to see that if the foods which Nature provides had not been perfectly adapted to the needs of the body the race could not have survived.

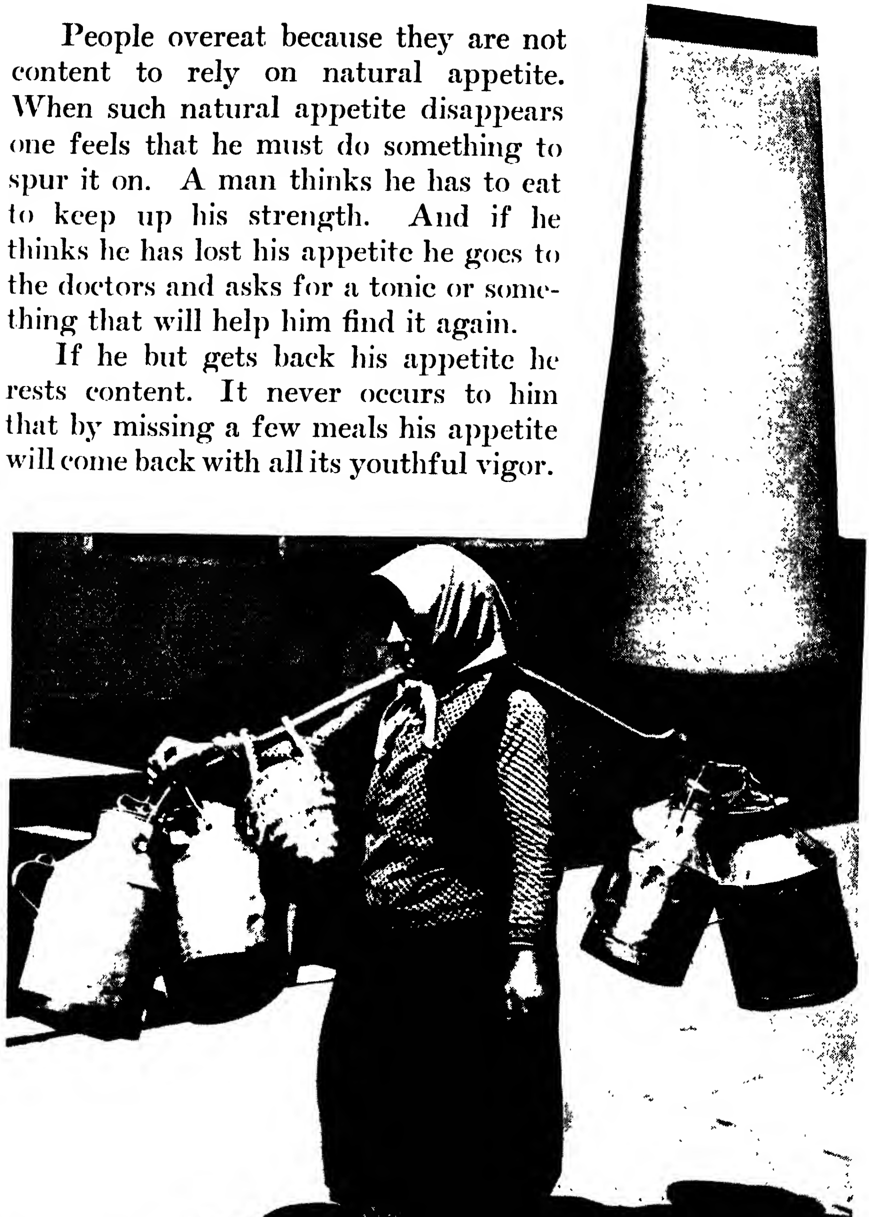
Tendency Toward Overeating

THIRD PRINCIPLE: *Overeating is adult civilized man's most common dietary error.* Food taken in excess of the body's actual needs is worse than wasted. It turns to poisons and overtaxes the organs of elimination. It is also a needless burden on the digestion, since Nature provides only enough digestive juices to handle the food the body needs.

People overeat because they are not content to rely on natural appetite. When such natural appetite disappears one feels that he must do something to spur it on. A man thinks he has to eat to keep up his strength. And if he thinks he has lost his appetite he goes to the doctors and asks for a tonic or something that will help him find it again.

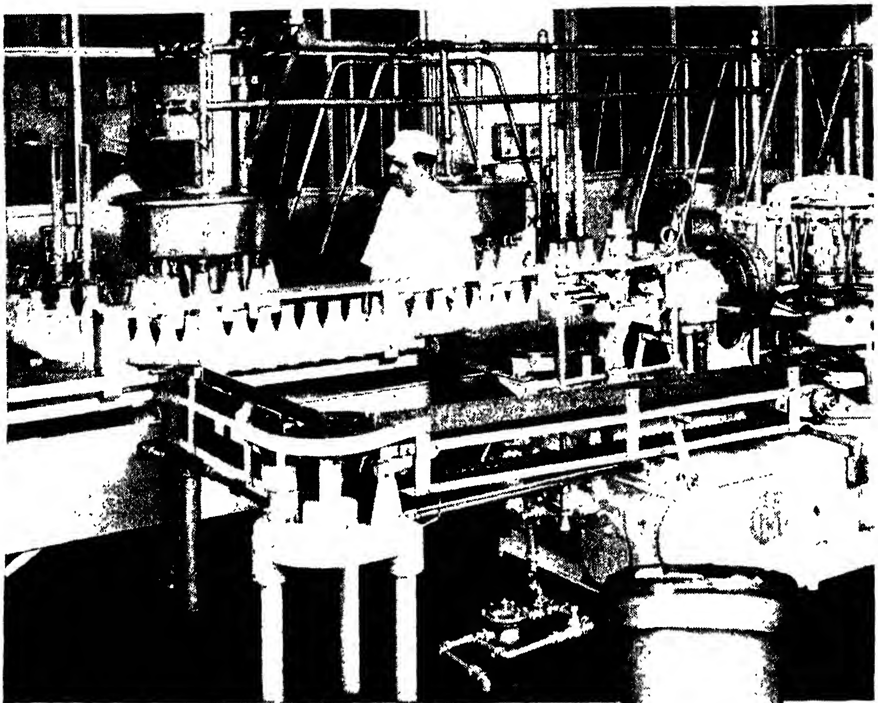
Fasting and Appetite

If he but gets back his appetite he rests content. It never occurs to him that by missing a few meals his appetite will come back with all its youthful vigor.



PHOTOGRAPH EWING GALLOWAY

A modern sealed and sanitary cardboard container for milk, contrasted with the time-honored milk distributing customs still pursued in many parts of Europe.




PHOTOGRAPH THE BORDEN COMPANY

A single generation witnessed the introduction of pasteurizing and sanitary milk production as well as the milk-bottle that became so familiar in the households of every class.

And this "something" will not allow the appetite or the stomach to readjust itself. Continued adherence to this policy sometimes destroys the appetite. You cease to enjoy your food but continue to eat as a duty. But you can wear yourself out prematurely through such overeating. You waste your vital energies and endanger your life. Far more people have died from overeating than from alcoholic indulgences.

Omission of Meals

Adult civilized man tends to overeat for many reasons. Usually his indoor habits of life and shorter hours of physical exercise have reduced his food requirements below those of primitive man, and also below those of more active civilized youth. The chief use for food in the body is to furnish fuel for muscular energy. Muscles may be developed by brief periods of well-selected special exercise, but their food requirements depend on both the degree and the duration of exercise. Hence even the physical culturist with well-developed muscles, if he exercises them only for a short time each day, is in grave danger of overestimating his true food requirements.

The cooking of foods and other softening processes lead to their being too quickly swallowed without chewing. The use of highly seasoned foods stimulates a false appetite, and the custom of eating three or more regular meals a day leads to eating without real appetite. Growing children occasionally overeat, but are not as likely to do so as adults, because their food requirements are greater and their instincts more natural.

"Three-Meals-a-Day" Custom

FOURTH PRINCIPLE: *Two meals a day are sufficient for the man or woman at light work.* The three-meal-a-day habit is a species of dietary slavery that sends many people to premature graves. People sit down to three meals a day merely because this was the habit of their hard-working pioneer forefathers.

True appetite and not convention nor habit should govern the frequency of meals and amount of food eaten. There is no more erroneous or pernicious doctrine than the belief that three full meals a day are necessary. Far from being essential to health they are often destructive to it. The three-meal habit was established when practically all people lived on farms, and both men and women were engaged in active physical labor for from ten to fifteen hours a day. Three full-sized meals may actually be needed under such circumstances, but the continuing of this habit by modern town-dwellers, or even, in these days of labor-saving machinery, by country people is often very injurious.

The food demands of the body vary according to circumstances, and our appetites are given us to enable us to govern our food supply according to these varying needs. The belief that the failure of appetite is always a sign of coming illness, and that the way to prevent the development of the illness is to force oneself to eat whether hungry or not, is not only absolutely wrong, but the practice is the surest way of bringing on illness. Yet that is just what insistence upon the regularity of meals is likely to lead to.

Hunger vs. Habit

Meals at regular hours are a convenience in the world of business and family life, but they have no foundation in nature. Hunger and the availability of food are the only natural factors that govern the eating habits of animals. Man might be better off if he ate in the same way. However, one will never suffer from putting off eating till the next regular meal-time. A far greater danger is that of always eating when the meal-time arrives even though appetite is lacking. If the appetite is slight one should eat accordingly.

The number of meals a day should be a matter for individual choice, and even then there can be no hard and fast rule. However, it is helpful for the individual to have some approximate plan. For men at hard labor and for active growing children three meals a day are generally desirable. For men at sedentary work and for most adult women, except those who are underweight, two meals is the best general plan. An alternative plan is one heavy meal and two light ones; but even when two meals are eaten one of the meals should be less than the other.

The time of the meals depends on the working habits of the individual. Breakfast is the meal most frequently omitted but others prefer to omit the midday meal. The heavy meal of the day may be taken either at midday or in the early evening. Late meals at night are not to be recommended, neither should solid food be taken just before retiring. Nothing, ordinarily, should be eaten between meals. The exceptions allowed to this rule are the drinking of milk in the case of milk diets, or in cases of underweight or malnutrition, and the use of fresh fruit or fruit juice in other cases.

Fasting for Remedial Purposes

FIFTH PRINCIPLE: *Fasting is an important health-restoring and health-preserving measure.* For the habitual evils of overeating and loss of appetite there is only one remedy and that is to fast for two or three meals and sometimes for several days. This is guaranteed to bring back an appetite that will not only enable you to enjoy your food but will insure proper digestion and assimilation.

PHOTOGRAPH EWING GALLOWAY

Readily assimilable and rich in mineral salts, as well as in protein and fat, milk is the ideal food for growth in childhood. In the form of the milk diet it is equally ideal for re-growth or re-building of the adult body.

Your body will then be supplied with the quality of blood that will give you force and enthusiasm. You will have that feeling of aliveness and buoyancy that will throw out gloom and despair.

When you eat wholesome foods solely at the dictates of a normal appetite they taste delicious. And the ability to enjoy life in all its various phases is fully possessed. Do not make the mistake of forcing an appetite. Wait for it!

Fasting: A Natural Process

I usually fast one day every week, sometimes two or more days. When Monday appears the subject automatically presents itself. That is my fast day and the query as to whether I need a fast must be faced. I have no rigid rule. If my appetite is good fasting is omitted.

All animals and primitive men were subject to occasional enforced fasts, due to lack of regular food supplies. Therefore the belief of modern man that fasting is a dangerous and destructive thing has no foundation in nature or science. Because of these enforced fasts the animal and human organisms are provided with nutritive reserves, and it is quite as natural to make use of these reserves occasionally as it is to derive sustenance for a complete lifetime from a supply eaten daily.

This principle was recognized by ancient peoples, as is evidenced by the wide prevalence of some form of fasting as a religious or purifying ceremony, and it is my belief that a man's health will be improved and his life prolonged by taking occasional short fasts, even when in health. In disease physical culturists hold fasting to be a valuable curative measure and have for years advocated its use for remedial purposes. Fasting is a natural and instinctive remedy used by all animal life. The prejudice against it does not rest upon real evidence, but is due to the fact that it is at variance with conventional opinion. Curative fasting will be fully discussed under its proper heading in another volume.

SIXTH PRINCIPLE: *One should not eat too many kinds of food at a meal.* Civilized man not only eats too much and too frequently but his meals are too complicated. We may need variety of food to secure a variety of food elements but we should get that variety from meal to meal and not try to eat everything at one meal. No animal under natural conditions eats like that.

Few Foods at Each Meal

It has been proved that there is a certain amount of special adaptation of the digestive juices to the specific purpose of

PHOTOGRAPH JESSIE TARBOX BEALS

A group of northern vegetables rich in cellulose: Asparagus, egg plant, artichoke, kale, rhubarb, peas, parsley, and white summer squash. Cellulose adds bulk to the diet and aids intestinal peristalsis.

digesting the different types of foods. Obviously, there would be a lesser degree of perfection in such adaptation of the digestive juices when too wide a variety of foods is put into the stomach at one time. It is little wonder, then, that nine-course dinners, each course consisting of several ingredients, or of dishes made of several ingredients, should result in the breakdown of the digestive systems of those who persist in indulging in them.

Carrying this principle of the simplification of meals to the most logical end would give us meals consisting of a single natural food at each meal. This plan of eating may be called a "mono-diet," though perhaps a better term would be the "mono-meal," as the plan is to use only one food at a meal, and not one food as a continuous diet. This simple procedure is often very beneficial in relieving digestive disorders, and the meal of a single food has the further advantage of enabling one to learn which foods can be digested easily and which give distress.

Mono-Diets

The principle of "food combinations" which has been elaborated in detail by some writers is founded on this principle of avoiding the complicated meals of conventional cookery. The combinations recommended are usually more easily digested than the senseless meals elaborated by the average cook. However, this theory is capable of misapplications, and many of the lists of forbidden combinations frighten people into limiting their foods to such a degree that they are more likely to suffer from dietetic deficiencies than to gain any benefit from the supposedly better combinations. As a general truth it may be stated that any foods which are good in themselves may be eaten in any simple combinations that do not cause symptoms of indigestion or distress.

Combination Diets

SEVENTH PRINCIPLE: *Food is a major factor in the cause and cure of disease.* The statement has often been made that we are to a large extent what food makes us. It furnishes the various elements that feed the body, and our physical and mental, and even moral status is to a large extent controlled by the character and quantity of food.

With the science of health-building founded on a proper basis we should acquire knowledge of the various foods and their uses that would enable us to predict definitely certain physiological results. Even very brief experimentation produces really amazing evidence as to what can be accomplished through the scientific use of various diets.

The common-sense consideration of the great part that food plays in the building and daily maintenance of the human body convinces us that diet should be a major therapeutic method. This simple idea has been obscured by resort to drug medication, but food therapy has gained far greater recognition and development in the last twenty years than ever before. Dietetics has now become one of the fundamental factors of healing even among orthodox medical physicians. Numerous diseases are now conceded to be of nutritional origin and curable only by dietetic methods, while, in the case of others, diet is recognized as an important factor.

Diet and Disease

The accumulating evidence of the value of curative diets is, in fact, so great that some enthusiasts proclaim diet as a cure for everything. That is a dangerous doctrine, and is especially so when it takes its cue from old drugging notions and tries to find a specific food, analogous to the specific drug, to cure each particular disease. There is no basis for this idea in Nature. If undernourishment has been a factor in bringing about disease, an especially complete and readily available form of nourishment is needed. But when overnourishment has been a major factor in producing it, then fasting or partial fasting, or some special purifying and eliminative diet, is called for.

A specific and very important application of curative dietetics is the milk diet. This perhaps has a wider application than any other curative diet, and, often preceded by fasting, is a most effective remedy. In this connection it should be noted that milk is different from all other foods in that it is produced for the special nourishment and rapid growth of the young animal organism. There is no other food like it in this respect, and therefore no other food can rival it as a body-building and curative agent. The importance of the milk diet is such that, like fasting, it is discussed in detail in a later section of this volume.

Remedial Foods

Certain special uses of fruits and vegetables or their juices combine the principles of both the fast and the milk diet. Milk is a complete building and fuel food, including most available forms of sugar, fat and proteins, as well as all minerals and vitamins. Fruits and vegetables with a large proportion of water are not such complete foods, and are not alone adapted fully to nourish the body.

But there are occasions when the body has been overfed on the more common food elements and especially on protein and starches. Then it may require abstinence from such elements, and at the same time need a ready supply of the minerals and vitamins which have been denied it. This is the explanation of the special value of such measures as the orange-juice or the grape-juice diet, and also of the use of vegetable juices and leafy vegetables.

Fruits and Vegetables as Curatives

Such special uses of these products are likely to be indicated in cases of overweight, just as the milk diet is likely to be desirable in cases of underweight. However, there are occasional cases in which the body is not overweight yet in which the use of fruit or vegetable juices for a short time will rest the digestive organs and help in the elimination of accumulated toxins, or poisons, from the body. That such a use of these foods is intended by Nature is indicated by the frequent craving we have for acid fruit juices.

PHOTOGRAPH UNDERWOOD & UNDERWOOD

Enormous pineapple plantations are cultivated in the Hawaiian Islands, where large factories preserve in cans the huge yields of the fertile soil.

A further specific remedial application of food is for the relief of constipation. Man's bowels were made to accommodate a certain amount of fiber, and when it is entirely omitted from his diet there is not enough bulk left after digestion to fill the intestines sufficiently to get speedy elimination of the wastes. Lack of exercise contributes to the difficulty, so that the prevalent condition of civilized man, especially when engaged in sedentary work, is one of chronic constipation.

Diet and Constipation

Constipation is the source of much disease, and is certainly incompatible with health. This filthy internal condition of the human body is inexcusable and cannot be tolerated by any person with a proper sense of either health or cleanliness. Right food is the remedy, and one of the worst practices which we have inherited from our unenlightened past is that of periodically relieving the condition with drug purges.

Today nearly all medical men condemn the habit of using purges and cathartics and acknowledge natural foods as being the only satisfactory means of preventing or curing this condition. Progressive physicians carry this idea to its logical conclusion and condemn the white flour and similar denatured foods which are chiefly responsible for constipation and related troubles.

Eighth Principle: *Water is more essential to life than food.* We can live longer without solid food elements than we can without water. We often overlook the importance of water to health because it is not costly nor hard to prepare. Yet two-thirds of the weight of the body is water and water is the universal solvent that enables the life processes to be carried on.

Water and Elimination

Whereas the most common danger in the use of foods is overeating, the great danger in the use of water is underdrinking. Means for the harmless elimination of surplus water from the body are provided, and in this process, whether through the kidneys or the skin, various waste products and impurities are also eliminated. Hence when too little water is taken dangerous wastes must be retained in the body. Moreover, the evaporation of water from the skin is Nature's means of controlling body temperature—hence the especial importance of drinking freely in warm weather.

Sweating is a natural process and every man would be better off if he secured one good sweat every day by means of ample water-drinking and active exercise. He will likewise be benefited if he also passes a copious, though not excessive amount, of water from the kidneys.

Thirst: What It Indicates

The instinct of thirst is separate from that of hunger and should be independently satisfied. It is better that a man drink enough water between meals so that he is not too thirsty at meal-time. However, if he is thirsty at meal-time he should drink to satisfy that thirst, for it may indicate an insufficient amount of water in the body to furnish the proper fluid consistency for the digestive juices. But water, when drunk at meal-time, should never be used to wash down food which has not been sufficiently masticated to be swallowed in a natural fashion.

PHOTOGRAPH INTERNATIONAL NEWSREEL

The date palm and fruit borne by one prolific tree.

Ninth Principle: *Thorough mastication of* *food is essential to health.* Our teeth were given us to use and we should use them to chew our food. Too many soft, pasty, mushy foods should not be used; neither should foods be ground and milled too fine. Raw foods are better than most cooked foods to encourage chewing. Whole-grain products demand more chewing than the refined forms, and unpeeled fruits and vegetables more than those from which the skins have been removed. Foods that are good to prevent constipation are usually good also to encourage mastication, though this is not always true. Pure starchy products like white bread may, when hard-toasted, encourage chewing without either preventing constipation or contributing much to nutrition.

Thorough Mastication Essential

Even milk should be "masticated," that is sipped slowly and moved about in the mouth a moment for the enjoyment of its taste and to mix it with saliva before swallowing. It should be remembered that milk is a food and you should not drink it like water. Absolutely the best way to take milk, however, is to make the opening of the lips so small that one has to draw in the milk with a small amount of energy. One then exactly imitates the suckling of an infant, which enables

PHOTOGRAPH EWING GALLOWAY

The Eskimo still obtains his food supply under conditions that existed in the glacial age, although vegetation is not completely lacking in many sections of the Arctic regions.

one to get all the delicious flavor out of the milk, which is then assimilated advantageously.

Hasty eating and bolting one's food without mastication is a prevalent cause of indigestion. When one hasn't time to eat properly one should not eat at all or should take only such amount as can be properly eaten in the time allowed.

TENTH PRINCIPLE: *Meat is adapted to use as a food with certain reservations.* Meat does not always combine satisfactorily with the other foods with which it is eaten. The meat-eating animal eats meat alone. The vegetarian-fruit-eating animal never eats meat. The digestive processes do not easily combine. If you want to eat meat, the more nearly you make your meal on meat alone the more easily it will digest.

Meat-eating vs. Vegetarianism

A great many people have associated meat-eating with all sorts of disease. Meat, as a rule, is more inclined to fill the tissues with foreign elements or poisons than vegetarian foods.

PHOTOGRAPH UNDERWOOD & UNDERWOOD

Figs are an important factor in the foodstuffs of Eastern lands. That they are still esteemed the world over, is proved by such scenes as this waterfront view of the port of Smyrna, showing tons of figs in bags. From this shipping point figs are sent to all parts of the world.

The meatless diet is less stimulating, but will usually give one more endurance and less immediate strength, which would indicate that one ought to live longer on a non-meat diet than on a meat diet.

If you eat meat it is usually desirable to avoid immature meats, like veal, though lamb is not so objectionable. Fully matured meats like beef and mutton are more commendable. Avoid pork altogether. Moses, the great law giver, undoubtedly had the health of the Jews in mind when he eliminated pork. It is not a wholesome meat, though ham and bacon are less objectionable than fresh pork. The preservative process through which ham and bacon are put destroys some of the germ life that pork sometimes harbors.

The fact that so many people eat and apparently thrive on meat is simply evidence of the truly amazing digestive powers of the race.

If you like meat and it agrees with you, eat it.

The question of meat-eating is one of the most disputed points in dietetics. Perhaps more of this argument is due to moral or sentimental feeling about the slaughter of animals for food than to actual consideration of the value of meat for human nourishment. Extreme vegetarians refuse not only all meat, but even milk and eggs. On the other hand are found those who think meat the most essential food and condemn all systems of vegetarianism.

Lacto-Vegetarianism

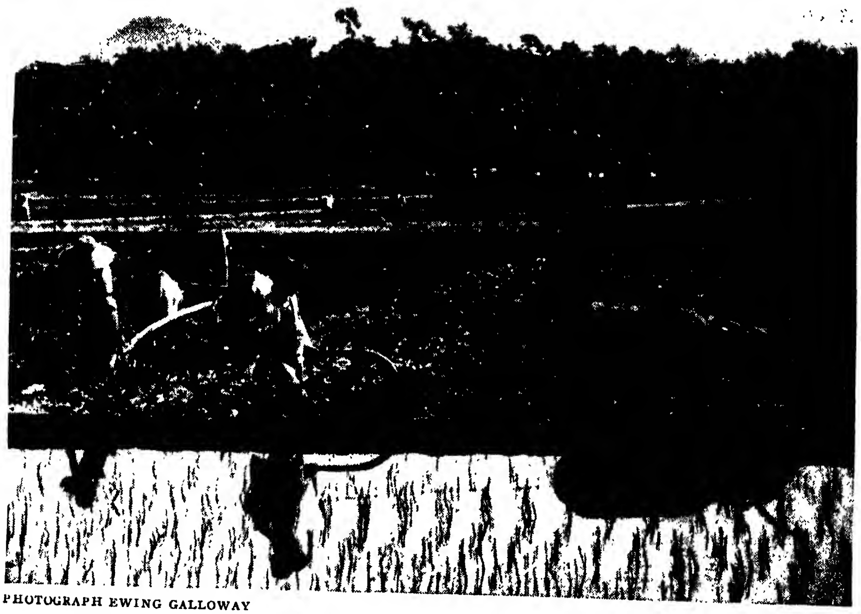
Between these extreme views there are two forms of compromise. One is that of the lacto-vegetarians who do not eat the flesh of animals, but who use a plentiful supply of milk, butter, cheese and usually eggs; the other is that of light meat-eating, which may vary from the use of meat once a day to its use once a week. On either of these compromise plans it is usually easier to obtain perfect nutrition than by either rigid vegetarianism or the conventional diet in which meat is eaten twice or three times a day and made the chief dish of practically every meal.

Those who have a sufficient knowledge of dietetics are able to work out most excellent and nourishing menus either with or without the use of any animal products whatsoever. But in diets not carefully selected some animal products, especially milk, add materially to the completeness of nutrition, and for most people to the palatability of the diet also. For children particularly, milk is highly desirable and well-nigh a necessity, though when overnourished, as indicated by the appearance of colds, boils, etc., milk should be avoided or used exclusive of all other foods, fruits being excepted. In many cases where sweet whole milk does not combine satisfactorily with cooked foods in adult life, soured milk products do so combine.

But little justification exists for those who condemn the use of milk on the ground that it is unnatural food for man.

Loss of Vital Elements

ELEVENTH PRINCIPLE: *Foods robbed of their vital elements by commercial refining should be avoided.* Modern white-flour milling, the refining of sugar and many other artificial processes of refining and purifying foods destroy true food values. Such processes were developed for commercial reasons either to make the foods keep better or to improve the appearance to the eye and hence the sales value to those who do not realize that they are thus being tricked and robbed of the vital elements of life.



PHOTOGRAPH EWING GALLOWAY

The primitive conditions under which rice is cultivated are interesting. Yet they are far less important than is the retention of the natural nutritive qualities of the cereal in its preparation for human food. The best kind of rice is the natural grain, unpolished and unrefined.

White flour and other forms of denatured cereal products, together with refined sugar, candy, artificial beverages and pastries are robbing millions of people of vitality and health. There is no way to protect consumers against these grave dangers except by education. Pure food laws do not help, because the trouble with the over-refined foods is not the addition of adulterants but the absence of natural elements, the minerals and vitamins and coarse fiber, that are removed from the natural products.

White Flour Harmful

There may be worse foods in the world than white flour, but there is no food equally defective that is so widely used. This deficient flour has been a major element in our diet. Statistics indicate that about one-fourth of the total amount of food consumed in this country is wheat, and probably nine-

PHOTOGRAPH UNDERWOOD & UNDERWOOD

Light and fluffy white breads probably attained their popularity in civilized countries because of their extreme contrast with darker and less delicate breadstuffs, despite the greater food value of more primitive products of the miller and baker.

tenths of this is still used in the form of white flour. If such a proportion of flour is used on the average, many of the poorer families must use even larger proportions. With lard and sugar added to this white flour, probably many people are trying to live with considerably more than half their foods derived from these three products, which are almost completely devoid of cellulose or fiber, and therefore highly constipating, besides being otherwise deficient.

Growing Use of Whole-wheat Products

It has been gratifying to watch the growth of the advocacy and use of whole wheat products. Whole wheat is now recommended by the majority of doctors, food scientists and writers. Popular use has not spread as fast as the popular advocacy, but this is true in the case of many reforms, especially if powerful commercial interests oppose the change. However, if people know what they should use it is their own fault if they fail to put this knowledge into practice, and no one is to blame but themselves if they suffer for their negligence.

Refined cane sugar is even more devoid of vital food elements than is white flour. Of the food sugars found in nature, cane sugar is one of the rarest; yet under civilized conditions refined cane sugar has become one of the most prominent constituents of our diet.

PHOTOGRAPH INTERNATIONAL NEWSREEL

The breadfruit, romantically named, modern science finds no more complete as food than many other natural products.

There seems to be no limit to this pernicious appetite for artificially sweetened foods. The use of white flour and lard are now beginning to decrease, but the consumption of cane sugar continues to increase. The per-capita consumption of sugar in America has reached about 120 pounds per year. This means a third of a pound a day for every man, woman and child. If some do not use so much, it means that others are using even more. Probably many individuals use as much as half a pound of sugar a day, which would mean anywhere from a fourth to a half of their total food consumption. Much sugar is used in the form of candy. Soft drinks of all kinds probably account for still more. Canned fruits, preserves, jams and jellies further add to the quota, and so do syrups of various sorts.

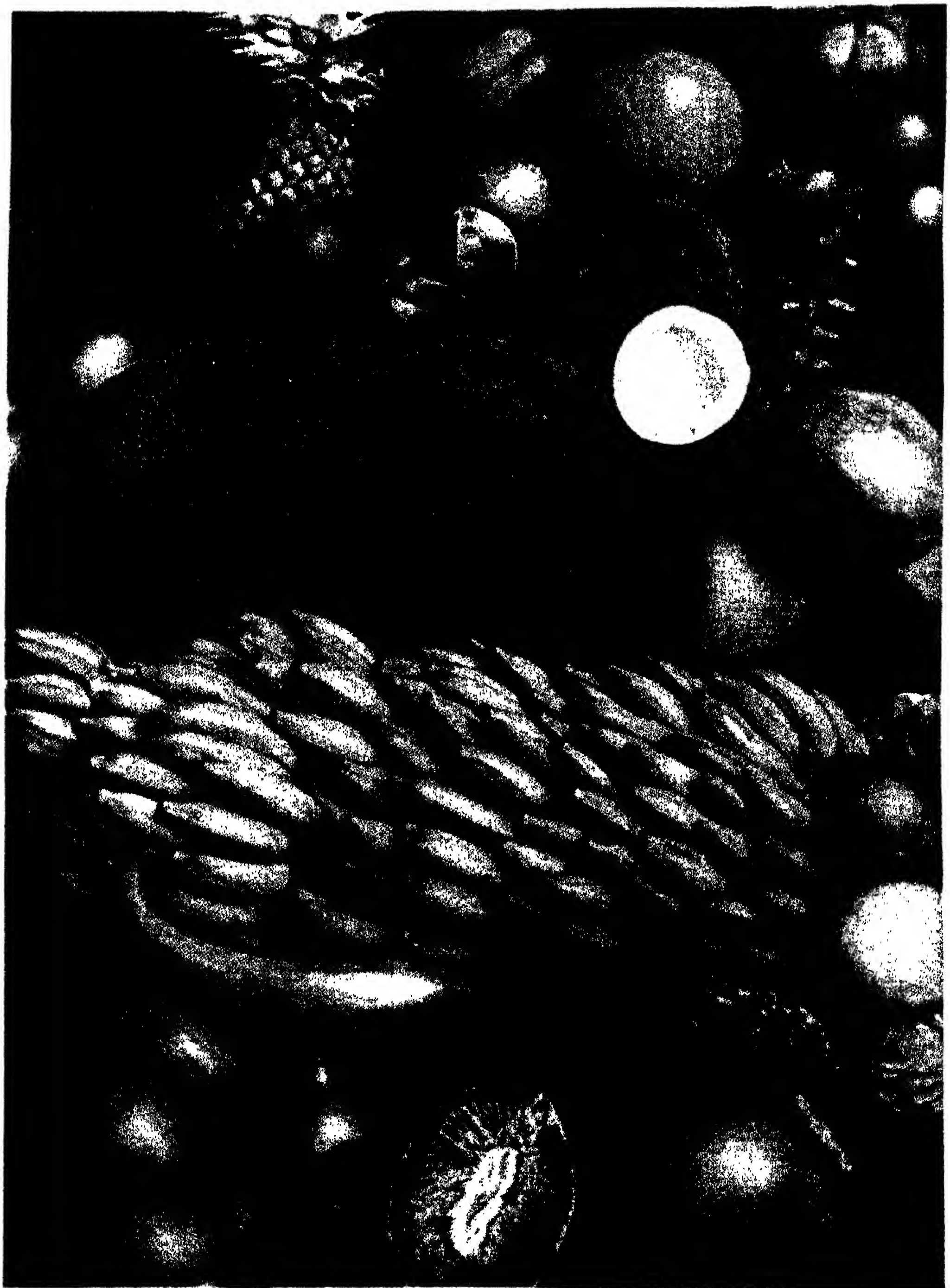
The use of a reasonable amount of cane sugar on the table in conjunction with various foods and drinks is not in itself as dangerous a practice as the eating of highly sweetened foods, such as cakes, pies, pastries and the like. For these foods contain quantities of sugar unknown to the person who eats them.

Overuse of Sugar

But the habit of sweetening nearly all foods has grown to such a degree that one feels obliged to caution people to cut down on sugar wherever possible. No one type of use would be particularly objectionable, but all such used together overload the system with sugar and crowd out not only natural sweets, but other articles of food as well.

A third form of fuel in a refined form is oils and fats. Some of these are needed in the diet, but when they are added to the starch and sugar elements the total result is made worse. White flour, pure fats and refined sugar have each been proved incapable of supporting life alone, and no diet of which such substances form a large proportion can possibly be free from the danger of disease-breeding deficiencies.

TWELFTH PRINCIPLE: *Many foods are more nourishing in their natural uncooked state.* Cooking is a wholly artificial and unnatural process, but it is not without its advantages. It renders many foods more palatable and in some cases more digestible. Cooking should bring out flavors. Any form of cooking that destroys the natural flavor of food should be looked upon with suspicion as it may indicate a destruction of nutritional value.



PHOTOGRAPH UNDERWOOD & UNDERWOOD

PLATE 16. Tropical fruits shown in this colored photograph include: Pineapple, mango, pawpaw, oranges and cocoanut (in upper portion), breadfruit—large, round green fruit—and bananas (in center), with unicorn fruit and interior of pawpaw (in lower portion).

When the writer first advocated a greater use of uncooked foods the idea was met with ridicule. Today dietitians stress the importance of eating more uncooked foods.

The plan of using a wholly uncooked diet, while not adopted by any large number of people, has a growing following of enthusiasts.

Uncooked Foods Advisable

The belief that the cooking of practically all foods was necessary to health and digestion was at one time almost universal. This can be explained only by man's natural inclination to go to extremes in the application of any idea that has once become popular. A diet consisting largely of meats, grain products, potatoes and beans is obviously more palatable when cooked. These staples were formerly much more used than they are today, and so cooking became universal. Those who wrote on foods looked about for arguments to uphold the prevailing practice, for the ordinary mind is always more interested in finding reasons for defending existing customs than in trying to discover the real truth.

There are, no doubt, many individual foods that are more digestible and certainly more palatable when cooked. Yet there are also many that are both more nutritious and more palatable when uncooked. Hence, on the whole, the advocates of the uncooked diet have a better argument than the advocates of universal cooking. Moreover the advocates of cooking have never been wholly consistent. Conventional diets have always included a large number of foods in uncooked form. To mention a few, we have lettuce and celery, apples and oranges, milk and nuts, which have always been used extensively in the uncooked forms. Therefore any such sweeping arguments as that cooking is necessary to make food digestible for the human stomach, or to destroy disease germs, are obviously inconsistent with established customs.

Laboratory scientists, using the biological method of experimentation, have now developed evidence of the positively harmful effects of cooking on vitamins, particularly vitamin C. Modern scientific discoveries thus furnish evidence of the soundness of the idea of seeking to develop rules of living based on a common-sense interpretation of natural laws.

Fried Foods

Of the cooking processes frying is the most objectionable. The American custom of frying foods, especially in lard, is objectionable both because of its effect upon the food so treated, and the effect of adding so much pure fat to the diet.

The Overuse of Fats

An ideal natural diet includes a considerable proportion of fat, and such fat is an integral part of many natural foods. This is true of milk, of eggs, of nuts and also of many other vegetable foods. Most fruits have very little fat; yet the olive and the avocado, or alligator pear, are very rich in it. There are also some excellent combinations in which fat is added to foods that have little or none. Examples of this are the use of butter to spread on bread, and of olive or other vegetable oils to dress salads. Such uses of fat create no indigestible compounds. But when food is fried, or when fat is added to flour and sugar mixtures in the making of pastries, we thor-

PHOTOGRAPH EWING GALLOWAY

Crude as is the method of crushing grain still followed by these South American Indians and coarse as the flour thus produced, it retains its nutritive qualities more effectively than the bleached product that results from the use of our highly developed machinery.

oughly coat and saturate the other food particles with the penetrating hot fat and make a combination that taxes the digestive powers.

THIRTEENTH PRINCIPLE: *Excessive seasoning with salt, sugar, spices and condiments should be avoided.* The best natural foods need no artificial seasoning or flavoring of any kind. This is certainly true of fruits, nuts and milk. Other foods are flatter in taste, and the temptation to use some flavoring agent to make them more palatable is natural. But the flavoring of foods with salt, pepper and hot spices and artificial acids like vinegar, to say nothing of still more artificial synthetic products, is a perversion of natural taste instincts that may lead to serious evils.

Effects of Various Seasonings

All such added food flavorings are habit forming to some degree, in that once their use is begun the tendency is gradually to increase the dosage, until natural flavors are destroyed or disguised and the natural appetite is submerged by a multitude of artificial cravings. When this stage has been reached the value of appetite as a guide in the selection of food, either for quality or quantity, is almost entirely lost. Overeating is thus encouraged, resulting either in the breakdown of digestion or in obesity.

Most food seasonings have little or no nutritive value. Sugar is an exception in that it is high in fuel value. It is the taste element in sugar, however, rather than the nutritive element, that is responsible for its excessive use; hence much that is here said in regard to seasoning also applies to the sweetening of food with sugar. The use of vinegar or other added acids to give a sour taste is obviously a perversion of our instinctive taste for acid fruits which have real value. The use of pepper and numerous other hot spices originally came about because they were used as food preservatives in hot countries where foods spoil very quickly.

There is, perhaps, more ground for debate about the use of common salt than about that of any other food flavoring. The scientific details of this argument will be taken up under the discussion of mineral nutrition. Some salt is needed by the body but it is quite as evident that its use to the extent common today is wholly unnecessary and probably quite injurious.

PHOTOGRAPH INTERNATIONAL NEWSREEL

Oven of primitive design as used in Sweden for baking "Flatbrod," a form of bread made in flat loaves from rye flour.

FOURTEENTH PRINCIPLE: *Artificial coloring, flavorings, preservatives and adulterants in food are not to be tolerated.* On the use of such nefarious substances there never has been any great difference of opinion, except on the part of people who were making money from such indefensible practices. Happily the worst abuses of this sort have now been eradicated. The Pure Food Law has been well enforced, because popular opinion favored such enforcement. However, it is generally conceded that it did not go far enough in that it failed to forbid the use of certain preservatives, dyes and flavorings which, if not positively proved to be harmful, are at least in the doubtful class.

Flavorings Destroy Food Instincts

Many have unfortunately accepted the idea of "purity" as being a sufficient standard by which to measure all food values. Yet some of the very purest foods are the poorest foods—refined sugar, for example. The idea of purity is too generally associated with the processes of refining, whitening and bleaching.

All such artificial purifying processes are likely to result when applied to food, in the removal of the very elements upon which life depends. Hence, while physical culturists want pure foods in the sense that they do not want adulterants or poisons added to them, they do not want them artificially purified by the removal of natural food elements. When this distinction is not clearly understood, it is quite possible that the idea of judging foods solely on the basis of purity or color may result in more harm than good.

Fifteenth Principle: *Enjoyment of food essential.* Sound enjoyment of the nutritive qualities of foodstuffs will enable man to reject devitalized and deficient foods. With such knowledge, intelligent selection of foods to build mind and body becomes possible.

To eat without an appetite and without enjoyment is to place a burden upon the digestive organs, with the absence of the digestive processes that are essential to normal and healthful nutrition. To relish the food we eat is the first important step in its digestion. Science and human experience prove that when healthful appetite exists, the first taste, indeed, even sight of food invites the flow of digestive secretions that are essential to assimilation.

To eat without enjoyment is to court indigestion. The building of healthy cells and of energy and vitality depends in great measure, upon the degree to which you relish your food.

Pure Foods and Poor Foods

To conclude this introductory survey of principles of nutrition we are impressed that directly or indirectly the problems of modern diet come out of the fact that man's food instincts tend to be confused and defeated because of the vast changes that have been wrought in human foods and eating habits by the conditions of modern civilization.

This situation renders it difficult for man to rely wholly on his instincts and therefore requires an intelligent study of foods and their uses if we are to hope to achieve a maximum degree of health and vitality under our present conditions of life.

B. M.

PROGRESS IN FOOD SCIENCE

Section 1

ABOUT the close of the nineteenth century, when the work of building up the physical culture movement was beginning, there existed a very dogmatic fund of knowledge which was supposed to be the last word in food science. This science had been largely developed by food chemists in Germany and by chemists employed in the agricultural experiment stations of this country. The science of medicine for the most part ignored diet altogether, except in a few diseases such as diabetes, and in so far as it paid any attention to the subject it accepted the teaching of the government food chemists. Their theories, although interesting, were useless for practical purposes. People might have found themselves worse off if they had tried to apply the teachings of those early government bulletins on foods and diet.

Origin of Food Science

During the last twenty years great progress has been made in this field and the food scientists today are much more nearly in line with the common-sense doctrines summarized in the Foreword of this volume. Still orthodoxy in any field of knowledge dies slowly, and while the progressive scientists have greatly changed their teachings, the elementary textbooks in the schools and the many less original teachers, doctors and writers are still repeating the blunders of a generation ago.

The blunders of this earlier school of food science lay not so much in teaching actual fallacies as in overlooking important truths. It was built on the scheme of analyzing all foods for five classes of nutritive substances. These were designated as water, protein, carbohydrates, fat and ash. But no live food (natural form of food) ever was completely analyzed until vitamins became a factor in food science.

Water

The term *water* is self-explanatory, and the percentage of this element was given in the early food analyses chiefly

A visual demonstration of caloric values. Two quarts of buttermilk (or skimmed milk) as shown on the left are found to equal in calories the three-quarters of a full pint of thin cream, or the three-quarters of a half-pint bottle of heavy cream, or a quart of whole milk.

as an indication of the degree to which it lessened the economic value of a food, water in the food substance having no more value than water from a well, for which we do not wish to pay at the same rate as for food.

Carbohydrates

The term *carbohydrates* is a group name for starch and various kinds of sugars. These were rated together for the very good reason that starch during digestion is changed into one of the sugars and hence serves the same ultimate function in the body. Starches and sugars are all fuel foods and serve no other purpose. *Fat* was listed separately for the reason that it is a more concentrated form of fuel, one pound of fat having two and one-fourth times as much fuel value, or calories, as a pound of starch or sugar.

When foods are burned a certain small proportion of their substance remains. This material was listed either as *ash* or *minerals,* and little thought was given either to its actual composition or its value to the body. Some of the text-books stated that minerals existed in the body, and cited the bones and teeth as being made of such minerals; but little attention was paid to the subject and no practical application made of the facts.

Discussion of *protein* has been withheld until the last, because we have so far said little about it in this volume, and also because it was considered of the greatest importance in the period of food science under consideration. Protein is a group name for many actually different substances that have the one property in common of possessing the chemical element *nitrogen,* whereas the carbohydrates and fats contain only oxygen, carbon and hydrogen. These latter elements are fuel elements only, and their use is to be burned or oxidized in the body. Protein contains the same fuel elements and these elements are also capable of being burned. But not the nitrogen. The nitrogen of air will not burn in a fire, nor will nitrogen in food burn in the body. Instead, it is eliminated, after it has served its purpose, as a waste product through the kidneys, mostly in the form of urea and to a lesser degree as uric acid, creatinine and other chemical compounds. Not only is protein distinguished from the other food elements because of this separate method of final elimination from the body, but also because the body itself is built of substances that contain nitrogen and therefore class as protein. This is true of all tissues and organs except the body's stored fuel in the form of fat. Even bones contain protein as well as minerals.

Protein

It is no wonder, then, that protein was considered a very important element in food, in fact the most important element. For many years the value of foods was largely rated by the proportion of protein which they contained, and such a rating is still popular in many minds, especially in the case of those partial to a diet composed largely of meat, since lean meat is the muscle of animals and, like human muscles, is composed of protein and water.

Water and Ash Given Little Value

In the above system of estimating the value of foods, the item of water was thought to have no great significance, which belief is still commonly held today. The item of ash or minerals was also largely ignored, which most modern scientists now realize to have been a very grievous mistake. This left only three groups to be considered, the protein, carbohydrates and fat. A still further element of simplification was achieved in the invention of the term *calorie* to measure the fuel value of the carbohydrates and the fat and also of that fraction of the protein that was capable of being oxidized or burned in the body. For practical purposes, therefore, only two facts were thought to be significant, and these were the amount of protein and the total calorie value of the food as daily consumed.

Calorie is always a puzzling term. It is not a substance any more than pounds or gallons are substances. All such terms are units of measurement. One can have a pound of feathers or a pound of shot, or a gallon of water, or a gallon of molasses. So one can have a calorie of sugar, or a calorie of fat, or a calorie of beans, or a calorie of milk. The calorie is, strictly speaking, a unit of measurement of the amount of heat that is given off when any fuel is burned. The heat may be given off rapidly and at high temperatures, or slowly and at low temperatures, but the calorie measures the amount of total heat in any case. The word calorie means the amount of heat that will raise one kilogram of water one degree on the Centigrade scale. Foods differ widely in their fuel capacity according to the different amounts of water or carbohydrates which they contain. The more water foods contain the less calories, but the more fat, sugar or starch the more calories.

Calorie, the Measure for Fuel Food

All this elaborate analysis of hundreds of foods having been made and the calorie values per pound of each kind of food having been calculated, the next problem that arose was what use could be made of the knowledge. When any fund of knowledge has been assembled, the presumption always is that it must have some practical application and use. So the food chemists of that period felt that since they could tell people

In glasses from left to right appear: Mayonnaise dressing, French dressing and "boiled" dressing, containing 100 calories each. Of the lettuce, nearly 20 ounces are required to provide the same amount of calories as contained in the several "dressings" mentioned.

what was in their foods they ought also to be able to tell them how much of each food element or property they should consume. But all this knowledge of the composition of foods was gained before we really knew much about the actual uses of food in the body. No one even knew how much protein a man should eat, or how many calories he either should or did consume in a day.

The natural course was to find out what people actually did consume. So a large number of dietary studies of various groups of individuals were made and from these studies of actual diets scientists made up what they called the standards of food requirements per day. The standards most used and most often quoted in America are those of Professor Atwater and are as follows:

	Grams of Protein	Calories
Man at hard muscular work	150	4150
Man at moderately active muscular work	125	3400
Man at sedentary or woman at moderately active work	100	2700
Man without muscular exercise or woman at light to moderate work	90	2450

Calories in the Daily Ration

These standards have been taught to thousands of girls in cooking schools and have been read by hundreds of thousands of people; but it is questionable whether they have ever been of any practical use in improving the diets of those who studied them. Sometimes, perhaps, the contrary has been the case.

Their fundamental error lies in the fact that they failed to take into account the possibility of error in the prevailing dietary habits. The approach to the problem was made on the ever-popular assumption that whatever is, is right, which in this particular field meant that what the average man ate every man should eat. That the result was to incorporate errors in the standards no one would now question.

The natural tendency of man to overeat when offered an abundance of cooked and highly seasoned food was responsible for the most conspicuous of these errors. People like the taste of food and like to eat till they are forced to stop by an overloaded stomach or the loss of appetite. There are many factors about modern foods that tempt man to eat too rapidly and to eat, not the minimum requirement, but to maximum capacity. As a logical result any dietary standard based on

PHOTOGRAPH INTERNATIONAL NEWSREEL—EWING GALLOWAY

PLATE 17. Wheatfield in Northwestern America, with stack of wheat shown with child in inset.

what people do eat must carry this typical error. It is difficult, however, to be very definite in criticizing the standards on this score, because of the looseness of their terms. Of course, we must assume that they were meant for men and women of average size. But even for individuals who are typical in that respect, application of the standards to the personal diet would be likely to lead to serious mistakes.

Can We Adopt a Standard Diet?

No man likes to consider himself lazy or inactive, and hence persons seeking guidance from this source would be inclined to class themselves rather higher in the scale of activity than the facts justified. Thus a man working in a factory and feeling very tired at night would probably decide that he belonged in the group engaged in "moderately active muscular work." But if his work consisted in handling light tools, or operating a power-driven machine, and if he took no strenuous outdoor exercise, the chances are that his actual food requirements would be much nearer those prescribed for men "at sedentary work." Therefore, in attempting to apply such a table to his own case he would merely be forcing himself to overeat to the extent of 500 to 1,000 calories per day. This would be disastrous to his health.

Likewise a typical office man, who considers himself a hard worker and perhaps plays golf on Sunday, would be likely to place himself in the group calling for 2,700 calories a day. The error would not be so great as in the previous case, but the estimate would still be from 200 to 500 calories in excess of his real needs, and that would be sufficient to make him accumulate fat.

The women, to whom only two classifications are given in the tables, would be even more likely to go astray. A woman engaged in the tiresome business of running a large household might class herself as an active worker and try to consume her 2,700 calories, whereas her real requirements would be nearer 2,000. In fact, only the exceptional woman, who is engaged in some sort of outdoor labor or very active sport, is ever likely to require more than 2,500 calories per day, and most women in the modern world require less than 2,000. No wonder, with such standards officially taught, that the women of the past generation were plagued with obesity!

Woman's Diet

In the matter of the protein standard the error was even

Old Ideas Still Prevail

greater in proportion, though perhaps not so serious in consequence. For one thing, muscular work does not create an additional demand for protein. This fact has been known to science for nearly a hundred years, and yet the idea is still prevalent that hard-working men require more protein than others, in the shape of good lean meat. That again is merely a case of putting the stamp of scientific approval upon human indulgence. The hard-working man has a good appetite and craves meat because he likes the taste of it. But he does not actually need it in quantities appreciably greater than the sedentary man. However, he can eat it more safely because his activity enables him to dispose of the surplus with greater ease. These old standards, therefore, had two blunders in regard to protein. The amounts stated are much too high for any group of men, and the assumption that greater muscular activity increases the protein requirement is also false. This subject will be gone into more thoroughly later.

The reason these old dietary

The sweet potato, a high calorie vegetable, provides about 50 per cent. more food value than the white potato.

PHOTOGRAPH EWING GALLOWAY

standards and theories have been discussed is because this conception of food science which was orthodox a generation ago still pervades so much of our popular teachings in schools, in the medical world and in popular health books and publications. It is therefore the approach to nutritional science that most people have, or still get when they begin to study the subject.

The entire scheme came out of the conventional or orthodox belief that prosperous people were eating as they should, and that the function of science was to study such ways of living and set them up as standards for all to follow.

Individuality and Diet

Physical culturists, on the contrary, approached the subject on a basis of suspicion of the food and health habits of conventional people. They believed that the weakness and disease of civilized man were brought about by departure from Nature's laws, and not by the ill-will of Providence. That this viewpoint is sounder than the other has not only been demonstrated by the success of the physical culture movement but by the later developments of science.

Modern nutritional science has no quarrel with physical culture; in fact, the two have merged and become one and the same thing. But the general public has a hard time keeping up with modern science, and does not know that the early theories have been discredited.

Therefore these erroneous ideas are still used by certain food interests, such as the meat industries and the manufacturers of refined fuel foods. These stand to profit by the retention of the old dietary habits, and by old dietary teachings that not only justified a wrong selection of foods but sanctioned their overuse.

All this does not mean that the earlier nutritional science is useless, or that such terms as *caloric, carbohydrates, fats* and *protein* are to be abandoned. We are still interested in the classifications of food designated by the latter terms, and the calorie is still useful as a unit of measurement. But to understand all the properties and purposes of food we need other knowledge also.

NEED OF COMPLETE NUTRITION

Section 2

CONSIDERING the fact that the living body is built from food, we find that a knowledge of the science of chemistry, or the composition of matter, is a great aid in the study of nutrition. But chemistry, like mathematics, is an abstract and dull science that can be learned only by years of tedious study in schools; and most people who study it in schools forget it in time, unless they make later application of the knowledge to some purpose in which they are interested. No attempt will be made in this work to go into abstract chemistry, but such chemical science as applies to our purpose, that is, the understanding of food and its use in building and maintaining a healthy body, will be presented in as simple and readable a manner as possible.

Chemistry and Food Problems

One fundamental principle of chemistry is that all matter is composed of relatively few chemical elements. There are some eighty-odd elements known. But less than twenty of them are biological elements, essential to the composition of living matter or to the maintenance of the functions of life. Most of the remainder either do not concern us in studying the life processes—or they concern us only as things to be avoided, since many of them are poisonous when taken into the body.

A further principle of chemistry is that the elements cannot be created nor destroyed nor changed. This statement may not be entirely in harmony with some of the finer researches of modern science. In rare instances the creation of elements from other elements may have actually been demonstrated; and during the tremendous eons of time that measure the history of the universe, no doubt such changes in chemical elements have taken place and have consumed or released vast stores of cosmic energy. But these far-flung theories of science do not affect our brief lives. For the practical purpose of studying the chemistry of our own bodies we may accept the law of the unchangeableness of the chemical elements.

The practical conclusion from these principles is that plant or animal organisms cannot grow nor function without a supply of certain chemical elements. If these elements are not available, life cannot come into existence. If the supply is not kept up, life will cease. If the needed amount of any element is limited, life will be impaired, function disturbed and disease created.

This is the modern deficiency theory of disease, which teaches that pathological conditions may be caused by an insufficiency of some required chemical or nutritional element. In other words, the body is starving for that particular element. This does not mean that the element is entirely absent. In the complete absence of an essential element life would cease. But for each element there is an optimum quantity or proportion best suited to maintain the functions of life, and departures from these ideal quantities must mean impairment of the functions of life.

Chemical Elements Needed for Life

The problem of feeding the body is the problem of maintaining the ideal quantities and proportions of all the needed elements. Either an excess or a deficiency of these quantities produces an unideal or unhealthful condition. Either an excess or a deficiency might be equally harmful. The healthy body, however, has rather remarkable powers of casting off or eliminating any surplus of nutritional elements, whereas it cannot add to a deficient supply. The existing supply can be husbanded and conserved to a certain and, in fact, a rather remarkable extent, but no chemical elements can be created in the body. They must come from the food eaten, and if they are not supplied in proper quantities health will be impaired and ultimately life will be destroyed.

Certain diseases are now clearly recognized as being due to the lack of definite substances in the food and are known as deficiency diseases. But there is a far greater number of diseases the cause of which does not appear to be so simple, in which various deficiencies play a part and add to or aggravate other disease-producing factors. The typical case of ill-health is due to a combination of deficiencies of some food elements and excesses of others. In other words, the diet is not properly balanced or proportioned. This creates an abnormal blood chemistry. Thus the power of resisting or keeping out foreign organisms is decreased, and we may get bacterial penetration or infections which appear to be the cause of the disease, though the prime cause was in the failure to maintain normal blood chemistry.

The Blood as Sewage

The blood is the depository of all life's constructive forces. It also acts as the outlet for the destructive elements (the sewage of the body). This life fluid is the base from which all health procedures must begin, and if we would woo and win health we must see that all its constituents are maintained in their correct proportions and that the sewage is not allowed to accumulate in it.

By such reasoning we see that poor nutrition, or wrong feeding of our bodies, is an almost universal cause of disease. There are other factors of course, but the failure of proper nutrition is the basic and most prevalent cause.

So far the chemical elements have been spoken of as if they were the food elements. Food and all other substances in this material world are composed of chemical elements, but whereas there are only a few chemical elements there are many thousands of chemical compounds. The difference between a chemical element and a chemical compound is that the element cannot be divided or changed into something else while the compound may be.

Water is a chemical compound. A molecule of water is made of two atoms of hydrogen and one of oxygen; hence the familiar chemical formula H_2O. Under certain conditions an electric current will decompose water into hydrogen and oxygen. Water is a liquid at ordinary temperatures, but the two elements of which it is composed are gases. When they are mixed in the proper proportions and ignited, the mixture instantly explodes or burns. What happens is that the two gases combine to form water again. At first it is gaseous water, or steam, because of the high temperature; but as soon as this steam cools it liquefies into a few drops of water, leaving a vacuum if the vessel in which the gaseous mixture was exploded was sealed. Because water can thus be shown to be a compound made of two elements, we know that water is not an element. Because the oxygen and hydrogen have never been separated into other elements, we believe them to be final chemical elements.

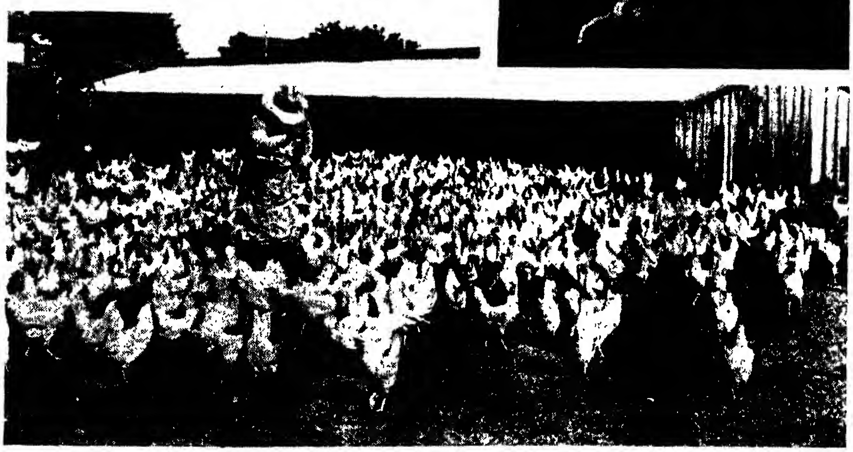
The Human Body and Water

The human body requires water for its existence, as do all living things. In fact, it requires a great deal of water, because water is its chief component. Life can be preserved in a dormant state, as in the seeds of plants, with but little moisture; but the living tissues of all forms of animal life must contain a great deal of water, and death occurs if this percentage of water is decreased very much below the normal proportion. This is death by thirst, and in such cases thirst is merely a deficiency disease caused by lack of water. We do not consider water a food, and yet in the larger sense it is a food and a very essential one.

Oxygen is an element and also a food—in fact it is the most important of foods. It is so important that instead of taking it into the stomach along with other foods, we have developed a special organ known as the lungs by means of which we feed ourselves on oxygen. And whereas we can go several days without water and many weeks without solid food, life can last but a few minutes when the sup-

Modern poultry farming has greatly increased our supply of eggs, recognized as an important factor in diet.

PHOTOGRAPH EWING GALLOWAY



ply of oxygen is shut off or the lungs cease to function.

The oxygen in the air is not compounded or chemically combined with any other elements. It is simply mixed with other gases, the chief of which is nitrogen. Nitrogen, which is more abundant in the air than the oxygen, is perfectly useless to us while in the elemental gaseous form, but we can and do use elemental oxygen in the gaseous form. It passes into the lungs, is absorbed by the blood and carried to all the tissues. There it combines with carbon and hydrogen, but only after these have been combined into the chemical compounds known as sugars and fats, which already contain some oxygen. These are the fuel foods referred to in previous sections. When the fuel foods containing carbon and hydrogen are burned or united in the tissues with the oxygen brought from the lungs, the result is again the simple oxygen-hydrogen compound of water and the equally simple carbon dioxide. Thus we form water in our bodies and use the elemental oxygen in making it.

Elements That Are Unavailable

But we cannot use hydrogen in its elemental form. Elemental hydrogen is not a food and is of no use to the body; yet as a component of water, or sugar, or fat, or protein, it is an essential of life.

Likewise carbon, which as an element is useless to the body, is still necessary to life, and all common foods contain it. Elemental carbon in the crystalized form of diamonds is worthless to the nutrition of the body, though some people place considerable value upon it as a body ornament. Lampblack and charcoal are also elemental carbon. This form of carbon is an excellent fuel for a furnace, but worthless for that purpose to the human body. Powdered charcoal and lampblack are useful to take internally on certain occasions, which will be discussed later, just because they are wholly indigestible and are wholly unchanged in passing through the alimentary canal.

The above discussion will serve to illustrate some of the common principles of chemistry as they apply to life and nutrition. The four chemical elements of oxygen, carbon, hydrogen and nitrogen are the most abundant elements in our bodies, and therefore the most abundant elements in our foods. One is not more important than the other, since they are all absolutely essential. And yet the way in which they are es-

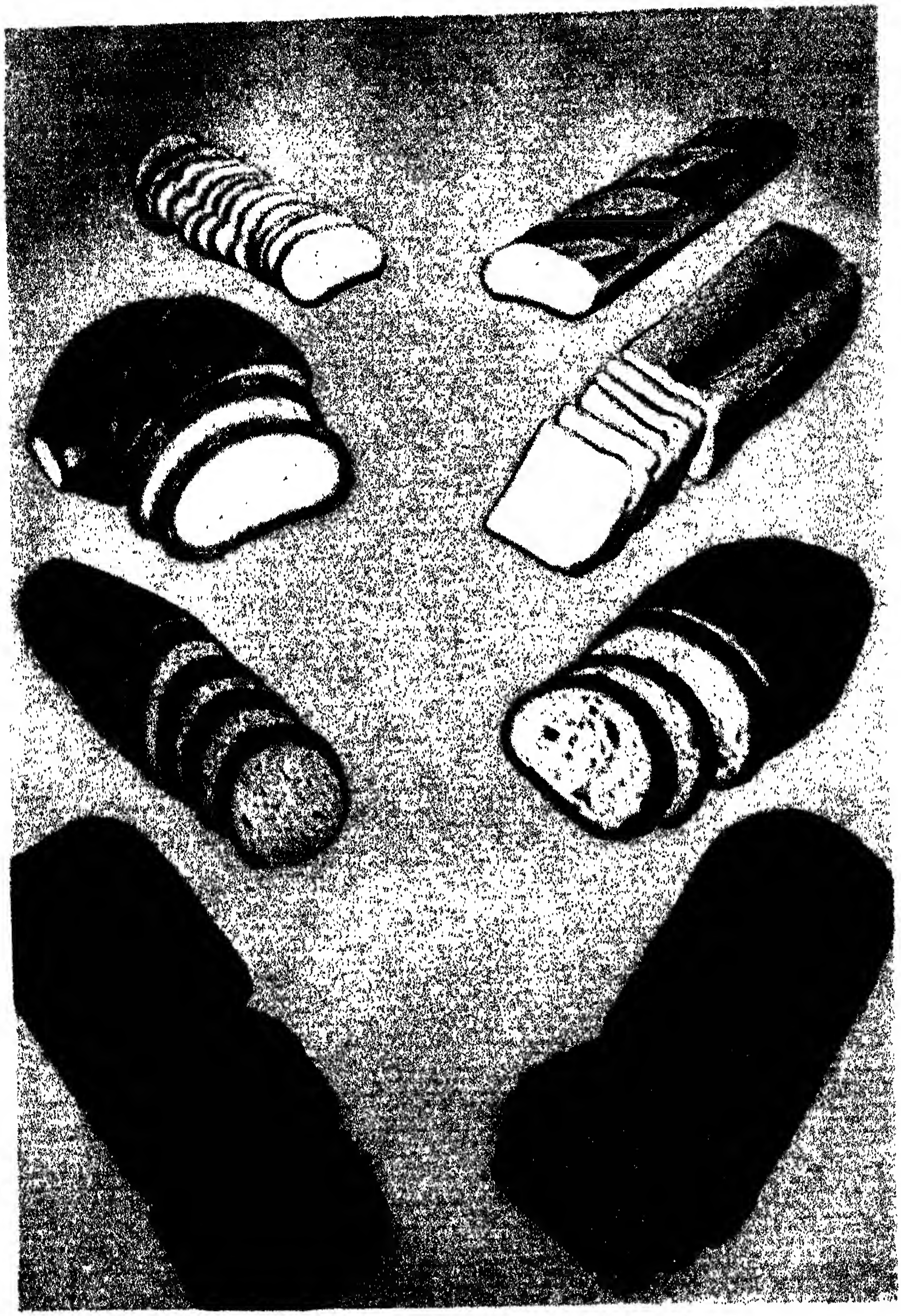


PLATE 18. Types of bread, including: White bread, in long French loaf and in round and long square loaves (in two upper rows); rye bread, in round and oval loaves (in third row); pumpernickel at left and whole-wheat bread at right (in bottom row).

sential varies in each case. The oxygen we must take directly in its elemental form every minute of our lives, and we take it through our lungs from the air. Yet the nitrogen, which is as truly essential to life and is also taken into our lungs every minute, is utterly worthless to us in that form. It passes into the lungs and passes out again, its only use to us being that of a dilutent of the oxygen. The elemental hydrogen gas is also worthless, as is the solid, but also elemental carbon. Yet the former is essential in water and also in food, and the latter in food. These last three elements are not only essential, but it is essential that we get them in certain compound forms which the body can utilize. They are worthless to us, not only in their elemental forms, but in many compound forms.

Indeed, some of their compound forms are worse than worthless, for they are deadly poisons. Thus hydrocyanic acid is composed of the three elements, carbon, hydrogen and nitrogen, all essential elements of the body, and yet when in this particular combination they become the most deadly of all poisons. Many other examples could be cited. For instance, carbon dioxide, which we form in large quantities, is an essential substance in our body chemistry and only becomes a poison when in excess. But carbon monoxide, made of the same two elements combined in a different proportion, is a rank poison and is the effective agent when people commit suicide by turning on the gas, or are asphyxiated while working in a tightly closed garage filled with exhaust from a running motor.

Some Elements Poisonous

The chemistry of life and nutrition, therefore, teaches us that we must not only have all the chemical elements that the body requires, but must have them in a suitable chemical state or compound. We therefore use the term "food element," not to indicate a chemical element that is essential in food, but rather to indicate the essential chemical compounds needed to support life. The term "food essential" would probably be less confusing than "food element," but the latter term has been largely used and will therefore be employed in these pages.

The four chemical elements so far discussed—carbon, oxygen, hydrogen and nitrogen—are essential in large quantities, whether from air, water or food. Because we are dealing with them in relatively large quantities and their forms and functions in the body are well understood, we will have no trouble in considering them in their proper food forms, such as water, carbon dioxide, sugar, fat and protein.

Food Elements

But when we consider the dozen other chemical elements that are used by the body in much smaller quantities, we find that it is the common practice to list food values by the amount of these elements contained rather than by the compound forms or food elements. The other chemical elements of the body (in addition to oxygen, carbon, hydrogen and nitrogen) are collectively known as mineral elements. These can be grouped in several ways, according to chemical kinship or physiological functions. At the present moment we shall ignore such groupings and merely list them according to their approximate amounts as contained in the human body.

Calcium and phosphorus exist in relatively large amounts, because in the compound form of calcium phosphate they compose the inorganic or noncombustible

The turkey has been considered a table luxury since the earliest American settlers first served it on their tables. Widespread as its use for food has been, this fowl has not proved as well adapted to domestication as the duck and chicken.

PHOTOGRAPH EWING GALLOWAY

part of our bones. They are also present in appreciable amounts in all body fluids and cells, and along with them are the elements potassium, sulphur, sodium, chlorine and magnesium. These seven mineral elements, with the four non-mineral or organic elements previously named, are the only elements present in the human body in quantities measurable in pounds or ounces.

Mineral Elements

We next come to a very important element and a very common one; namely, iron. There is about an ounce of iron in the body and almost all of it is in the hemoglobin of the red blood-corpuscles. It exists with the organic elements in a highly complicated compound form, so that the actual proportion of iron is small, even though the substance into the formation of which it enters exists in very considerable quantities. An iron deficiency causes anemia.

Iodine

Then we come to iodine, of which the body requires very minute proportions and almost all of which is concentrated in the thyroid gland. Yet it is absolutely essential to life, and when there is not enough of it we get the deficiency disease known as goitre.

CHEMICAL ELEMENTS IN THE BODY

	Per Cent.		Per Cent.		Per Cent.
Oxygen	65.00	Sodium	.06	Copper	Trace
Carbon	18.00	Magnesium	.05	Fluorine	Trace
Hydrogen	10.00	Iron	.004	Silicon	Trace
Nitrogen	3.00	Iodine	.000003		
Calcium	2.00	Aluminum	Presence or functions uncertain		
Phosphorus	1.00	Manganese			
Potassium	.35	Bromine			
Sulphur	.25	Arsenic			
Chlorine	.09	Zinc			

This makes a total of thirteen chemical elements whose functions in the body are well understood and about the necessity of which to life and health there can be no argument. But various books give a larger number. The number sixteen has been generally popularized, but, strange to say, the same elements are not always enumerated in such lists of sixteen.

The trouble is that the necessity and purposes of the other elements are not well understood. For instance, silicon and flourine are almost always listed, but they are more abundant in foods than in the body, and some might argue that they exist in the body accidentally as impurities. The same is true of aluminum, which seems to serve no purpose in animal life, and yet in the quantity in which it exists in the body appears to be inert and harmless. There are other more active elements, such as bromine, arsenic, zinc and copper, which certain investigators have maintained to be, like iodine, essential to life in small quantities, but which in much larger quantities, also like iodine, would undoubtedly prove to be serious poisons. Lead and mercury are two elements which, so far as anyone has ever contended, are always poisons. They have been used in medicine, but no one ever claimed that they were food elements.

Body Must Have What It Needs

So we see that even so simple a question as identifying all the chemical elements of the body may get us into uncertainty and mystery. These uncertainties are greatly complicated when we go into the question of the essential chemical compounds. While the chemist can always detect the presence of the elements, even in minute quantities, he may fail to detect the presence or absence of certain compounds which exist only in the most minute proportions, and yet are essential to life.

The *vitamins* come in this class. These interesting substances were discovered by biological rather than by chemical methods. What we mean is that they were discovered by feed-

PHOTOGRAPH EWING GALLOWAY

The Pekin duck has been domesticated in Far Eastern countries for untold centuries. In the efficiency with which it turns grain carbohydrate into fat, it rivals even the pig.

ing animals certain artificial diets and noting that they developed various types of disease, even though all the chemical elements known to be essential to life were present in their food, while the addition of certain foods to the experimental diet restored them to health. The conclusion was that some chemical compound which was essential to life and which the body could not form out of ordinary food compounds, had been missing. The vitamin researches, which we will explain at length in later chapters, have done much to increase the respect of scientists for the doctrines of the physical culturists regarding natural foods, for it has been conclusively demonstrated that there are life essentials in natural foods that escaped the methods of chemistry.

Vitamins Known only by Results

By thousands of tests upon animals the presence of such vitamins in various foods has been determined, and even the relative richness of the foods in such rare but vital nutritional elements have been approximately determined. There are six of these vitamins about which the scientific world is fairly well agreed, and from time to time many nutritionists set forth claims to further discoveries in this fascinating field of research.

Enough has been given you in this section to impress upon your mind the principle from which it takes its subject and title—"Need of Complete Nutrition." If the body doesn't get what it needs, the functions of life will be impaired. If the lack is serious enough, life will cease. And yet with all these complicated chemical and vital requirements, which even scientists do not fully understand, how does it happen that the common man, wholly ignorant of such things, can keep life in his body?

In answer to that question we can only ask another. How does it happen that the lower animals, or the plants, or the microscopic single-celled organisms, have thrived for countless ages without any knowledge of these matters?

To such questions no man knows the answer. They are part of the mystery of life. Yet we all try to answer them in some fashion. Some will say that a divine Providence implants in each creature the power to select its essential food and to reject what it does not need or cannot use. Others will prefer to substitute the term Nature for that of Providence, but in so doing will not gain much further light. It is not our purpose here to go into these arguments, upon which religions and philosophies of life are based and which are beyond the sphere of positive knowledge. But we can point out some interesting facts that may make it clearer how we are able to come as near to getting perfect nutrition as we do.

Life Lives on Life

One such great basic truth is that life lives on life. This could not always have been true if we concede that there must have been a beginning of life; but it is true for us now and has been true for all the higher and more complicated creatures for millions of years. The chemistry of all forms of life, while not identical, is very similar. The higher plants and animals are made up of groups of living cells. The single living cell, of which millions can thrive in a simple drop of water, must take its food in directly through the cell walls from the chemical elements dissolved in the water around it. The lower forms of life originate in the sea—and the sea is "salt water." In fact, in addition to common salt, or sodium chloride, which makes the water of the sea salt, there are also dissolved in it many other mineral salts. And these elements are essentially the same elements that exist in all living things and that form the salts of the blood of a man or the sap of a tree.

These mineral elements in the sea water are there essentially because they are soluble. According to the scientific theory of the formation of the earth, the sea began as a fresh-water pond. It was fresh water because it was rain water. As the earth cooled the land was condensed from the gaseous form before the water. At a temperature about a hundred degrees hotter than is now found anywhere on the earth's surface there could be no liquid water. It would form an atmosphere of steam, just as we now have an atmosphere of air. As the cooling continued the steam became vapor clouds, and then fell as rain and ran down the slopes of the bare rocky earth and collected as a great pond or sea in the lowest parts. As it ran over the rocks the more soluble minerals dissolved into the water. And with the continuance of rains for these countless years the process has continued. All water that seeps through the ground and runs out again as spring water to form brooks and rivers is mineral water. The quantity varies, but the minerals are always present and do not rise again when the water evaporates. They remain in the sea.

So whether in sea plants or sea animals, or land plants or animals, the sources of all these minerals is the same and they must all be soluble in water.

Wherever life began it was life based on such water solutions, and hence the supply of salts or minerals was similar. Yet minerals form only a small percentage of the substance of living creatures. The great bulk of their bodies is composed of the four non-mineral or organic elements, oxygen, carbon, hydrogen and nitrogen. These four elements all exist either in the composition of water itself, or in the air. In fact all of them but carbon are exceedingly abundant in water and air.

The Source of Minerals

Carbon is a relatively rare substance, and yet it is really the basic element of living as distinct from non-living matter. Sometimes the chemistry of living things is called the chemistry of the carbon compounds. Most chemical elements combine with each other in only a few ways, but when carbon is present the compounds that may be formed run into the thousands. The vast majority of these carbon compounds also

PHOTOGRAPH EWING GALLOWAY

Meat drying in the sun. This is the method of preservation used by South African natives. While it may seem a crude method it serves its purpose effectively.

contain hydrogen and oxygen, and a very considerable proportion of them have the added element, nitrogen. From the thousands of compounds of these four elements, with carbon always present, comes the possibility of the complexities of the chemistry of life, and those countless chemical changes and recombinations that make up the activities of life.

And yet there is no living creature in the world today that is made solely of these four wonderful elements. They form the bulk of his substance and make him organic as distinguished from inorganic, yet before life can function this little group of about a dozen water-soluble mineral elements must also be brought into action. That does not make the mineral or inorganic elements "organic," as some writers maintain, but it is only in connection with the organic or carbon compounds that the inorganic life elements can function in living processes.

The Chemistry of Living Things

So involved is all this that the task of understanding it may seem hopelessly complicated, and so indeed it is. But happily for the practical purposes of life no man has to understand it all. Perhaps a higher intelligence than ours has seen to that, and given us from our birth an instinctive knowledge that our lives can be maintained only by making use of those simpler forms of life that select for us the elements we need from the air and water and soil and build them into the compound forms which we can utilize. No chemist lives today who, if put into the greatest laboratory in the world, could keep himself alive beyond the period on which he could exist from the stored food of his own body, unless that laboratory was stocked with substances derived from some previous living creatures—plant or animal. Of course, there are scientists who maintain that some day man will learn to make truly synthetic foods from non-living chemicals and so become able to live without the aid of other animals or plants. Whether that is or is not possible only time can tell; but no man now alive, nor any of his grandchildren, is likely to live to see it.

It does not follow from this that man cannot make use of any inorganic foods, nor that all organic foods are perfect. There are plenty of substances produced by both plants and animals that are poisonous to man. Moreover, there are plenty of things offered us as foods that are very incomplete and ill-balanced, although derived from plant or animal sources.

But the great underlying truth remains that the chemistry of all living things is similar, though not identical, and that complete, living and vital portions of plant or animal are more likely to be complete foods for us than are isolated or refined substances, even from plant and animal sources.

For instance, the obvious fact that so many animals live by eating other animals is used as an argument by those who advocate the use of meat as human food. But the meat commonly eaten by civilized man consists of two highly specialized animal tissues. One of these is muscle or "lean" meat and the other is fat. The fat is not an active vital tissue, but only a fuel store. Not only is it devoid of all mineral elements, but it is even devoid of nitrogen. Any creature trying to live on fat alone dies very quickly. Muscle is a much more vital and complete structure than fat. Yet muscle has little in common with the bones, blood, nerves and glands of the body. Theoretically there is no reason to believe that muscle alone would completely nourish any animal, and tests prove that it will not. It is very deficient in calcium and lacking also in vitamins and other highly essential compounds. Many carnivorous animals have been lost in zoos because they were fed on muscle and fat, the meats selected by man. Carnivorous animals eat the whole of their prey, and truly carnivorous men, like the Eskimos, do practically the same thing. Otherwise they could not exist. Such facts are not very welcome to the meat-lover, because most civilized men have a repugnance to eating the organs of animals. In fact there is nothing that would be so likely to bias the average person in favor of vegetarianism as the full facts about the nutritional value of animal organs. Yet our objection to eating such parts has exceptions, and some of these exceptions are important. For instance, we eat the whole of the oyster except his shell. Also we ate liver, which is a glandular organ, long before we knew that it was of great value in the treatment of the deficiency disease of anemia.

Part of Animal Makes Incomplete Diet

When we turn to the plant world we find no such deep-seated repugnance toward any particular parts. Yet here we can make even more grievous blunders than with animal foods by trying to live on a diet made up too largely of certain comparatively simple plant substances, such as starch, sugar or

PHOTOGRAPH UNDERWOOD & UNDERWOOD

The olive as it ripens upon the tree. One of the oldest of cultivated foods and a primitive source of vegetable oils and fats for cooking. Great quantities of olives are also preserved in aromatized brine and eaten as a relish.

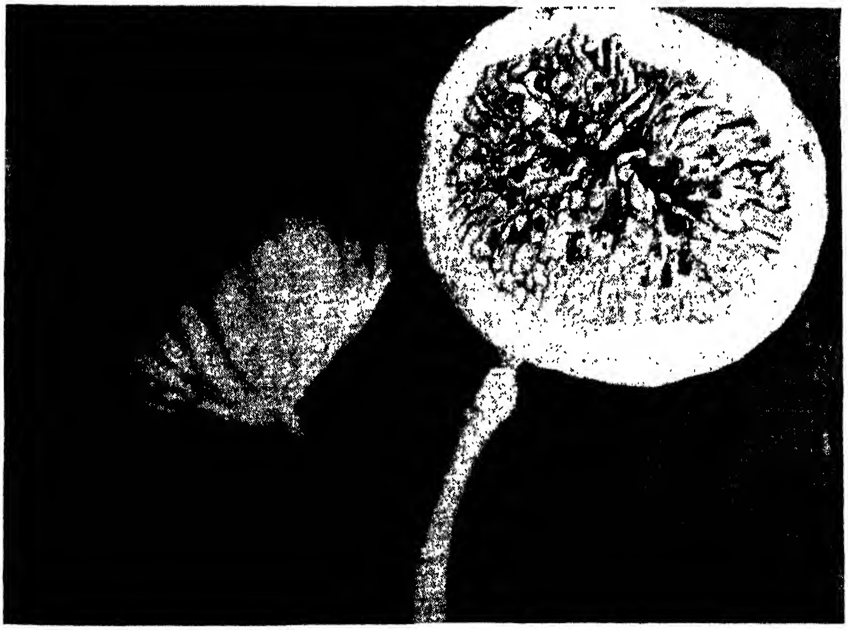
fat. There is, for instance, an important plant substance which man cannot digest but which is nevertheless a very necessary part of his diet. This is the cellulose which forms the skeleton or supporting structures and much of the skins or protecting structures of plants, one of its most familiar examples being the wood of trees. Just because it cannot be digested, this substance, in some of its forms (we cannot, of course, eat sawdust or cotton, which are cellulose), is indispensable to us, and one of the great faults of the modern diet is that it does not contain enough of it.

Why Eat Potato Skin?

In the case of all animal life there is a certain proportion of non-absorbable material in the food swallowed, and it is necessary that this should be expelled from the body. That fact should be obvious enough, even to the mind of a child; and yet failure to appreciate its importance is responsible for much of the misery of man, and there is some reason for our turning a blind eye to the facts. It is a law of life that the waste products of any living creature are obnoxious or even poisonous to that creature. So we have an instinctive attitude of repugnance toward the wastes of the body. That is certainly a useful instinct which none of us would wish to destroy or change, since decency and cleanliness depend upon it. And yet there is a very grave danger to life and to that very instinct of cleanliness in the refusal to consider this subject. Such an attitude may defeat its purpose by developing habits of life which result in the retention of the wastes toward which the instinct of repugnance is directed. It is a sad fact that those squeamish minds which refuse to consider this essential function of life are most likely to dwell in bodies that instead of being the cleanest are the filthiest. For by undue retention the obnoxiousness of the wastes of life is greatly increased. In the light of science, on the contrary, much of the sense of filth associated with this subject disappears, and incidentally such intelligent consideration of the facts enables us also to reduce, to a great extent, the actual objectionableness of the wastes in question.

Why Waste Products are Poisonous

To get a clearer understanding of this problem we must



Figs, with a cross-section photograph showing the inside of the fruit, which contains: Calories per pound 330; protein, 1; fat, 0.1; carbohydrates, 17; being rich in both calcium and phosphorus. In its dried state, the calories amount to 1290 per pound; the protein to 10.1; fat, 1.3; carbohydrates, 74.6.

now differentiate such body wastes into three components. First there is the true non-digestible food residue. This may be composed of any substance that chances to be swallowed with food or drink. Such a substance is not necessarily objectionable. It may be the cleanest sort of material, but simply insoluble or inert to the digestive processes. The greatest portion of such substances commonly taken with natural food is the cellulose, or structural fiber of plants.

The Non-digestible Food Residue

Chemically, cellulose is a carbohydrate, just as are sugar and starch. It is composed of the three elements, carbon, hydrogen and oxygen. It is non-poisonous and non-nutritive to the higher forms of life. There are lower forms that can digest cellulose. It can also be digested artificially by chemical reagents and so converted into sugar. It is perfectly good sugar, the same that we form by the digestion of starch, which is the sugar of our blood and identical with the natural simple sugar called dextrose or glucose which we get from fruits and honey. Many scientists predict that in the future we will digest the cellulose of wood in chemical laboratories and thus make sawdust into sugar and use it as food. In Germany notable progress has already been made in this direction. This shows the chemical kinship of cellulose to the foods. The value of cellulose in the diet of man, however, rests upon the very fact that it is not digestible.

Cellulose: Non-digestible

Other non-digestible substances may act in the same way. Sand, or for that matter any ordinary clay or soil, is also non-digestible. Many animals eat more or less soil with their food. Outside of possible organic contaminations such soil is harmless, just as cellulose is harmless, because it is unaffected by the animal digestive solvents. Charcoal acts in a similar fashion. So do many other substances. Bismuth sub-nitrate, despite its formidable name, is an innocuous substance because it is insoluble. Being opaque to the x-ray it is frequently given to man and animals with their food so that photographs showing the progress of the latter along the alimentary canal may be obtained.

There are also numerous organic products that belong in this class, among them being many petroleum products, such as paraffin, vaseline and other heavy petroleum oils. These oils are popularly known as mineral oils, to distinguish them from animal or vegetable oils, although in chemistry they are classed as organic products. They are all slightly differing compounds of carbon and hydrogen, and they are all non-digestible and physiologically inert. The animal and vegetable oils or fats contain a small portion of oxygen in addition to the carbon and hydrogen, and this makes a vast difference in that it renders them digestible and combustible in the animal body. Although non-digestible, the mineral oils have the properties of other oils, one of which is that of making surfaces smooth and slippery, and advantage is taken of this fact for the purpose of facilitating the passage of the wastes of digestion along the alimentary canal. This use of inert oils as a supplement to food could hardly be called a natural process, but it happens to be one of the artificial substitutes for a natural process that is beneficial, whereas the substances that

PHOTOGRAPH EWING GALLOWAY

The peanut belongs to the legume or bean family and contains about an equal amount of protein, fat and starch. The oil of the peanut is widely used in cooking and in food preparations.

Other Non digestible Substances

influence the bowel movements through chemical reaction are all injurious.

All these chemically inert substances which by chance or intention find their way into the alimentary canal pass through it and are cast out again. Chemically they have no function, but mechanically they are of the greatest importance for reasons presently to be pointed out. With them in the final bowel-residue we find another group of substances that are of entirely different origin. These are true physiological wastes from the living body. They are excreted into the digestive tract from the blood in the intestinal walls or from specialized glands, having outlived their usefulness to us, just as have the salts that are strained out of the blood by the kidneys and passed out of the body in water solution by way of the bladder.

Function of Non-digestible Substances

A third element in the final refuse of the alimentary canal is not a product of human cell-life, but of foreign organisms that dwell in the canal. The healthy body itself does not contain any such foreign cells or organisms. But the contents of the alimentary canal are not part of the living human body. We eat thousands of bacteria with every mouthful of food, and while the acid and alkaline digestive juices may check their growth to some extent, the conditions of temperature and moisture are favorable to them and they thrive fairly well. The bodies of these bacteria, living or dead, form a varying part of the alimentary waste, and the chemical wastes of such bacterial life are also present. Some of these bacterial products are absorbed and may act as human food; others are physiological poisons. The bacteria and the wastes they produce vary with the nature of the food. Some may be comparatively harmless and others distinctly objectionable. The longer the food or its residue is retained in the alimentary canal, moreover, the more rapidly they increase. In constipation, or the abnormally long retention of the bowel wastes, these bacteria may become prolific sources of putrefaction and decay, creating many poisonous substances which, being soluble, may pass through the bowel-walls and enter the blood-stream. Indeed, it is to the products of such bacterial decomposition, rather than to the merely non-digestible substances taken with food, or even the actual wastes of the body, to which the noxious and poisonous nature of the bowel wastes is chiefly due.

That all these wastes must be excreted from the alimentary canal is obvious enough, for if long retained they would fill up the passage and stop the forward progressive movement of the oncoming food. But it is not so apparent that this excretion must be prompt, and that any delay in this progressive movement is a serious disorder of digestive functioning, and owing to the production of bacterial poisons, a serious source of contamination and disease.

Foreign Organisms in the Alimentary Canal

At first thought it might be presumed that since such bowel waste is an objectional thing which we want to be rid of as soon as possible, the amount of it should be reduced to a minimum. But this is exactly the opposite from the truth, because the speed of the passage of the material through the bowels is chiefly determined by its volume. This is more easily understood when we consider the nature of this forward movement or the mechanics of digestive action.

The alimentary canal is an elastic muscular tube. The progress of food or food residues along this tube is sustained by a series of rhythmic contractions that pass along it in wave-like motions. This is known as the *peristaltic action.* Peristalsis is stimulated by the presence of something to move; otherwise there would be no movement, and indeed such movement practically ceases when the canal is empty, as in fasting. In the reverse condition, when one is eating heavily and the canal is well filled, the peristaltic action is increased and the passage time is shortened. This is the reason why a man at active labor who requires and eats much food is not subject to constipation, whereas a man at light labor, even though he eats the same kind of food, is very likely to suffer from it. But in either case, when the lower portion of the alimentary canal has been reached, the bulk of the contents depends largely on the completeness of digestion. If the food eaten is of the sort that is almost completely digestible, the non-absorbed residue will be correspondingly reduced and the peristaltic action will be slowed down. Conversely, if the food taken contains a large proportion of non-digestible substances, the residue and the bulk in the alimentary canal will be proportionately greater, peristaltic action will be stimulated, and the

Peristaltic Action

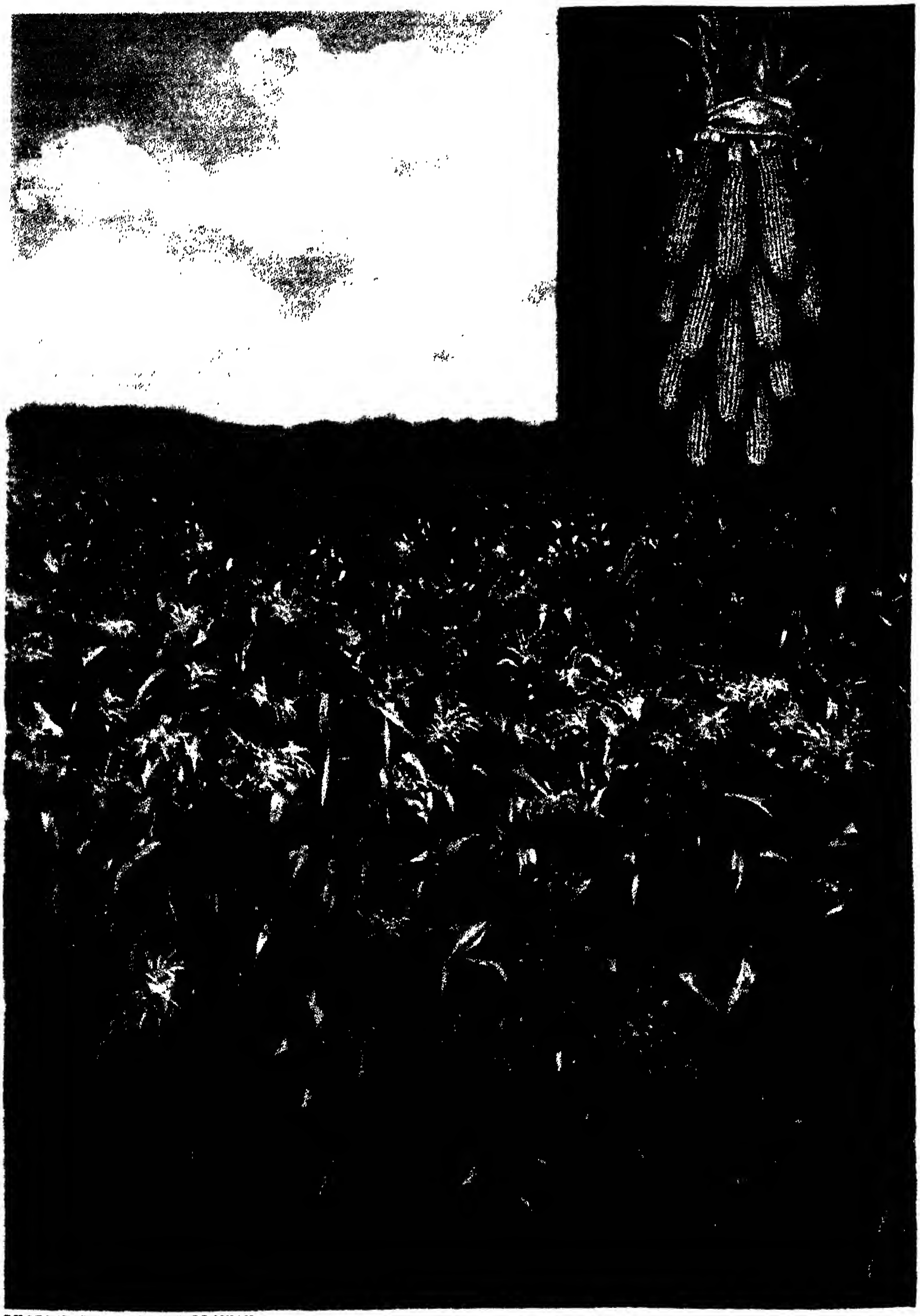
mass will be moved rapidly and more promptly eliminated.

The natural diet of man contained a very considerable proportion of cellulose which, being non-digestible, was left as a bulky waste and so stimulated this peristaltic movement as to bring about prompt evacuation of the bowel. The quantity of food eaten by man is chiefly determined by his physical activities, or muscular work. As these decrease under conditions of civilization his food requirements also decrease and he eats less food, even though he may be overeating in the sense that he eats more than he requires. Under such conditions the food wastes decrease also, even if the same kind of food be eaten. This results in a decreased bulk of intestinal contents and decreased movement. Under these conditions the proportion of non-digestible substance, of which cellulose is the chief component, should be increased. Thus the accustomed bulk of waste which the bowel is fitted to deal with most effectively will be maintained. But instead of doing this the general tendency of civilized life has been exactly the opposite. Thus the two factors of decreasing food needs and increasing refinement of foods by the elimination of the non-digestible cellulose have conspired to make abnormally slow and delayed elimination of alimentary wastes an almost universal condition among civilized men.

Control of Peristaltic Action

There is no more common nutritional error than the notion that the completeness of digestibility of a food is a measure of its value. On the face of it this might seem to be the case. In practice the exact opposite is true of our common run of foods. Most natural foods, such as vegetables, fruits, nuts and whole grains, contain considerable proportions of cellulose. Many refined or commercially processed foods, on the contrary, contain little or no cellulose and hence are more completely digestible than natural products. Because of that fact they may be worth a little more per pound as measured in the terms of digestible nutrients; but they are worth much less in building health, because they lead to overlong delay in the elimination of bowel wastes and a resultant increase in the growth of poison-producing micro-organisms. Public ignorance on this vital subject is taken advantage of by certain food-manufacturers, or by dieticians who wish to curry favor with them. They play up the high digestibility of their prod-

High Complete Digestibility Not Always Desirable



PHOTOGRAPH EWING GALLOWAY

PLATE 19. Field of growing corn, or maize, with dried corn on the ear in inset.

ucts as an argument for their use, although it leads to both overeating and to constipation, the two most prevalent evils in the nutrition of civilized man.

Not that all foods free from cellulose, or non-digestible elements, are dangerous and must be avoided. Some of them are very excellent foods and may be used to advantage in the diet, provided other foods that are rich in cellulose are also used each day, or preferably at each meal, to furnish the waste needed for easy and speedy elimination. Indeed, it is difficult upon a civilized diet to avoid the use of all the cellulose-free foods. Hence the only sensible and practicable thing seems to be to make a point of eating certain other foods with them that have a large proportion of this non-digestible element. Thus we can balance up our diet so that it will yield something like the bulk of non-absorbable material that was furnished in the more abundant and wholly unrefined diet of primitive man.

Value of Cellulose in Elimination

Without some such intelligent correction of the tendency of civilization to too small a proportion of indigestible material in our diet, it is impossible to maintain the cleanly process of the prompt elimination of bowel wastes which is normal to all animals on a natural diet. This is one of the fundamental problems of maintaining health in civilized society, and failure to deal with it properly is one of the greatest of all sources of ill health and disease. Indeed, this state of constipation, or waste retention, is so common among us that most people do not realize that they are departing from Nature's ways and disobeying the fundamental laws of health until the disturbance reaches an acute stage, manifesting itself in local and painful symptoms and demanding immediate mechanical relief. But very great damage may be done and the seeds of disease implanted throughout the body before any such extreme condition of constipation is reached.

Acids

Food Acids and Acidosis.—A primary chemical classification divides substances into acids, bases and salts. Experience has shown this subject to be especially confusing to those who attempt to follow food science without preparatory study of chemistry. Therefore, before proceeding to any further discussion of food and nutrition, it seems well to devote ourselves to its consideration.

Acids, bases and salts are never single elements, but are always chemical compounds. All acids contain hydrogen in combination with one or more other elements. Thus hydrochloric acid is composed of hydrogen and chlorine (HCl), and nothing else, while sulphuric acid contains hydrogen, sulphur and oxygen (H_2SO_4).

The base, or alkali, as it is perhaps more commonly called, always contains both oxygen and hydrogen or the OH combination. This oxygen-hydrogen combination, or hydroxide, acts as a unit, and the action is exactly opposite to that of the single atom of hydrogen in the acid. A typical base or alkali is caustic soda, or sodium hydroxide, with the formula of $NaOH$. Na is the abbreviation for *natrium,* the Latin name for sodium.

How Salts are Formed

The salt is formed by the reaction of an acid and an alkali, as illustrated by the chemical equation $HCl+NaOH=NaCl+H_2O$. What this means is that one molecule of hydrochloric acid (which contains one atom of hydrogen and one atom of chlorine) combines with one molecule of caustic soda (containing one atom of sodium, one of oxygen and one of hydrogen) to form one molecule of common salt (containing one atom of chlorine and one atom of sodium), while from the hydrogen and oxygen left over there is formed one molecule of water containing two atoms of hydrogen and one atom of oxygen.

Now if the proportions are correct, all the acid and all the alkali will be used up and we will have nothing but salt and water left. This chemical reaction is made use of in the manufacture of glucose from cornstarch. To the starch paste is added a small percentage of hydrochloric acid which, when heat is applied, changes the starch to glucose (also called dextrose). This is the same change that occurs when we digest starch to form this same simple sugar which is always present in our blood. After the starch has been converted into glucose it is desirable to remove the hydrochloric acid, which would be objectionable in a food, even though we have plenty of it in our stomachs. Therefore an exactly equivalent amount of caustic soda is added to the syrup, and this completely combines with the acid, forming common salt. Since the amount of the chemicals used is small, the amount of salt produced is less than is commonly used in foods and the finished product is quite safe and wholesome, even though two very strong chemicals have been introduced during its manufacture.

Hydrochloric Acid and Caustic Soda in Food

The fact that both hydrochloric acid and caustic soda are used in the manufacture of a food product and not removed may seem alarming to those unfamiliar with chemistry; but the processes continually going on in our own bodies would sound just as terrifying and often involve the same chemicals that are used in the industries. Although starch is not digested in the alimentary canal in precisely the same way as in the factory, the temperature factors being different for one thing, yet the use of hydrochloric acid and its neutralization by a sodium alkali is very similar to what occurs in digestion, the hydrochloric acid being neutralized and changed into salt on meeting the alkaline juices of the intestines, though in this case a surplus of alkali is left after the neutralization of the acid. But food-manufacturers, of course, may blunder in the handling of their chemicals, either through ignorance or indifference, while we can trust Nature—at least as long as we have our health—to carry on her chemistry correctly.

There are thousands of acids, alkalies and salts known to chemistry, and many of them are much more complicated than the simple ones mentioned. No one but a chemist could get them all straightened out; but it is easy to learn which chemical elements in food and in our bodies are acid-forming and which are basic or alkaline, and it will pay us to do so.

The major portion of our foods, which are made up of the organic substances in which carbon is combined with hydrogen, oxygen and nitrogen, are neither strongly acid nor alkaline; nor would they class as ordinary salts. But when we come to the mineral elements we find them falling more strictly into these classifications.

Chlorine, sulphur and *phosphorus* are the important acid elements which are involved in the life processes. *Iodine* is also an acid element, but exists in food and in the body in too small amounts to be of much concern in this connection. The corresponding alkaline elements are *sodium, potassium, calcium* and *magnesium*. *Iron* is also a basic or alkaline element, but like iodine is not present in the body in sufficient quantities to have much effect on reactions of this class.

When we say "acid-forming" elements we mean that these elements combine with hydrogen in various ways to form acids. There is only the one chlorine acid, whereas several acids are formed from sulphur and phosphorus. In a similar manner various alkalies may be formed from the alkaline elements. From these seven elements in various combinations quite a number of salts can, therefore, be formed, and these salts are found not only in foods, but in all fluids and tissues of the living body. Most of them are readily soluble, but the one of which we possess the greatest quantity owes its value to us in its comparative insolubility. This is the calcium phosphate which forms, along with a much smaller proportion of magnesium phosphate, the mineral matter of our bones and teeth.

The Alkaline Elements

The skeleton of a new-born infant is mostly cartilaginous, containing less mineral matter than that of an adult. As the bones harden, and of course as they grow, it is obvious that more calcium and phosphorus must come from the food to effect these changes. Dogs eat bones, but men do not, though perhaps they would sometimes be better off if they did. However, it is not necessary to get calcium phosphate from other bones, or even to get it in the exact form of calcium phosphate. Practically any food source of calcium and phosphorus can be used for bone-formation. Indeed, it is necessary that it be derived from sources in which these minerals are sufficiently soluble or digestible to pass in solution through the intestinal walls and be carried in solution through the blood. It is only when deposited in the bone-cells that they come out of solution and form the solid or crystalized calcium phosphate that gives the bones their hardness and solidity.

Bones Formed of Calcium Phosphate

In the bones the rôle of the minerals is obvious, but the mineral salts in the bones are no more important than those in the soft tissue and fluids of the body. Even calcium and phosphorus have many other vital and important parts to play outside of this major use in bone formation.

In solution any acid can combine with any alkali, and so in the blood and other body fluids we have the constant problem of keeping all the minerals properly balanced to give the exact preponderance of acid or alkaline elements that each particular fluid requires.

The blood is slightly alkaline; and yet from it may be formed the strongly acid gastric juice, or an acid urine, and also the strongly alkaline juices of the small intestine. Such changes are brought about by the selective action of certain body-cells. It is obvious that the hydrochloric acid secreted by the stomach glands must have been present in the blood, but it did not exist there as free acid because there were enough alkaline elements to more than neutralize it. As the blood gives up this acid element it might be expected to become more alkaline. But no perceptible change occurs. One of the reasons is that in a normal healthy individual the secretion of the acid is followed by the secretion of corresponding alkaline fluids by the liver, in the form of bile, by the pancreas and by the intestinal glands. These again neutralize the acid from the stomach and ultimately the salt formed is reabsorbed. So the changing cycle does not permanently affect the balance of the blood.

Neutralization of Acids and Alkalies

But when we come to consider the secretion of these mineral elements through the kidneys, in the form of urine, which leaves the body, we find a situation in which the nature of the secretion does decidedly affect the composition of the blood. Minerals thus secreted from the body must be replaced by those from food, and from the proportions of the various minerals in the urine, as well as from its degree of acidity or alkalinity, a great deal may be told about the nature of one's diet, and something, too, about the mineral content of the blood. However, the blood maintains a much finer balance and proportion of its various mineral ingredients than does the urine, for through the latter excesses of any minerals taken in the food are cast out of the circulation. To distinguish between the substances being cast out merely because they are being eaten in excess of the body needs and those that are true waste products of mineral metabolism is no easy matter, and many mistakes in judging the true needs of the body have been made by confusing these two sources of excreted materials.

Mineral Content of the Blood

All this suggests further problems in body chemistry that have a very important bearing on health, but before considering them we must study further the chemistry of acids, bases and salts.

The strong mineral acids which we have been considering

The first simple sugar was discovered by chemists in grapes and named grape sugar. The same sugar is now known as dextrose or glucose.

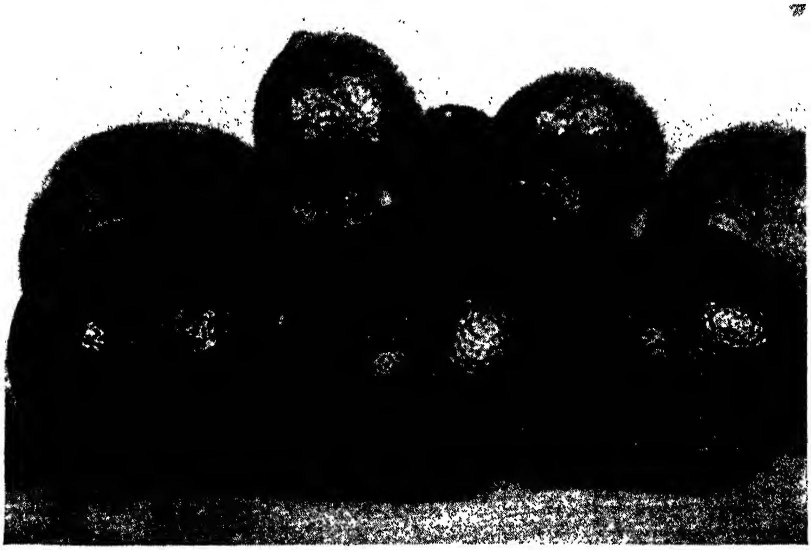
are all part of the scheme of inorganic chemistry; that is, the chemistry of substances that are not concerned with life. According to the scientific viewpoint, the fact that some of these chemicals also play important parts in the functions of life does not make them organic. There is a popular use of the terms organic and inorganic that classes any substance that is a vital part of a living thing as organic and the same substance when not concerned with living matter as inorganic. This use of these terms, however, is not recognized as correct in the scientific world. In the following section we will take up this discussion of organic and inorganic substances and explain both the scientific and the popular use of the terms.

Organic and Inorganic Substances

Among those substances that all recognize as organic, however, we also have a large number of acids. Among them are the well-known acids found in foods, most abundantly in fruits, which give them the characteristic sour or acid taste. Typical among such acids are malic acid, found in apples; citric acid, found in all citrus fruits; and tartaric acid, found in grapes. To this list we might add two very common acids that result from bacterial growth; namely, the lactic acid of sour milk and sauerkraut and the acetic acid of vinegar. All of these acids are non-mineral or organic. Each of them has one or more of the characteristic hydrogen atoms that give the acid property. But instead of an acid-forming mineral element being combined with the acid hydrogen atom or ion, we find a little group of atoms made of the three elements, carbon, hydrogen and oxygen. These elements are all organic, and with the addition of more oxygen may all be burned or oxidized in the body, with the result that nothing is finally left but water and carbon dioxide.

Organic Food Acids in Fruits

This fact puts these organic food acids into an entirely different class from the mineral acids as far as their physiological action is concerned. Water and carbon dioxide are constantly being formed in the body in large amounts, for the bulk of our food, including starch, sugar and part of the protein, is oxidized into these water and carbon-dioxide molecules. Water so formed is exactly like the water we take in food or as a beverage, and is disposed of in the same way, by evaporation through the lungs or from the skin, or by excretion through the bowel or kidneys. Carbon dioxide is constantly cast off with every breath from our lungs. So



Lemons, oranges and grapefruit are important factors in a well balanced diet. All of the citrus fruits are vitamin carriers and they are particularly good in diets for both the sick and healthy, and when weight reduction is desired.

there is no difficulty in disposing of any amount of these two substances up to the limits of our breathing and sweating capacities, as seen during violent exercise. At such times a vigorous man can eliminate these products about five times as fast as he would when sleeping. The organic acids, therefore, leave no acidity behind in solution in the blood, and hence, though they are acids, they are not acid-forming.

We now come to a point on which perhaps more people get an erroneous idea than in the case of any other phase of food science. Of late years much attention has been given to the problem of acidosis, which is held to be an important factor in the production of ill health. In this connection the fact has been emphasized, both in popular writings and in the advertisement of fruit, that acid fruits are not acid-forming but instead tend to prevent acidosis.

What is Acidosis?

This statement is quite correct, but the explanations offered for the seeming paradox are often erroneous. We are usually told that organic or fruit acids are changed into alkalies during digestion. This explanation is wrong in two ways. In the first place, though acids can be neutralized with alkalies and their acid properties destroyed, or, if they are organic, can be oxidized or burned into carbon dioxide and water, which also destroys their acid properties, they cannot be converted into alkalies. In the second place, the acids in question are not altered during digestion. They are absorbed into the blood as acids, *but are so quickly oxidized* in the tissue cells that no great amount is present in the blood at any one time.

But while these facts explain why such acids are not acid-forming, they do not explain how the use of acid fruits prevents acidosis and increases the alkaline elements of the blood. The reason for this is that acid fruits, together with sour milk and sauerkraut, contain a preponderance of alkaline minerals. These minerals are not an essential part of the acid, though in some cases they may enter into combination with it and if the acid predominates we may have what is known as an acid salt.

Such substances, half way between acids and salts, are formed when two or more of the acid hydrogen atoms are present in the acid molecule. A well-known example of an acid salt is cream of tartar. The substance exists in the juice

Like all leafy vegetables, the particular value of cabbage is in its mineral content. It is better eaten raw than cooked, and when shredded or minced makes an excellent salad combined with some simple dressing. Calories per pound, 140; protein, 1.2; fat, 0.3; carbohydrates, 5.5; vitamins A, B and C.

of grapes, and when the grapes are fermented into wine the alcohol renders it less soluble, so that it collects in the bottom of the wine-casks as a solid. The scientific name of cream of tartar is acid potassium tartrate. Tartaric acid has two acid hydrogen ions, and when there is not enough alkali present to fully neutralize the acid, one atom of the hydrogen is replaced by the potassium atom, while the other remains. The result is a half-neutralized acid, or an acid that is just half as strong as the full tartaric acid. When cream of tartar is used in baking-powder it is mixed with soda, and no action occurs as long as the mixture remains perfectly dry; but when water is added reaction occurs, and the other hydrogen atom is replaced by an atom of sodium. The final result in this case is a double salt, or potassium-sodium tartrate. This is a salt, neither acid nor alkaline.

Cream of Tartar, an Acid Salt

Now suppose we had eaten the original grapes with the cream of tartar in solution in the juice. What would happen then is that the acid salt would be oxidized, forming carbon dioxide and water from the organic portion, and as a result the potassium atom would be set free as an alkaline element and would speedily combine with some other acid element in the blood, thus reducing its acid content, or having an alkalizing effect in keeping down an accumulating acidity.

Why Fruits Prevent Acidosis

The above is but one example among many, for acid salts of the organic acids are very common, not only in fruits but in vegetables. The degree of acid taste in the food is determined by the excess of the acid over the alkaline elements. The amount of acidity does not determine the amount of alkaline elements present, but is incidental to it. Thus lemons are much more acid than oranges, because they have a greater excess of citric acid, but the amount of alkaline salts is about the same in both fruits.

Some of the common vegetables, on the other hand, contain so much of the alkaline elements that any organic acids which may be present are completely neutralized, so that there is no acid taste. Yet the organic acids may be present in this neutralized form, and when oxidized they free alkaline elements. Spinach has more of these alkaline elements than any other natural food, and other leafy vegetables rank relatively high in them, cabbage having an abundant supply. When cabbage is made into sauerkraut additional organic acid is developed by bacterial action. This is lactic acid. It gives the cabbage a sour taste but does not change the final effect in the body, as the same proportion of alkaline elements remains as was there in the first place, provided the juice from the kraut is not run off, which would, of course, carry away a portion of them.

Alkaline Foods

The lactic acid in sour milk is developed by similar bacterial action, and again this does not change the original balance of the mineral elements in the milk, which also happen to be predominantly alkaline, chiefly owing to the large amount of calcium present.

While it thus happens that the acid foods we use have an alkaline reaction on the blood, it is not the acid that causes this reaction but the alkaline salts that are also present in these foods. On the theory that the acid itself is the beneficial element, one can easily go wrong, as in the case of those artificial beverages referred to in a previous section. Such synthetic drinks may contain the same acid as the fruit imitated, but do not contain the associated alkaline salts. They cannot correct acidosis, but neither would they cause it so long as the acids used were of the organic group that can be completely oxidized in the body. When beverages are made with mineral acids, on the other hand, the situation is quite different. Such acids cannot be oxidized and must be eliminated through the kidneys. They combine with the alkaline elements in the blood, and if there is not a superabundance of these present would certainly cause acidosis. This would apply quite as truly to the acids of those minerals that exist in the body as to those of elements foreign to it.

Hydrochloric Acid as Medicine Inadvisable

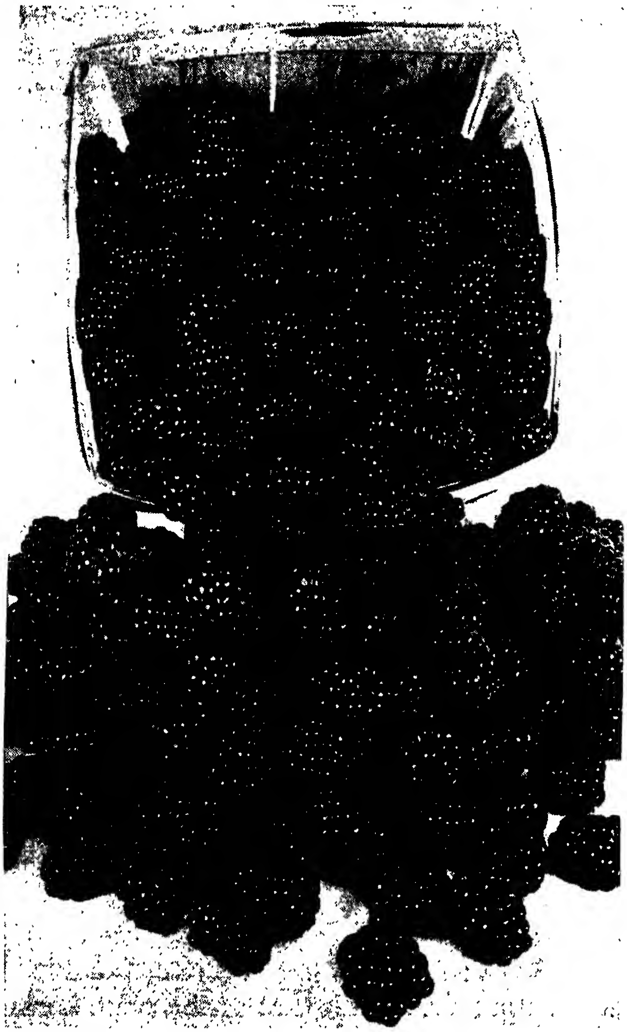
The three acid minerals of the body are chlorine, sulphur and phosphorus. Hydrochloric acid is sometimes given as medicine in case of a lack of the proper secretion of the same by the stomach. But the practice is of dubious value, for it would result in a serious increase of chlorine in the body, which does not occur in the normal process by which hydrochloric acid is withdrawn from the blood and then returned to it in the same amount. If such additional hydrochloric acid is given at all, it should only be under the supervision of experts who are keeping tabs on the acid-alkaline balance of the blood and urine and know that ample alkaline elements are available to neutralize the added acid without depleting the body's requisite supply.

Sulphurous Acid as a Preservative

There is even less excuse for the administration of sulphuric or sulphurous acids, and the practice of sulphuring fruits, which leaves in them sulphurous acid, is therefore to be strongly condemned as contributing to the production of acidosis, even if there were no more serious consequences from the use of food so treated.

The two acids above mentioned are taken into the body, the one as medicine and the other as a preservative; but their use in these ways is less common than is that of the phosphoric acids as the basis of artificial acid beverages. The fact that the acid used is not the full-strength acid, but the acid salt or phosphate, does not make the practice any wiser, for unless the diet is deficient in phosphorus and excessive in calcium or other alkaline elements, it cannot be otherwise than harmful. To make matters worse it so happens that the diet of the average person, being composed largely of meat and denatured wheat products, already has a relative oversupply of phosphorus and a relative shortage of calcium.

These phosphates have been purchased by the public under the mistaken notion that phosphorus, being a necessary nutri-



PHOTOGRAPH EWING GALLOWAY

The blackberry, aside from the nutritive values it has in common with other berries, possesses astringent qualities in its juices and pulp.

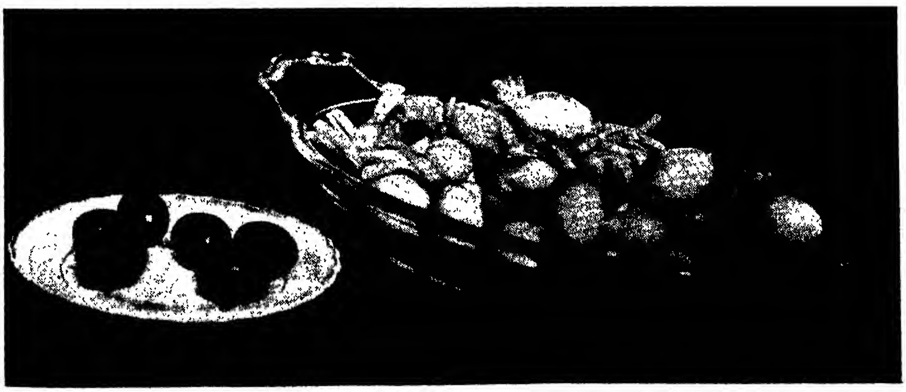
tional element, would be beneficial. And so it would be if phosphorus were lacking in the diet. But since there is likely to be a relatively superabundant supply of it as compared with its natural neutralizing element, calcium, this use of additional phosphorus in the form of the acid salts of phosphoric acid is, in general practice, an unwise and decidedly injurious proceeding. However, phosphorus properly balanced with calcium and other alkaline elements is a highly important factor in nutrition and this balance exists in natural wheat, corn, rice, barley, grains and in pure milk.

The Harmful Effects of Phosphoric Acid

It is true that both alkaline and acid minerals are needed to sustain life. But in the process of metabolism we are always freeing the acid minerals by the destruction of proteins. Whether these acids come directly from food eaten at the time, or whether, on a fast, we are consuming the stored proteins of the body, makes no difference. While there are many proteins and their composition is not all the same, there is, on the average, a constant percentage of both sulphur and phosphorus in the protein molecule. When this protein is metabolized the carbon, hydrogen and oxygen are burned and the nitrogen forms urea. This leaves the sulphur and phosphorus free in the form of acids in the blood.

Proteins Add Acid Elements

Of course, the eating of meat or other high-protein foods very greatly increases this source of the acid elements. The thinking man will ask at this point why the carnivorous animals and men on heavy meat diets are not killed by such a superabundance of acid elements without the offsetting alkaline minerals that are derived from fruits and vegetables. The answer is that a compound is formed from protein that can act as an alkali. This is ammonia as it exists in combinations to form salts. Thus the acid elements may be formed into ammonium salts and so excreted through the kidneys. There is a corresponding process by which an excess of alkaline minerals may be disposed of. In this case the carbon dioxide, always abundant in the blood, unites with water to form the weak acid known as carbonic acid. This then unites with the alkaline minerals to form carbonates which are also neutral salts that may be readily excreted. Thus the urine of a carnivorous animal contains a predominance of the ammonium salts of the acid elements, and that of a herbivorous animal



Despite the marked discrepancy in the number of olives shown at the left, and the radishes in the larger dish at the right, each food in the quantity shown approximates 100 calories.

contains mostly the carbonates of the alkaline elements.

Acidosis is speedily remedied by the use of either less acid-forming foods or more alkaline elements. Which course would be proper depends on whether the diet as a whole has been rich or poor in minerals. If the condition has been one of mineral deficiency then, obviously, more alkaline minerals are needed. But if the diet has been rich in minerals and is still acid-forming, then what is indicated is a cutting down of the source of the acid minerals.

Preventing Acidosis

The statement that sugar and starch are acid-forming is not a correct one, as pure carbohydrates and fats contain no minerals of any sort. However, a diet largely made up of these demineralized foods does tend to produce acidosis as it does not provide the elements needed to neutralize the sulphur, phosphorus and other acid products continually being freed from our own protein tissues.

ORGANIC VERSUS INORGANIC FOODS

Section 3

A MUCH debated subject that affects our understanding of the science of nutrition and the chemistry of life is that of the *organic* versus the *inorganic.*

The original meaning of the terms seems clear enough. Those substances that were found in living organisms, or were created by living organisms, were called organic, and substances like the air, the water, or the solid crust of the earth, that were obviously not a part of living matter or created by it, were termed inorganic.

Products of Life, Organic

This distinction enabled the naturalist in a pre-scientific age to group the things that he found in nature into two great divisions. As applied to the food of man or other animals, it also offered a pretty good line of demarcation between what was food and what was not. The plant very obviously sent its roots down into the soil and by some miracle appeared to transform inorganic or mineral elements into organic substances which men or animals could eat. Yet if the animal should try to derive his sustenance wholly from the sources tapped by the plant, starvation immediately would ensue.

It was later learned that the bulk of the plant substance does not come from the soil, but is formed by the combination of water with the carbon dioxide of the air, which transformation was wrought by the energy of sunlight. But this still did not change the conception of the organic versus the inorganic as food for man or animal, for obviously the animal could not eat air and water as the plant did and thus add to his weight and substance. True, the animal found both air and water necessary to life, but not for the purpose of building tissue and producing heat and energy. The food that made him grow and kept him warm came always from plants, or from animals which in turn had got it from plants. So it seemed very evident that there was here some fundamental difference.

As the science of chemistry developed it was found that

A platter of uncooked foods, including avocado or alligator pear with ripe olives, stuffed tomatoes, Waldorf salad, etc.

many of the elements and substances of the inorganic world also existed as active parts or component elements of living or organic substances. Not only water, but common salt and the mineral matter of bones and shells were identified as common inorganic chemicals that existed abundantly in the earth's crust as well as in living creatures. But there were still great and complicated varieties of substances found in plants and animals that were not found in non-living matter, and which at that stage of science could not be made in the chemical laboratory. Therefore the idea continued to prevail that life added something that did not exist in inanimate nature and could not be duplicated in the laboratory.

Early Developments in Chemistry

Not only was the belief general that science could not create life—which belief still exists, for it has not yet been disproved—but until about a hundred years ago it was also believed that we could not create in the laboratory any elements created by living things and not also found in inorganic or dead nature. Then a very interesting thing happened. A German chemist succeeded in making urea out of obviously inorganic elements. Urea, while a waste product of life, had never been found in inanimate nature and had therefore been classed as an organic substance; yet it was created in the laboratory without the aid of life and is today manufactured by the millions of pounds as a fertilizer.

From this simple beginning scientists have succeeded in making not one or a dozen but literally thousands of chemical combinations that are exactly like those created by living things. Yet they have not succeeded as a practical thing in making human food, and perhaps never will. Opinion here is still divided. Some still believe that there is some line of demarcation between what can be done artificially and what life itself can do. Others say that there is no such fundamental difference, but merely that the chemistry of life is so enormously complicated that science has not yet fathomed it. They might further add that even though science could produce some simple foods in laboratories it would not pay to do so, much for the same reasons that it does not pay to make artificial diamonds. It can be done, but it is still cheaper to mine them.

Organic Substance Now Made From Inorganic Elements

Most of this argument about the fundamental distinction between organic and inorganic substances is now a matter of history. Life still holds its secrets, but the popular belief that they are beyond the possibility of man's finding out has been proved to be without adequate basis. In spite of the breaking down of the old distinctions, however, it is still found convenient to make a special science of the chemistry of those substances which are typical of life and which are not ordinarily found in non-living matter. Hence the continued use of the terms *organic* and *inorganic* chemistry.

Thus modern science of organic chemistry is sometimes called the chemistry of the carbon compounds. For practical purposes we may consider as organic those substances which blacken when charred in a fire and which, with sufficient heat and oxygen, will burn, forming carbon dioxide and water. This test applies to any plant or animal substance, and certainly to any substance which will produce growth and an increase of weight in a living body, or which will sustain body heat and muscular energy.

Yet when a plant or animal substance is burned it usually leaves a white ash—a mineral or inorganic fraction. When bones are placed in a fire they first blacken, then the "animal" matter burns out and we have left a frail shell from which the strength has departed and which may be easily pounded into a white powder. That powder is found to be calcium phosphate, a common enough chemical and easy enough to make from its elements in a laboratory. Was the bone then organic or inorganic? Obviously it was both. While not so readily demonstrated, because the percentage of ash is smaller and loses its form, the same holds true of any animal or plant substance. Wood, leaves, blood, brain, muscles or milk, all leave their mineral ash when burned, and this is composed of common inorganic minerals that can be duplicated from the crust of the earth or the water of the sea.

Now, almost anyone will concede that these minerals, after being through the heat of a consuming fire, are no longer any different from common inorganic minerals. But there are some who contend that the fire has again reduced them to an inorganic state, and that while they were in the original substance of the plant or animal they were in some way transformed and given a vital property of life, making them organic. This contention is not without some element of truth, for it is very certain that the action of the fire does change the minerals. They are not in the same chemical state as when doing duty in the living substance.

Can Chemists Make Artificial Food?

The practical question which arises from a consideration of the facts is: Can minerals from inorganic sources be utilized as food, or must we always get our supply from those held in combination or association with organic substances? There is still much division of opinion on this subject, but it has been demonstrated that there are at least some minerals which we can take from their simple inorganic salts.

Sodium, chlorine, potassium, magnesium, and calcium and phosphorus for bone-construction, at least, are all available to life from such sources. But there are other combinations of phosphorus which are found only in living substances and which science cannot duplicate. These cannot be built up in the human body from the simple mineral forms, and a similar statement may be made for iron and iodine. The dispute about the finer points of mineral nutrition will perhaps be carried on for many years yet. At present it is mainly a matter of academic interest, being of no practical importance to those who live on natural foods. In the case of those who insist on removing the minerals that Nature placed in their food it may be making the best of a bad business to restore them to the diet by a deliberate addition of mineral elements. But such a scheme of living suggests the idea of chopping off one's foot and then using a crutch to walk with. Under such circumstances the crutch would no doubt be a useful thing, but except for perverse stupidity in the first place it would never have been required.

The only mineral that anyone has ever maintained could not be had from natural foods in any part of the world is iodine. This element actually seems to be so scarce in the water and soil of certain regions that plants grown there do not contain enough of it to support healthful animal life. But every other mineral can be had in superabundance through the proper selection of natural foods, and, as already noted, there are some that can be utilized in combinations that are found only in living substances.

Iodine Lacking in Many Foods

Furthermore, scientists have not as yet precisely duplicated the vitamins in natural foods. Numerous chemists are working to discover their chemical identity, the problems involved being important. However, natural food, not chemistry, seems the logical place to obtain our vitamins.

Vitamin-bearing foods generally supply the required minerals also. Indeed, the similarity of the sources of good mineral combinations and good vitamin stores is such that one of the leading advocates of natural food maintained for many years that the effects credited to vitamins were nothing more

A platter of mixed cooked and raw vegetables including cabbage stuffed with mushrooms, stuffed cucumbers, baked potatoes and mixed salad, all excellent in a reducing diet.

than the results of better mineral nutrition. Most scientists do not accept this explanation of the action of vitamins, as they believe it to have been conclusively demonstrated that the vitamins are not minerals. No doubt they are right about this, but the fact that the best sources of vitamins usually prove to be also good sources of minerals is certainly an excellent reason for using such natural foods for our mineral supply instead of attempting to get it artificially.

Are Vitamins Minerals?

Perhaps, with further research, scientists may be able to prove some exceptions to the above conclusion and show us that we can improve our nutrition by some artificial altering of the mineral balance of our diet. Up to date the best results secured in this way have come from increasing the percentage of calcium in proportion to the percentage of phosphorus. In the case of farm animals such an increased supply of calcium—or lime, to use the less technical term—seems to be advantageous. Even in this case, however, it cannot be said that man has improved on nature. It seems more probable that the diet supplied by him to farm animals is not well balanced. Grain products are relatively higher in phosphorus than in calcium, and therefore added calcium may improve them. As meats are also high in phosphorus and low in calcium, no doubt the effect of the undue quantity of meat in the human bill of fare might be offset by such additions to the calcium supply.

Additional Lime Sometimes Needed

When such calcium salts are administered it does not seem to make much difference in what form they are given, as extensive tests with laboratory animals prove that all the common calcium salts are equally available to the animal body. These salts are plainly inorganic, as is common salt or sodium chloride.

To summarize the conclusions of this section, it cannot be asserted that man cannot use any inorganic substance for purposes of nutrition, for evidence *of science* very clearly shows that he can. But this evidence certainly does not constitute an argument against natural foods. It goes to show rather that when men and animals need inorganic elements in addition to their ordinary food this food has been tampered with by artificial processes, or chosen in accordance with the customs of civilization rather than by natural instinct.

CARBOHYDRATES—SUGAR AND STARCH

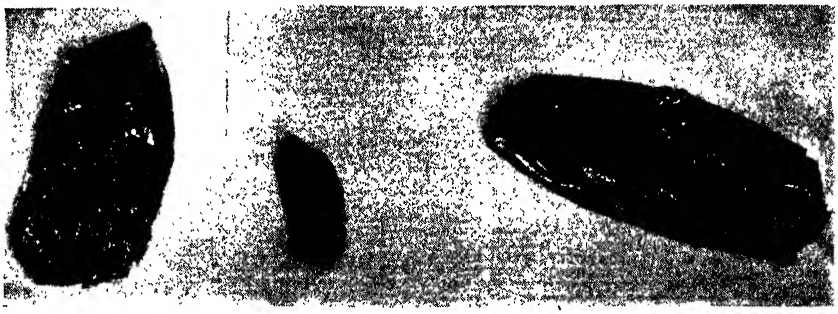
Section 4

A LITTLE knowledge is surely a dangerous thing when it comes to tampering with the laws of Nature and changing the natural diet of man. And since we live in civilized society and cannot entirely avoid artificial foods, our best protection lies in gaining fuller knowledge. Thereby we can offset and correct the nutritional mistakes made by society as a whole, and perhaps secure even better nutrition and better health than primitive man ever did.

What Are Carbohydrates?

In the foregoing sections some typical errors made by civilized man in tampering with his natural food supply have been pointed out and the basis of chemical science by which you can form your own opinions on these matters has been given. With this groundwork of knowledge we are now ready to consider more in detail the orthodox classification of the major food elements on which we live.

The group of food substances that furnishes the bulk of human food is known as *carbohydrates*. The word means literally *carbon and water*. Water is H_2O, or hydrogen and oxygen at the ratio of two atoms of hydrogen to one of oxygen. If we take six molecules of water we would have $H_{12}O_6$. If to this we add six atoms of carbon we would have $C_6H_{12}O_6$, which is the chemical formula of the simplest carbohydrate with which we are concerned in our food supply. This is the formula of the sugar found in the sap of many plants and in the blood of all animals, including man. Unfortunately this sugar is burdened with many confusing names. In chemistry it is called either glucose or dextrose, which names are interchangeable. It was formerly called grape-sugar because it was first discovered in grapes. Commercially it is now called corn-sugar, and the manufacturers, perhaps because they think that name sounds cheap, have added another "cerelose." Dieticians frequently speak of it as fruit-sugar, as it is abundant in most fruits. Lastly physiologists, to emphasize its



Date fruit is quite rich in sugar. It is, on this account, considered a natural sweet. It ranks very low in protein. In the illustration are shown dates, and the small stone taken from the center of the fruit.

importance in the body, may refer to it as blood-sugar. But to the unfortunate diabetic who has lost the power to properly oxidize it, and therefore excretes the accumulating surplus in the urine, it is simply "sugar" and a thing to fear.

A Sugar with Many Names

Nothing more prettily illustrates the harmony of nature than the cycle of the formation or destruction of this glucose or simple sugar. Glucose is formed in the green cells of plants by the energy of sunlight. But sunlight, while a source of energy, contains no matter or substance. The raw materials of glucose are carbon dioxide and water. The chemical equation by which it is formed is $6CO_2+6H_2O=C_6H_{12}O_6+6O_2$. The plant makes it from the carbon dioxide of the air and water and gives back to the air pure oxygen. When this sugar made by the plant is eaten by an animal and burned in its muscles with the oxygen drawn in by its lungs, the process is exactly reversed and the chemical equation becomes $6O_2+C_6H_{12}O_6=6H_2O+6CO_2$.

The energy of the sunlight is thus caught and bottled up in the sugar, and that energy is again released in the muscles of the animal to make heat or do physical work. Meanwhile nothing has been lost to the world. The water the plant absorbed from the soil has been given back to the air in the breath of the animal and will ultimately fall again as rain to water the plant. Likewise the carbon dioxide cast off by the animals is absorbed by the plant, while the oxygen given off by the plant may again be absorbed by the animal. The waste product of the animal is the food for the plant and *vice versa*. This balance of nature is such that if an animal were

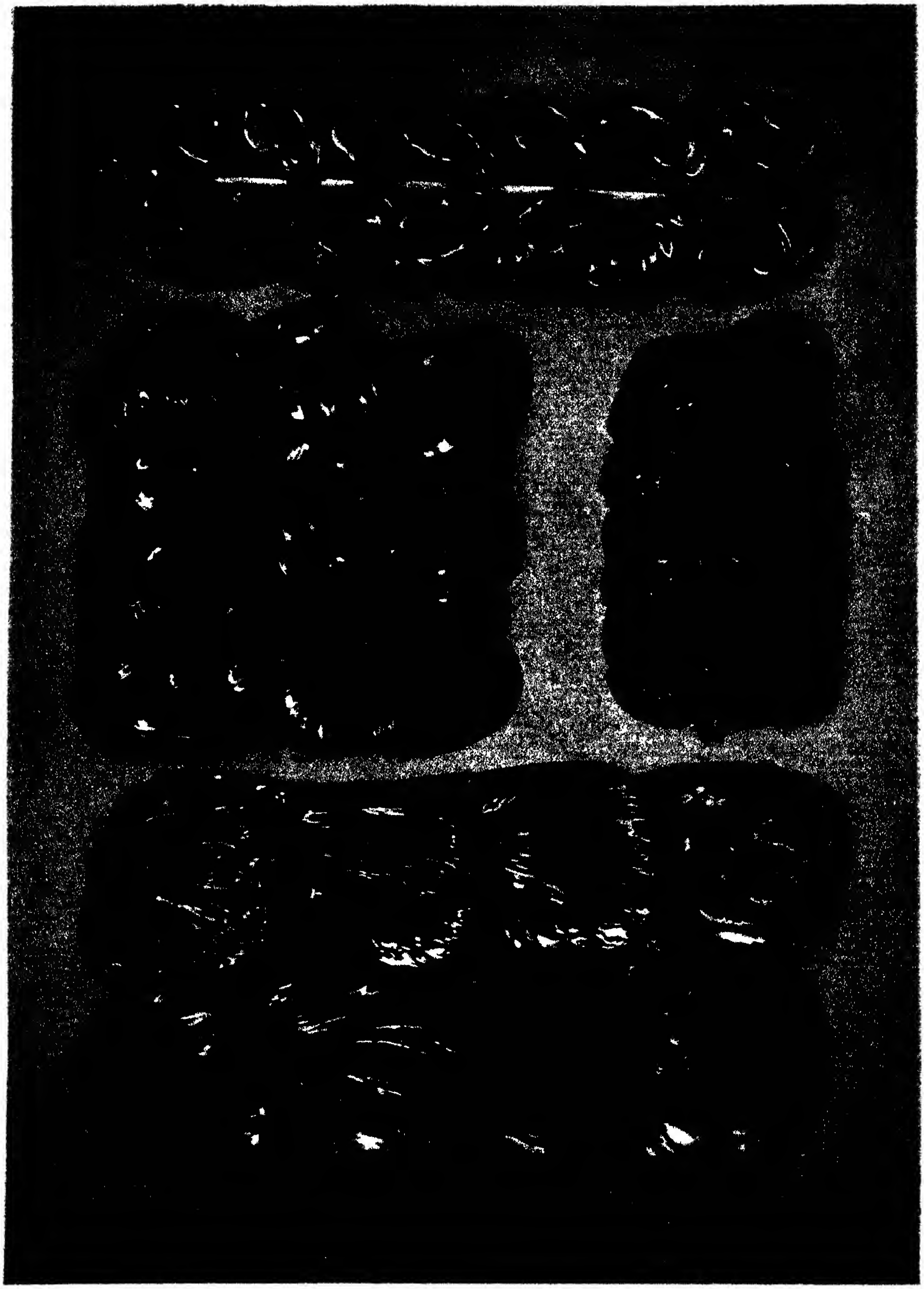


PLATE 20. Forms of sweet fruit which are used dried or dehydrated, including: Dates on stalk (top); black or mission figs (left center); raisins (right center), and golden figs (lower row).

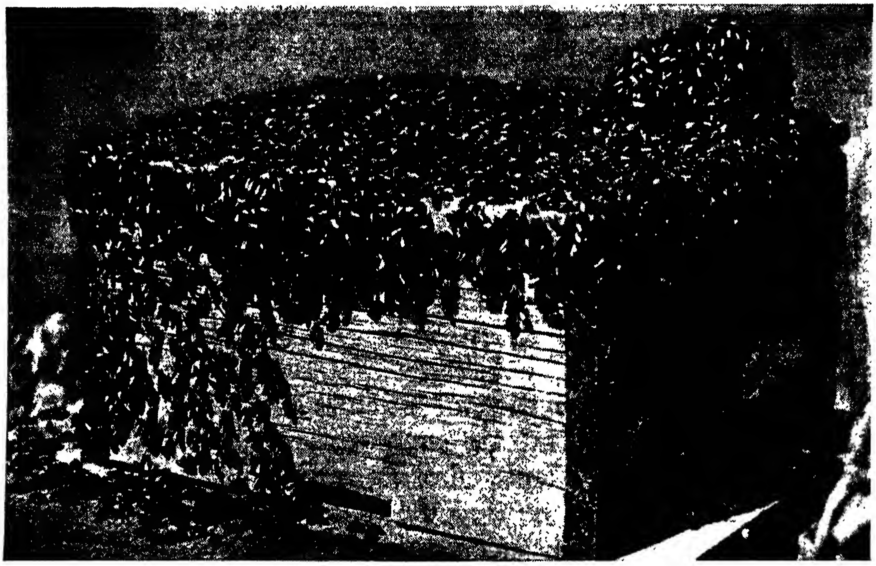
shut in an air-tight glass house with plants of equivalent capacity, each would purify the air for the other, and, with the proper handling of other elements through the soil, each could completely feed the other.

This endless reciprocal cycle of life goes on wherever plants and animals exist, and yet scientific philosophers tell us that ultimately both plants and animals will be starved out by the exhaustion of the carbon dioxide of the air. The reason is that the sea is full of robber creatures who take a quota of carbon dioxide (dissolved in the water from the air), lock it up forever and sink it in the bottom of the sea. This robbery is effected by the formation of calcium carbonate ($CaCO_3$), of which shells and coral are composed. By this process the air is gradually being depleted of its carbon plant food, which, we are told, is the reason that the luxurious vegetation of the carboniferous age no longer persists on the earth. Coal and perhaps oil were formed in those bygone ages and likewise buried much carbon, part of which man is now digging up and releasing again to the air by burning it for fuel.

That the plant world is now on a starvation ration of carbon dioxide is demonstrated by recent experiments which show that the growth of ordinary plants may be increased twofold and threefold by shutting them in greenhouses and giving the air more liberal doses of carbon dioxide. Man's food supply could be greatly increased in this fashion were it not for the prohibitive cost of the greenhouses. However, the problem need not concern us, except as an idle speculation, for the carbon of the air will not be exhausted for millions of years, nor is there any danger for many thousands of years of the exhaustion of the soil in the great tropical jungles, which could feed many times the present population of the earth.

From the basic sugar, glucose, many other forms of carbohydrates are built up in the plant world. They all contain the same three elements in practically the same proportions. In fact, there are several kinds of simple sugars that have exactly the same chemical formula, all containing the six atoms of carbon and the six molecules of water. This group is called the *simple sugars* or *monosaccharides*. Only three of them are common enough to concern us in nutrition. These are glucose, fructose and galactose. Fructose is found in

The Simple Sugars



PHOTOGRAPH EWING GALLOWAY

A swarm of bees going into a home-made hive. Honey is the oldest concentrated pure carbohydrate food known to man.

fruits and in honey along with glucose. Galactose is derived from the digestion of lactose or milk sugar.

How substances can contain the same elements in the same proportion and yet be different substances is one of the mysteries of chemistry that require finely spun mathematical theory for their explanation. The theory in this case is that the atoms of the chemical elements are the same in kind and number, but are hitched together differently. The difference in these sugars which have the same chemical formula was discovered by means of the action of light. A certain type of light-beam when allowed to shine through a sugar solution is bent or refracted. Glucose bends the light to the right; hence it is called *dextrose*. Fructose bends it to the left; hence it is called *levulose*. The chemist makes use of this interesting phenomenon in analyzing sugar solutions.

Dextrose and Levulose

These differences, however, do not affect the food value of these simple sugars, which is the same for all of them. They are all absorbed from the alimentary canal without any digestive process whatever, passing, like common salt or water, unchanged into the blood. Then they are carried to the liver and the liver builds them up into a more complicated substance called animal starch or glycogen. Later, when more glucose is needed by the blood, the liver proceeds to reconstruct it from glycogen. Thus, strangely enough, the glucose, fructose and galactose that went into the liver as three different kinds of sugar came out again as one; namely, glucose. Somehow the liver has twisted them around so that the left-handed sugar has become right-handed. The liver does a lot of queer things. It is the most remarkable chemical laboratory in the world.

Liver's Action on Glucose

We have just stated that these simple sugars are nutritionally equivalent, and so they are; and yet as foods they differ in one rather important particular. The different twist of the atoms in the molecule does not affect their nutritional value, since the liver straightens that all out; but it does affect their taste.

Taking cane sugar as the standard of sweetness we find that glucose is only about three-fifths as sweet; and since most people use sugar to sweeten things rather than for its food value, this lack of sweetness in glucose is a serious commercial handicap for it as a sugar. It can now be made out of corn-

PHOTOGRAPH UNDERWOOD & UNDERWOOD

While its carbohydrate content is low, as compared with other fruits, the strawberry, in addition to its protein value, contains mineral acids and salts, including iron.

Levulose, the Sweetest Sugar

starch, and is cheaper in this country than cane sugar. Besides it is a better sugar nutritionally. But the public does not like it, because when they add the accustomed amount to foods they do not get as sweet a taste.

Fructose or levulose, on the other hand, is much sweeter than cane sugar. If there were any cheap commercial source of levulose it would be a very popular commercial product. It is noteworthy that the United States Department of Agriculture has made extensive experiments for the purpose of discovering practical commercial processes for making levulose from both sweet potatoes and Jerusalem artichokes. If this sweetest of sugars could be manufactured cheaply enough, it could be mixed with glucose to form a sugar of the same sweetness as cane sugar and this mixture would be acceptable to the public as a substitute for cane sugar.

Cane Sugar vs. Cornstarch

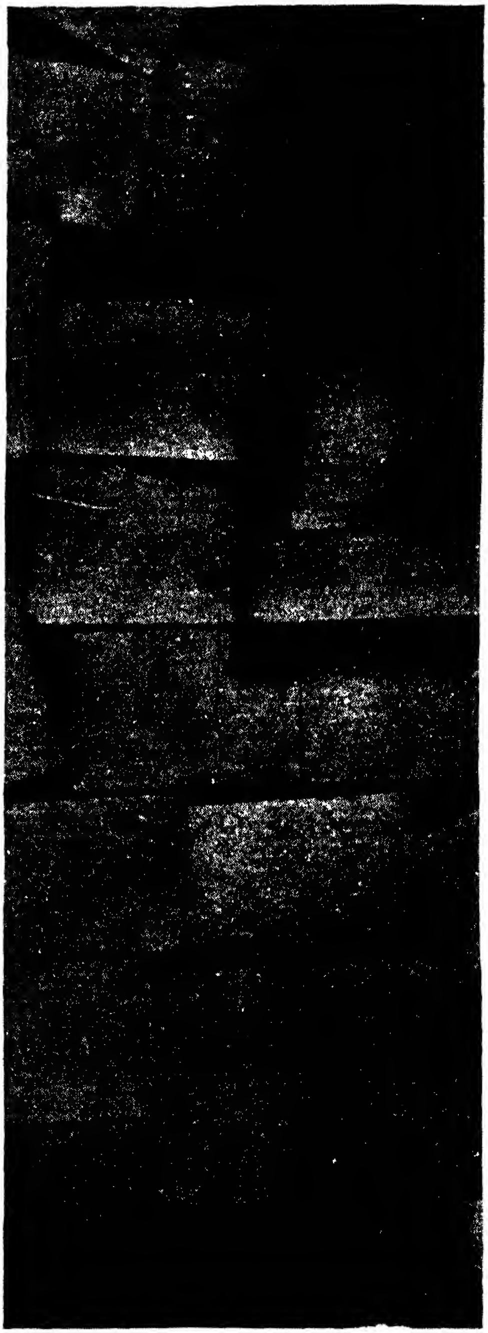
Cane sugar is a *disaccharide,* which means a *double sugar.* The plant makes it by putting together two molecules of simple sugar and then removing one molecule of water. This gives it the chemical formula of $C_{12}H_{22}O_{11}$. Cane sugar is found in the sugar-cane plant from which it takes its popular name, the chemical name being *sucrose;* but it is found in many other plants as well, and nearly half the world's supply comes from the extensively cultivated sugar beets. Cane sugar and beet sugar are identical and have the same dietetic value, for both are chemically cane sugar or sucrose. Other sources of cane sugar are sorghum and maple sugar, while there are considerable amounts in melons, pineapple, carrots and some other fruits and vegetables.

The statement that maple sugar is cane sugar may surprise many. The sugar is the same, but maple sugar, as we get it in the market, contains the minerals of the maple sap and also the delightful flavor elements, whereas the cane sugar is refined until it is nothing but chemically pure sugar. The problem of the refining and hence demineralizing of sugars we shall take up later, but now we are speaking of the chemical substance, sugar, and not of the natural sweets that may contain valuable minerals along with the sugar.

Cane sugar rightly deserves to be considered a natural food element, for it is widely distributed in many excellent foods. The reasons for criticizing it dietetically are its refinement and its overuse. It does not, moreover, seem to be as safe a sugar physiologically as are several other types of sugar which, unfortunately, are less widely used. Glucose, for example, is a natural constituent of the blood, and is available for the use of the body when injected directly into the blood-stream. Cane sugar so injected is rejected and passed out by the kidneys as a foreign material. Before cane sugar can be utilized as food it must go through a process of digestion which is called inversion. By this process the molecule of water is again added and the double molecule of the cane sugar becomes two molecules of simple sugar, one being glucose and the other levulose, the same sugars that we derive from fruits, and valuable elements of nutrition.

The Digestion of Cane Sugar

This inversion of cane sugar may take place in the presence of acid, and the hydrochloric acid of the stomach has some such ef-



White sugar pressed into blocks. In this form cane sugar is one of the most refined foods used by man, and the most denatured.

fect. However, when cane sugar is eaten in any quantity it is not digested in the stomach, but in the intestine, by a digestive enzyme called *invertase.* When large amounts of such sugar are fed, two things may happen that are not desirable. Some of it may pass unchanged into the blood to be eliminated by the kidneys and passed out of the body, and some of it may undergo an acid fermentation in the stomach through bacterial agencies, in which case it is a source of considerable irritation and possible inflammation, giving rise to symptoms of indigestion. No other food sugar seems to be subject to such difficulties in digestion.

Honey, Jams and Jellies

Honey is cane sugar that has already been largely inverted or, in a sense, predigested. Jams and jellies made of acid fruit undergo a similar process of inversion, so that much of the cane sugar is converted, after standing, into simple sugars.

There are two other kinds of disaccharides that have the same chemical formula as cane sugar. These are lactose, the sugar of milk, and maltose, the sugar of malt. Lactose when digested takes on an additional molecule of water and breaks into two molecules of simple sugar, one being glucose and the other galactose. Maltose also breaks into two molecules of simple sugar in a similar manner; but whereas cane sugar and lactose form one molecule each of two different simple sugars the maltose forms two molecules of the same sugar; namely glucose.

Lactose and Maltose Valuable

Both lactose and maltose are considered to be better physiological sugars than is cane sugar, and both can be more readily tolerated by a weakened digestive system; hence they are both preferred to cane sugar in the feeding of infants or invalids. But like glucose, neither of these sugars is as sweet as cane sugar, nor is either of them as inexpensive to produce. Furthermore, maltose has a great affinity for water and cannot easily be kept in dry or powdered form. Dampness from the air immediately makes it sticky, and hence the only form in which it can be had is that of malt syrup. While this is a commercial handicap, it has the dietetic advantage that there is little temptation to refine maltose and remove from it the minerals that are found in the natural syrup as made from barley by the malting or sprouting process.

Since our only source of lactose is milk, this sugar is even more likely than maltose to be combined with valuable minerals and other important nutritional elements. The use of both of these sugars, therefore, is to be highly commended, which cannot be said of cane sugar. One especially valuable property of lactose is that it encourages the growth of those lactic-acid bacteria in the intestines which act as deterrents to the growth of the objectionable bacteria of putrefaction. This is one of the chief advantages that is obtained from the milk diet, in which the sole source of carbohydrate food is in the form of lactose. In digestion lactose produces equal parts of glucose and of the slightly different galactose which is then converted into glucose by the liver in a manner similar to the conversion of fructose.

Why Milk Sugar Is Preferable

The most common and abundant of all carbohydrates is not sugar but starch. Starch is called a *polysaccharide,* which means that one molecule of it is made up of many molecules of simple sugar. The chemical composition of starch is expressed by the formula $(C_6H_{10}O_5)_x$. The proportion of atoms of the starch molecule is expressed by the figures, but the "x" signifies that the exact number is unknown. It is thought to be about 200. It has also been recently discovered that this very large starch molecule contains a single atom of the mineral element phosphorus. But the proportion of phos-

The Composition of Starch

PHOTOGRAPH EWING GALLOWAY

Despite their widely varying bulk, the foods here shown contain 100 calories each. Here are the contents of the dishes as they appear from left to right: Top row: lettuce, 20 ounces; lean beef steak, 2 ounces; fair sized sweet potato, 3 ounces; white flour, 1 ounce. Center row: whole wheat bread, 1⅓ ounces; brown sugar, 1 ounce; milk, 5 ounces; oatmeal, 1 ounce; large orange, 8 ounces. Lower row: Lima beans, 1 ounce; mince pie, 1⅛ ounces; butter or nut margarine, ½ ounce; large banana.

The potato is the most starchy vegetable in common use, rivaling grain as a commercial source of starch.

phorus is very small, being less than one part in a thousand by weight.

Starch is insoluble in water, which is probably the reason that so many plants convert their sugars into starch for the purpose of storage from one season to the next. Thus we find starch abundant in all grains and many other seeds, and in tubers like the potato which functions as a seed. When Nature wishes to make this food material again available for use, starch-digesting enzymes develop in the sprouting seed or tuber, and it is changed back into soluble sugar which can circulate in the sprouting plant and furnish the material for its growth.

Starch Foods Keep Better

Because starch is insoluble and not readily subject to decay, the parts of plants in which it is stored are much less perishable than other types of plant food, and have therefore been widely used for food by man. As long as he lived in the tropics, where vegetation flourished the year round, it was not necessary for him to provide himself with food stores for a winter season and he did not make such a preponderant use of starch-containing foods. But with his migration into regions with a non-productive season, due either to drought or cold, the finding of food that would keep became imperative. It was the starch-bearing seeds of the grass family, which we know as grains or cereals, that supplied this need and therefore became the backbone of agriculture. Much later the potato was added to the list, for although the potato is moist while the grains are dry, it also keeps marvelously well and furnishes food from one harvest season to another.

Thus it came about that starch became the greatest single food element in the diet of civilized man. Without it the entire history of civilization would have been different, and it is highly improbable that any such huge population as exists in the temperate climates today would ever have arisen. Yet there are good reasons to believe that this extensive use of starch as food is not without its disadvantages. Certainly there are many individuals today who appear to develop an inability to digest starch, and all sorts of devices have been tried with a view to rendering it available to such people. Overuse of starch, or perhaps its use in an otherwise defective diet, appears to be the cause of this trouble.

The Overuse of Starch

The starch molecule is digested by the addition of water, just as are the disaccharide sugars; but the process is much more complicated because of the far greater complexity of the starch molecule. It goes through a series of changes, first forming gummy substances called *dextrins*. These in turn are converted into maltose, and this, you will recall, is digested into glucose. So all starch that is completely digested is finally converted into glucose. The same series of changes takes place whether the starch is digested by the man or animal that eats it, or by the enzymes in the sprouting grain or potato, or by chemical processes in the corn-sugar factory.

Many chemical agents, under proper conditions of heat and moisture, will cause one or more of these changes. Thus in the dextrinizing of cereals or the making of zweibach out of bread, the agent is dry heat. In the malting of barley the process goes further and most of the starch is changed into maltose, though some remains as dextrins. In the making of corn sugar, or glucose, the agents are acid and heat, just as in the digestive tract. But for many years commercial glucose still contained a considerable portion of the gummy dextrins, and it is only very recently that the dry pure sugar could be made on a commercial scale.

There has been much dispute as to the most desirable form of starch for nutritive purposes. Because the raw starch digests rather slowly and in some people causes digestive disturbance, the idea of helping matters by various kinds of predigestion has been extensively exploited. Many such dextrinized or predigested foods were formerly on the market,

Starch and "Health Foods"

and indeed this claim was one of the chief arguments by which prepared cereals were first sold to the public as "health foods." Of recent years, however, scientists have generally lost faith in the value of such predigestion of starch, for the reason that it introduced unfavorable factors, such as the destruction of the vitamins, which often more than offset the advantages of such predigestion. A healthy individual in full possession of his digestive powers would probably do better to eat his starchy foods cooked in the ordinary way or sometimes raw, being careful not to use them in excess, instead of trying to secure them in predigested forms.

Sweet corn can be eaten in many delicious and palatable forms, raw or cooked. Calories per pound, 445; protein, 2.3; fat, 1; carbohydrates, 19.

Relation of Cellulose to Sugars and Starches

The other food elements that class as carbohydrates include some materials known as *pentosans,* which are found in vegetable gums but are of no great dietetic significance. We also have the substance *cellulose,* which has the same chemical formula as starch. Indeed, the sugars, starches and cellulose are all converted into one another in the life of the plant. Thus green fruits like bananas, or even green apples, contain much starch, which, as the fruit ripens, is converted into sugar. But in grains the situation is reversed, and we find that green corn in the roasting stage contains much sugar, but that as it ripens this is converted into starch. When carbohydrate material is circulating through the plant it must always be in the form of sugar, as that is soluble, while starch and cellulose are not. Thus the ascending sap in the maple tree is in the form of sugar, but is converted into cellulose with the growth of the leaves and wood. In the corn plant we can trace a still more complicated series of changes. The sugar is first formed in the leaves, then it goes as sugar to the growing grain and is there converted into starch. When that same grain later sprouts the starch is converted back into sugar, and this sugar forms the cellulose of the roots and shoots of the tiny plant till it can put out leaves and manufacture a new supply with the aid of the sun's energy.

The Function of Cellulose

Cellulose is the permanent and final form of carbohydrate in plant life. Once it has been formed there is no further conversion, except through the agencies of decay after the plant is dead. Neither the higher plants nor the higher animals can digest cellulose, and so it remains as the skeleton or structural material of all plant life and serves its interesting purpose in the digestive system of plant-eating animals by forming a non-digestible residue, without which the bowel of such animals has difficulty in voiding its waste.

FATS—CONCENTRATED BODY FUEL

Section 5

FATS and carbohydrates are composed of the same three elements, carbon, hydrogen and oxygen; but the proportions of the elements are fundamentally different and in comparing their food values that difference is very important. The fats contain much less oxygen and therefore are much more concentrated fuels than any of the carbohydrates.

Indeed, if one stops to think, the very name *carbohydrate* shows us why the sugars and starches are not very good fuels, for, as the name signifies and the chemical formula shows, the carbohydrate is really a compound of carbon and water. Water will not burn; that is, it will not take up any more oxygen. Therefore it has no fuel value. Glucose, the final carbohydrate fuel of the body, contains just forty per cent. of carbon by weight, the rest being water. Therefore it is in reality only forty per cent. fuel. But the fats contain about seventy-seven per cent. of carbon, or nearly twice as much as the sugars. In addition there is also more hydrogen than is required to form water, and this excess of hydrogen over the small amount of oxygen present adds to the fuel value. Thus the carbon alone counts for nearly twice as much fuel value in the fats as in the sugars and the hydrogen counts for enough more to give two and a quarter times as much fuel value to a pound of fat as there is in a pound of starch or sugar.

Composition of the Fats

If the pure hydrocarbons which are found in petroleum were available as human fuels they would yield a still higher fuel value, because they contain no oxygen at all. But they are not available, since in all digestive processes the food must pass into water solution before it can penetrate the intestinal walls. The fats are converted in the process of digestion into two other substances which are both soluble in water. One of these substances is soap and the other is glycerin. We do not think of soap as a food, nor would it be wise for us to eat it;

yet every particle of fat we swallow and digest is converted partly into this unappetizing substance.

Much nutritive value is lost by cooking. In the picture at the top three strips of bacon are shown. This amount is approximately equal in food value to six strips when cooked as shown in the lower picture.

This fact helps us to understand the chemistry of fats. As those familiar with soap-making know, the process consists in treating fats with a strong alkali. The alkali combines with the part of the fat that is known as the fatty acid to make soap, which is, therefore, an organic salt. The part of the fat that is replaced by the alkali is known as glycerin. The alkali required to effect this transformation is secreted in the digestive juices of the intestine. After the soluble soap and the equally soluble glycerin pass through the walls of the intestine they are again united to form fat, which then floats away in the lymph and empties into the blood-stream as tiny globules like the fat globules in milk. In neither case is the fat in solution. Meanwhile the alkali that was used to form the temporary soap has again been released and is free to repeat the operation.

Digestion Changes Fats into Soap

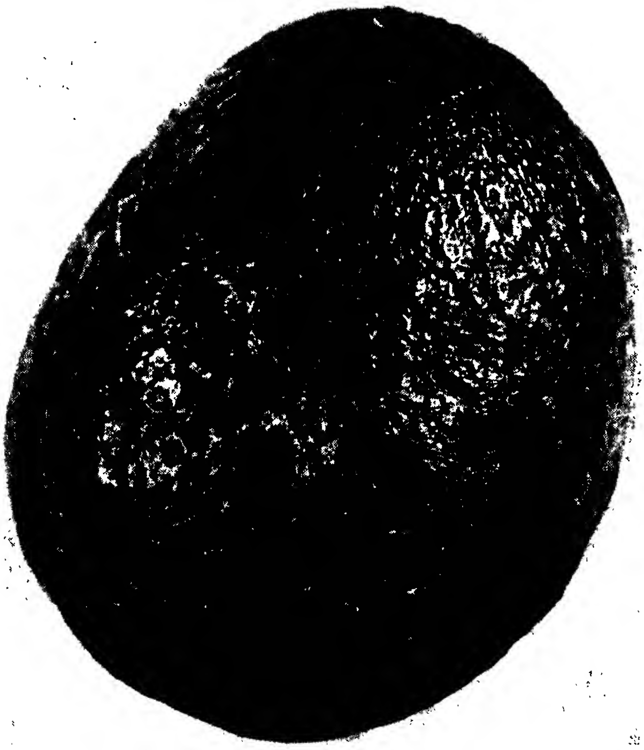
All fats are combinations of these fatty acids and glycerin. There are many kinds of fats in the chemist's classification; but none of them is ever found pure in nature, all natural fats from animal and vegetable sources being mixtures of many chemical fats. In the case of lard it is easily demonstrated that at least two fats, one liquid, the other solid, enter into its composition, for if it is allowed to cool slowly a small puddle of oil will often form in the center. In the old days farm boys used this lard oil for their dark lanterns. All fats, however, are so similar in their fuel value and other dietetic properties that it is unnecessary, from the nutritional standpoint, to master their different properties. The chief practical difference between them is their melting-point.

Stearin

Stearin is the fat that has the highest melting-point. It is not soft or greasy either at room temperatures or body temperatures, but hard and wax-like, something like hard paraffin.

Olein

Olein, on the contrary, is liquid at ordinary room temperatures. In beef tallow we have a mixture of these two fats, and so get a combination that is fairly hard and yet noticeably greasy. When tallow is heated and then allowed to cool slowly the stearin solidifies first, and at a lukewarm temperature the two can then be separated by squeezing the tallow through cloth. This separating process is actually made use of in the packing-houses to isolate the oleo oil, which then becomes the basis of oleomargarine. Such separation is not complete, however, and other fats are present also in the original tallow. The most important of these is *palmitin,* taking its name from palm oil. It is intermediate in



The avocado, or alligator pear, is one of the few fruits containing any appreciable percentage of fat. The pulp, when fully ripe, in color and consistency resembles butter.

its melting-point and has a consistency somewhat like that of lard. *Butyrin*, which has a low melting-point, is found rather freely in butter but very rarely in other fats. Of the other fats in the series each one has a slightly different melting-point, and the melting-point of mixtures is naturally determined by the proportion of the hard fats, having high melting-points, to that of the soft ones, with low melting-points.

Butyrin

The difference in the melting-points of chemical fats is determined by the number of carbon atoms in the fatty acids which combine with glycerin to form them. Such series are very common among carbon compounds. Thus one hears of the higher alcohols, meaning alcohols with a larger number of carbon atoms in the molecule. Similar series are found in the hydrocarbons of the fuel oils distilled from petroleum. Thus we get benzine, gasoline, kerosene, fuel oils, lubricating oils, vaseline and paraffin, all with different vaporizing points. Such series of carbon compounds all have similar chemical properties, but with a graduated scale of variations in their physical properties. They are usually used in complicated mixtures, and the commercial products with which we are familiar depend upon the proportions of the various elements of the series.

Why Oils Have Different Melting-Points

In the gasoline industry great efforts have been made to increase the proportions of the lower members of the series, the so-called "cracking" of petroleum being a process of reducing some of the heavier oils to lighter ones so as to get a larger proportion or percentage of usable gasoline.

But in the case of the food fats the situation is reversed. Those with melting-points sufficiently high to keep them solid at ordinary temperatures are more valuable than those of lower melting-point which are liquid at such temperatures. That led to the discovery of a method by which the melting-points could be raised. The process is called hydrogenation, and by means of it such oils as cottonseed are so changed in their consistency as to resemble lard. The first lard substitutes placed on the market were made by mixing some of the harder fats of tallow with cottonseed oil until the melting-point of the mixture approximated that of lard. Later the melting-point of cottonseed oil itself was raised by hydrogenation, resulting in the production of cooking fats which are now

A cross section of the avocado. When mixed with water, the pulp can be whipped into a rich cream for salad dressings. It is generally used peeled and sliced or eaten out of the rind.

commonly used. This process of hydrogenation is perfectly harmless and the product is not an adulterated one, but a pure oil changed by the addition of more hydrogen atoms to the molecule. This may seem a contradiction of the statement previously made that the fats of higher melting-point contain greater amounts of carbon. The explanation involves two series of fatty acids and need not be gone into here.

Hydrogenation of Food Fats

As a matter of fact the dietetic value of the different fats is so similar that neither their origin nor their exact chemical composition is of any great consequence. The commercial values depend almost wholly on the melting-points. Thus tallow, and particularly mutton tallow, is not very highly regarded as human food because it has too high a melting-point. One finds that out to one's discomfort when eating roast mutton and drinking ice-water, which has the effect of solidifying the fat in a coating on the roof of the mouth.

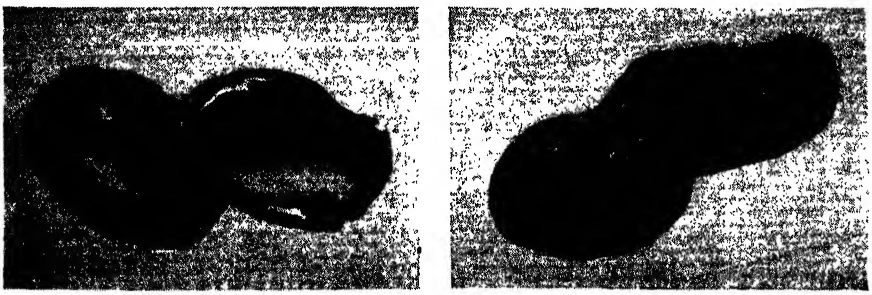
Americans prefer a cooking fat of about the consistency of lard or of butter. Hence the great effort that has been made so to mix or transform other fats or oils to get cooking fats or imitation butters of this semi-soft nature. Yet races that were trained to cook with olive oil instead of lard have no such preference, and will accept the less expensive vegetable oils in their natural liquid forms. Gradually Americans are being educated to use larger amounts of such oils in cooking. This is certainly sensible, as we have two great sources of food oil in this country, cottonseed and corn. Peanut oil and soy-bean oil are also coming into greater use, together with the imported coconut fat which happens to be of a somewhat higher melting-point and is therefore much used in nut margarine, or artificial butter. In so far as any difference in the food values of the oils and more solid fats can be shown, the oils actually have the advantage in that they are more digestible than the hard fats. A healthy man not using fats in excess would digest the oils almost completely, whereas from five to ten per cent. of a hard fat like tallow would fail to be absorbed.

A much more important consideration than the relative consistency of edible fats at ordinary temperatures is their vitamin content. Some fats contain the fat-soluble vitamins and some do not. Thus the fats from the green leafy tissue of plants are valuable sources of these mysterious elements, and so are milk fats, liver fats and egg-yolk fats. Lard and other commercial food fats, on the other hand, contain little or none of them.

Vegetable Oils Good Cooking Fats

Another interesting fact which might affect our choice of fat is that the nature of the fat formed in the body may be influenced by the type of fat consumed. The idea that the extreme oiliness of the skin and hair observed in some individuals, particularly in those races who are in the habit of using large quantities of vegetable oil to cook with, is due to an excess of fat in the food is not without scientific foundation. It is well known that swine fed on peanuts have much softer body fat than those which are fattened on grain, and there is no reason to believe that the same causes would not produce the same effects in human beings.

This brings us to the very interesting question of how fat



The peanut is one of the least expensive and most economical foods grown. It is high in both protein and fat, containing about 2500 calories per pound.

in the human or animal body is formed. It may be by the direct depositing of fats eaten, which accounts for the phenomena noted above. It may also be by the formation of fats from other foods, as every fat man who has tried to reduce knows, for he will continue to fatten if he eats enough, even though he eliminates all fat from his diet. Just how this occurs is somewhat of a mystery, and the question has been extensively investigated with animals. Swine have been fed diets that were free from fat and have yet accumulated large amounts of fat on their bodies. Cows have also been fed fat-free diets, and yet have continued to give milk with its proper quantity of butterfat and at the same time have accumulated fat on their bodies. That fat can be made even from protein is usually proved with carnivorous animals such as dogs, which can store body fat on diets of lean meat.

Food Values of Various Fats

Those who do not wish to add fat to their bodies, therefore, are not absolutely protected from doing so by abstaining from fat in foods. However, the fact remains that eliminating fat is the logical first rule of a reducing diet, because fat is certainly much more fattening than any other type of food, being at least two and a quarter times more fattening, pound for pound, than even pure sugar or starch. In practice the ratio is much greater, because food fats as we buy them are practically free from water, whereas most other foods, as purchased or eaten, contain anywhere from ten to ninety per cent. of water. A pound of pure oil may have as much as forty to fifty times as much fat-forming capacity as a pound of fresh vegetables.

Considered as fuel only, fat might not seem necessary in the diet, and yet practical experience seems to show that it is. During the war Germany suffered a fat famine, and the theory that fat is unnecessary in the diet because it can be made in the body from carbohydrates failed to work out satisfactorily in practice. The fat-hunger experienced by the German people was tragic, and this deprivation is believed to have been the cause of much increase in disease in that country during the war period. The question however is complicated, and it is quite probable that it was not the actual lack of fat that made the trouble, but the lack of certain vitamins, or other highly complex compounds, that are associated with fats in foods.

The palatability of any diet is greatly increased by a moderate proportion of fats. This is to be expected from the fact that fat is so widely distributed in natural foods. On the other hand, a diet with too large a proportion of fats is neither so digestible nor so safe nutritionally as one in which the proportion is kept within reasonable bounds.

Other Uses of Fats in Foods

In addition to its nutritional function, fat serves an important mechanical purpose in the body. It softens and lubricates intestinal wastes, provided it is not too speedily digested and absorbed. The fact that it is turned into soap before absorption would throw some light on this problem, for the admixture of soap with water certainly increases its lubricating effect. The presence of fat in the diet is undoubtedly desirable from the standpoint of the mechanical action of the bowels. That is one reason why very active men using a diet high in calories are less troubled with constipation than others. Less active persons cannot use enough fat to get this effect without overeating and suffering from obesity if the fat is digested. Hence the usefulness of the mineral or paraffin oils in cases of constipation or obesity. These oils are not true fats chemically, are non-digestible and have no food or fuel value in the body. But they are oils mechanically, hence serve as a substitute for food oils in the digestive tract.

The Fuel Value of Fats

The fats are commonly spoken of as having a fuel value only, and this is true of the far greater amount of the fat consumed. If it is not used at once to produce heat and energy, it is deposited as a fuel reserve. But every living cell contains a small percentage of fat, or products closely allied to it. Not a great deal is known about these more complicated fatty substances, but we do know that some of them are of the highest vital importance. Thus there is a fatty substance known as *lecithin* in the nerve and brain cells. This contains phosphorus as well as the carbon, hydrogen, and oxygen present in all fats. There is also a complicated group of fatty substances one of which is called *cholesterol.* The related ergosterol acted upon by ultra-violet light produces the vitamin D, with complex chemical processes involved. These rare fats, or fat-like substances, which in small amounts play a vital part in life's processes, are not to be found so much in the ordinary commercial refined fats as in natural foods.

PROTEIN—BODY-BUILDING MATERIAL

Section 6

THE chemistry of the proteins is even more complicated than that of the fats. Like carbohydrates and fats, they contain the three chemical elements, carbon, hydrogen and oxygen. But in addition they contain nitrogen and sulphur. A few also contain phosphorus, and the hemoglobin of the red blood-corpuscles contains iron. Typical proteins contain from 51 to 55 per cent. of carbon, about 7 per cent. of hydrogen, from 20 to 23 per cent. of oxygen, from 15½ to 18½ per cent. of nitrogen, and from 1 to 2 per cent. of sulphur.

Composition of Proteins

Nitrogen is the distinctive element of the proteins. In ordinary analyses of food or body substance the nitrogen is determined and multiplied by 6.25 to give the amount of protein. The determination of the nitrogen in the urine gives the measure of the protein metabolism of the body.

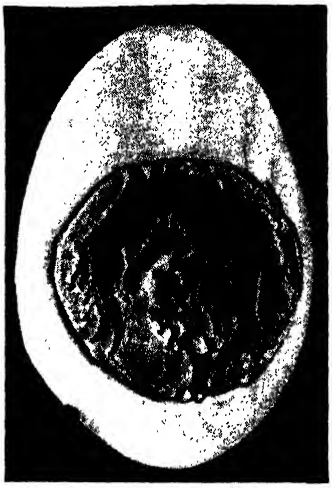
All living cells contain protein as their essential active element, and as there are hundreds of types of cells in the body of any plant or animal, it follows that there must be many kinds of proteins. It has been found, too, that any given cell may contain numerous proteins. The most nearly pure proteins that we find in nature are in parts that store protein for future use rather than in the living cells.

Egg-White Example of Protein

Eggs are the most familiar source of practically pure protein, as egg-white consists practically of nothing but protein and water. The egg-yolk is much more complicated. It contains a protein called ovo-vitellin; also a very complicated group of fats and a large quota of minerals and vitamins. Milk contains two dominating proteins. The most abundant is casein, which forms the cheese curd. The albumin, present in a lesser amount, is soluble and escapes in the whey, for which reason it is not found in cheese. Human milk contains less casein and relatively more albumin than does cow's milk. The protein of wheat is gluten, which gives this grain its particular

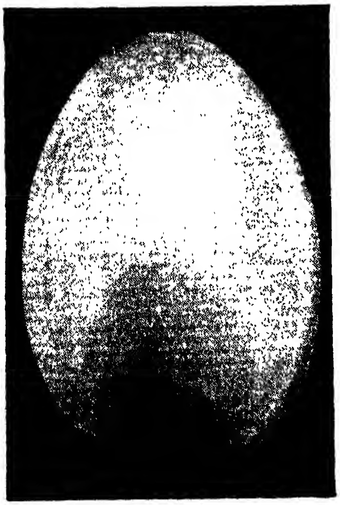
Milk Proteins and Wheat Proteins

advantage in bread-making. The substance gluten, however, is now known to be not a single protein but a mixture of proteins, of which gliadin and glutenin form the major portions. So we find that food proteins are really mixtures of several proteins in the chemical sense. Thus lean meat, or the muscle portions of all animal bodies, contains many proteins, of which myosin is the chief one.



The cross-section of an egg after boiling, showing the relative amounts of the yolk and the white. The yolk contains iron and other minerals and vitamins, while the white is almost entirely made up of albumin and water.

Complicated as all this seems, the chemist goes still further and proves that all proteins are made up of chemical combinations of a group of substances known as amino-acids. There are about seventeen of these, and none of them has any common name that the layman is likely to remember. A sample name of one of the groups should be enough to discourage the average man from any ambition in that direction. It is *diaminomonocarboxylic.* That means something to the chemist, however, as we could guess by dividing the word up, when it becomes *di-amino-mono-carboxylic.* The last part sounds like carbolic acid—but it isn't. In fact, neither the fatty acids nor the amino-acids are acids in the popular conception of the term, though they class that way in chemistry. There is only one fact that interests us in all this chemical lore about the seventeen amino-acids. It does serve to give us an idea of the complexity of



Eggs, like milk, provide man with food from the animal kingdom without recourse to the use of the flesh of living creatures.

these substances and also shows us why one protein is not necessarily as good as another for food purposes.

The Food Value of Gelatin

In the early stages of food chemistry any protein was thought to be as good as any other protein. Then they began to find exceptions. One of the first of these was gelatin. This is the protein substance that forms the tendons and cartilage of the body and also the non-mineral portion of the bones. Gelatin is easily extracted from such tissues by prolonged boiling and has long been an article of food and commerce. Because of its availability, gelatin was one of the first proteins to be tested in experimental feeding, and it was found that it would not alone support the protein needs of the body. So they called it an incomplete protein and doubted its food value. But with the progress of chemistry they found that gelatin was incomplete because it lacked a couple of the amino-acids, and that if used in combination with other proteins that contained these lacking elements it became a good food. In fact, gelatin proved to be quite rich in certain of those amino-acids in which other food proteins were lacking, so that combinations of the two would be better than either one alone.

Chemistry of Proteins Complex

We are able to comprehend better why this should be so when we consider the fact that all proteins are broken up in digestion into the amino-acids of which they are composed. When they are put together again we do not have an exact reconstruction of the original proteins, but various new types particularly fitted to construct the various human tissues. Indeed, if this were not the case life could not go on, because all our complicated organs and tissues could not be constructed directly out of the crude proteins in our food. This very complication of the proteins is what makes the distinction, not only between the different cells of our own bodies, but between the human cells and the cells of various other living creatures. Thus, while it makes the science of the chemistry of life seem hopelessly involved, it makes life, with all its varied powers, possible.

As a practical problem in nutrition we do not attempt to follow the exact chemistry of the proteins, but rather study the biological effect of the proteins from the different food sources. Such feeding tests indicate that the proteins of milk and eggs are of the highest biological value. Protein of meat would rank second and protein of grains third. The poorest group of proteins seems to be that from the legumes, such as beans and peas.

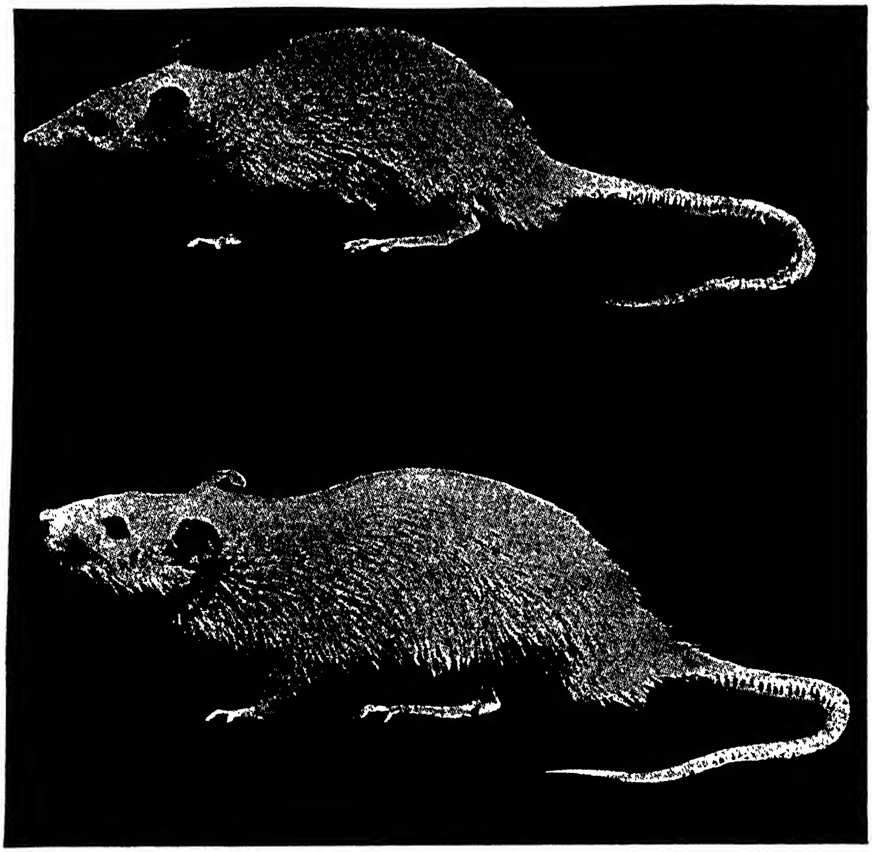
The above ranking is based on tests of the proteins of each source when fed alone, and has less significance than was formerly believed, for the reason that two proteins even of poor quality may supplement each other so that the combined effect may equal that of a protein of better quality. Thus the proteins of meat and grain when fed together give decidedly better results than when either is fed alone. Even the proteins of different grains supplement each other, and a mixture of two or more grains in the diet is superior in this respect to even the better grain when used alone.

Effect of Digestion upon Proteins

All of this would seem to show that a varied diet must be superior to a diet of a single food, and of course that is true, not only on account of the better effect from a mixture of proteins but from the similar supplementing of mineral salts and other nutritional elements. In a varied diet, whether it consists of animal and vegetable foods, or even of vegetable foods alone, the number of different sources of protein is usually such that the final effect is not very different, even though the diets differ widely. The milk diet is adequate in its protein supply, because the function of milk in nature necessitates that it be capable of supporting growth without other foods, and its proteins are therefore of unusually high quality. There is probably no other single food of which this could be said.

Feeding Tests Determine Value of Proteins

The question of the total amount of protein desirable in the human diet has been a subject of much dispute. The earliest ideas, discussed in a previous section, were based upon the actual amounts of protein that were consumed when people were left free to choose their foods as they wished, and all such studies were made with diets including an abundance of meat. Since meat is palatable, it is usually eaten in excess of any real needs that the body has for its elements. The belief that most people eat too much meat has been prevalent for a long time, but was not until recently based upon any real scientific evidence. The fact that it might supply an excessive amount of protein was not taken into consideration even by vegetarians, who, in eliminating it from their diet, thought it necessary to provide "meat substitutes," by which they meant vegetable



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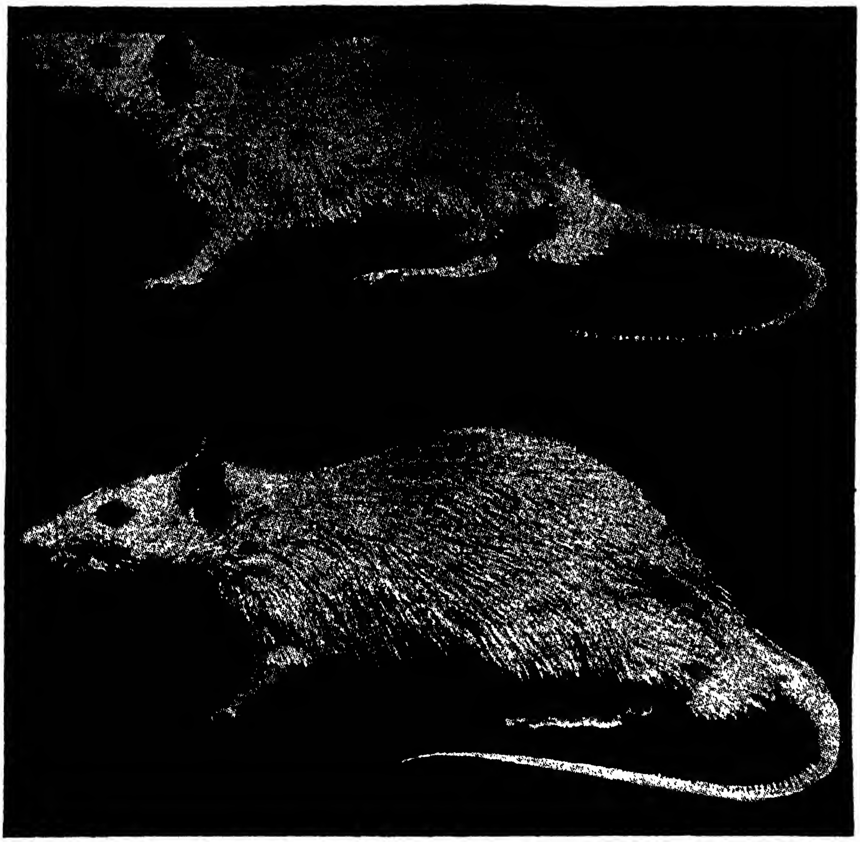
EFFECT OF THE SAME AMOUNT OF PROTEINS OF DIFFERENT QUALITIES

These two rats were both fed diets containing all elements of nutrition and in adequate amounts. But the upper small rat received a poor quality of protein, only a portion of which actually served to promote growth. Therefore, the rat is stunted quite as effectively as if it had been on a diet containing protein in insufficient amounts.

foods with high percentage of protein. Such meat substitutes are still very popular and are largely used by practicing vegetarians. This practice has no scientific foundations, since the proportion of protein in any varied diet of natural foods is greater than man's real need for protein—unless of course the selection of foods is such that the diet is composed chiefly of unusually low-protein foods.

High-protein Diet Unnecessary

The fallacy of the theory that a high-protein diet is necessary to human health was exploded by Chittenden of Yale University in 1904. He experimented with three groups of



PHOTOGRAPH BUREAU OF HOME ECONOMICS, U.S. DEPT. AGRICULTURE

EFFECT OF DIFFERENT AMOUNTS OF AN EFFICIENT PROTEIN

The smaller rat at the top of the illustration, at the age of 18 weeks, weighed 135 grams. The lower rat, during the same time, reached normal adult size of 283 grams. Both diets were complete in all elements of nutrition except that the diet of the smaller rat did not contain enough protein to permit of faster growth. Stunting in human beings from lack of a sufficient amount of protein occurs very rarely. Discussions about diets drawn from growth of rats or other small, fast growing animals do not therefore apply directly to human beings as far as the quantity of protein is concerned.

men—college athletes, soldiers and college professors. In all groups and in every individual case it was found that health and strength could be maintained over long periods upon a protein intake in a mixed diet that was far less than that indicated by the old standards.

Chittenden's Low-Protein Diet

These old standards called for from 100 to 125 grams of protein per day; but Chittenden found that from 40 to 60 grams were sufficient, according to the size and activity of the men. In other words, the old standards based on what people on a meat diet chose to eat called for more than double the amount of protein really needed.

Chittenden's work has been supported by numerous investigations since conducted. A compilation of 109 such experiments on men and women show an average requirement of 44.4 grams of protein per day (as computed for an average man weighing 70 kilograms or 154 pounds). This figure is an average of many tests, and, of course, some tests gave much lower figures, several running down to less than thirty grams—that is, less than an ounce of protein per day. Most modern authorities, while accepting these tests as proving the error of the old extremely high standards, do not, on the other hand, advise the minimum requirements as ideal standards. Instead they advise an intermediate figure ranging from 60 to 75 grams of protein per day (2 to 2½ ounces).

A brief discussion of the manner in which such scientific studies of the protein requirement are conducted will show you why the scientists were so long under the delusion that a high-protein diet was necessary.

Meaning of Nitrogen Balance

As previously stated, the amount of protein in food is ordinarily found by determining the amount of nitrogen present and multiplying this figure by 6.25. Since practically all of the nitrogen eliminated from the body passes out through the kidneys, the determination of the nitrogen excreted in the urine gives us a very good index of the amount of protein that the body is metabolizing and destroying. If we then compare the amount of nitrogen taken in as food with that excreted from the kidneys we get what is known as the *nitrogen balance.*

If more nitrogen is being taken in as food than is being excreted we have a positive balance, which indicates that the body is accumulating protein. This is what must happen during growth, or during any rapid increase in muscular development. If, on the other hand, more nitrogen is being excreted than is being taken in, we have what is called a negative balance, which indicates that protein is being lost from the body. Obviously, if such a loss continued, the body would gradually consume its muscular and other vital tissues and protein starvation would ultimately result. Therefore, the maintenance of the nitrogen balance was considered by the early food scientists to be a very important principle. The idea is sound enough, and yet in practice it helped for many years to maintain the old fallacy of the necessity of a high-protein diet. The reason for this was that when anyone attempted to live on lower amounts of protein than he had been in the habit of eating, he excreted more nitrogen in his urine than he took in through his food. The fact was that he was ridding himself of excess protein accumulated through his previous habit of eating it in excess. There was no evidence at all that such quantities of protein were necessary, and, in fact, as we have since learned, they are not only unnecessary but actually objectionable.

The error was finally discovered by studying the excretion of nitrogen in fasting, as shown in the following figures taken from the thirty-one-day fast of Succi. The figures represent grams of protein metabolized as calculated from the urinary nitrogen.

PROTEIN METABOLIZED BEFORE AND DURING 30-DAY FAST

	Grams per day
Five days on ordinary food	101.4
First to fifth days of fast	80.4
Sixth to tenth days of fast	53.1
Eleventh to fifteenth days of fast	36.2
Sixteenth to twentieth days of fast	33.1
Twenty-first to twenty-fifth days of fast	29.3
Twenty-sixth to thirtieth days of fast	33.3

Elimination of Protein

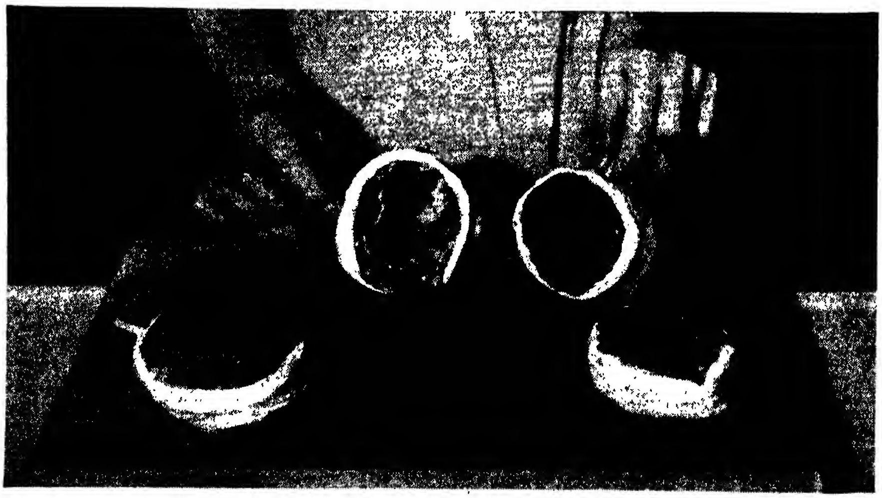
What this means is that Succi had been using a diet from which he obtained about 100 grams of protein a day and on which, presumably, he had been maintaining a nitrogen balance. When he ceased eating he continued for awhile to excrete nearly the same amount of nitrogen that he did while eating. But gradually, as the surplus protein in the body was destroyed, the nitrogen excretion decreased until at about the twentieth day it reached a minimum figure of about 30 grams per day.

Now if the results of this experiment had been based upon the first five days of the fast it would have been concluded that at least 80 grams of protein a day were metabolized by a fasting man, and that his food would have to supply that amount to keep him from nitrogen starvation. But by continuing the experiment the fallacy of this view was established.

Obviously, similar results would occur when a change was made from a high-protein to a low-protein diet. For many days there would be a draining off of the surplus protein accumulated in the body from the previous high feeding, and hence the nitrogen balance would be negative and give no indication of the true requirements. Only after weeks on the new diet could the truth be determined and a true balance computed. Of course, all modern studies of protein requirements take this fact into consideration, and the experimental diet is continued for some weeks before any attempt is made to say whether it will maintain a nitrogen balance or not. By this means surprisingly low records have been obtained, in some cases as low as 25 and even 21 grams of protein per day. These are lower than those obtained during a complete fast, which is due to the fact that during a fast some protein may be destroyed to furnish body fuel, which does not occur when ample fuel is supplied in the food from carbohydrate and fat sources.

Low-Protein Diets Beneficial

The surplus protein that is accumulated in the body as the result of high-protein feeding is sometimes called floating protein, indicating that it exists as a surplus in the body fluids and is not a part of any vital cell-structure. Such surplus protein



Different foods, containing the same amounts of protein, may vary widely in cost. Economy is especially important in the use of meat as protein. The cost of the chopped meat encircled with strips of bacon shown on the right is only 20 to 25 per cent. of that of the filets of beef tenderloin shown here on the left.

is believed to be useless and even harmful, and to furnish a possible material for various decompositions that may result in poisoning and disease. No doubt much of the benefit that comes from fasting is to be explained by the fact that it rids the body of surplus protein.

That health, strength and efficiency do not suffer from reducing the amount of protein in the diet was clearly established by Chittenden in his famous experiments. Chittenden first tried the low-protein diets on himself and his associates, with the result in every case that the men noted either no change in their general health or a marked improvement. Then he tried similar diets on a squad of soldiers who were required to take regular exercise as a military duty. The men all showed marked physical improvement during the several months of the experiment. Lastly the same test was made on a group of college athletes. These men not only maintained but in many cases improved their athletic records during the test, and one of them won an all-round championship.

High-Protein Advocates

In spite of this overwhelmingly conclusive evidence Chittenden's findings have not, even after 25 years, been universally accepted. No one has conducted any similarly thorough tests to disprove them, and yet many hide-bound scientists still argue for the old high-protein standards. The best evidence they can give is that many of the men who undergo low-protein experiments later return to a high-protein diet. Obviously they do this because they like the taste of meat and other high-protein foods, which is the real reason why the high-protein standards were adopted in the first place. They were records of what men like to eat and not of what they ought to eat.

These allegations are in no sense an argument for vegetarianism. The low-protein diet does not necessarily involve an abstinence from all meat, though, of course, it would pre-

The lima bean is often used by vegetarians as a meat substitute. Calories per pound, 525; protein, 5.3; fats, 6.0; carbohydrates, 21.6. It is rich in minerals, and strongly alkaline. When dried the protein content is raised to 18.8.

clude any large use of lean meat. As shown in an earlier part of this section, meat protein is of higher quality than most vegetable protein and for this reason a diet of low-protein vegetable foods plus a small amount of meat might be better than one made up of high-protein vegetables and no meat. Eggs and cheese are also high in protein, yet in moderation they are very good foods; but milk does not rank very high, though popularly classed as a "protein food." Owing to the misinterpretations of the old food tables, there are many such erroneous conceptions in popular classification of foods.

Protein in Eggs, Cheese, and Milk

There can be no doubt that the old standards calling for from 100 to 125 grams of protein per day led to serious results from protein decomposition in the bowels and surplus protein in the blood-stream. Both of these points will be further clarified in the two following sections. Yet we must not go to the other extreme and accept as ideal the amounts which can be shown to barely support the body's protein needs. As already stated, most modern authorities agree that from 60 to 75 grams of protein per day are about right for the adult man, and this conclusion is confirmed, not only by a study of the protein content of natural foods, but by the results one gets by using a properly selected natural diet.

The plan of Nature in this matter is, perhaps, most clearly revealed in the only perfect food created for the exclusive use of human beings. That is the breast milk which the mother feeds her babe. The chemical composition of human milk averages as follows:

Water	88.00
Protein	1.50
Fat	3.50
Sugar	6.50
Minerals	.50

For the purpose of comparing the protein content of this ideal infant food with that of the adult diet we need to know the amount of protein in proportion to calories. The typical male adult requires about 2500 calories per day, and 2500 calories of human milk yield 60 grams of protein. Such milk is, therefore, not a high-protein food, and considering that the baby of less than a year is growing more rapidly than at any

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 21 (a). Protein is supplied chiefly by animal food products. Examples of such forms of food appear above, including: Milk, haddock, mackerel, clams, fish-roe, oysters, eggs and cheese.

It is widely accepted that protein from animal products is more valuable than protein obtained from vegetable sources.

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 21 (b). **Beef, ham, chicken and mutton are also sources of protein.**

In human nutrition, the foods listed on these two pages might be ranked as to quality of protein in the following order: Milk, cheese, eggs, fish-roe, beef, mutton, ham, chicken and shellfish.

later stage in life this fact does not lend much support to the high-protein doctrine of adult nutrition.

As protein is the actual substance of growth, it would seem that the younger the animal the greater should be the proportion of protein in its diet. Not only does this sound like good theory, but any grower of chickens, or pigs, or calves, or laboratory rats will tell you that the principle works out in practice. With most of these species it is found that young animals make their best growth when fed about twice as much protein, proportionately, as the adult animal requires. As the animal gets older the proportion of protein in its diet is decreased, except in the case of milk cows or laying hens, which demand an additional source of protein for processes much resembling the growth of very young animals.

Infants' Protein Needs

On what basis of logic, then, does the human animal claim to be an exception in which the adult, after all growth has ceased, should require a diet not half but twice as rich in protein as does the rapidly growing infant feeding at its mother's breast? Yet that theory of diet was unchallenged until about twenty years ago and is still held and taught by many conventional scientists and doctors whose business it is to make theories to fit the wishes and habits of the majority of people.

At this point we seem to be reaching conclusions in favor of a very low-protein diet. The error in such reasoning, however, lies in the fact that the human infant, an extremely slow-growing creature, is compared with other young animals. The infant requires about one year to treble its weight. A calf doubles its weight several times in a year, and little pigs, young rats and rabbits double their weight every week or two. Now the meaning of this is seen when the analysis of the milk of various animal species is studied. It is found that the protein in the milk of various animals varies quite closely with the rapidity of the growth of the young of that species. Cow's milk has nearly twice as much protein as human milk. Sow's milk has about double that of cow's milk. Rabbit's milk, in accordance with the extremely rapid growth of this animal, contains 15 per cent. of protein, or ten times that of human milk.

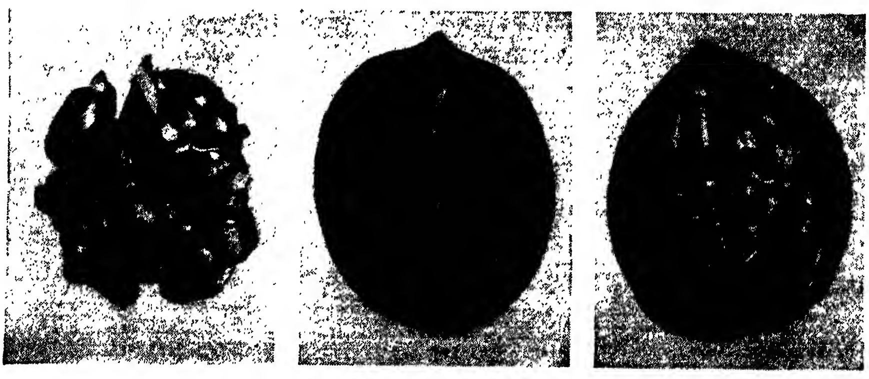
In the light of these facts we need not conclude that the adult of the human species requires as small a proportion of protein as compared with the infant as is the case with other and more rapidly growing species; but the fact that a baby is growing and a man is not might still seem to indicate that the baby would need more protein. This would be true if it were not for another fact, and that is that the baby, because of its smaller size, also requires a greater proportion of fuel compared to its body weight than does the adult. This is partly because the infant's pulse-rate is higher than the adult's, but is chiefly explained by the fact that the smaller body of the child has a comparatively greater radiating surface and hence dissipates relatively more heat.

Protein for Infant and Adult

Upon a careful study of the need of the growing body for more protein and of the smaller body for more heat we find that in the human species these factors about offset each other, and therefore there is no marked difference in the ratio of protein to calories in the ideal diet of the infant on the one hand and of the older child or adult on the other.

In human nutrition, therefore, we can accept essentially the same ratio of protein to calories for individuals of various ages, which fact greatly simplifies the problem of practical dietetics in family life.

These general conclusions, based upon nutritional biology, are confirmed by experience, and we find that an intermediate amount of protein gives the best results. A well-selected mixture of natural foods yields such a protein proportion, and it is easier to adapt the diet to the numerous other nutritional



The walnut is perhaps the best known of all the nuts. Here is shown the kernel, the nut, and the kernel resting in half the nut shell. The combination of this nut with fruits and vegetables in a salad supplies all the essential needs of the body.

needs if one does not attempt either to raise or to lower the proportion of protein. Nevertheless it is well to have some knowledge of the subject, and tables showing both the percentage of protein in our ordinary foods and the number of grams of protein per 2500 calories of each food are given in the section containing complete food tables.

In order to compare the protein content of different foods we require something more than protein percentages, or the amount of protein in a pound. We must compare protein with calories. The reason for this is obvious. It is not the quantity of the food eaten that determines its nutritional value (as a large part of it may be water, or may be inert), but, broadly speaking, its caloric value. The average food requirement of an adult man is, as we have seen, 2500 calories. When, therefore, we know the amount of protein to 2500 calories of a certain food, we can see at a glance just how well it is adapted to supply the needs of the body in this respect.

Relation of Protein to Calories

While the proportions of protein vary widely, the foods in the center of the following list very closely approach the medium standard now favored by most authorities; namely, sixty to seventy-five grams a day. A supply of 125 grams a day, in accordance with the old absurdly high standard, requires a large use of meat, eggs and fish and the insufficient use of many fine fruits. A very low standard, on the other hand, would unduly limit the use of milk, eggs and leafy vegetables and encourage the use of refined fuel foods, like fats, starches and sugars, which is likely to lead to mineral and vitamin deficiency. In the table below is shown the number of grams of protein in each 2,500 calories of the foods listed:

Egg-white	648	Peas, green	136	Oatmeal	82
Codfish	590	Lettuce	122	Tomatoes	79
Cottage cheese	463	Milk, whole	119	White flour	79
Oysters	296	Beans, navy	116	Walnuts, English	78
Lean beef	281	Peanuts	110	Almonds	74
Salmon, canned	275	Celery	110	Macaroni	73
Milk, skimmed	225	String beans	106	Parsnips	67
Egg, whole	210	Egg-yolk	104	Turnips	65
Spinach	180	Cabbage	96	Squash	61
Asparagus	169	Dandelion greens	94	Milk, human	60
Cheese	159	Whole wheat flour	84	Rice, unpolished	56

Strawberries	56	Figs	30	Apples	21
Potatoes	55	Peaches	29	Raisins	20
Corn meal	54	Bananas	28	Cranberries	17
Rice, polished	54	Watermelon	27	Prunes	15
Carrots	39	Sweet potatoes	27	Olives	15
Muskmelon	35	Plums	26	Dates	12
Pecans	34	Pineapple	24	Butter	3
Oranges	32	Pears	23	Fats, refined	0
Grapes	31	Cocoanut	22	Sugar	0

With this list of foods showing that the general tendency of natural foods is to give us a medium-protein diet, the question may present itself as to why so many races and people, when given the opportunity, eat so much meat and other high-protein foods. Certainly the use of such diets did not come from any reasoned standard, for these high protein standards were based on the fact of man's tendency to eat protein to excess. Then why this tendency?

Why Meat Is Popular as a Food

The average man would answer that question by saying that he ate meat and cheese and eggs and beans because they tasted good, and that a diet of low-protein foods tasted flat and did not seem to satisfy him. There is undoubtedly truth in this statement, and our instincts, at least as developed under civilization, do bear out the observation of Upton Sinclair that the only races that didn't eat a lot of meat were those who couldn't get it.

We therefore seem forced to the conclusion that man's instincts are capable of misleading him. An interesting explanation has been offered of this apparent fact that is given for what it is worth. According to this theory man was, through a long period of his early development, essentially a fruitarian creature. Before he reached that stage of intelli-

The pecan nut is a splendid substitute for meat. It is the richest of all the nuts in fat and is economical in that the shell is very thin. It is now marketed in a granulated form which simplifies nut-bread and nut-cake making.

gence which enabled him to invent fire, weapons, snares and traps, he could not obtain much meat and therefore, probably, ate very little of it. An inspection of this table of protein ratios shows that the idea that nuts are a high-protein food is a misconception. Hence man, as a tree-dweller and tree-feeder, but not a leaf-eater, would have had a low-protein diet.

On this hypothesis it might seem quite logical to suppose that man's diet through long periods of his development was one in which protein was comparatively scarce and sometimes insufficient. If that were true, it might also follow, on the theory of evolution, that the use of more protein food, when such was available, led to better growth, health and reproduction. If this were the case, the taste for protein might have become a fundamental instinct in the race.

Evolution and Meat Eating

Later, with the invention of weapons and the domestication of plants and animals, man could more easily get all the protein he wanted. But his instincts did not change so quickly, and so he still craved protein and therefore ate more than he needed and perhaps more than was good for him.

We may accept or reject this rather interesting theory as to the origins of man's love for the taste of meat. Many men and women, when given a wide variety of natural foods, find them attractive and do not go back to excessive meat-eating. It would seem, therefore, that an inordinate love for meat is merely a habit, as are many other artificial and unwise customs which modern man has developed.

In this connection Dr. Donald McCaskey says: "Without nitrogen we cannot exist. With a gross excess of nitrogen, which is promptly revealed by the chemistry of the blood, we are likewise cheated of life. Uremia, Bright's disease, acute dilation of the stomach, angina pectoris—all these are the final results of an excessive retention of nitrogen extending over a long period. Everything depends on the proportion of this element in our bodies. On the one hand we have nitrogen, the upbuilder of life; on the other, nitrogen, the destroyer."

CHEMISTRY OF DIGESTION

Section 7

VARIOUS phases of digestion have already been referred to; the subject will now be reviewed and the agencies that cause these changes will be studied more specifically.

Digestion proper includes all the chemical changes that take place in foods to prepare them for absorption into the circulation. That these changes should be brought about requires:

First, a definite temperature, which the natural heat of the body provides.

Second, a proper mechanical division of the food material, which is naturally brought about by the act of chewing, and which we aid by the grinding, chopping and cooking of foods.

What Is Digestion?

Third, the proper proportion of water, for the purpose of solution and chemical action, and to facilitate movement.

Fourth, the degree of acidity or alkalinity, as the case may be, required for the action of the digestive ferments or enzymes.

Fifth, the digestive agents, called ferments or enzymes.

The term ferment is confusing because the term fermentation is commonly applied to chemical changes brought about by yeast or other organisms. Such fermentation does occur in the human alimentary canal, owing to the presence of bacteria; but this is not part of the normal human digestive process. The ferments were formerly subdivided into the organized and the unorganized, the former term being applied to living cells, such as yeast and bacteria, the latter to substances that acted apart from the cell which created them. This distinction has now been dropped, because careful experiments showed that the action of all ferments was a chemical action capable of taking place outside of the cell if one could isolate the active principle. This was accomplished in the case of yeast by grinding the cells with powdered glass and then filtering off the liquid, which, though it contained no live yeast cells, was still capable for a time of converting sugar into alcohol.

The ferments, or enzymes, of digestion are secreted by living cells, in the various sections of the alimentary canal and in the pancreas, which pours its secretions into the canal. The bile, which the liver pours into the small intestine, does not contain any enzymes proper, but contributes alkaline salts which are essential to the digestion of fats.

The Ferments of Digestion

The digestive enzymes have the power to cause, or at least to hasten, chemical processes, without themselves being destroyed in any appreciable amounts. In this respect they act like what are known as chemical *catalysts,* substances that cause chemical action without themselves being consumed by the action. A typical case of such action is that of platinum on hydrogen peroxide. The latter substance decomposes slowly into oxygen and water, which is why peroxide gradually loses its strength; but brought in contact with a certain form of platinum this action is greatly accelerated. The blood and living tissue contain enzymes that have the same power as the platinum. That is why, when we put hydrogen

The black "eyes" of the pineapple are removed in a manner corresponding to the coring of other fruits.

peroxide on a wound, oxygen is generated so rapidly that the bubbles form a foam.

Work of the Digestive Enzyme

This speeding up of chemical action is the function of a digestive enzyme. The action might take place without the enzyme, but it would be entirely too slow. Thus you remember that in the digestion of fat it combines with alkaline minerals to make soap. This same combination takes place in a soap-maker's kettle, but only with intense heat and strong alkalies. At the temperature of the body and with the relatively weak alkaline salts of the intestinal juices, we wouldn't get much soap made if it were not for the help of the enzyme known as *lipase,* which is secreted by the pancreas.

Effect of Hydrochloric Acid upon Digestion

Another interesting fact is that hydrochloric acid, which is used to change starch into glucose in the corn-sugar factory, has no such action in the stomach. The acid is too weak and the temperature much too low, and there is no enzyme to work with the acid and speed up the action. Starch digestion in the alimentary canal takes place, not in acid but in alkaline solutions. It is started in the mouth, stopped in the stomach, and resumed and finished in the alkaline intestine. Even people who have an excess of hydrochloric acid in the stomach cannot digest starch there. Unfortunately the effect is quite the opposite. The acid interferes with the alkaline digestion of starch, so that one of the effects of such an excess of hydrochloric acid is to give trouble in the digestion of starch.

Under the proper conditions of temperature and alkalinity or acidity, the digestive enzymes are amazingly powerful. Anyone who is familiar with the process of making junket or cheese with rennet or "junket tablets" must be amazed at how little of this substance is required to curdle large quantities of milk. Rennet is a true digestive enzyme, being merely an extract from the walls of calves' stomachs. The purified enzyme known as rennin is capable of coagulating about half a million times its weight of casein. Pepsin is equally powerful and will dissolve 500,000 times its weight of meat. Amylase of the pancreatic juice has been known to digest 4,000,000 times its weight of starch.

Chemically, the digestive enzymes are special proteins. They are not mineral salts, and should not be confused with either the hydrochloric acid in the stomach or the alkaline

Pineapples contain considerable amounts of cane sugar and are rich in vitamins.

salts of sodium and potassium that are in the saliva and the intestinal juice. These acid and alkaline substances are also necessary to the normal process of digestion, but are separate factors.

All this helps us to understand why we can have many kinds of digestive disorders. Thus in the digestion of protein both hydrochloric acid and pepsin are needed. Either too much or too little acid will make trouble, and so will lack of pepsin.

List of Digestive Enzymes

The following is a list of the principal digestive enzymes, where they are found and what their chemical action is.

Ptyalin is found in saliva, and acts in an alkaline medium to convert starch into maltose.

Amylase is found in the pancreatic juice, and acts in an alkaline medium to convert starch into maltose.

Invertase is found in the intestinal juice and converts cane sugar into glucose and fructose.

Maltase is found in the intestinal juice and converts maltose into glucose.

Lactase is found in the intestinal juice and converts lactose into glucose and galactose.

Lipase is found in the pancreatic juice (possibly also in the gastric juice) and splits fats into fatty acids and glycerin, after which splitting action the fatty acids readily combine with the alkaline salts to form soap.

Pepsin is found in the gastric juice and acts in an acid medium to convert proteins into proteoses and peptones—an intermediate product of protein digestion.

Rennin is found in the gastric juice and coagulates milk.

Trypsin is found in the pancreatic juice and acts in an alkaline medium on proteins in a manner similar to that of pepsin, only carrying the action further and creating some amino-acids.

Stomach Digestion Over-estimated

Erepsin is found in the intestinal juice and acts in an alkaline medium to complete the digestion of proteins by converting the peptones into amino-acids.

From the study of the above list you will see that no type of digestive action is completed either in the mouth or the stomach. In fact, the action of both these organs is decidedly preliminary, and it is the small intestine that is the real organ of digestion. The digestive function of the stomach was formerly over-rated. It is a conspicuous organ and attracts our attention because it is the immediate receptacle of the foods we eat. Certainly preliminary digestive processes do go on in the stomach, and foods generally, but especially meats, lose their solid form and become liquefied there. For that reason early observers thought the stomach was the chief organ of digestion and that the function of the long winding tube of the small intestine was chiefly to give a large surface from which the blood could absorb the liquefied food.

Small Intestine Chief Digestive Organ

Fuller knowledge of the process of digestion, however, shows the function of the stomach to be of much less importance than that of the small intestine. Any process of digestion may take place entirely in the intestine, as is demonstrated by the fact that life may continue after the stomach has been removed. Such a condition involves considerable inconvenience, however, for the stomach is a very useful organ. One of its main functions is to receive and hold the food and feed it out gradually to the small intestine, which organ would be incapable of receiving a normal meal at one time without very serious disturbances.

No one part of the alimentary canal functions separately. It is one continuous tube controlled by nerves that coordinate its entire action. The secretions of one portion pass on and affect the chemical state of the following sections. Thus the action of the saliva, while being comparatively weak, is cer-

The carrot is one of Nature's antiseptics when eaten raw in large quantities. Calories per pound, 200; protein, 0.7; fat, 0.4; carbohydrates, 8.9; vitamins A, B and C. It ranks high in calcium and phosphorus.

tainly important to the normal action of the digestive tract as a whole. Some of you will remember the experiment the old physiologies asked us to perform to demonstrate the effect of saliva in changing starch to sugar. By chewing a mouthful of bread for a long time we were able to develop a sweet taste. Since no one actually chews bread so long in practice, it might appear that this action of saliva was of no importance, for it is well known that the action ceases shortly after the food comes in contact with the acid gastric juice. However, recent investigations have shown how erroneous it is to belittle this action. It appears that the end of the stomach at which the esophagus enters is comparatively inactive, and that in eating an ordinary meal much of the food remains in this end undisturbed by the gastric juice for a considerable time, thus allowing the action of the saliva to continue long enough to be quite effective.

Digestion in the Mouth

Obviously this state of affairs would be disturbed and the action lost by the use of foods that were already liquefied, as the proper flow of saliva would not be stimulated by chewing. As all starchy foods in their natural state would require considerable chewing, we can here see a possible cause for the development of starch indigestion from the use of starchy foods in mushy and liquid forms and the consequent failure of mastication and of proper salivary action.

Food Must Be in Soluble Form

We have several times referred to the action of digestion as being a process of converting solid foods into soluble form so that they could be absorbed through the walls of the intestine. This viewpoint, however, will need a little elaboration, for while all food that is absorbed must be in solution, not all foods that are in solution are absorbed.

Bacteria in Alimentary Canal

In the first place you should clearly understand that there are no holes or pores in the walls of a healthy alimentary tract. The only exception is the small tube through which the ducts from the pancreas and the gall-bladder enter, and this is closed by a valve that allows nothing to flow back through it. Otherwise the intestinal wall is tightly sealed against the passage of even a microscopic particle. If this were not the case, bacteria or other foreign particles could gain entrance to the abdominal cavity. That they do not and must not do so is emphasized by the very serious consequences that occur when the intestine is penetrated by accident and its contents are thus allowed to escape into the body cavity. Equally disastrous results would occur if intestinal bacteria had free passage into the circulation. Therefore all food before absorption must be reduced to a state of solution in which the individual molecules, which are many times smaller than any bacteria, can pass through the membranes and enter the blood-stream through the walls of the capillaries which are closely interlaced in the walls of the alimentary canal. The process by which foods filter through these membranes is called *osmosis*.

Wall Cells Have Selective Power

Furthermore, the cells in these walls have a selective power which enables them to reject even soluble materials that are not ready to enter the blood-stream. Thus cane, malt and milk sugars, though soluble, are not absorbed until acted on by digestive enzymes that convert them into the simpler sugars that the blood is ready to receive.

One might logically ask: Why, if these cells act so intelligently, do they allow any poisons to enter the blood? The only answer we can give is that they seem to have developed the power to reject only objectionable substances with which they are ordinarily confronted in the normal exercise of their duties, but fail to cope with many foreign substances that have no business to be in the alimentary tract. They prevent the absorption of a vast amount of offensive and poisonous material that is normally excreted by the bowels, but cannot always protect us against foreign poisons or the poisonous products excreted by bacteria that under certain conditions may thrive in the intestine. Considering the frailty and delicacy of the membrane that separates the interior of the gut from the blood-vessels, its resistance to bacterial penetration is indeed remarkable. Only a few of the most destructive bacteria, such as the germs of cholera, typhoid, tuberculosis and amebic dysentery, are able to overcome this resistance and penetrate and grow in the intestinal walls.

We now come to a subject to which the old-school food chemists paid a great deal of attention, and that is to the matter of the digestibility of foods. Before discussing this we must, however, distinguish between the scientific and the popular use of the terms *digestible* and *indigestible* and the related term indigestion. What the ordinary man means when he says he has an attack of indigestion is that his digestive organs have ceased to function normally and he has become aware of their disturbed action through some symptom of illness or pain. In other words, his digestive organs are causing illness. He therefore assumes that a food which is said to be indigestible is one likely to cause some such distress or pain if he eats it. And he would further assume that a food that was said to be highly digestible was one that caused no such distress. But these effects are likely to be associated with pathological conditions, such as the presence of some poisonous element in the food, or its development during digestion, and may have little or nothing to do with digestibility in the sense in which the food chemist uses this term.

Digestibility Defined

What the food chemist means by digestibility of food is the completeness, not the ease, with which it is digested. A food that is highly digestible is not necessarily, therefore, one that is easily or painlessly digested, but one of which a large percentage is digested. Thus fats are considered highly digestible foods, because they leave little residue or waste to be expelled from the body. Lettuce, on the other hand, is a food of low digestibility because a much smaller fraction of its substance is digested. But this does not mean that lettuce is more likely to cause a man to suffer pain or disturbance of his digestion than fat. In the majority of cases it would be the other way around, though that would depend both upon the individual and upon the amount eaten. To take another example, cooked cabbage is much more likely to cause indigestion in the sense of pain and distress than is raw cabbage. But of the two raw cabbage is the less digestible in the sense that a larger fraction of it will be expelled from the bowels because it has not been digested. A third example is one to which reference has already been made; namely, white flour. It is much more digestible than whole-wheat flour, but that does not mean that it is less likely to cause pain or disease of the digestive organs. On the contrary, whole-wheat flour will usually relieve digestive troubles caused by the use of white flour.

Two Meanings of Indigestion

These two meanings of the term *indigestible* coincide only when the symptoms of indigestion as a disease take the form of a diarrhea, or looseness of the bowels. That is likely to be a case of indigestion in the scientific sense also, because the bowels are then passing the food out too quickly and before sufficient time has elapsed for the digestive and absorptive processes to be completed. The cause of such a diarrhea may be any chemical irritant or poisonous substance, such as a common purgative drug or green fruit. In that case the indigestion, in the sense of incomplete conversion of the food into material suitable for assimilation, would also occur with any food that happened to be in the alimentary tract at the time, even though it were one which under normal circumstances would be highly digestible.

Action of the Whole Digestive Tract

The idea that high digestibility is desirable in a food comes from the consideration of the feeding of farm animals rather than from the feeding of human beings. A common fault of the civilized human diet is the tendency to be so digestible that there is not enough residue left to insure normal bowel action. This, however, is not true of farm animals, which are fed large amounts of hay, straw, corn fodder, unhulled oats, bran, and so forth. With such fibrous or high-cellulose feeds often less than half of the substance is actually digested. Therefore it becomes a matter of economic importance to the farmer to know what portion of his cow or horse feeds is digestible and what portion merely passes through his animals without being absorbed.

Much of the early work in human food chemistry was done by scientists in the Department of Agriculture or at agricultural colleges. These men had been trained to think along the lines that were important in the nutrition of farm animals. So they made elaborate tests of the digestibility of human foods and conveyed the impression in their reports that a high degree of digestibility was always a desirable thing, whereas in human practice, with the customary overuse of refined foods, quite the opposite interpretation should have been given to these findings.

Food and Bowel Action

A test of the digestibility of a food is at best only approximately accurate, since there is no way to separate the bowel wastes that are actually non-digested foods from those that are the result of bacterial action. No matter how digestible the food under observation may be, there will always be some bowel waste. For that matter there is some excretion from the bowels even when a man is on a complete fast. It is argued, however, that if certain foods cause more bowel waste than others such waste should be charged against the food, for it is lost from the body when the food is eaten, whether it is merely food that is non-digestible, or substance drawn from the body into the alimentary canal for the purpose of digesting that food.

Figured in this fashion the percentage of the digestibility of an average mixed diet runs about as follows: Protein 92 per cent., fat 95 per cent. and carbohydrates 98 per cent. The average digestibility of groups of food is as follows:

PERCENTAGE OF DIGESTIBILITY OF FOOD GROUPS

	Protein	Fat	Carbohydrates
Animal foods	97	95	98
Cereals and breads	85	90	98
Dried legumes	78	90	97
Vegetables	83	90	95
Fruits	85	90	98

Digestibility of White Flour

A more interesting comparison is that of the digestibility of white and whole wheat flour. Since flour contains but little fat, the digestibility of the protein and carbohydrates only was studied. The average of a series of experiments shows that white flour has 88.6 per cent. of the protein and 97.7 per cent. of the carbohydrate digestible. The contrasted figures show 74.9 per cent. of the protein and 89.2 per cent. of the carbohydrate of whole wheat flour as digestible. As the protein constitutes only about one-seventh of the nutritive elements in the flour, the figures for the total substance would show white flour to be about 96 per cent. digestible and whole wheat flour about 88 per cent.

These figures have been used repeatedly by white-flour millers to sell their product, and yet to anyone understanding their real significance *they are the most damaging facts that could be published* on the subject. Looked at from the standpoint of the economy of getting the most digestible substance out of one's food, 8 per cent. greater digestibility would make white flour appear to be one-twelfth more valuable than unbolted flour. In other words, if the latter was worth 5½ cents a pound the white flour would appear to be worth 6 cents. But since a man would rarely eat more than half a pound of flour a day, the saving would be only one fourth of a cent a day, or seven and one-half cents a month.

The Argument for White Flour

But when we look at the figures of the non-digestible fraction we find that this is 4 per cent. in the white flour and 12 per cent. in the whole wheat flour, or three times as much. A man on an exclusive bread diet made up of white flour would, on a basis of 1½ pounds of food a day, have only 1 ounce of solids with which to form his bowel waste and the result would be extreme constipation. He would be lucky indeed if his savings, 22½ cents a month, on the more digestible food were not paid out many times over for drugs and medical service as the result of the condition that such a diet would bring about. And yet this argument has been used repeatedly in behalf of white flour, and not only by the millers but by government scientists and professors who ought to know better.

The ideal percentage of digestibility of foods would be much nearer that of whole wheat flour than that of white flour. Fruits and vegetables, as you will note from the preceding page, average about 90 per cent. digestible, which is not far from the figure for whole wheat flour. Even when these natural foods are used in considerable quantities many people will still have to use bran, mineral oil or other especially non-digestible substances in order to get normal bowel action. This may be due to one or more of several causes. The percentage of the more highly digestible foods, such as milk, eggs, butter, cheese, meat, oils and sugars; the small amount of the total food-intake; the degree of physical activity; and the activity of the bowel as determined by past eating habits—all enter into the individual problem.

Constipation and Digestible Food

The fact is that the whole scheme of civilized diet, supported by erroneous teachings, encourages the use of foods that are too digestible, and that a moderate degree of indigestibility in a food product is an asset rather than a liability. Indeed there is no type of food which is more useful, or which can more honestly be called a health food, than one that has a fairly large proportion of indigestible or non-digestible elements. Yet there seems to have been a sort of silent conspiracy on the part of many scientists to convey the opposite impression; namely, that the value of food to man is measured by its completeness of digestibility and, therefore, its ability to cause constipation—the mother of disease.

METABOLISM—ASSIMILATION OF FOOD

Section 8

METABOLISM in its broadest meaning includes all the chemical processes of the body, but a simpler view is to define it as what happens to food after digestion. In this section we will discuss metabolism as applied to the various nutritive elements.

There is a still more limited meaning of the word metabolism that refers to the oxidation of food as fuel. This interpretation of metabolism involves the idea of the measurement of the total heat and energy generated in the body by such oxidation. Such metabolism is greatly influenced by the amount of muscular activity.

Digestion, Then Metabolism

The term *basal metabolism* means the minimum rate of such oxidation in any individual and is therefore measured when the body is in complete rest. The phases of metabolism discussed in this paragraph will not be considered in this section but will be found near the close of the section entitled "Measuring What We Eat."

Most people who have studied a common-school physiology have a pretty fair conception of the chemistry of digestion, but very few have any idea of the chemistry of metabolism; that is, of what becomes of food substances after they are digested. Metabolism is really the more important subject of the two, for it is only after foods are absorbed into the blood-stream that the real problem of nutrition begins. Digestion is only a matter of the preparation of foods to enter the body; their use does not begin till digestion is finished.

The inclination to consider the food problem as one of digestion only is a very prevalent one. It is a natural error, because anyone can realize that the health and action of the digestive organs is dependent upon food, since their function is so obviously concerned with it. But after food materials are absorbed into the circulation their identity as foods is lost and it takes much more thought and imagination to realize

PHOTOGRAPH UNDERWOOD & UNDERWOOD

PLATE 22. Unripe bananas prepared for shipment from plantation in Southern America. The insets show the familiar yellow variety of bananas, also the red type of the fruit, as ripened on the stalk after shipment from the tropics.

that the entire body is still concerned with them and, therefore, that the health of any organ or function of the body is quite as much a matter of food or nutrition as is that of the digestive organs.

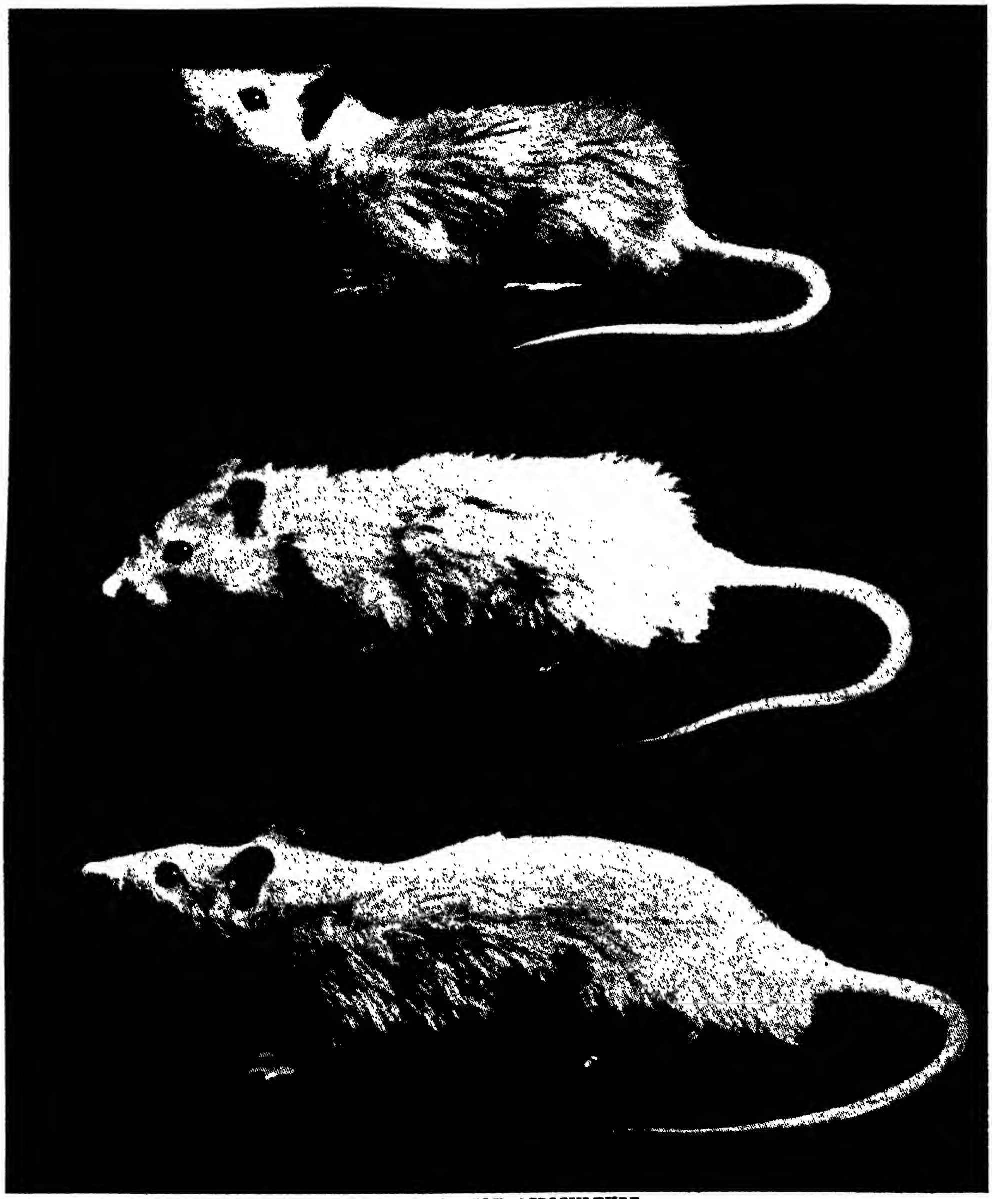
Indeed, many of the disorders of the digestive organs themselves are due not to any immediate effect of the foods which pass through them in the process of digestion, but to the effects of food materials after they have been digested and have entered into the chemistry of the blood-stream which nourishes the digestive organs just as it does every other part of the body. Sudden and acute attacks of indigestion are likely to be caused by the immediate presence of some offending food in the digestive organs; but the typical cause of chronic digestive troubles is rather the failure of the glands to secrete the proper digestive juices, and the composition of the juices is determined by the chemistry of the blood and by the nervous control.

Digestive Disorders

A factor that makes such digestive disorders especially difficult to cure is that once the function of digestion is deranged, the digestive organs become incapable of handling food in a normal manner. As a result the patient selects some diet, often under a doctor's orders, which is not complete or well-balanced in the nutritional sense. This may result in relieving the immediate symptoms of indigestion, but at the same time it serves to keep the chemistry of the body in an unbalanced and unsatisfactory state. This is not only bad for the general health, but may permanently aggravate the very trouble for which relief has been sought. In cases of this kind it may sometimes be necessary to choose temporarily diets that will improve the functioning of the impaired organs rather than those that will best maintain the general health of the body; but such inadequate diets should be discontinued as soon as possible.

Unbalancing the Diet for Temporary Relief

The ordinary "invalid cookery" may ease the immediate task of digestion, but usually has little health-building value. For example, beef broth and toasted white bread might be a very acceptable diet for a sick man and involve no risk of immediate digestive disorders (other than constipation, which the doctor often relieves by drugs), *but such a system of diet is not designed to restore health.*



PHOTOGRAPH BUREAU OF HOME ECONOMICS, U.S. DEPT. AGRICULTURE

GROWTH MAY BE CONTROLLED BY DIET

These three rats, together with three shown in the next picture, illustrate how growth may be controlled by the diet. The smallest rat at the top weighed 89 grams and received all it would eat of a diet composed of lean meat, potatoes, butter, whole wheat, sugar and salt. The middle rat weighed 137 grams and ate the same diet to which a small amount of root and leafy vegetables was added. The bottom rat was provided a small amount of milk along with the regular diet instead of the vegetables. Its weight was 187 grams.

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U.S. DEPT. AGRICULTURE

GROWTH MAY BE CONTROLLED BY DIET

In this experiment the basic diet was lean beef, potatoes, whole wheat, butter, sugar and salt. The top rat reached a weight of 194 grams by having added to the diet small amounts of milk and vegetables. The middle rat weighed 236 grams and in addition to the foods that all the rats were fed, was allowed to drink all the fresh milk it wanted. The bottom rat, weighing 167 grams, had no milk but instead was supplied all the vegetables it wished to eat.

All carbohydrates enter the blood through the walls of the intestines, either in the form of glucose, or the related simple sugars with the six carbon atoms in the molecule. The blood then passes, by the portal circulation, directly through the liver, which removes from it all the sugar that is in excess of the small fraction normal to it. The quantity varies from eight-hundredths of one per cent. in fasting to two-tenths of one per cent. after a heavy meal of sugar, and is usually about one part in a thousand (one-tenth of one per cent.). This sugar is the body's chief source of muscular energy and of heat, and is also the biggest single item of our digested food-supply when we are on a normal mixed diet.

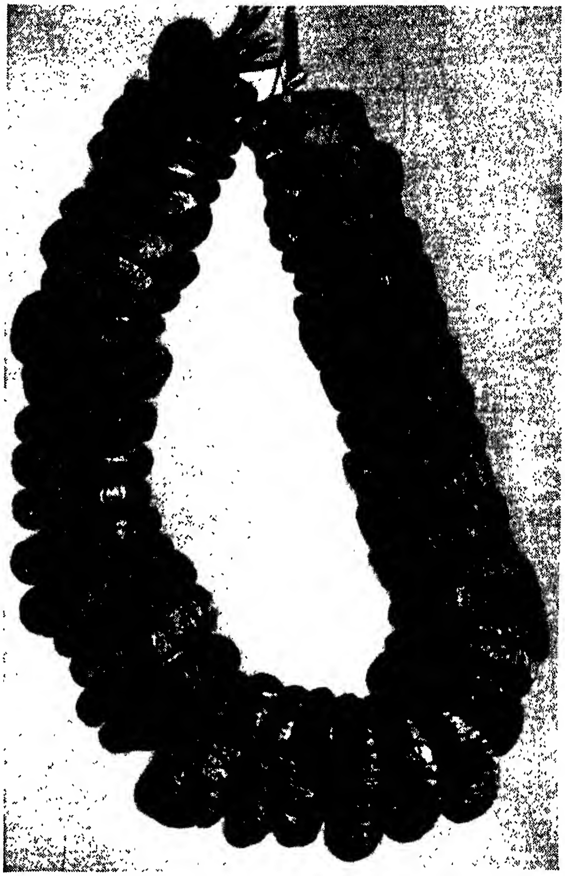
The Process of Metabolism

In vigorous muscular action, however, the supply would be exhausted in a few minutes if it were not continually renewed, and one of the prime functions of the liver is to keep a store of it available and feed it to the blood as needed, thus keeping the percentage in that fluid fairly constant. It first converts the glucose or other simple sugars into glycogen (sometimes called animal starch), and after the digestion of a heavy meal may contain as high as 10 per cent. of this substance. It can form glycogen from any of the three simple sugars (glucose, fructose and galactose) but always reconverts the glycogen into glucose before returning it to the blood.

The muscle-cells also have the power of forming and storing glycogen, their content of it varying from mere traces to as high as 2 per cent. Therefore the availability of the supply is probably in the following order: First, the sugar already in the blood as it circulates through the muscles. Second, when fuel is needed at faster rates, the glycogen in the muscle-cells. Third, the bigger reserve of glycogen in the liver, which must be converted into sugar and sent through the blood as needed to the muscles. Fourth, the stores of body fat.

When Are Fuels Ready for Use?

The different rates at which such fuels would be available to the muscle-cells probably has much to do with the limitation of a man's power to keep up a given rate of muscular exertion for a given time. A period of rest and proper nutrition sufficient for the muscles and liver to accumulate their maximum store of glycogen would seem a logical preparation for the greatest muscular activity. This certainly works out in athletic practice and explains why an athlete should take a



Figs are classified with the "sweet fruits" to which raisins and dates also belong. In protein, figs rank above both dates or raisins.

day or two of rest before any extreme effort and during that time should eat reasonable but not excessive meals, largely of a carbohydrate nature. For this purpose nothing could be better than sweet fruits. The last meal should be eaten long enough before the athletic event so that its digestion may be completed and the sugar properly stored in the liver before extreme muscular activity begins. Obviously when the whole available blood-supply is required to carry oxygen to the muscles and carbon dioxide back to the lungs, the alimentary tract should be at rest and comparatively free from blood. If a heavy meal is in progress of digestion under such circumstances, digestion will stop. This is not a desirable thing, as it may result in unfavorable nervous reactions, or even actual pain or distress. Many an athlete has lost a long-distance run or swim because he was ignorant of the fact that he could not digest a heavy meal and put forth his best muscular effort at the same time.

The Athlete's Digestion

The best estimates available indicate that the amount of glycogen stored in the muscles and liver of a healthy, well-fed, rested man is about 400 grams, or nearly one pound. This would yield on oxidation about 1,600 calories. In a race, whether swimming, running, or walking (which is as laborious as running), a man uses about 600 calories an hour. Therefore, we see that the body's store of glycogen is sufficient to provide for an athlete's fuel needs for from two to three hours.

Digestion during Muscular Activity

It follows, as a matter of good logic, and the conclusion is amply backed up by experience, that muscular endeavor up to about the limit of time and effort mentioned is not helped by feeding or by having a meal in process of digestion at the time. But when the muscular effort is to be put forth continuously for a greater period than two or three hours of maximum effort, then fuel must be supplied from one or both of two other sources. Either more sugar must be supplied to the blood directly from the alimentary tract, or the body's store of fat must be called upon.

Sources of Immediate Energy

Opinions differ as to which is the better method of supplying this additional energy. The customary practice is to feed the athlete while he is making a distance swim or an all-day run. Some authorities, however, believe that the body's store of fat is a more logical source of fuel under such circumstances. In this connection it should be noted that no visible deposit of fat is needed in order to supply fuel for such purposes. All men in ordinarily good condition carry many pounds of fat in their bodies, even when they are trained down to athletic trim and are free from visible external fat. Certainly the human body is capable of exerting a degree of muscular effort beyond the power of the digestive organs to supply fuel for it, and under the conditions of wild nature any living creature would have been greatly handicapped if it had not been able not only to store glycogen for more immediate needs but also fat for more prolonged efforts when food was either unavailable, or the creature was too busily occupied to eat it or had to spare a supply of vital energy and blood to digest it.

Under the conditions of civilization, with our three regular meals each day and our lesser need for supreme muscular efforts, popular ignorance has come to assume that the body's best source of immediate energy is from foods in the process of digestion, and that when eating ceases the body is weakened and loses its power to perform its maximum work. Nothing could be more ridiculous, and no popular notion about food and nutrition is further from the truth.

The chemistry of the burning or oxidation of sugar in the body is comparatively simple, and has already been given. From each molecule of glucose six molecules of water and six molecules of carbon dioxide are produced. Since the exact amount of oxygen present in the sugar is found in the water, the combustion of sugar consists of the burning of carbon and the release of water—hence no fuel energy is contributed by the hydrogen in the sugar. However, the exact chemical process that takes place is not the separation of the water and the later oxidation of the carbon. That would be impossible in the body, since free carbon would be an insoluble black powder, such as is deposited by a sooty flame, and this sort of fuel the body could not handle. The oxidation takes us through several intermediate steps, one of which is thought to be the formation of lactic acid, which is always found in active muscular tissue. But whatever the intermediate steps, the finished product of the combustion of glucose in the muscles is always an equal number of molecules of carbon dioxide and water. Both of these products reenter the blood, the water acting no differently from other water, and the carbon dioxide being carried to the lungs and cast out in the expired air.

Process of Oxidation

When fat is digested into soap and glycerin, it does not enter the blood directly but passes into the lymph vessels and is gathered by them into the thoracic duct, where the fat forms a creamy emulsion. This is poured into the blood circulation near the heart, the fat globules being unchanged, so that after a heavy meal of fat the blood actually shows a turbid appearance from the presence of this emulsified fat. Within a few hours it will all have been deposited in the fat-storing cells in whatever part of the body fatty tissue is accumulating—unless the sugar and glycogen in the body are running low, in which case it is likely that some will be immediately needed for fuel and will be used for that purpose without having been deposited in the fat-storing cells.

What Becomes of the Fat?

In the section on proteins we learned that they are very complex substances composed of about seventeen different amino-acids. When we discussed digestion we further learned that the process of digesting proteins is the breaking up of the complex protein molecule into these various amino-acids. It is in this form that the protein is absorbed and passed through the intestinal wall into the blood. There are true proteins in the blood, but they are a part of it and function in it. They are not what nourishes the cells and solid tissues of the body. That nourishment is carried in the form of amino-acids and is not changed into protein till it reaches the cells. These cells take from the supply of amino-acids in the blood as they need, in the proper proportions, and form them into the proteins required.

Conveying the Supplies for the Body Cells

To picture this process, which is the true process of growth and repair, we might imagine an endless belt moving beside a group of workmen. On the belt are various materials and the workmen alongside are building many different kinds of machines. From the belt-carrier as it passes, each workman takes the materials he requires for his particular type of construction. One may use more brass than the others, a second more steel, a third more aluminum, according to the type of work upon which each is engaged. The cells of the body are supplied by the blood-stream, acting as a carrier, with the seventeen amino-acids. It also carries the mineral elements in solution and other rare elements of nutrition, such as the vitamins and certain special fat-like substances. No one at

Simple combinations of vegetables frequently offer a pleasing variety in the diet. In the illustration is shown the stuffing of green peppers with sweet corn to make a palatable dish.

the present time knows how many of these different elements there are. Probably they would total many score. Indeed, the old conception that the body was nourished by carbohydrates, fats and proteins is as crude a conception of nutrition as would be the notion that houses are built out of stone, wood and iron. Not only does any modern house have many other materials not included in such a classification, but different kinds of wood and stone and different forms of iron or steel parts would go into the completed structure.

Amino-Acids

The living body is much more exacting in its structural needs than any inanimate thing like a house. Indeed, the better analogy would be between the body and a great city, with each cell a building. The amino-acids could then be considered the building materials and the different ways in which they are combined into the protein molecule would be somewhat like the different ways in which the various building materials are used in different types of buildings.

After the digestion of a meal containing considerable protein, physiological chemists have been able to show that the blood contains considerably more free amino-acids than it does on a fast or on a non-protein diet. But within a short time these amino-acids disappear from the blood. They have been used by the cells of the muscles and other active tissues throughout the body where they are reconstructed into the more complex protein molecules. This protein varies according to the type of cell or tissue that constructs it from the supply of amino-acids in the blood.

Animal Muscle Protein

The original protein in the food might have been that of the muscle of some animal in the form of meat and therefore almost, though not quite, identical to human muscle protein. But there is no direct transference of the protein as a whole from the animal muscle to the human muscle. It has all been first dismembered into its simple amino-acid parts and these are reassembled and chosen in proportion to the needs of the particular human cells, without regard to what original types of food protein these simpler substances may have come from.

There is no provision made in the body for any store of excess proteins in particular locations as there is for the store of excess fat or even of excess sugar. Instead, when protein is taken in excess it must all be stored in the active cells and their limit to store such excess protein material without interfering with their functions is not great.

The capacity of the body to store fat is much greater, and is a function that might be said to be provided in anticipation of a fuel famine. To realize why this provision is made we have only to consider the conditions under which all animal life evolved, which certainly included very irregular feeding. When food was plentiful it would be to the advantage of any organism to be able to store a surplus, because such superabundance was frequently followed by scarcity.

Surplus Food and Appetite

But civilized man has a surplus of food available at all times and has formed the habit of eating till appetite is fully satisfied. It is therefore obvious that his body will at all times be loaded up to its maximum capacity of food retention. The conventional, half-educated mind, biased by the love of eating, assumes that this condition of being constantly surfeited with food is a good thing. There is, however, no more reason to believe that the body will function at its best when its cells are always surfeited with food than there is for expecting such a result from a state of nutrition constantly at the very minimum that can sustain life.

We have at last learned that there is a state of body weight intermediate between fatness and emaciation that is more conducive to health than the plump condition formerly thought to be ideal. This state is called the metabolic balance or equilibrium. Surplus fat stored in the body is mostly visible externally. But the condition of protein storage is not visible because its maximum degree would represent only a pound or two over the ideal proportion. The fuel requirement is so much greater than the protein requirement that provision has been made for deposits of fat that are separate from other and more vital tissues. No such provision is made for the storage of protein. It must all be stored in the active cells of the muscles and the liver, and possibly to a lesser degree in other active tissues. The excess that can be stored in such active cells without interfering with their function is comparatively small, and it logically follows that such an excess is more undesirable than an excess of fat stored in non-active cells. As soon as one ceases to pour into the blood-stream this daily surplus of protein the excess begins to oxidize and drain off

No Provision to Store Great Excess of Protein

through the kidneys in the form of urea. Instead of being any disadvantage to the body, this is an advantage, as is shown by the fact, previously mentioned, that the low-protein diet results in an improvement in muscular strength and particularly in endurance.

What Becomes of Excess Protein?

We have now to consider what becomes of the protein that is eaten beyond the capacity of the cells to utilize or store it. This excess protein must be turned into substances that can be excreted, for (except in very serious kidney disorders, when albumin may appear in the urine), *no protein leaves the body as protein.* Neither is it passed out in the form of the amino-acids which circulate in the blood. Instead, it is broken down into much simpler chemical forms.

Since protein contains considerable carbon and hydrogen, a portion of it can be burned or oxidized, just like fats and carbohydrates. This oxidizable fraction is easily eliminated in the form of carbon dioxide and water; but nitrogen and sulphur, which are also present in protein, cannot be disposed of so easily. While there are gases known to chemistry that contain both nitrogen and sulphur, they are not formed in the body, nor can the nitrogen in protein be set free as pure nitrogen gas. Therefore, these elements must be eliminated through the kidneys as solids dissolved in water. Most of the nitrogen is so eliminated, in the form of urea, which is an organic salt composed of nitrogen, carbon, hydrogen and

Fowl is a favorite meat food and is fairly rich in protein. It contains less iron than the red meats.

oxygen. Lesser amounts of nitrogen are also eliminated through the kidneys in the forms of uric acid and ammonia. The latter substance is alkaline and has the power to combine with acid minerals, like sulphur and phosphorus, to form ammonium salts.

All these products that must pass through the kidneys are much more difficult to get rid of than are those that can be eliminated through the lungs or the various channels of water elimination. Therefore, an excess of protein overtaxes the kidneys, and some very serious diseases are associated with the breakdown of these organs, or with the imperfect metabolism of protein substances. One of these is gout, due to an excess of uric acid, which is not easily soluble and which, when formed in excess or not properly eliminated, may be deposited as crystals in the tissues. Carnivorous animals are provided with much more efficient powers of metabolizing and eliminating an excess of nitrogen than are we human beings, or the herbivorous animals. Millions of human beings have their tissues flooded with such sewage—plain poisonous excess baggage—and often carry it around with them for years, at the same time imagining that they are in a state of "normal health."

Results of Excess Protein

The fuel fraction of surplus protein is associated with several interesting effects.

As body fuel, protein ranks just about the same as sugars and starches. Therefore, one cannot reduce weight merely by eliminating carbohydrates and fats from the diet and eating unlimited quantities of lean meat. Carnivorous animals can become fat on a diet of lean meat if they get enough of it, and so could man if the difficulty of eliminating the nitrogen and sulphur fraction did not impair his health. A reducing diet should, therefore, contain only the amount of protein that the body normally requires. An excess may not be as likely as are the pure fuel foods to form fat, but it will be used as fuel and thus spare the fat of the body which would otherwise be used for this purpose.

As the body cannot store protein except in small quantities, any excess must be rather promptly got rid of. The kidneys excrete what they can in the form of urea, and the fuel fraction is burned or oxidized. Such oxidation of protein, unlike that of fats and sugar, seems to occur regardless of the body's need for the elements as fuel. In other words, it seems to be burned up to get rid of it. The result is that on a high-protein diet, or especially for a few hours after a big protein meal, the general metabolism of the body is increased. By this we mean that more oxygen is required, more carbon dioxide given off and more heat developed. This action has been studied in both man and animals and is called the *specific dynamic action* of protein.

Protein in Cold Weather

Because of this production of heat, in addition to that created by muscular action, a protein-rich diet is better adapted for cold weather or cold climates than for hot weather or hot climates. The general experience of the world bears this out. The meat diet used by Eskimos and by white men in the polar regions appears to be well adapted to the conditions requiring the generation of as much heat as possible, but such diets have not been found satisfactory in hot weather or in tropical climates. While a high-protein diet is not desirable at any time in temperate climates, it is obviously less objectionable in winter than in summer, and the fact that the danger from the spoilage of meat is greatest in hot weather seems to be a kindly hint from Nature to warn us against its use at the season when it is most likely to do us harm. Obese people who have trouble in keeping cool in summer should certainly not try to use high-protein diets in the belief that they are less fattening. Such diets will increase their discomfort from heat, and unless the calories are kept down will not reduce their weight. A diet with only the minimum requirement of protein and made up otherwise of carbohydrates rather than fats combines the best reducing conditions with the greatest cooling effects.

Meat as a Strength-giver

Our knowledge of the dynamic action of protein explains the popular belief that meat is stimulating and gives one immediate strength. Many athletes believe that a diet containing considerable lean meat has this effect, although many physical culture exponents maintain that it is not as good for endurance as one containing a smaller amount of protein. The former is what we should expect from the quicker burning of protein. But a high proportion of protein means an excess of the non-oxidizable elements of the protein, which must either be eliminated through the kidneys or allowed to accumulate in the body. With the other demands made upon the circulation during active exercise the robbery of the alkaline salts of the blood is started, leading to a condition of acidosis. This acidosis is what hastens the advent of fatigue symptoms. This is the explanation of the failure of a high-protein diet to produce endurance.

Protein and Acidosis

The main facts of the metabolism of the three chief groups of food elements—the carbohydrates, the fats and the proteins—have been traced here. There are still many other problems of nutrition and metabolism to be considered in more detail. Some of these are problems of normal physiology; that is, the chemical processes that normally occur in the healthy body. There are still other problems of abnormal metabolism, or pathology. Some of those which are more specifically and clearly related to the subject of nutrition will be discussed in this volume, while others will be treated only under the heads of the various diseases in the volume devoted exclusively to that subject.

THE VITAMINS: PROOF OF NATURAL FOOD INSTINCT

Section 9

SCIENCE has as its chief function the accurate interpretation of Nature's laws. Yet science at many stages of its history has tried, and in certain fields of investigation still sometimes tries, to quarrel with Nature and substitute for the obvious principles of life complicated man-made theories.

It is often said that a little knowledge is a dangerous thing. But it is also true that too much technical knowledge may be a dangerous thing. Such knowledge may fill a man with conceit in his own book wisdom and with contempt for the really greater wisdom of those who, with less specialized knowledge, have taken pains to observe the actual facts of life and nature.

Nothing has better illustrated the conceit and blindness of technical science than its disregard of the principles of the physical culturists. Yet it should be said to the credit of the scientists that when, in their own way, they find out the truth, they abandon their errors more readily than other types of minds.

Natural Food Supplies Vitamins

This has been strikingly illustrated by the complete change that has taken place in the viewpoint of nutritional scientists in regard to the superior value of natural foods as compared with diets made up on the basis of chemical knowledge. They could not see the importance of the doctrine of natural food as physical culturists have preached it since the beginning of the twentieth century, and we could not argue with them in their own technical phraseology, nor demonstrate the correctness of our views by elaborate laboratory experiments. Therefore, they looked upon us as outsiders with no right to have any ideas on the subject, until they ran square against the fact that natural foods had a potency unknown to diets made up on a purely chemical basis. In other words, the discovery of vitamins and the demonstration that the biological method was the only real way to test the value of foods justified the teaching of physical culture that proper diet is a dominant factor in the cure of disease and that drugs and chemicals foreign to the body cannot cure it.

At the present time the world of orthodox science and medicine has fully accepted the fact that certain diseases are caused by lack of particular vitamins in the diet, or by other specific deficiencies or excesses of certain nutritional elements. But it is still unwilling to accept the more general and more important truths of the relation of food as a whole to health and vitality as a whole.

When medical scientists can isolate and name a particular disease and isolate and name a particular dietetic error as the cause of that disease, and the correction of that error as the remedy, then they have faith in food; but many of them are still chasing all sorts of vague and conflicting theories of the cause of other diseases that physical culturists are curing every day merely by diet, exercise and other simple measures of natural living. Ever since the Russo-Japanese war, however, when innumerable cases proved that polished rice caused beri-beri, we have been making rapid progress, and the biggest part of the task of converting the doctors to a recognition of the relation of food to health and disease has been accomplished.

A Lesson from the Russo-Japanese War

Today an increasing number of them are studying foods more than drugs, and some even grasp the larger truth that food and the method of its use or disuse, as the case may be, with the proper elimination of nutritional and other wastes from the body, are of fundamental importance to the health and vitality of every living creature and that it is foolish to look for other methods of cure until the state of nutrition has been corrected.

Sir Arbuthnot Lane, one of England's greatest physicians, has for years labored to impress the medical world with the fundamental importance of food and the elimination of food wastes, in solving the problems of health and disease. After summarizing the evidence that causes him to believe that a vast preponderance of diseases are of nutritional origin, he says: "To deal with them efficiently we must devise means by which their causation can be controlled and eliminated. This can be done by instructing the people in the laws of health, and in

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PLATE 23. Some of the foods supplying Vitamin A are here shown in this order: Spinach, squash, lettuce, butter, lentils, cowpeas, cream, milk, cod liver oil, carrots, cream cheese, sweet potatoes, tomatoes, bananas, green peas, liver and eggs.

rendering accessible to them just such foods as are essential to health."

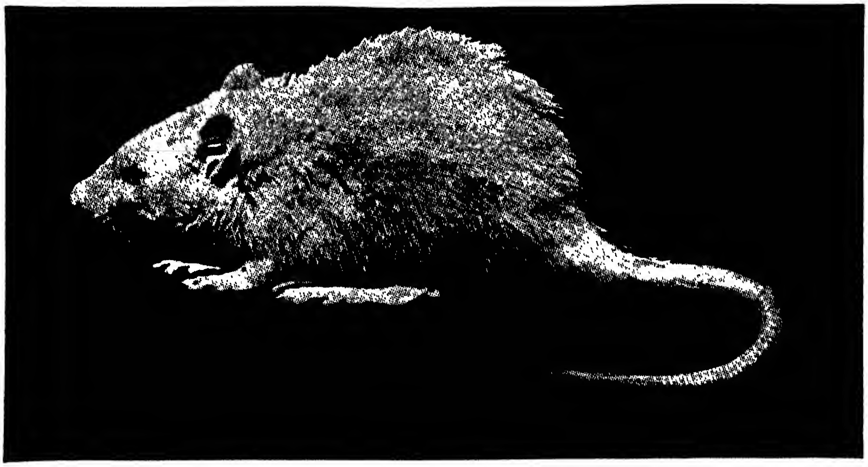
Perhaps undue attention has been given to the specific vitamins as compared with proper nutrition as a whole. Nevertheless, the vitamin investigations, because they fitted in with the orthodox habit of believing in specific remedies for specific diseases, have served as a wedge to open the medical mind to the larger conviction of the absolute dependence of all life processes upon nutrition. When not one but a dozen of diseases have been shown to be caused by specific nutritional errors, it is hard to avoid the conclusion that many other diseases and chronic ill-health in general may also have nutritional errors as, at least, a factor of their causation, and that nutritional principles furnish at least one of the elements in their cure.

Vitamin Foods Available to All

Further evidence of the slowness of chemical and medical science to acknowledge the relation of nutritional factors to disease is seen in the fact that some of the plagues that are now considered classic examples of vitamin deficiency have been recognized as nutritional diseases for decades, or even centuries. And yet medicine, while providing remedies in the forms of natural foods, still continued to look for the germs of these diseases and to seek drugs to cure them. The history of the disease known as scurvy affords a striking illustration of this sort of stupidity.

Medical Science and Nutrition

Scurvy was a plague all through the middle ages. It decimated armies and lost wars and caused besieged cities to surrender. It emptied jails and almshouses via the potter's field. It checked exploration, colonization and commerce by incapacitating the crews of sailing vessels. In more recent times it was the dreaded scourge of Arctic expeditions. Centuries ago intelligent observers noted that scurvy abated as soon as fresh food became available to the stricken people, but the medical profession continued to argue and speculate about the matter. Cold and exposure, air and climate, contagion and germs, all continued to be set forth as causes, in spite of the fact that proper fresh food alone did always prevent scurvy or cure it. The medical mind only grudgingly recognized food as an essential factor in the cause and cure of disease; and so long as it was natural food, whether limes,



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EFFECT OF VITAMIN A ON GROWTH AND HEALTH

This picture shows the effect of or lack of vitamin A upon the growth, health and vitality of the rat. The upper rat, which lacked vitamin A, weighs only 56 grams as compared with its litter mate that weighs 123 grams. The stunted rat looks somewhat larger than the weight indicates because it is ill and thin, and its hair is fluffed up. This rat is nearly blinded by the diseased condition of the eyes due to the fact that lack of vitamin A suppresses the secretion of the tear glands, as it also does of many other internal secretions. Lack of this vitamin is often a serious fault in human diets.

Scurvy Caused by Deficient Foods

lemons or other fresh fruits, vegetables or fresh meat, that appeared to do the curing in the case of scurvy, it could not be satisfied, but had to seek some other remedy. As soon as a scientific name was attached to the curative principle in these foods, they ceased to doubt and began to proclaim as a discovery the cure that had been used for generations.

Laboratory proof, too, seems to be necessary to carry conviction to the ordinary medical mind. Human beings had been getting scurvy for centuries as a result of living on denatured foods; but it was only when it was found that you could produce the disease in guinea pigs by feeding them such diets and cure it by giving them oranges and cabbage, so that any scientist could produce his own scurvy and be convinced by his own evidence, that the relation between cause and effect was considered to have been proved.

The method of feeding small animals for the purpose of producing disease, and then curing the disease by correction of the diet, is the biological method of studying the relation of food to disease. Whatever criticism of it one may make, it has certainly done a lot to convince doctors and other scientists of the relation of nutrition to the health of man.

Eijkman's Discoveries in Beri-beri

If we take into consideration the antiquity of the practice, among sea captains and polar explorers, of giving fresh food to prevent scurvy, this disease gives us the longest history of the therapeutic use of vitamins. But it was not scurvy, known more to the western than to the eastern world, but beri-beri, an Asiatic disease, which led to the definite discovery of a vitamin and gave us the theory of vitamin deficiency as a cause of disease.

Beri-beri is a very old disease among the rice-eating Orientals, going back many centuries in their history. No progress was made in its conquest till about 1880. At that time there were 323 cases a year per thousand sailors in the Japanese Navy; that is, nearly one-third of the men suffered each year from the disease. The director of the Japanese Navy, after studying the life of British sailors, decided that the Japanese diet was at fault and changed it in imitation of the British, with the result that the disease almost immediately and completely disappeared.

Ten years later the exact fault in the Japanese diet that was responsible for the disease was discovered by Eijkman, a Dutch physician in Java. He observed that some chickens were suffering with a disease which he thought resembled the beri-beri from which the inmates of local hospitals also suffered. Eijkman inquired as to how the chickens were fed and found that their diet consisted solely of polished rice. He substituted for this natural brown or unpolished rice, and the chickens recovered.

This discovery was soon applied to men. Thus at Buena Vista, a military outpost in the jungle of Cavite Province, Philippine Islands, in 1905, a U. S. army surgeon eradicated a beriberi epidemic within six weeks among Igorote troops, by changing their diet from the white polished to the brown unpolished rice. Thus it was shown that the disease was not due to any fault of the rice grain but *was the fault of man*, who rubbed off the brown bran coating which contained the substance essential for its prevention.

The name *vitamin* was later applied by Dr. Casimir Funk, a scientist then working in the Lister Institute, London, to this substance in rice polishings, and further experiments with chickens, rats and pigeons have shown it to be equally abundant in wheat germ and bran and in whole grains generally, but absent from all denatured grains, including not only polished rice, but white flour, degerminated cornmeal and so forth. In the present classification this substance is known as *vitamin B*. It is widely distributed in natural foods, whole grains, vegetables, fruits, nuts, milk and eggs. Yeast happens to be very rich in it. It is the most abundant of the vitamins, and it is only because people insist on using large quantities of denatured foods, like polished rice, white flour, granulated sugar and commercial fats, that there is any risk of their running short of it.

Vitamin B in Natural Foods

The story of the relation of two of the vitamins to great disease plagues has been given because they were associated with our earliest knowledge of the subject. Let us now go back to a more general survey of the scientific study of nutrition by animal experimentation which has developed from the study of the relation of vitamins to disease.

If we review the history of food science for a quarter of a century, we find that a situation very annoying to the scientists had developed. They wanted to demonstrate to their pupils the theory that the essentials of nutrition were protein, carbohydrates and fats, together with certain more or less ignored minerals or ash. So they took chemically refined protein, fats and carbohydrates and added to them the minerals or ash of milk and so made artificial diets that were theoretically com-

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EFFECT OF VITAMIN B ON GROWTH AND HEALTH

A lack of vitamin B shows even more rapid destructive effects upon health and growth than of vitamin A. The stunted rat at the top weighs only 31 grams and scarcely increased in weight at all from the time vitamin B was denied it. The litter mate (lower photograph) on a normal diet weighed four times as much. Vitamin B is sometimes called the growth vitamin because a lack of it results in seriously stunting growth. It serves other needs, however, than of growth only, and is necessary in the diet of adults as well as for the young. This vitamin was first discovered in rice bran and germ.

Scientists Experiment with Refined Food

plete. These were then fed to laboratory animals to prove that the scientists knew just what was necessary to support life, that it was all a matter of chemistry and that there were no principles nor ingredients needed which they had not discovered and analyzed. Imagine how embarrassing it was to find that the hardiest little animals, like rats and mice, could not live, but sickened and died on these theoretically perfect diets. Yet the same species of animals thrive very well when left to forage for themselves in an old barn! They usually did very well also if any portion of natural whole foods was included in their diet. But the moment everything was refined down to chemical purity they died.

McCollum Discovers Vitamin A

This was about the stage that nutritional science had reached in the years just prior to the opening of the World War. In his efforts, about this time, to feed white rats on chemically pure diets, Dr. E. V. McCollum, at the University of Wisconsin, had observed that better growth was obtained when butter was used as the fat element of the diet than when lard or vegetable oil was used. This led to the conclusion that some element essential to life which chemistry had failed to detect was dissolved in some fats. This element was named *Fat-Soluble A* and later came to be known as *vitamin A*.

This idea of naming the vitamins for the letters of the alphabet was generally adopted, and the previously discovered vitamin in the rice polish became known as *vitamin B*. Next the element in citrus fruits and other fresh foods that prevents scurvy was brought into the vitamin class and called *vitamin C*.

What Are Vitamins?

By the end of the war the search for new vitamins was on in full swing among the scientists. Thousands of feeding experiments with small animals were conducted all over the world in an effort to find new elements of this sort, or to determine which foods contained the vitamins already discovered. It was not, however, until about 1922 that a fourth vitamin, able to stand the tests of scientists more skeptical than the first discoverer, was found. But before taking up this discussion of *vitamin D,* which leads us to the story of the scientific vindication of another great principle of physical culture, let us stop to consider just what is meant by a vitamin and why these elements still remain things of mystery, in spite of the enormous amount of work done to learn about them.

The scheme of naming the vitamins by the letters of the alphabet seems rather childish to the man who does not comprehend why it has been done. But the explanation is very simple. It is the custom in algebra and other branches of

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EFFECT OF VITAMIN C ON GROWTH AND HEALTH

Guinea pigs and not rats are used for tests of vitamin C. To the experienced eye the upper guinea pig shows by his roughed fur and crouched position (due to sore joints) that it is suffering from scurvy. The lower guinea pig is normal, having been supplied enough of vitamin C for its bodily requirements. Guinea pigs are more susceptible to scurvy than are human beings and hence make a very delicate living test to detect the absence of vitamin C in any food or diet.

Why Vitamins Were Named with Letters

mathematics to use a letter to indicate a quantity, force or substance, either because it is unknown, or because a brief expression is wanted by which to designate it. In the case of vitamins the chemists presumed they were dealing with some unknown chemical substance, and until they could find out exactly what it was they thought to designate it temporarily by a letter. But when the discoveries began to excite popular interest these temporary names struck the public fancy as mysterious and fascinating and were at once adopted. They will probably remain as the popular names of these substances, even should the chemists later discover exactly what they are, and thus be able to give them their correct chemical names.

But how is it that the chemists can know that vitamins exist and yet cannot find out what they are? The explanation is that they exist in very small quantities and are also either quite complex or quite easily destroyed by the processes of chemical analysis. Vitamins were not discovered by chemical means but by biological observation. When the alert Dutch physician observed that chickens got beri-beri when eating polished rice and recovered when fed whole rice, he discovered that there was something in the whole rice which prevented and cured the disease. Other investigators later found that wheat germ, yeast and, to lesser degrees, hundreds of other natural foods, had exactly the same effect, and similar observations were made in the case of *vitamin C* in relation to scurvy and of *vitamin A* in relation to an eye disease.

Symptoms Showing Lack of Vitamins

The final explanation of the eye disease proved to be very simple. Without the vitamin the tear glands do not function. The eye is not washed with its natural cleansing agent and so dries up and becomes filthy and is subject to attacks from bacteria. This suppression of tear secretion is only an incidental external symptom, for the same vitamin is essential to the functioning of many other glands, and more broadly to the whole process of life and growth.

A similar arresting of growth occurs also from lack of *vitamin B,* for growth is a complicated process involving many factors that are closely related to the secrets of life itself. The eye trouble in the one case, and the beri-beri (or polyneuritis, that is, inflammation of all the nerves), are merely symptoms, the effect of the lack of any one of the vitamins being much more sweeping than that and including many functions necessary to life, growth and reproduction. These biological effects, or effects on life, were the means by which the vitamins were discovered, and a chemist working on dead matter by the usual means of chemical analysis may have not discovered them.

This puzzling situation has led many to believe that the

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PLATE 24. The sources of Vitamin B include: Tomatoes, whole wheat bread, parsley, celery, parsnips, potatoes, rutabaga, asparagus, cauliflower, onions, cabbage, kidney, fish-roe, milk, liver, bran, pecans, almonds, egg yolk and walnuts.

vitamins are not chemical substances at all, but vital forces, emanations or radiations, or perhaps some peculiar condition, like the difference that many believe to exist between "organic" and "inorganic" mineral salts. Chemists do not concede the failure of chemical science to isolate and determine the nature of all nutritional elements, but they are obliged to admit that their chemical methods failed to learn all we need to know about foods. The method of biological research, or the experimental feeding of animals, has added vastly to our knowledge. Physiology offers a parallel case in the form of enzymes.

Vitamins Known Only by Effects

The ferments, or enzymes, which constitute the active principles or effective essences of the digestive juices, are in this class. Instead of being lettered they were named from their effects. While these names seem to the layman to tell what they are, they do not tell the chemist anything; he knows only what they will do. Such a term as *sodium chloride* (common salt) tells the chemist just what elements the substance in question has in it and in what proportions they are combined; but the word *enzyme* and *ferment* and *vitamin* convey no such definite information.

The chemists hope, however, to discover ultimately just what vitamins are, and perhaps to create them in the laboratory, as they have created many rare chemical substances that were first known only in plant or animal substances.

The realm of drugs, especially of those from plant rather than mineral sources, has always been full of substances known only by their effects, and some of these have now been chemically identified. For instance, Peruvian bark has been used for centuries to combat malaria, but it was only about one century ago that the essential curative substance, quinine, was isolated from it. Thyroxine, the active chemical substance of the thyroid gland, is an example from the animal body.

Physical culturists take no credit for these intricate experiments or complicated theories about vitamins or other finespun problems of nutrition. But long before science could see any sense in our position we did insist that there were reasons for the use of natural foods in the original and unrefined states. We did not pretend to say just what substances were in those foods and label them with letters of the alphabet, and yet we felt convinced that there was something in natural foods that man, in the conceit of his artificial processes and cocksure knowledge, could very easily destroy or cast aside as one might discard pearls with pebbles.

Medical scientists today concede the importance of the discovered vitamins and other specific principles of nutrition the lack of which has been shown to cause definite diseases and symptoms. But still they fail to give full credit to the basic principle that any disease might likewise be caused by, or at least aggravated by similar errors in nutrition or disobedience to other natural laws of living, even though the specific relation between cause and effect has not yet been discovered.

Physical Culture and Vitamins

Physical culture was not set forth to the world solely as a new food therapy, but as an effort to glorify life as a whole, by producing vigorous and vital, strong and beautiful human bodies through the following of *all* Nature's laws. It is certainly no new idea to physical culturists that exercise, fresh air, bathing and sunshine are all integral parts of Nature's plan of life for man, and that the goal of perfect health is only to be attained by a proper regard for these laws. But the specific way in which two of these seemingly unconnected factors have been recently shown to be related has been the culminating, and in many ways, the most marvelous vindication of our faith. This discovery was made in the years following the World War in connection with the disease known as *rickets.*

Rickets is a failure of bone-growth in childhood. Bones are formed of a combination of the minerals calcium and phosphorus; hence, at first sight, the failure of bone-growth would seem to be wholly a matter of mineral nutrition. If there was a shortage of either calcium or phosphorus in the diet the bones could not grow any more than men could build a steel-framed building without steel. That is common sense and obvious truth, and it can be easily demonstrated, as it has been hundreds of times in animal-feeding experiments. Since phosphorus is more abundant in food, it is usually the calcium that is kept too low for growth of the bones, and it is easy enough to check growth by lack of calcium and to start it again by adding this element.

Were this all there was to it, the problem of bone-growth and rickets would be a comparatively simple matter. But it

Spinach is a source of iron in cases of anemia. Other valuable properties make it an excellent addition to any diet, in health or sickness.

has long been known that even where calcium and phosphorus were abundantly supplied bone-formation might still fail and the disease of rickets ensue, with its resulting spinal curvatures, bow-legs, abnormally shaped heads and other hideous and crippling deformities.

Why Bones Fail to Grow

Before this fact was explained by science two vastly important and seemingly irreconcilable facts were known about this bone disease of childhood. One was that sunshine would prevent or cure it; the other that cod-liver oil would also have these effects. What could there possibly be in common between sunshine and cod-liver oil? What could either of them have to do with the formation of bones from the minerals calcium and phosphorus? Certainly neither of these minerals exists in the oil, which is practically mineral-free. More certainly there are no minerals in the sunshine! Here, indeed, was a real mystery for science to solve. And science has solved it, yet felt it marvelous enough to be called a "mystery" still.

When the vitamins were discovered, and especially the fat-soluble vitamin A, it was only natural that cod-liver oil, with its century-old reputation as a medicinal substance, should be tested for vitamins. It proved to be immensely richer in vitamin A than butter, or any other then known substance. The logical presumption was that vitamin A was the active principle in cod-liver oil, and was responsible for its effectiveness in curing rickets.

The Effect of Cod-liver Oil and Sunshine

This was the state of knowledge and theory in the year 1922. That season Milo Hastings, of the staff of *Physical Culture* magazine, had a chicken farm at his country place in New Jersey. Mr. Hastings had in earlier years been a poultry authority in the national Department of Agriculture and was thoroughly familiar with the problems of chicken nutrition and chicken diseases. By 1922 he had come to the conclusion that an old and well-known disease involving faulty bone-growth in young chickens and popularly called "leg weakness," was nothing but the disease of rickets. If so, according to the new theories vitamin A should prevent or cure it.

Now, butter is not a practical feed for chickens, but next to butter, green leaves had been found to be one of the richest sources of vitamin A. Mr. Hastings, to distinguish between the effect of outdoor life and the effect of green food, kept his chickens shut indoors on the upper floor of a building, but he grew a superabundance of green leaf food in his garden which was cut and fed to them. Though they ate many times the usual amount of greens, these chickens still got rickets. But when turned out of doors or exposed to the sunlight they did not get the disease. Also they did not get rickets, even when kept in the dark in small pens, provided they were fed even very small percentages of cod-liver oil. He therefore came to the conclusion that vitamin A did not prevent rickets in chickens, but that both cod-liver oil and sunshine did do so.

Milo Hastings' Experiments with Chickens

Coincidentally, during the same year Dr. McCollum at Johns Hopkins' University reached the same conclusion by experimenting with rats. He heated cod-liver oil with a current of oxygen which destroyed the vitamin A in it, and found that it still possessed some other factor or vitamin that prevented or cured rickets in his rats. This fourth vitamin was named *vitamin D.* Both these experimenters found that cod-liver oil would prevent or cure rickets and also that sunshine would prevent or cure it.

Other scientists had gone further in analyzing the effect of the sunshine and proved that its antirachitic effect was due, not to the visible light rays, but to the short-wave ones beyond the violet light of the spectrum. This invisible light is called ultra-violet light. It does not shine through ordinary glass, but does pass through quartz. The mercury-vapor light, when generated in quartz tubes, gives off these rays in abundance. So do certain types of carbon arc lights which burn in the open without any enclosing glass to cut off the ultra-violet rays. These artificial lights were found to have effects similar to those of sunlight in preventing or curing rickets in babies or animals, and also in the healing of bone tuberculosis.

Steenbock and Ultra-violet Rays

The final stage of this interesting research explained the seemingly inexplicable fact that cod-liver oil and the ultra-violet rays could do the same thing. This was done by Dr. Hess in New York and Professor Steenbock at the University of Wisconsin. These men proved that the action of the ultra-violet rays shining upon the living animal would prevent rickets by creating the vitamin in the animal. They also proved that the same light could be made to produce the same vitamin by shining upon certain foods. Steenbock even went so far as to prevent rickets in his rats by the use of ultra-violet light at any one of four stages. He could use the light on the rats, on the goat's milk which the rats ate, on the goats that gave the milk, or on

The codfish is the source of cod-liver oil which is very valuable because of its marvelous richness in health-giving vitamins.

the clover hay eaten by the goats. In each and every case the effect on the rats was the same. Thus the mystery was solved and a creative force that could build this vitamin was found in the ultra-violet light as well as in complete sunlight.

And now for the mystery of the cod-liver oil and its marvelous richness in this vitamin. The codfish lives in seas of the subarctic region where there is abundant light in summer and the days are dark in winter. The sunlight shining on the surface of the sea produces the vitamin in the surface seaweeds on which the cod feeds. This vitamin is stored in the oil or liver fat which the cod accumulates in greater quantities than most other species. There is no more potency in cod-liver oil than in other liver oils, but it so happens that codfish yields it in abundance. "Haliver" oil (from the liver of the halibut), shark-liver oil and other fish-liver products are marked by similar qualities.

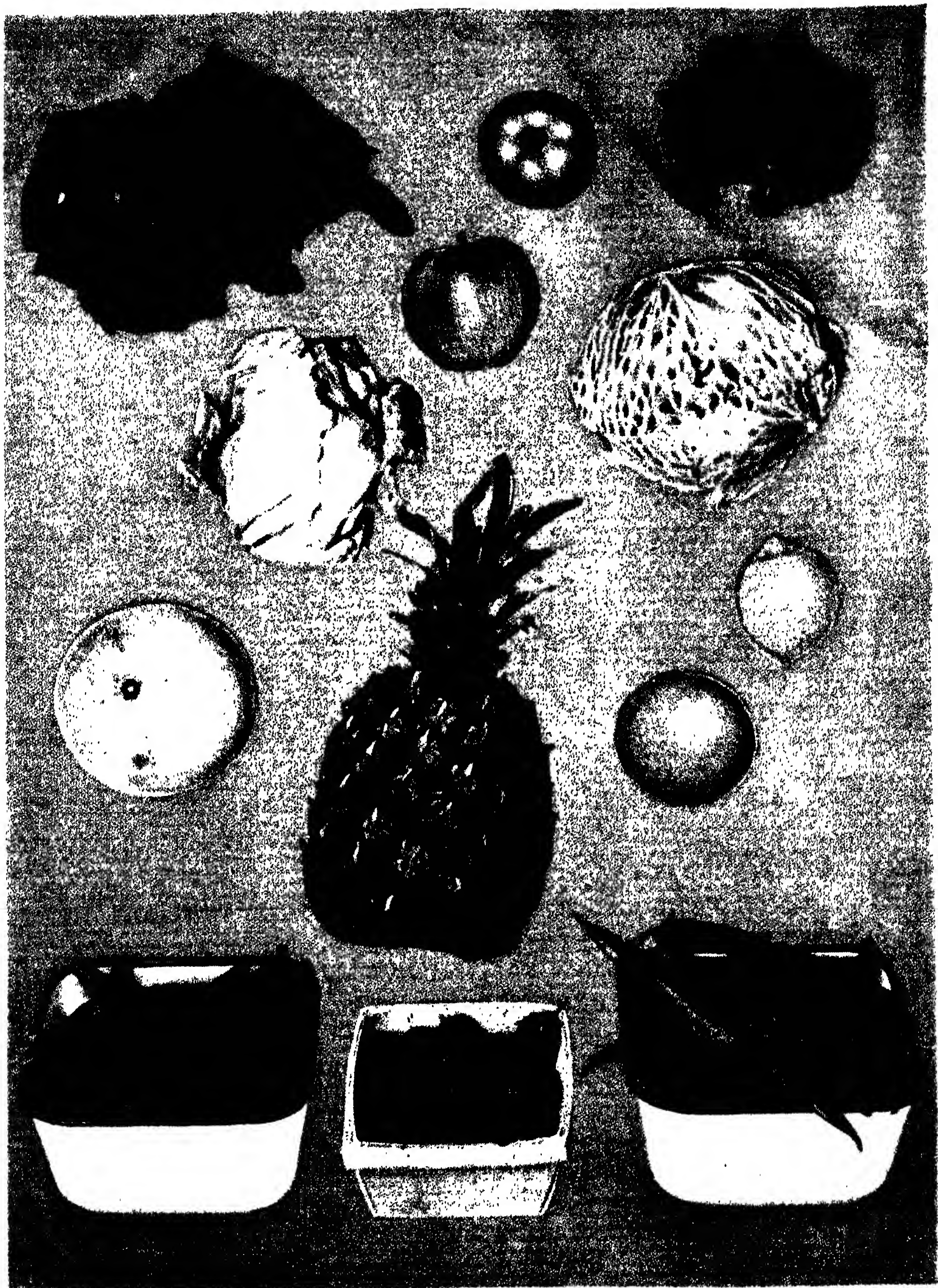
Why is Cod-liver Oil so Effective?

But does the ultra-violet light produce this vitamin? Chemists would dispute a statement that radiant or any other form of energy could actually produce a solid chemical substance. Of course the rays do not actually produce or create a substance, *but they furnish the magic energy* to transform substances and so make one thing out of something else. Indeed, the ordinary visible rays of the sun create all the world's food fuel by building sugars, starches and fats out of carbon dioxide and water.

The raw material in which the vitamin is formed by the action of ultra-violet light is a fat-like material that was first thought to be cholesterol, and is now considered to be a closely related substance known as *ergosterol*. This is a type of fat-like substance which exists only in small quantities but is widely distributed in both plant and animal life, being present in the skin of all animals and in many plant substances as well. The ultra-violet light in some way activates or changes ergosterol, giving it the powers of vitamin D. This discovery is an important scientific step.

Vitamin D Formed from Ergosterol

One point alone remains of this interesting story, and that is the question of what this rare fatty substance does to make bones grow. We can only say that the actual bone-cell is formed when the insoluble salt calcium phosphate is deposited in the cartilaginous cells of the growing bone. The vitamin



PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 25. Typical sources of Vitamin C: Spinach, tomatoes, parsley, lettuce, apples, cabbage, grapefruit, pineapple, oranges, lemons, green peas, strawberries and green beans.

is in some way essential to this final transformation of the soluble forms in which the elements calcium and phosphorus exist in the blood into the insoluble bone mineral, and its depositing in the growing bone. Just how it does this we do not know. But we know that it does it, because a microscopic examination of the bones of rickety animals shows that the cartilaginous cells have been formed ready for the mineral deposit while deposition has failed to take place. When similar animals are given the vitamin in their food, or create it in their skins through the action of ultra-violet light, then, without any added amounts of either calcium or phosphorus, the bone growth is resumed.

Vitamins and the Bones

We have noted that scientists are quick to concede the particular worth of individual vitamins but slower to concede the importance of the broader principle of the value of natural foods. Therefore, they are likely to grasp the specific evidence of the effect of particular kinds of light in preventing or curing particular kinds of diseases and fail to grasp the much broader truth that man normally requires the action of sunlight on his body and has, in large measure, shut himself off from one of the essentials of life by living indoors and wearing clothing. This subject is more thoroughly discussed in another volume of this encyclopedia. Only such phases of it have been brought out here as are needed to explain its relation to this most interesting of all vitamins.

The four vitamins thus far discussed are now recognized by the world at large, and have been studied by hundreds of investigators. At the present writing two others have received a much more limited recognition based upon the work of a few scientists.

Vitamin E, the Reproductive Vitamin

One of these is the fertility vitamin known as *vitamin E*. The effect of the absence of this vitamin is to destroy the power of reproduction in both sexes. In the male this effect is brought about by the destruction of the germ-cells. In the female these cells are not destroyed, but die after impregnation, when the embryos may be reabsorbed in an early stage of their existence. The fertility vitamin is found in the germs of whole grain and also in leafy foods. Both of these natural food substances are rich in vitamin B and contain considerable vitamin A also. This leads one to question whether vitamin

E is a distinct vitamin, or some sort of combination of effects of other vitamins. At present it seems that the vitamin E effect has been clearly enough established by experimental results on white rats, but that it has not been very clearly demonstrated upon any other species of animals. As yet no human experimental work has been done with this vitamin. But even if this were fully demonstrated it would not make any difference in dietetic practice, for the value of whole grains and leafy foods had already been sufficiently proved.

Lack of Vitamins Causes Pellagra

Vitamin deficiency is also associated with a great non-contagious plague similar to the plagues of scurvy and beri-beri; namely, pellagra. This is a disease of the poor and meagerly fed. It exists in many sections of the world, but has been chiefly studied in the southeastern part of the United States and in Italy. For many decades it has been recognized as a disease due to a poor diet and many dietetic theories have been set forth to explain it. For a long time it was supposed to be due to eating moldy corn-meal, since the classes who suffered from the disease in both the United States and Italy lived largely on this product, which, in the hands of poor and ignorant people in warm countries, is apt enough to become moldy. Later, because the patients recovered on generous mixed diets, the theory was advanced that the disease was due to a lack of protein. This also seemed a logical enough conclusion, because the diet of the poor in the pellagra sections consisted of corn, fat pork, white bread and molasses, and when these people were fed more liberal and more expensive diets such things as milk, eggs and meat were naturally added along with fruits and vegetables. In spite of much evidence indicating a dietetic origin, many doctors also contended that pellagra was a contagious disease. There was circumstantial evidence for this in the prevalence of pellagra in poorhouses, jails and similar institutions.

Prisoners' Diet Causes Pellagra

That the disease was caused by poor diet and nothing else was finally demonstrated, however, by a remarkable human experiment. The Governor of Mississippi offered pardons to certain prisoners if they would voluntarily subject themselves to an experimental diet of cornmeal, grits, polished rice, white flour, refined sugar, syrup, greens and fat pork. Twelve prisoners volunteered for this experiment. Six of them developed very definite cases of pellagra though there had been no previous case of the disease in the prison at the time, and no cases developed among prisoners who were not on the diet. This experiment put an end to any doubts as to the dietary origin of pellagra. Further experiments have shown that the cause was not lack of protein, since the addition of relatively large quantities of casein, or purified milk protein, does not cure pellagra, though the same substance will readily lead to fine growth in children or animals that have been stunted from lack of this element.

Good Food Prevents Pellagra

At the present writing the view is held by the leading workers in this field that pellagra is caused by lack of a definite substance which they call *vitamin G.* Thus again are the doctrines of physical culture justified by orthodox science. The pellagra-preventing factor differs from the beri-beri preventative in that it seems usually to be most abundant in protein foods and animal products, but the very richest source yet discovered is yeast, a purely vegetable product. The facts do not, therefore, give us any sweeping endorsement of the meat diet.

The important point in this latest discovery is that the plague pellagra is caused by lack of something that natural foods contain, and is a disease prevented by proper diet.

It will be noted that the use of the letter G in the vitamin series leaves a vacancy in the alphabetical order, this being the letter F. This resulted because the vitamin that prevents beri-beri and the one preventing pellagra were formerly confused, and both classed as vitamin B. When it was subsequently accepted that these diseases were prevented by two distinct vitamins, the letters F and G were applied to the latter two. But further research proved that the original vitamin B and vitamin F were the same, hence the designation F was dropped and G retained.

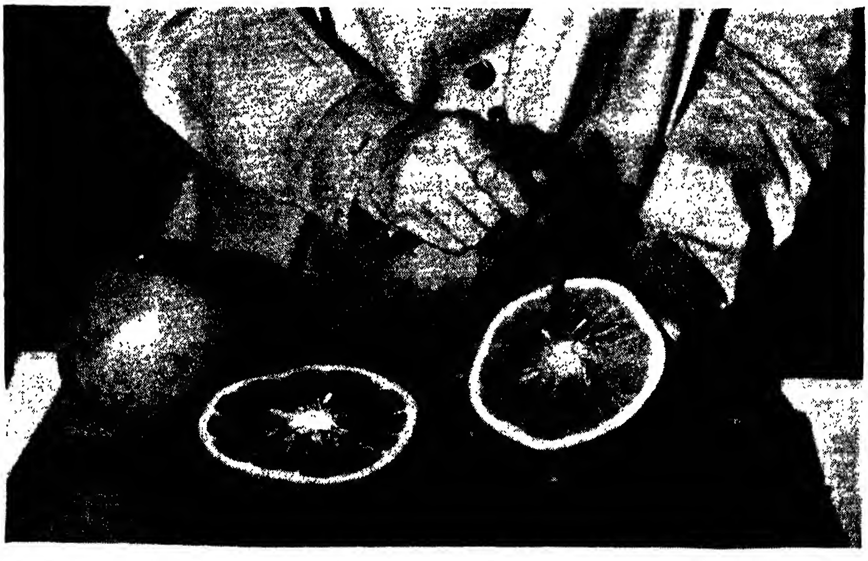
Without the development of such diseases as those mentioned above, the evil effects of a faulty diet are likely to be overlooked. Denatured foods, even among the more prosperous classes, doubtless slaughter millions of people, but they do it less directly and in a more varied manner. Only when a large group of people eat exactly the same deficient fare do we get the same symptoms. In a more prosperous population every family's bill of fare is different and hence may cause different diseases, with all sorts of complications, so that no characteristic disease is produced.

Scientists Overlook Natural Foods

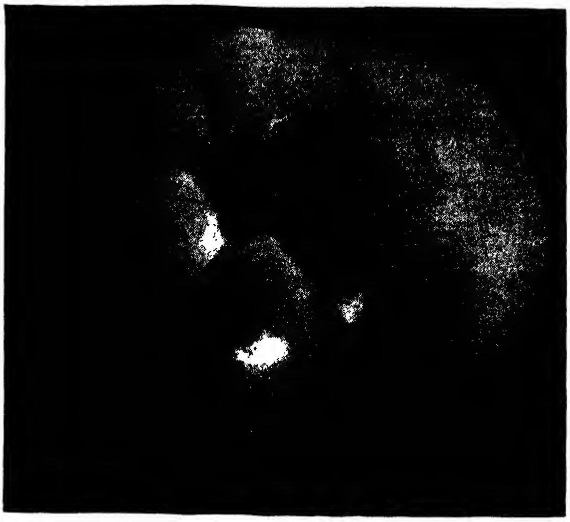
Yet none of these diseases of vitamin deficiency would ever have occurred had whole natural foods been generally used. Even an economical and monotonous diet, as in Denmark during the war, would still be a source of health instead of disease, provided it consisted of whole natural foods. Certainly no better testimony to the fundamental soundness and common sense of the philosophy of natural living on natural foods could be found than this whole history of the vitamin researches.

In recent years many efforts have been made to commercialize the knowledge of vitamins. In the case of a few articles this may be justified. Among these might be mentioned cod-liver oil for children at seasons or in locations which make it impossible to give them enough sunlight. Yeast, also, is an important source of vitamins.

The greater use of citrus fruits and tomato juice, especially by children, has also been justified, though in the case of



Citrus fruits are rich sources of vitamin C. As usually prepared, the grapefruit is freed of the skin by passing a knife around the fruit within the edge of the rind. The segments of fruit may then be separated so that they will lift freely from the fibrous partitions.



Next to the citrus fruits the tomato ranks as a high source of vitamin C. The tomato ranks high in vitamins A and B also, and is generally one of our best and most healthful foods.

citrus fruit there were ample health arguments for its use before the discovery of vitamins. Milk, eggs and butter, also previously recognized as valuable foods, have received a further sanction by the vitamin knowledge. Meat lost prestige correspondingly.

Vitamins Change Food Valuations

In the main one does not need to study the details of the effects and sources of vitamins in order to insure a sufficient supply. Natural foods, such as whole grains, fruits and vegetables—particularly leafy vegetables—will do this without any special effort to find rich sources of this or that vitamin. Nor can one really figure out any exact vitamin rations as one could figure protein or calories. This is because there is no way to analyze foods and say exactly how much vitamins of each sort they contain. All science can do is to make feeding tests and judge the approximate richness of the various foods in each of the leading vitamins. This they express by a system of grading into classes, because it cannot be expressed in exact figures. In the table of food analyses in another section of this volume you will find such vitamin rating of all foods so far as our knowledge of the subject goes. The table is interesting and will help you in a general way to judge the relative worth of foods in this particular. But with the specific exceptions above noted it is not wise to attempt to select foods for vitamins alone. The vitamin content is merely a further evidence of the value of a food.

Vitamins Not Chemically Analyzed

The table may also keep you from being led astray by false claims as to vitamin values. It is quite legitimate to claim for any food the presence of vitamins when science backs up the statement. But a little study of the equally sound evidence as to the presence of vitamins in other foods may prevent you from choosing some particular foods that may be otherwise unsuitable just because a noise has been made about their vitamin content. It is easier and often less expensive to get your vitamins from a generous selection of natural foods.

MINERAL NUTRITION

Section 10

IN PRECEDING sections of this volume the mineral elements of food and their necessity in the diet have been referred to. It has been impossible to give the scientific evidence of the value of natural foods without such references. In this section the subject will be taken up in more detail. *The elimination of minerals is one of the great blunders of modern diet.* But this has come about quite incidentally. No one has ever set out deliberately to rob foods of their minerals.

The minerals are most abundant in the active, vital and complete structures and tissues of plant and animal life. They are less likely to be present in the mere fuel-storage portions. Pure fat contains no minerals; neither does pure starch, nor pure sugar. The purest forms of protein that we commonly use as food, the muscle meats, are not devoid of minerals, yet they do not contain the right mineral balance for our general nutrition.

Minerals Vital to Plant and Animal Life

For practical considerations we should include in the above list the denatured forms of grain products. White wheat flour is typical of the group. It contains practically all of the starch of the wheat, together with considerable protein; but the minerals, as well as the cellulose and vitamins, are mostly discarded with the germ and the bran. A very similar rejecting of similar products occurs when rice is polished, and many commercial products made from the corn grains are also in this class. Bolted rye flour is analogous to white wheat flour.

When all these foods are considered, we have the staple food items of civilization. Hundreds of other foods may be used in small quantities, but the grain and flour products, the sugar and commercial syrups and starch, the fat meat and the fats and oils of both animal and vegetable origin are all used in so much greater quantities as to completely overbalance the wider variety of more natural and complete foods in our diet. For this reason the conventional diet is a demineralized diet, and many civilized peoples are on the verge of starvation for one or more of these elements.

Foods Having Minerals Removed

Many dieticians and food scientists, who have more education than common sense, defend foods that are devoid of the life-sustaining minerals. They admit the deficiency, but argue that one should eat them for their sugar, starch, fat and protein and get minerals, vitamins and cellulose from fruits and vegetables. These people seem to forget that the natural diet of man, like that of other animals, is composed entirely of foods which carry all the food elements, including these same fats, sugars, starch and protein, together with the minerals, vitamins and cellulose. When a part of the diet is composed of natural foods and part of it of demineralized foods, the whole balance of nutrition is upset. An illustration will make this clear. Let us assume whole wheat to contain just enough iron for man's needs, whereas white flour contains very little. Then a man living on whole wheat would get enough iron and one living on white flour would die for lack of it. But a man living on equal parts of whole wheat and white flour would get just half enough iron and hence suffer from chronic iron starvation. To get enough iron from such a mixture he would have to eat twice as much of the other food elements as he needed. The same principle applies, of

The whole wheat loaf supplies the diet with iron, an element almost entirely lacking in white bread.

course, in the case of potassium, sodium, calcium and other constituents of our diet. In an effort to get enough of the rarer food elements the man overeats and gets a surplus of the other elements. So he combines starvation for some things with poisoning from excess of other things. *This is really the typical chronic state of the average man,* and, with numerous variations, *may be considered the basic cause of the diseases of civilization.*

Dangers of Demineralized Foods

The situation can be improved, in a measure, by using with the denatured foods other foods that carry the needed elements in superabundance. Thus a calcium shortage can be overcome by using plenty of milk; and leafy foods, which are low in calories but relatively high in minerals, vitamins and cellulose, would help to balance white sugar and white flour. But it is only when the demineralized foods are reduced to small proportions in the diet and the offsetting foods are especially well chosen that the scheme of balancing the denatured foods in this fashion becomes safe.

The importance of a diet containing all the elements of nutrition has been repeatedly stressed throughout this volume, and the best way to insure this is by using a variety of natural foods. These will supply all of the minerals needed by the body without any special consideration of individual minerals, with the exception of phosphorus, calcium, iron and iodine, which we will presently consider in greater detail. Before doing so we shall review a few special aspects of the other minerals, beginning with sodium and chlorine. These minerals are commonly considered together because they form the chemical compound *sodium chloride,* or common salt.

Sodium chloride stands in a unique position, because it is the only mineral element that man commonly adds to foods. Just why he should have developed the appetite for added salt is somewhat of a mystery. It seems to be shared by certain other animals, especially the grazing animals, like cattle and deer, which in the wild state develop salt licks at salt-water springs. Carnivorous animals, on the contrary, seem to have no such craving for salt.

Why Do We Crave Salt?

The evidence from animal life seems scarcely sufficient to settle the question as to whether or not man should add sodium chloride to his food, and the habit of eating such added salt may reasonably be explained, not by a craving for this mineral substance in particular, but by a need for food minerals in general. Since common salt is the dominating mineral in sea water, which contains many minerals, it is quite possible that the taste for it, in both man and animals, represents an instinctive craving for all food minerals.

The Instinctive Craving for Food Minerals

To understand this problem thoroughly it should be made clear that all natural foods contain small amounts of sodium chloride. This amount varies in different cases, but in an average mixed diet it will about equal one-fourth of one per cent. of the total weight of the food. The amount of common salt in the human body is estimated to be one-sixth of one per cent. (or about one ounce). It therefore appears that a proper diet of natural foods should contain enough salt to nourish the body without the added salt which we commonly use for seasoning. As a matter of fact, many people have maintained excellent health on diets free from such added salt, and in some cases improvement in health has been noted after it was dispensed with. This would suggest that the use of added salt is unnecessary, and may sometimes, at least, be injurious. In the case of certain diseases, such as kidney troubles, dropsical conditions and hyperacidity of the stomach, salt-free diets are frequently prescribed by doctors and with marked benefit.

By some students of this subject the theory has been advanced that it is the form of the salt which one adds to food rather than the amount that should be blamed for any injury resulting from its use; but, as already explained, the science of chemistry does not recognize any distinction in kind between the sodium chloride which exists in natural foods and the sodium chloride of commerce, which we use on our tables.

All Salt Identical

To elucidate the problem experiments were made in the Physical Culture Food Laboratory. White rats were fed an otherwise nutritious diet composed of food elements that were almost entirely free from sodium chloride of any kind. They failed to thrive on this salt-free diet. Other groups of animals were fed the same diet with the addition of various amounts of common table salt. It was found that the addition of one-fourth of one per cent. of salt resulted in the maximum growth of the animal. Greater additions of salt did not result in any better growth, but in a slight retardation of growth and vitality as compared with the animals which had the minimum but necessary amount. The injury done to the test animals from the use of one and two per cent. of salt, such as would be used by man in an ordinary diet, was very slight; but when the amount was increased to five or ten per cent., the injurious effect was marked.

These experiments demonstrated that some salt is necessary to life, a conclusion hardly to be disputed, because of the presence of salt in the human body and in all animals. A properly selected natural diet should contain enough salt for nutritive purposes, but on account of the use of so many refined and mineral-free substances in the modern diet we may be justified, as a matter of precaution, in adding a little salt to our food. These facts do not justify, however, the use of this substance in the excessive quantities that are all too common.

Experiments Show Salt Necessary

There is a further objection to the heavy salting of foods. This is that it disguises the natural flavors of food, and therefore, like spices and condiments, tends to destroy our finer sense of taste and leads to overeating and cravings for deficient foods which would have little or no taste appeal without such artificial seasoning.

Those seeking perfect nutrition should certainly avoid the excessive use of salt in their food, and young children should especially be watched to see that they do not form a taste for it.

Potassium is closely related chemically to sodium. It is present in the human body, being more than twice as abundant as sodium. But potassium is also much more abundant in natural foods, being one of the commonest of food minerals. This, perhaps, explains why man has never formed the habit of adding potassium salts to his food, as he does the sodium salt.

Potassium is found in goodly quantities not only in meat and milk but also in foods of vegetable origin. Whole wheat and beans each contain about twelve times as much potassium as sodium, oranges about eighteen times as much and potatoes twenty times as much. From these few examples one can readily see that any diet of natural foods will contain ample supplies of potassium for the needs of the human body, and that only on a very artificial diet would there be any danger of

Potassium In Food

deficiency. Even in such a case it would be foolish to add potassium as a separate mineral, since the use of even a few natural foods would supply the element in much safer form.

In regard to four other mineral constituents of the human body (sulphur, magnesium, silicon and fluorine) the situation is the same.

Ample Magnesium in Diet

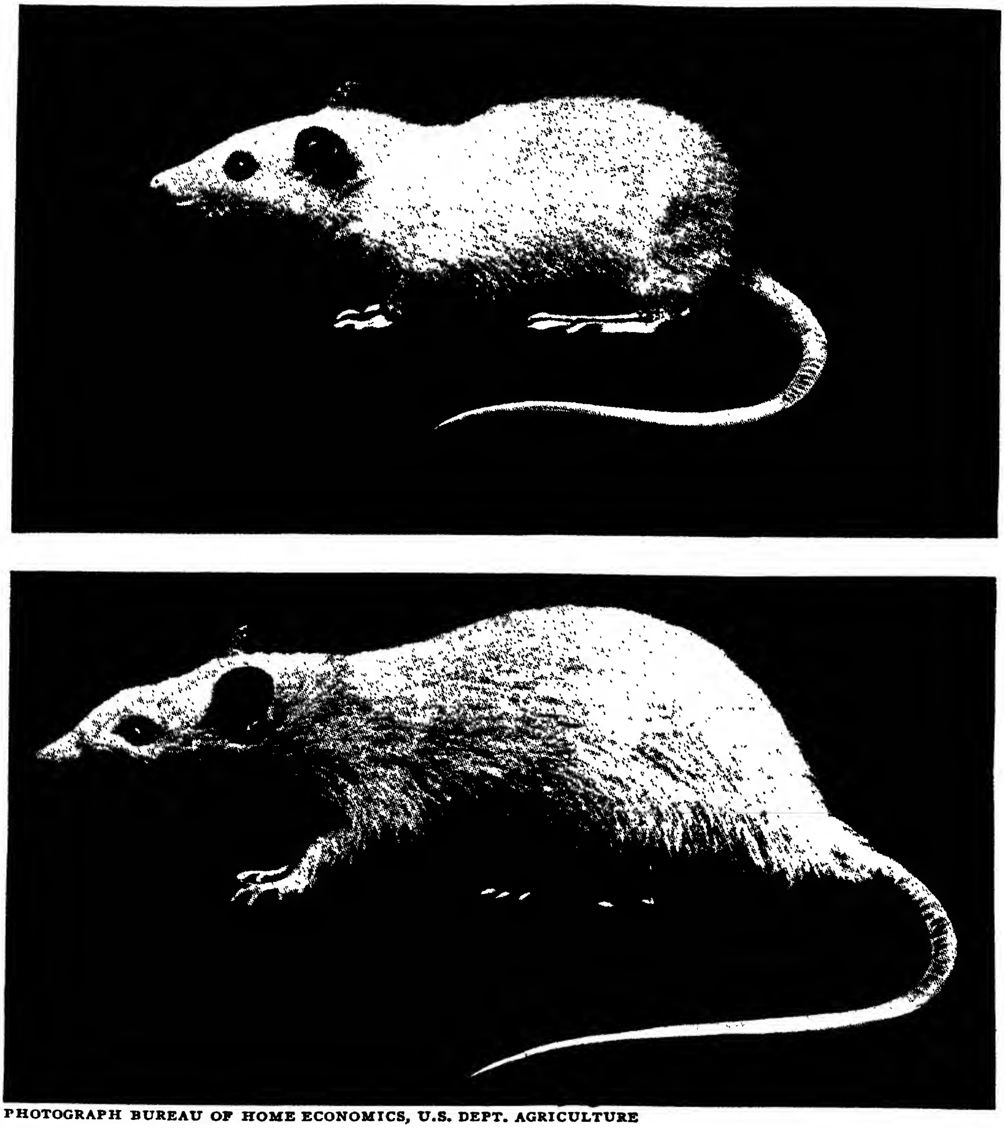
The element magnesium is used in bone-formation and is commonly associated with calcium in foods. Frequently they contain as much as or more magnesium than calcium, whereas our bodies contain only one-fortieth as much. Therefore, it is highly unlikely that a diet would be deficient in magnesium.

Plenty of Sulphur in Proteins

Not only do we secure considerable sulphur through the presence of the sulphur salts in our food, but there is an even greater amount of the element in organic combination, because sulphur is an essential element in protein. When protein is broken down and oxidized in the human body the sulphur is released in the blood, where, as an acid mineral, it combines with the alkaline minerals and is excreted through the kidneys in the form of sulphates, or neutral salts. It might be possible to make up a diet that would be deficient in sulphur, but even in that case a man could live for a long time on the sulphur derived from the destruction of his own proteins. There is, therefore, never any practical dietetic problem of a deficiency of sulphur. Not only is there always an abundance of it, but there is an excess which must be eliminated as a waste product.

The elements silicon and fluorine exist in foods in only comparatively small quantities, but are widely distributed. The quantities required by the body are so minute that scientists have not been able even to demonstrate their necessity by experimental evidence. The fluorine is found as calcium fluoride in the enamel of our teeth, and the silicon is present chiefly in the nails and hair. The proportion, however, is small, and any natural diet will undoubtedly supply us with quantities ample for our needs.

The remaining mineral elements of the body are phosphorus, calcium, iron and iodine. It is with one or more of these four elements that the serious problems of mineral deficiency usually occur. Such deficiencies are very common



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EFFECT OF DIFFERENT AMOUNTS OF PHOSPHORUS ON GROWTH

Phosphorus is essential to bone growth. Hence the growth of the skeleton and therefore of the entire body is affected by the amount of phosphorus available. The upper rat weighed only 60 grams at the age of nine weeks while its brother from the same litter weighed 115 grams. The only difference in the diet was that the smaller rat received an insufficient amount of phosphorus; otherwise the diet was adequate. Except for stunting, the effect of phosphorus deficiency upon health and vitality does not appear to be as destructive as some other types of deficient diets. Liberal amounts of vegetables, whole grains and fruits in the diet will generally restore the phosphorus balance. Leafy foods also contribute to the phosphorus supply and aid in securing calcium, a mineral even more important than phosphorus in a wholesome and healthful diet.

and have important relations to specific types of diseases or ill-health.

Calcium and phosphorus considered together are by far the most important minerals in the human body in a quantitative sense, because of the fact that our bones are chiefly made of calcium phosphate. Obviously, therefore, if there should exist a shortage of either calcium or phosphorus bone-growth could not occur. The subject of bone-nutrition would be much simplified if calcium phosphate in its combined form could be taken in our food and carried through the blood as we take sodium and chlorine in the combined form of salt. But it is easy to explain why this cannot be. The bones, as the rigid supporting framework of the body, must be composed, not of soluble, but of insoluble mineral substance. Otherwise they would dissolve in the body fluids. Bone substance is not only insoluble in the body fluids but is an almost indestructible material.

Calcium and Phosphorus Essential to Bone-growth

But insoluble substances cannot be conveyed through the blood-stream and, therefore, the provision of the bone material involves a number of very complicated chemical processes. The elements calcium and phosphorus, derived in various chemical forms in our food, must be carried in the blood as separate and soluble salts of calcium and phosphorus. These separate elements must then be reconstructed into the insoluble crystals of calcium phosphate, which crystals are deposited in the cartilage cells of the forming bone-structure. This interesting process of bone-growth involves the action of vitamin D which we discussed in the section on vitamins. The vitamin itself is not used as a material of the bone-formation, but should rather be classed as a chemical workman making use of the calcium and phosphorus in solution in the blood to construct the insoluble and permanent substance of our bones.

The failure or success of bone-growth, therefore, depends upon the proper supply of three separate things: the calcium, the phosphorus and the vitamin. If there is a lack or deficiency of any one of these three requisites normal bone-growth cannot occur, and there develops the condition known as rickets.

The problem is still further complicated by the fact that there must be a certain proportion of calcium to phosphorus

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 26 (a). Phosphorus is found in animal products supplied by milk, eggs and cheese, also by beef, poultry, fish and shellfish.

Foods in common use found deficient in phosphorus are sugars, starches, certain fruits and fats.

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 26 (b). Notable vegetable sources of phosphorus here shown, are dried peas, lentils and beans. Whole wheat and undenatured rye products also contain phosphorus, the phosphorus content of grains being chiefly in the outer coating. This gives bran high ranking as a source of phosphorus. Such vegetables as cauliflower, string beans and spinach are sources of phosphorus, as are also potatoes. Nuts of most varieties also supply phosphorus.

available. Even if there is enough of each element in absolute quantity, the building of the bone substance may be disturbed if there is too great an amount of either in proportion to the other element. We can illustrate this roughly by assuming that a brickmason is up on a scaffold laying a wall and has two hod-carriers waiting on him, one bringing up mortar and the other bricks. Obviously the work will have to stop if he runs out of either material; but it could also be interfered with if one of the hod-carriers should become so ambitious as to flood the working platform with an unreasonable excess of one material.

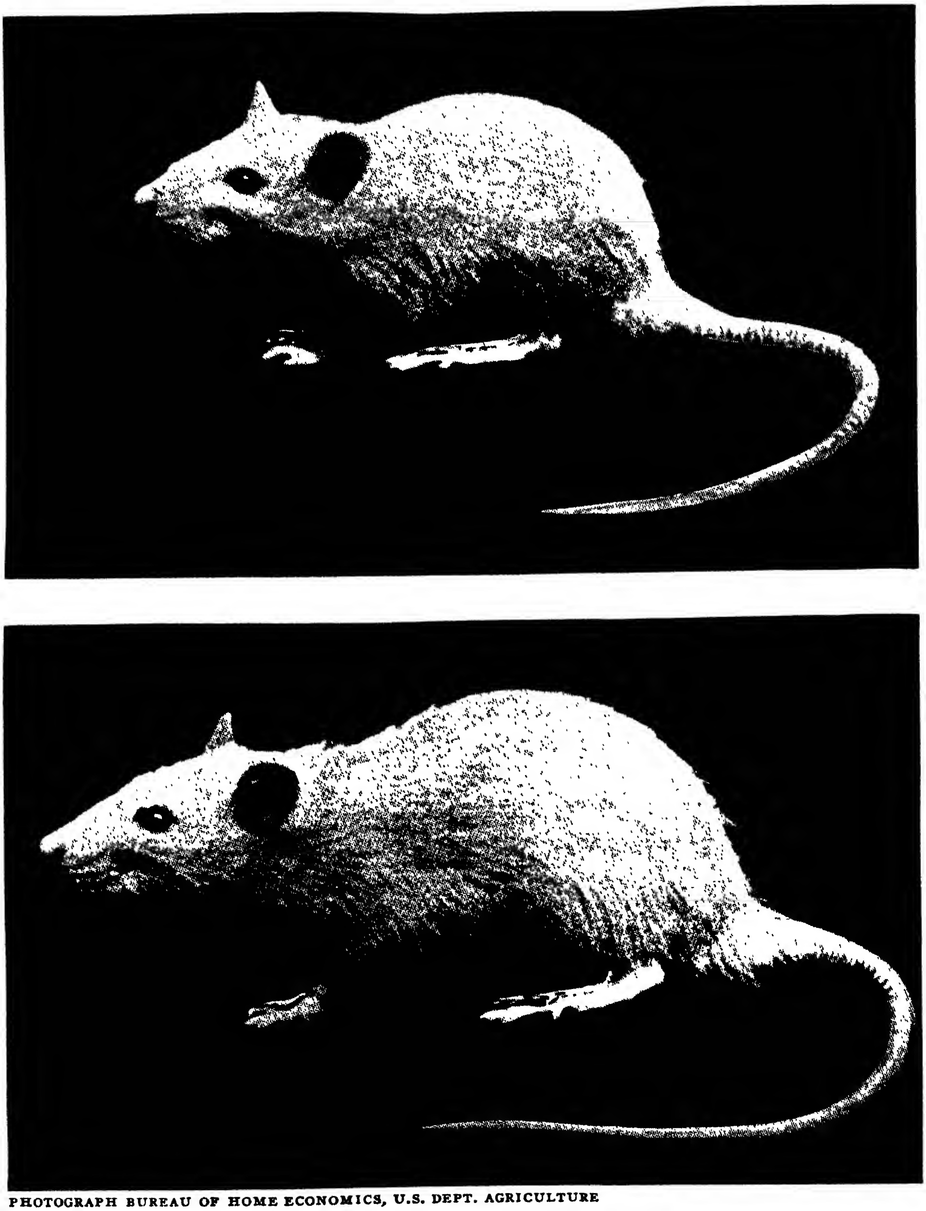
While phosphorus and calcium are chiefly required for bone-formation, they also exist in soluble forms in the fluids and tissues. Calcium is an essential element in the process of coagulation of the blood, without which one might bleed to death from the slightest wound.

In the majority of diets phosphorus is likely to be in greater abundance than calcium. This results from the extensive use of two common groups of food, meat and grains.

Amount of Phosphorus and Calcium Needed

The amount of calcium in the muscles is comparatively small, and the proportion of phosphorus is comparatively great. Carnivorous animals, like the dog, restore the balance by devouring a considerable amount of soft bone, which can be dissolved by their digestive juices. But man cannot do this, and the use of bone-meal, often fed to farm animals, such as pigs, chickens and even calves, would not appeal to him. His only recourse, if he wishes to eat meat, is to supply the deficiency of calcium from some other source. Instead of doing so, however, he often adds an excessive amount of those foods in which there is a similar excess of phosphorus over calcium; namely, the grains. If whole grains are used the calcium shortage is not as serious as with refined or denatured grains. In the latter case the total mineral content is reduced, but the preponderance of phosphorus remains.

The actual proportion of calcium to phosphorus in the body, including the bones, is about two to one. The proportions in milk do not show quite as much difference, but calcium still predominates. But in meat there is about twenty times as much phosphorus as calcium, and in white flour there is four times as much. These figures show in startling fashion



PHOTOGRAPH BUREAU OF HOME ECONOMICS, U.S. DEPT. AGRICULTURE

EFFECT OF DIFFERENT AMOUNTS OF CALCIUM ON GROWTH

The stunted rat shown at the top of the illustration lacked calcium, another element aside from phosphorus, essential to bone growth. A lack of both calcium and phosphorus has the same effect as the lack of either. The rate of growth is dependent upon the available amount of the scarcest element. In actual practice, in both animal and human nutrition, calcium is much more frequently supplied in insufficient quantities than is phosphorus. The best known food for calcium supply is milk.

how utterly unbalanced in these most important mineral elements of the body is a diet of meat and bread.

Other natural foods contain varying proportions of calcium and phosphorus. The green leaves contain about equal parts of the two minerals. Carrots, which are ranked next to milk as a source of calcium, contain about twenty per cent. more calcium than phosphorus.

The practical problem of the supply of these bone-forming elements usually reduces itself to a problem of securing sufficient calcium. As in the case of potassium, it is possible that a diet which has been generally robbed of its minerals may lack phosphorus as well as calcium. In fact, this is more likely to occur with phosphorus than with potassium, but the danger of calcium shortage is much greater.

Calcium Shortage

Professor Henry C. Sherman, a notable authority on mineral nutrition, has computed the amount of both calcium and phosphorus supplied by the diets that were actually used by two hundred American families. In four per cent. of these diets he found that the supply of phosphorus was below the bodily requirements, while sixteen per cent. of the families were attempting to live on diets containing too little calcium either to nourish the adult body or to maintain growth in children. To realize the full seriousness of the problem we should consider the fact that, in addition to the danger of shortage in these two bone-forming minerals, there is also the even greater probability of a shortage of the vitamin essential to their proper utilization.

Phosphorus Shortage

The shortage of phosphorus which Professor Sherman found in these diets is to be explained by the overuse of foods devoid of all minerals, such as refined sugars, starches, fats and white flour. After whole grains have been introduced into the diet, together with liberal amounts of vegetables and fruits, no shortage of phosphorus can occur. It is still possible, however, even with such a natural diet, that there will not be sufficient calcium. This condition can be partly remedied by the selection of certain vegetables rich in calcium, of which carrots are an example and also all leafy foods. Indeed, it is the availability of green leafy foods, combined with abundant sunlight, which makes it possible for the people in many countries to exist and for the children to grow. This applies to China and other Asiatic peoples and also to the inhabitants of Southern Italy. Races living on such foods in warm sunny lands where the children are amply exposed to the sunshine run no risk of deficient bone-growth and rickets.

Supplementing the Diet for Calcium

In more northern lands, where children are bundled up and kept indoors and where green foods are less used, it becomes possible to nourish them properly only with the aid of cow's milk, and, when sunshine is not available, cod-liver oil or the rays from ultra-violet lamps. Cow's milk is the outstanding and assured source of a sufficient calcium supply for the diet of both children and adults in our type of civilization. The families which fail to reach the normal calcium requirements are almost invariably those which fail to make free use of milk and cheese together with whole grains.

Professor Sherman finds that the average body waste of Calcium is .45 grams per day, of phosphorus .88 grams. On the principle of allowing fifty per cent. excess of this minimum requirement as a measure of safety, a reasonable allowance would be about .67 grams, or expressed without the decimal, 67 centigrams. For phosphorus the figure would be 1.32 grams, or, without the decimal, 132 centigrams.

In the two tables following below we have arranged a group of leading foods according to their content of calcium and of phosphorus. The figures given represent the number of centigrams of each mineral in 2500 calories of the food. Therefore a food should be considered rich or poor in the element as it exceeds or falls short of the figure 67 for calcium, or 132 for phosphorus.

Iron in the Body

The presence of iron in the human body is one of the most spectacular facts of the science of nutrition. The commonness of iron (in its slightly modified form of steel) in our mechanical civilization makes everyone familiar with the element. This is not true of the other mineral elements of the body. They are not common in their elementary form and their names seem strange outside of chemical laboratories. But every child knows what iron is. Moreover, it seems to be wholly unfitted for food, and when accidentally swallowed in the form of carpet-tacks becomes a tragedy. Even if in a safer mechanical form, as ground to a fine powder, metallic iron would still be indigestible and worthless as food.

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 27 (a). Calcium is found in legumes such as peas, lentils and beans, in greater degree than in grain products, in which the calcium content is low.

Green leafy vegetables that are sources of calcium include: Spinach and cabbage, as well as celery and cauliflower. Among fruits, oranges and figs are especially rich in calcium. Whole milk is a notable source of this mineral.

PHOTOGRAPH BUREAU OF HOME ECONOMICS, U. S. DEPT. OF AGRICULTURE

PLATE 27 (b). Buttermilk, as well as natural whole and undenatured cane-molasses and maple-sugar, contain calcium, as do various forms of cheese. Vegetables such as turnips, carrots and parsnips are also sources of calcium. Shellfish are proportionately much higher in calcium content than animal meat products.

CENTIGRAMS OF CALCIUM IN 2500 CALORIES

Celery	1052	Figs	128	Sweet potatoes	40
Buttermilk	735	Navy beans	118	Pecans	30
Tomatoes	725	Eggs, whole	112	Apples	30
Spinach	702	Mushrooms	101	Whole wheat flour	22
Lettuce	560	Grapefruit	100	Bananas	22
Cheese	530	Almonds	92	Lean beef	16
Milk	435	Egg yolks	90	White flour	15
Dandelion greens	430	Lentils	78	Cornmeal	12
Turnips	402	Peas, green	65	Unpolished rice	8
Cabbage	358	English walnuts	65	Pork chops	7
Carrots	310	Dates	48	Butter	5
Asparagus	300	Raisins	48	Polished rice	2
String beans	270	Grapes	47	Refined fat	0
Strawberries	260	Prunes	45	Refined sugar	0
Oranges	220	Oatmeal	42		
Bran	135	Potatoes	40		

CENTIGRAMS OF PHOSPHORUS IN 2500 CALORIES

Bran	1365	Egg yolks	290	Raisins	95
Spinach	713	Turnips	290	Sweet potatoes	92
Buttermilk	680	Tomatoes	283	Grapefruit	90
Mushrooms	637	Carrots	250	Prunes	87
Lettuce	560	Oatmeal	248	Grapes	80
Milk	535	Cabbage	230	Bananas	78
Celery	502	Strawberries	180	Polished rice	67
Asparagus	440	Almonds	180	White flour	65
Cheese	390	Potatoes	173	Apples	50
Navy beans	343	Whole wheat flour	165	Dates	40
Lentils	315	Unpolished rice	150	English walnuts	38
String beans	315	Pork chops	132	Butter	5
Lean beef	312	Cornmeal	132	Refined fats	0
Peas, green	312	Pecans	113	Refined sugar	0
Eggs, whole	305	Oranges	100		
Dandelion greens	292	Figs	95		

Therefore the statement that iron is an essential element of the body seems on the face of it to be preposterous. However, it is true. The iron does not exist in the body in a simple elementary state, but in a highly complicated compound known as hemoglobin, which is the essential substance of the red blood-corpuscles. The portion of iron in these bodies is very small, and yet it is absolutely essential and nothing else can be substituted for it. The amount of the element in the healthy adult body is about three grams, or one-tenth of an ounce.

Hemoglobin and the Red Blood Corpuscles

The vital importance of this iron is due to the fact that the red blood-corpuscles are the vehicles that carry the oxygen from the lungs to the various cells throughout the body, the hemoglobin having the power to absorb oxygen very readily, by holding it in a loose chemical combination, and to give it up with equal ease. The bright red color of arterial blood going from the lungs is due to the change in the color of the hemoglobin caused by the absorption of this oxygen. After the oxygen has been given up to the cells where it is used, the hemoglobin, now loaded with carbon dioxide, becomes darker in color, as seen in venous blood.

Without a suitable supply of iron the capacity of the blood to carry oxygen and carbon dioxide could neither be increased nor maintained. When a baby grows from a few pounds at birth to a man weighing twenty times as much, it is quite apparent that additional iron must have been derived from food; else the additional blood could never have been formed. But the demand for iron for blood-formation is a constant one even in adult life. Exactly why this should be so is one of the mysteries of nature, but we do not seem to be able to use any element or bodily substance over and over, without wastage or loss, and hence the constant need of new supplies of the same material. This is true even of the elements that form the bones, the most permanent structures of the body. In the case of iron in the blood the rate of wastage and renewal is considerably greater.

Wastage and Renewal of Iron

Professor Sherman estimates that the body discards ten milligrams of iron per day. But to be on the safe side the dietetic requirements are set at fifty per cent. higher, or fifteen milligrams. A milligram is the thousandth part of a gram. As already stated, the

The use of liver as a curative food for anemia has increased the demand for this meat. Its palatability is improved by proper preparation. The first step is to remove the tough outer membrane.

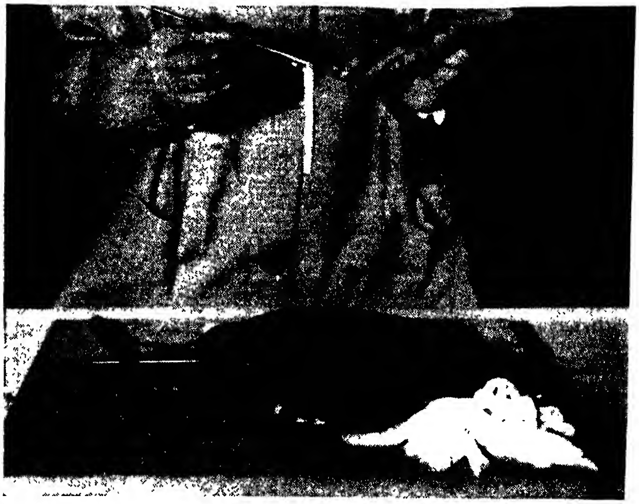
quantity of iron in the average body is three grams, or one-tenth of an ounce. Therefore, if we waste and renew ten milligrams of iron per day, it would take one hundred days to use a thousand milligrams, or one gram, and three hundred days to renew the entire iron supply of the body. Obviously the maximum degree of health and vitality can be maintained only when the normal quota of iron is present in the body, giving us the greater power to carry oxygen to the tissues and therefore maintain all the bodily functions in the highest degrêe of efficiency. Death occurs from lack of iron when about half the supply is lost.

Notwithstanding the fact that the absolute amount of iron in the body is so very small, it is the element which can be most readily measured. This is because practically all of it is in the red blood-corpuscles. Since the blood can be sampled without serious injury the physician, or blood chemist, can readily determine the proportion of iron in a given weight of blood and, therefore, the approximate amount in the body. The average physician makes such determinations quite frequently by a simple color test of a blood sample. For more accurate estimation a more elaborate chemical analysis is necessary. However the color test is sufficiently accurate to show iron deficiency and its approximate degree.

Anemia: Its Cause

Lack of a sufficient number of red blood-corpuscles is known as anemia, no matter what may be the cause of the condition. Thus the loss of a considerable amount of blood creates an anemic condition because, while the fluid loss is rapidly replaced by water, and most of the other elements are replaced rather quickly, the rebuilding of the red corpuscles is comparatively slow, as a good supply of iron as well as of other elements is required. With a proper diet, however, there is some storage of iron in the liver and in the red marrow of the large bones, the latter being the actual manufacturing establishment that turns out the red blood-corpuscles.

Simple anemia can also be created in an otherwise healthy body from lack of food iron. *Pernicious anemia, however, is a different thing,* being due to a failure in the formation of hemoglobin. The usefulness of liver in the treatment of this condition seems to depend, not primarily upon its iron, but



As liver lacks natural fat, strips of bacon or pork are inserted in it by means of a larding-needle. Threading the needle.

upon some other factor which enables the body to utilize iron in the construction of hemoglobin. Evidence recently tends to prove that this additional factor may be the element copper.

The liver is a very wonderful chemical workshop and contains many vital elements, among them being the vitamin D, so abundant in cod-liver oil, which is concerned with calcium metabolism. Since the liver is rich in iron and also has this potent vitamin D, it might be assumed that the combination of the two is what makes this organ such an excellent remedy for pernicious anemia. However, our present knowledge does not indicate that the vitamin D is the essential factor.

What has been established by a Boston physician, Dr. Minot, is that a diet containing large amounts of liver will restore patients suffering from pernicious anemia, a disease for which science had hitherto found no remedy.

The Liver and Vitamin D

In pernicious anemia we are dealing with a disease due to the failure of the body to metabolize iron. It may not involve any lack of iron supply in the food. In simple anemia we are dealing with an actual lack of food iron. Therefore, in simple anemia, there is no particular occasion for using liver. It is a good source of food iron but there is no evidence that it is any better than other sources which we shall shortly enumerate.

When investigating the amount of iron in various foods one is surprised to find that milk, otherwise considered so nearly a perfect food, has only minimum quantities of iron. Why this is so we do not know. That the young calf or young infant can live and thrive on milk only is obvious, and yet theoretically, the milk does not seem to supply enough iron. Scientists claim to have found an explanation for this seeming inconsistency of nature in the fact that the new-born animal has accumulated from parental sources a considerable surplus of iron which is stored in the liver. This theory is confirmed by the apparently contradictory fact that guinea pigs are born with no such accumulated iron in their livers. These animals come into the world in a more advanced stage of growth than the young of most other species. They nurse very little, and when only a day old will calmly eat cabbage or other leafy food along with their parents, in most sophisticated fashion. Leafy foods are excellent sources of iron, and, therefore, the guinea pigs would appear to have little concern with the problem of prenatally-stored iron, or with the question of iron in milk.

Does Milk Have Enough Iron?

However, when we look more closely at this question of the small amount of iron in milk we find reason for taking it less seriously than some authorities do. The fact is that the milk diet is excellent for enriching the blood and may actually be used as a remedy for at least cases of simple anemia. To show that this observation is not inconsistent with the comparatively low iron factor in milk we must presume that all of the iron is available, which is certainly not true of the iron in many other food products. The milk diet when properly used is always a body-building diet, but milk must be used in comparatively large quantities to give a surplus of all body-building materials. For the average-sized adult the typical quantity is five quarts, or ten pounds, per day. Careful calculation shows that these ten pounds of milk contain 10.8 milligrams of iron. We previously noted that the average daily requirements of iron were estimated to be ten milligrams per day. But in many foods much of the iron fails of absorption; hence the custom of making the allowance more liberal than the actual need, and requiring fifteen milligrams per day. But if the iron in milk is all available, we can see that a full milk diet would just about supply the iron requirement. However, there would be no surplus, and milk in small quantities, such as the usual quart per day, would supply but one-fifth of the body's iron need. Hence milk in the quantity generally used does not insure us against iron deficiency, as it does against calcium deficiency; and since the evidence shows that the milk diet yields only just enough iron when large quantities are used, it would seem to be wise, when using it for anemia, to add some egg-yolk, which is a very concentrated source of food iron of high quality.

The Iron Supply in a Milk Diet

Still more important is it not to depend upon milk to supply the need of children for iron after the prenatal store of the liver has been exhausted. A quart of milk a day is commonly allotted to children from one to five years of age; but, a quart of milk supplies only one-fifth of the adult's iron requirements, and the average active child of three to four years of age has a considerably greater food requirement than one-fifth that of the adult. Therefore, he must get iron from sources other than milk.

As stated, the best source of iron is that other remarkable growth food, the egg. The iron in the egg is contained solely in the yolk, the white being worthless in this respect, and the amount of iron in egg-yolks is thirty-six times as great as in milk. Expressing this relation in simpler form, we find that one egg-yolk contains about one and a half times as much iron as a quart of milk. Therefore, the addition of an egg-yolk per day to the child's diet gives an excellent assurance of a sufficient supply of iron. For this reason many authorities on child nutrition advocate beginning to feed the baby a slight amount of egg-yolk daily, at about the age of six months, increasing this to one full egg-yolk at the age of nine months, which supply may be continued throughout childhood. The whole egg may be substituted at about the age of two years. Any further need of iron will be met by a general mixed diet. In the case of anemia egg-yolk is equally valuable for adults. We know that the iron in an egg must be physiologically available, since an egg when incubated is the only substance needed to produce a fully formed chick with a well-developed blood-stream.

Egg Yolk Rich in Iron

Iron exists in meat in proportion to the amount of blood retained in it. Hence, good red beefsteak is a better source of iron than pale or white meats. Liver, as before stated, is an excellent source of iron. It is rather strange that many dietetic writers have taught that white meat, such as the bloodless breast meat of chicken, or the flesh of fish or other cold-blooded animals, is superior to red meat. This view has no scientific foundation, but comes from a sentimental reaction against the idea of the shedding of blood, and a consequent prejudice against the presence of blood in food.

Thus far we have spoken of the sources of iron in animal foods chiefly. This is because our knowledge on this point is more definite than in the case of plant foods, not because animal foods are the only sources of food iron. In fact, such a conclusion would be ridiculous. How, in that case, could the herbivorous animals build up their blood-supply? The fact is that iron is widely distributed among natural plant foods, and plenty of data is available to show the absolute amount of iron in such foods. We cannot, however, rely on such knowledge as well as we can upon our knowledge of iron in the animal product, because we do not know enough about the availability of this vegetable iron.

Iron in Plant Foods

The reason the subject is difficult to study is because we are dealing with very small quantities. The daily iron requirement of ten or fifteen milligrams is a very small amount. In metal form it would be a mere speck, much smaller than the head of a pin. Hence it is difficult to make digestive experiments that show whether the iron from a given food is digested and retained by the body. However, we feel safe in assuming that the iron found in leafy foods must be fairly available, because of the obvious fact that the grazing animals have no other supply. This fact, together with the high percentage of iron shown by chemical analysis to be present in leafy foods, places them in front rank as sources of food iron.

Whole wheat is also considered a good source of food iron; but as this iron is almost wholly contained in the

Liver is here shown with strips of fat threaded through it. This treatment adds to palatability and better balance of protein and fat.

germ and bran, there is practically no iron in white flour. Bran has come into wide use as a remedy for constipation, because of the indigestible cellulose which it contains. But it also contains much material that is absorbed, equal in fact to about half the total weight of the bran. This digestible portion of bran is an abundant source of all food minerals and especially iron. In fact, the absolute amount of iron in the wheat germ and bran, pound for pound, is very nearly equal to that of egg-yolk, although there is less proof of its availability, for which reason it cannot be considered an equally reliable source.

Iron in Whole Wheat and Bran

The following brief table gives the relative iron values of the more important foods. In conformity with our large food table, the figures represent the number of milligrams of iron in twenty-five hundred calories of the food, a man's average daily food-intake. You will recall that the average loss of iron per day was ten milligrams, and that fifteen milligrams was considered a safe minimum allowance. The table will show you which foods are rich or poor in iron, according to whether the amount is greater or less than 15 milligrams.

MILLIGRAMS OF IRON IN 2500 CALORIES

Spinach	386	Dates	21
Asparagus	113	Pork	19
Dandelion greens	110	Buttermilk	18
Lettuce	92	Whole wheat flour	17
Bran	88	Raisins	15
Cabbage	87	Almonds	15
Celery	68	Bananas	15
Lentils	62	Grapefruit	14
String beans	62	Unpolished rice	14
Egg yolks	58	Apples	12
Eggs, whole	51	Sweet potatoes	10
Strawberries	51	Whole milk	9
Navy beans	50	Oranges	9
Tomatoes	44	Grapes	8
Beef, lean	43	American cheese	7
Peas, green	41	Cornmeal	7
Potatoes	39	English walnuts	7
Carrots	33	White flour	6
Turnips	31	Polished rice	4
Oatmeal	29	Butter	1
Prunes	25	Lard	0
Maple syrup	25	Sugar	0
Figs	24		

Iodine is the rarest known element essential to life. We found that the amount of iron in the healthy human body is about three grams or one-tenth of an ounce. The amount of iodine in the normal body is twenty-five milligrams. Since a milligram is the thousandth part of a gram, this means we have only a fortieth of a gram of iodine, or a hundred and twentieth of the iron factor. We are dealing here with the metrical units of weight which are not familiar to many English readers, nor can we express these figures in any more familiar terms, since weighing in such small quantities is seldom done outside a laboratory. We may, therefore, attempt to attain a practical idea of the quantity of iodine the body contains by stating that its weight would be equal to about half that of an ordinary grain of wheat, or perhaps a little more than the weight of a radish seed. Probably the presence and significance of iodine in the human body would never have been discovered if this minute proportion had been distributed throughout the body. The reason we can be so positive about it is that it is concentrated in a single small gland and is an essential component of the vital secretion of this gland.

How Much Iodine in the Body?

The gland referred to is the thyroid, which is located in the front of the throat, resting in a saddle-like formation across the windpipe just below the larynx. The normal thyroid gland weighs a little less than an ounce and ordinarily is not externally visible. The thyroid is one of the ductless glands which function by secreting a hormone, or activating substance, into the blood-stream. The substance secreted by the thyroid is known as thyroxine. For many years it was known that thyroxine was comparatively rich in iodine, and in the year 1915 a pure crystalline substance known as *thyroxine* was isolated and found to contain about sixty-five per cent. of iodine. In more recent years this same substance has been made synthetically, so that it is clearly established that it is a definite chemical substance.

The Thyroid Gland and Iodine

Thyroxine is a very powerful drug and one milligram of it has been found to increase the basal metabolism three per cent. A single administration of it to a person with a defective thyroid gland is sufficient to influence the latter over a period of five or six weeks. It should be clearly understood that the chemical element iodine is not the same thing as the chemical compound thyroxine. Thyroxine is formed in the body by the thyroid gland, iodine being the distinctive chemical element required for its formation. In both cases, however, we are dealing with substances whose physiological effects are powerful in very minute quantities.

Thyroxine and Iodine

The thyroid secretion, or thyroxine, influences practically the whole of the life processes. It has a direct activating or controlling effect upon our general metabolism or rate of fuel oxidation and heat production. Thyroxine is the only drug definitely known to cause a reduction of body weight without diet restrictions or exercise. But it is very dangerous to use it for the purpose, since it causes an artificial fanning of the flames of combustion not unlike that of a destructive fever.

Presumably the purpose of thyroxine in the normal body is to regulate the rate of metabolism. It also has profound effects upon growth. When this substance is insufficient, owing to lack of iodine, there may develop a form of pathological dwarfing known as *cretinism*. Cretins are not only physical dwarfs, but are also mentally defective. Thyroxine also is vitally concerned with the reproductive function, especially in women. Girls at the age of puberty and women during pregnancy are especially subject to the development or aggravation of the symptoms of goiter, showing that the reproductive functions require an increased amount of the thyroid secretion. This subject is discussed at length in another volume under the general subject of internal glands and their functions. It is spoken of briefly here as an illustration of the importance of a single mineral element, though required in very minute quantities.

Cretinism

The establishment of the fact that the function of the thyroid gland depends upon the presence of iodine has clarified what was for centuries a medical mystery. The disease known as *goiter* is a very serious one and in its extreme form results in the failure of both physical and mental growth. In its less pronounced form it is chiefly noted because it results in an unsightly tumorous growth upon the throat. This is brought about by an abnormal enlargement of the thyroid gland, which in some cases reaches proportions that seem rather remarkable for so small an original structure.

One of the peculiar facts early noted in regard to this disease was its extreme prevalence in certain regions only. The greatest goiter belt in the world is in the Swiss Alps. Other goiterous belts have been found in many parts of the world. One is in the Himalaya Mountains in Asia, and a less severe but more extensive belt can be traced in the United States around the region of the Great Lakes, extending along the northern half of the country through Montana and into Washington and Oregon, except on the coastal plain west of the Cascade Mountains.

Goiter and the Thyroid Gland

The geographical localization of goiter, together with the proof that the function of the thyroid gland was dependent upon the presence of iodine, has led to the conclusion that it was lack of sufficient iodine in food and in drinking water that caused this disease. To understand why this should be so takes us to the study of the distribution of iodine in nature. This element is comparatively rare and also extremely soluble. Hence whatever iodine may have originally existed in the rocks and soil of the earth's crust has been largely dissolved by the continuous leaching of rain-water and washed into the sea.

The only considerable source of iodine in the world today is in sea-water or the fossil remains of sea creatures. For this reason certain inland areas, like high mountains and glacial regions, are likely to be devoid of the element. On the other hand lowlands along the sea coast are comparatively well supplied with iodine, as are also geographical formations that have risen from the sea in more recent times. The amount of iodine necessary to supply plant and animal life is so small that it is thought that coastal regions may actually secure their supply of iodine from the air, into which it is carried by the lashing of sea-spray. That this theory is plausible should be evident from the fact that in many places several miles from the sea so much common salt is carried through the air that the screens on houses or exposed tools will rust more quickly than they will in equally damp inland regions.

The theory that life on this earth originated in the sea and that the mineral elements necessary to life are essentially the same as those of sea-water, while seemingly fantastic, fits pretty closely with the known chemical facts. The relation is the most remarkable in the case of iodine, because of the comparatively small amount of this substance required. In the case of plants and of lower forms of life no intelligent study of the iodine requirement, or its physiological effects, can be made, because there is no localization of this substance in any single part. In the higher animals, including man, the iodine is concentrated in the thyroid gland; hence its presence is revealed and its function can be determined. Man is not the only creature that is subject to goiter. Indeed, the presence of goiter, or iodine deficiency, in swine is a very practical problem and there are extensive regions in the northwestern states where swine-raising was not profitable until it was discovered that the goiter in these animals could be prevented by the administration of iodine.

Goiter in Animals

One of the puzzling features of this problem is the fact that the common symptom of goiter is the enlargement of the thyroid gland, while the cause of the trouble is supposed to be a lack and not an excess of the substance essential to the functioning of the gland. The explanation given is that when the iodine is lacking the gland enlarges in a sort of blind effort to make up for the loss of raw material by increasing the size of the laboratory. But there are so many rather fantastic facts connected with this problem as to make some skeptical as to whether a lack of iodine is actually the cause of goiter. The theory becomes convincing only upon the presentation of positive evidence that the adding of iodine to the diet will prevent goiter. Proof that it does this is based upon large-scale experiments, of which the most notable is that of the Swiss government. Goiter was so prevalent in Switzerland that it could be detected by a greater or less degree of thyroid enlargement in 87 per cent. of the public school children. After the administration of iodine over a period of four years its incidence decreased to 13 per cent. Even more striking results were obtained in the city of Akron, Ohio. Iodine was administered to 2000 school children, of which only five cases showed any enlargement of the thyroid during such administration. A similar number of children under the same condition to whom iodine was not given showed 500 cases of thyroid enlargement.

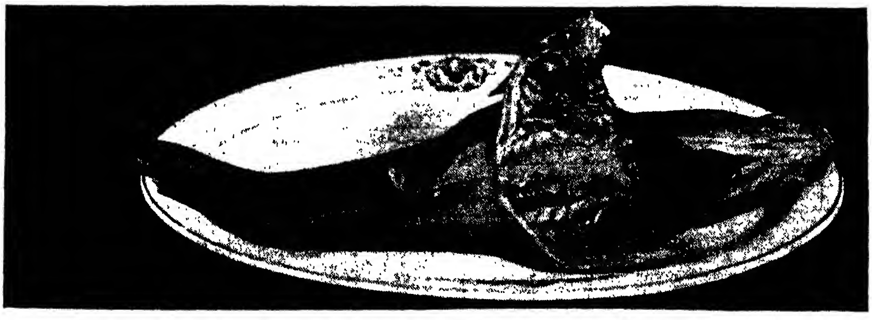
Glandular Indications of Goiter

In spite of this seemingly overwhelming evidence that the administration of iodine will prevent goiter or check its development in early stages, we find there is considerable criticism even among medical men of the use of the substance as a remedy for the disease. This criticism is based upon unfavorable developments following such treatment. The trouble, however, probably comes from overdosing. Even though the amounts of the drugs usually given by doctors is small when compared with food quantities, yet when it comes to this rare element the amount required by the body is much smaller than the quantities usually employed in drugs. The whole quantity of iodine in the body would make a small dose as a drug, but this accumulated amount is probably equal to the normal intake for many months.

Effect of Sea upon Goiter

In all lands favorably located in relation to the sea sufficient iodine is supplied in food. People whose diet includes sea foods are practically free from goiter. Hence the food remedy for goiter would seem to be the use of a certain amount of such food. At the present writing a scientist in the U. S. Department of Agriculture is working on investigations concerning the use of some form of seaweed as a food ingredient to supply iodine. He considers this method of supplying iodine much safer and better than its medical administration.

The problem of the iodine in foods is distinct from the problem of other minerals, because we cannot say that certain foods, like wheat or cabbage or oranges, yield certain amounts of iodine, as we can say that they yield certain proportions of calcium, iron and more common minerals. All efforts to determine the amount of iodine in food seem to show that the



A codfish of moderate size dressed for cooking, with liver and other organs removed. From the livers of these fish, growing to immense size, is extracted the cod-liver oil of commerce, which provides vitamin A and vitamin D as well.

place where the product is grown is much more important than the species of plant or animal, or the particular part chosen. According to recent investigations by the Department of Agriculture of South Carolina, vegetables grown in this coastal state are good sources of iodine. Of course, the purpose of this investigation was to boost the local products; but the results are in accordance with our previous knowledge of the subject.

The Future of Iodine

If it becomes clearly established in the public mind that iodine is an essential element of life and should be provided in food, the problem will doubtless be solved by the universal use of iodine-rich substances, from sea-plants or animals, in manufactured foods, or perhaps by the growth of produce in goiterous regions with some form of iodine fertilization of the soil.

The discoveries concerning iodine and the marvelous effect of the very minute quantities present in the body suggest that the scientists who have recently discovered so many marvels in nutrition should hesitate to conclude that they now know it all. If iodine had not happened to be concentrated in a single small gland, it is likely that both its presence in the body and its function would have remained undiscovered. There may be many other such essentials of nutrition of which we have as yet no inkling. Such facts should increase our respect for Nature and for the natural foods which maintain life, even though the user be utterly ignorant of their chemical composition, or of the mysterious ways in which they perform their wonders.

Natural Foods Again Predominate

Until comparatively recently many scientists holding college diplomas and degrees have scoffed at the idea that natural foods are essential to complete nutrition. They thought they had traced all of the essential elements of food. Then began a period of discovery in which the scientists fell over themselves in their efforts to find new vitamins and rare minerals and to trace their effects in the body. This is all very fine. We are delighted to observe it. But we believe Nature has yet many secrets which science has not fathomed. *Hence we do not feel that we are ready to relinquish our faith in Nature and the worth of natural foods in favor of any artificial diet compounded in chemical laboratories.*

HOW FOODS MAY POISON

Section 11

IN discussing the subject of the necessity of complete nutrition it has been shown that there is grave danger of an absence or shortage of some of the numerous elements that are needed for the support of life and health. These deficiencies result in the starvation of the body, and such starvation is one of the fundamental causes of weakness, disease and premature death. Another danger to which we are perhaps even more frequently exposed is that of poisoning. To these two causes one might say that all disease and all death, except in case of purely mechanical injury to the body structure, are due. The term poisoning, as commonly used, conveys the idea of sudden illness or death. Yet slower forms of poisoning may be just as destructive in the long run. Indeed, life is a constant struggle against slow poisoning.

Body Poisoning from Food

Whether the injury to life comes from nutritional deficiencies or from poisonings, the normal chemical balance of the body is disturbed. In the one case something is lacking, in whole or in part, that should be there. In the other something is there that should not be there. It may be a substance that is wholly foreign to the body, having no business to be in it in any quantity. Or it may be a substance normally present in the body in certain proportions, but which becomes injurious when the quantity is excessive.

The Chemical Balance

Any type of departure from the normal body chemistry is injurious to life, and the degree of departure that can be tolerated varies with each substance under consideration. Nor is there any general rule that an element or substance that is normal to the body is less injurious when present in excess than a wholly foreign substance. Thus iodine is essential to life, but only minute quantities are needed. Iodine in larger quantities is much more destructive than would be similar quantities of many less active substances which are of no use to the body at all.

Poisons may be divided into the following groups:

1. Substances wholly foreign to the body. These may be taken into the body: (a) by mistake, (b) with the intent to do body injury, (c) under the mistaken notion that they will be beneficial. Many medicines come in this last class.

2. Substances that are normal to the body but which are taken in quantities beyond its power to utilize them. An example of this would be an overdose of common salt.

Kinds of Food Poisons

3. Poisons created in the body. These are: (a) The wastes from normal physiological processes when these are produced in excessive amounts, or accumulate because of failure of elimination. (b) Abnormal products created because of the failure of normal processes, or the development of abnormal physiological processes or diseased functioning. (c) Products produced by the presence of foreign cells or pathogenic germs in the fluids or tissue of the body. (d) Products produced by similar organisms in the alimentary canal and absorbed into the blood.

Food is the cause, directly or indirectly, of almost all body poisoning, unless one deliberately swallows poisonous substances. Of course, there are a few other ways that the body may be poisoned, but they are comparatively rare. One may breathe poisonous gases, such as carbon monoxide. One may also be poisoned through the skin, as by poison ivy or certain strong chemicals. Workers in lead or phosphorus may be gradually poisoned, either through the lungs or by accidental introduction of the poisonous substances into the mouth. Workers with radium paint were poisoned by wetting the tips of the paint-brushes with their lips and so gradually swallowing minute amounts of the potent radio-active substance. But none of these sources of poisoning need be feared by the average individual.

Poisonous Plants

One way we get poison through food is by the mistaken use of food substances that contain poisonous elements as a normal part of their composition. Many natural plant substances are poisonous to man, but we have long since learned to avoid most of these as food, though they have been assiduously sought after as medicine.

Perhaps the poisonous substance most commonly used by man as a food, or at least with his meals, is the drug caffein in tea and coffee, of which it is a natural part. This drug is certainly a poison, and if concentrated and taken in large doses would prove fatal. In the small doses in which we get it in these beverages it classes as a stimulant, its chief action being that of stimulating the heart. The use of coffee to keep one awake is based upon this effect, as sleep comes only with a slower heart-action and a general decrease of the rate of metabolism.

Poisonous Drugs

Whether one should class all substances that produce abnormal physiological effects as poisons or not is a matter of viewpoint. We might define drugs as substances foreign to the body and productive of abnormal effects that the user believes will be beneficial, and poisons as substances producing abnormal effects which the user concedes to be harmful; but there are very few types of poisons that have not at some time or by some group of people, been taken with the faith that the abnormal effects they produce are beneficial.

An example of a poisonous substance that is still used as a food is the oxalic acid of rhubarb. No one denies that oxalic acid is poisonous, but its use has been continued because it occurs in an otherwise tasty and pleasing plant and because in the dosage ordinarily taken the effects are not noticeably harmful. But occasionally people are made quite ill by eating rhubarb stalks, and if the leaves are eaten the chances of serious poisoning are much greater. The various sour sorrels many children eat are also heavily laden with this same acid. However, poisons that are part of the natural substance of plants and animals are rarely used as food, because man, in common with other animals, has had ample time to learn to avoid them.

The Danger of Oxalic Acid

The poisons which civilized man is liable to take into his body are much more likely to be the products of civilization than the products of nature. In this class come those poisons that are added to food by unscrupulous manufacturers for purposes of adulteration, preservation, flavoring or coloring. With the growing knowledge of chemistry and the increase in food-manufacturing, as distinct from the use of food products directly from the farm and gardens, such doping of food was greatly on the increase until the first decade of this century. The evil had by that time become so great as to cause a popular revolt, led in this country by Dr. Harvey W. Wiley, with the result of the passage of the national Pure Food Law and similar laws in states and cities.

As result of this agitation rather, perhaps, than because of the enactment of laws forbidding it, such doping of food with harmful ingredients has largely ceased. This is not because food-manufacturers as a class have become suddenly more righteous, but because they are simply good business men. The public has now been sufficiently educated on the subject to make it a foolish policy to disregard the law. A large firm might be willing to run the risk of fines, but it could hardly afford to take chances with the publicity resulting therefrom. The growth of food journalism, with many magazines and newspapers maintaining food departments in the hands of experts, has contributed further to the stopping of such practices. The standards maintained by many of these journalistic authorities are even more strict than those of the law, and the wise manufacturer knows better than to risk the ill will of those who have this power of publicity behind them.

Pure Food and the Public

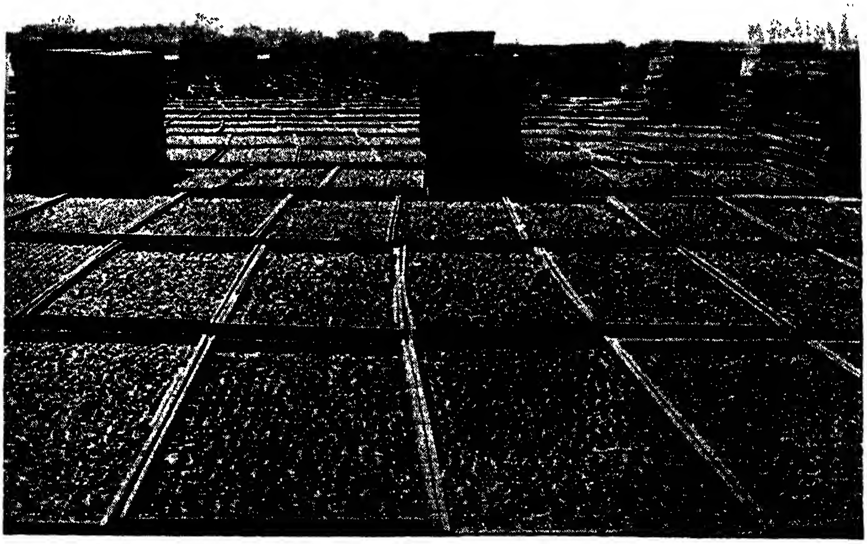
When the Federal law was passed there were two preservatives the harmfulness of which was disputed. These were sodium benzoate and sulphur dioxide. The law permits them to be used, but only in limited quantities and only when the fact of their use has been declared on the label of the food. But the diffusion of knowledge resulting from the discussion of the subject, and the continued opposition of health authorities to the use of even the less harmful preservatives, has resulted in the restriction of such use to a comparatively few products, while many leading manufacturers have eliminated them entirely. Even in tomato ketchup, which, because it is used in such small quantities that it may be a week or more after a bottle is opened before it is finished, has to be made so that it does not spoil readily, their use has been found not to be essential.

Law Against Preservatives

In one case, however, a backward step has been taken. Owing to the activity of prohibition officials, the use of benzoate of soda in cider became much extended. Dealers refused to handle the sweet natural cider lest while it was in their possession it might develop a sufficient percentage of alcohol to run afoul of the prohibition law. So the makers, in order to sell their cider, were obliged to dope it with sodium benzoate. This seems like a case of the law standing up so straight that it leans over backward. The amount of alcohol that would ordinarily develop in cider before consumption would hardly be as harmful as this preservative. The use of the one-tenth of one per cent. of sodium benzoate was permitted chiefly for the benefit of the manufacturers of ketchup. But when one uses a spoonful of tomato ketchup a day with one-tenth of one per cent. of benzoate of soda, one gets only one one-thousandth of a spoonful of the chemical. But a man who likes cider may readily drink a quart or more a day, and with the same percentage of benzoate in it he may thus imbibe a hundred times as much of the preservative as he would ever take in ketchup. In such quantities it is distinctly poisonous, and persons who are fond of cider have been made ill by drinking the prohibition variety too freely.

Danger of Sodium Benzoate

The other type of food preservative with which we have still to contend in this country is sulphurous acid, which is still widely used to preserve and brighten certain dried fruits. During the curing process these fruits are smoked with fumes which contain sulphur dioxide. This unites with the water



PHOTOGRAPH EWING GALLOWAY

Apricots in process of drying under the California sun. The darker color of natural sun-dried fruit distinguishes it from brighter colored fruit treated with sulphur dioxide.

in the fruit to form sulphurous acid. It is an effective destroyer of bacteria and insects and hence acts as a preservative. However, since properly dried fruits will keep without it and insect eggs can be destroyed by a mild degree of heat, it is not necessary for these purposes. The real reason for its use is that it preserves a brighter color in fruit and thus makes it more attractive to the average purchaser. This is particularly true of dried apricots and dried peaches. Dates are rarely if ever sulphured. Neither are figs and raisins ordinarily, but figs put up in transparent packages are still so treated, and also the white or bleached type of raisins.

Dangers of Sulphurous Acid

Sulphured fruit may be known by the labels of the packages. The law requires that the presence of both benzoate and sulphur dioxide be plainly declared on the label, and this law is strictly enforced. Therefore, you are at liberty to use or not use these harmful preservatives, as you wish; but anyone who understands that anything which will destroy one kind of living cell is likely to be harmful to another kind, will probably not wish to do so. That chemical preservatives are, as a matter of fact, harmful to man was proved by experiments which were summarized in the Remsen report to the United States Government, November 1st, 1911.

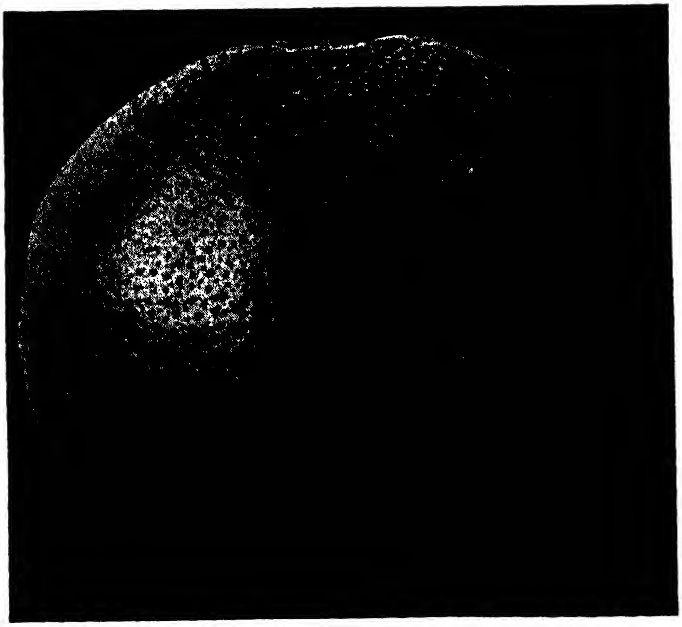
This principle does not apply to the preserving of foods by heating them. The heat is a temporary thing, and after the food has cooled again the destructive effects of the heat cease. The preserving action of heat as applied to canned goods or other foods should not, therefore, be confused with the use of chemical preservatives. Heat leaves no poison in the food.

Artificial Flavorings and Colorings

Artificial flavoring and colorings in food are in a class different from that of preservatives. The preservatives, in order to be effective, must of necessity be destructive to lower forms of life, and hence are likely to be more or less poisonous to man. But this rule does not apply to either colors or flavors. Some colors and some artificial flavors formerly used in foods were found to be poisonous and were ruled out by the Pure Food Law. There are plenty of harmless colors and flavorings that could be used in their place, and hence there was no excuse nor argument that the manufacturers could put up for the poisonous ones.

The essential point of this question, however, is that Nature has given so much pleasing color and flavor to foods that there is no need for artificial concoctions, and while these may not be directly injurious they are indirectly so, since they mask inferior products. A good illustration of their use for this purpose is afforded by the synthetic drink made to imitate orange juice. The usual formula for these beverages is: Yellow coloring matter; oil of orange skin, which gives the odor or flavor; citric acid, which is made from waste lemons; and cane sugar. Two of these four ingredients do come from the real citrus fruit. The oil from the orange skin has, however, no food value, and, in fact, is probably somewhat harmful. When we eat an orange we do not eat the outer skin, but we get its perfume or odor while eating the pulp. When we make our own orange juice there is enough of this odorous oil in it to give the characteristic aroma. But in the artificial product they usually give us an overdose, so that we will not notice the poor flavor of the drink. The citric acid is the most important ingredient of such drinks and is pure organic acid, whereas in the orange it is combined with valuable alkaline minerals. The vitamins, including vitamin C, which are present in the genuine juice of any of the citrus fruits, are, of course, wholly absent in the artificial concoction.

Artificial Concoctions for Drinks



The orange is a most popular citrus fruit. Calories per pound, 210; protein, 0.6; fat, 0.2; carbohydrates, 10.5. It contains vitamins A, and B, but is especially valued for vitamin C.

Even the sugar is not as valuable, for the superior fruit sugar is replaced entirely by ordinary cane sugar. So while there may be nothing actually harmful or poisonous in these synthetic imitations of natural fruit juices, we certainly do ourselves injustice and injury when we use them instead of the highly beneficial real fruit juices.

Spoiled Foods as Poisons

Poisoning of an entirely different type may occur from the use of spoiled foods; that is, foods in which bacteria or molds have produced poisonous by-products. Such poisoning has been a common enough experience in the history of the race to give us all an instinctive fear of spoiled or decayed food, especially in the case of meats or other protein-rich foods. Happily such putrefactive decomposition is usually accompanied with unpleasant odors and there is no temptation to use such foods. This element of protection is not wholly reliable, however, for the disagreeable odor of decayed food is only incidentally related to the actually harmful factors. Spoiled foods can have a very offensive odor without being actually poisonous, and conversely they may have no disagreeable odor and yet be rankly poisonous.

Bacteria May Be Helpful or Harmful

The hundreds of species of bacteria by which foods are attacked cause widely varied forms of decomposition. In some instances the resulting changes, instead of being harmful or unpleasant, are pleasing or even beneficial. Practically all ripened cheese has been subjected to such bacterial action; and while opinions may vary as to its palatability, we can hardly class such cheese as poisonous. The various types of sour milk, including the plain home variety, are also the result of bacterial action which produces lactic acid from the sugar of the milk. Such lactic-acid milk is a good food, and indeed has actual medical value, since it inhibits to a greater or less degree harmful germ action in the alimentary tract. In recent years great success has attended the use of lactic-acid milk in infant feeding. Hence we cannot class all bacterial action in food as undesirable, albeit the general presumption must remain that foods are at their best in their original forms, before being changed by such bacterial fermentations.

The general term *ptomaine poisoning* has been applied to acute poisonous effects due to bacterial action in food before it is eaten. The word ptomaine is merely a synonym. It was adopted as a general name for bacterial poisons in food before the species of bacteria that produced the poisons were known.

The most fatal form of poisoning from food contaminated by bacteria is known as *Botulism.* The poison may occur in many kinds of food, but is the most common in home-canned vegetables that have not been properly sterilized. String beans seem to be most frequently subject to such deterioration. The spoiled product is not readily revealed by taste or odor, and the poison is not destroyed by reheating the food after it is taken out of the can. Cases of genuine botulism usually prove fatal within a few hours, and no remedy is known. The destructive effects are due directly to the poison generated in the food and not to infection by living germs, for were the latter the case resterilizing of the food would prove a protection.

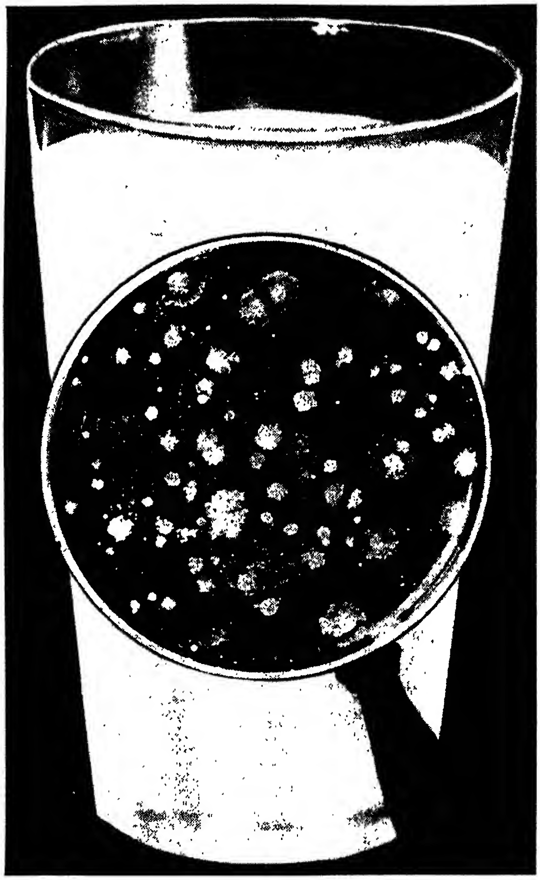
Such cases of poisoning, involving the sudden death of all who eat of a certain food, are so sensational that they usually receive wide publicity. Hence the danger appears to be greater than it really is. The actual cases are very rare indeed. Probably we suffer a greater risk of losing our lives from walking on sidewalks, even if we never attempted to cross a street, than we do from acute poisoning from eating spoiled food. By far the greatest danger that any of us run of being poisoned by food arises, not from the comparatively rare conditions in which foods are poisonous when we eat them, but from the wrong use of perfectly good foods.

Poisons Developed in the Alimentary Canal

Under this head we should first consider the development of poisons in the alimentary canal. The poisons actually created there are entirely due to the presence of bacteria or other living organisms, and not to the chemical reactions of the foods themselves. This latter theory has been somewhat popular in recent years, but has no scientific foundation. There are so many ways in which the digestive functions can fail, and so many forms of bacterial fermentation that may occur in a weak and disordered digestive tract, that the notion that "wrong combinations" of foods gave rise to injurious chemical reactions seemed a plausible explanation for some of these disease-breeding results. All sorts of destructive and poison-producing reactions may occur in the human digestive tract, but it is erroneous to presume that these are caused by the foods themselves. In every case there are bacteria present and it is these that cause the fermentation, giving rise to gases and various chemical products that are more or less injurious and poisonous.

Cultivating the Helpful Bacteria

It seems a rather shocking fact that our food, while digesting, should be contaminated with living bacteria; yet the same is true of all animals when on their natural diets. Hence we must accept it as a natural part of life. However, the bacteria vary widely both as to numbers and species. Certain species seem entirely harmless and indeed quite normal. Others are abnormal and harmful. The maintenance of a healthy condition of the alimentary tract is therefore not a matter of entirely eliminating all bacteria, but of cultivating the beneficial instead of the harmful types.



PHOTOGRAPH INTERNATIONAL NEWSREEL

Science applied to the handling of milk has enormously reduced its contamination. Through the lens in this picture we see types of bacterial colonies developed in the laboratory from milk kept under unsanitary conditions.

Thus the intestinal contents of the healthy infant while nursing at its mother's breast are a culture of the acidophilus bacteria, which live on milk sugar and convert it into lactic acid. The acidophilus, or similar species of bacteria in the intestines, produces lactic acid, which in turn checks the growth of other species, particularly the putrefactive bacteria that thrive on meat proteins and produce a series of foul-smelling and poisonous chemical products. These products are absorbed through the intestinal wall into the circulation and may then be eliminated by the kidneys and appear in the urine. Most conspicuous of these poisons is one known as *indican.* The presence of indican in the urine is therefore evidence of an unhealthy bacterial growth in the bowels. A meat diet encourages such growth. Constipation, or delayed removal of the bowel wastes, makes matters worse. The combination of a meat diet and the condition of constipation is therefore most dangerous to health. One may be constipated on a low-protein or vegetarian diet with much less serious consequences.

Bacteria and Constipation

Obviously the ideal condition would be that of a low-protein diet with no constipation. In that way the number of harmful poison-breeding bacteria in the intestines is kept at a safe minimum. If at the same time the acidophilus bacteria can be cultivated by the plentiful use of milk, milk sugar, lactodextrine or acidolphilus cultures, the bacterial healthfulness of the bowels is still further encouraged. It may be wise to make use of any or all of these measures in certain cases, but in ordinary health the use of a low-protein or non-meat diet, combined with any program that will fully overcome constipation and give a prompt passage of the contents of the bowels, will keep the poison-producing organisms under control.

There are also many gas-producing organisms that thrive in the human digestive tract. These do not live on protein but on carbohydrates, and therefore thrive on a vegetarian diet and in vegetarian animals. Their presence in moderate numbers is not objectionable, but when they become excessive and the formation of gas in the stomach or intestines is too great, the result is unpleasant and in severe cases may be injurious. In such cases the products that feed such bacteria may have to be eliminated from the diet and a greater use made of fats than of carbohydrates. Fats are the one type of food on which no bacteria seem to thrive, but as we cannot live on fats alone their use is not a complete remedy for such conditions.

Gas-producing Organisms

We would do well to inquire here as to what it is that causes bacteria in the bowels to get beyond control, so that their growth becomes a source of danger. Every living organism tends to resist the growth of other organisms in its tissues. Were this not true none of the higher forms of life could exist, as they would be speedily destroyed by lower forms, as indeed their bodies are as soon as death ensues. This protection is not complete for the contents of the digestive organs, but there is a partial protection which keeps down the number of bacteria and checks the growth of the more harmful sorts.

Checking Bacteria in the Intestines

The mechanism of this protection is the alternation of an alkaline and acid medium as the food progresses through the digestive tube. The first of these reactions is the alkaline effect produced in the mouth by saliva. This is mild, however, and probably has little destructive effect on bacterial life. But when food passes into a healthy stomach, it comes into contact with the very strong and distinctive hydrochloric acid, the secretion of which is an essential part of the work of the glands in the stomach-wall. It was formerly assumed that the purpose of this hydrochloric acid was that of a digestive fluid. But a more logical conception is that it serves to check the growth of bacteria that require an alkaline medium. The real digestive effect in the stomach is from pepsin, which is fitted to work in an acid medium. But as soon as the food passes out of the stomach it enters the duodenum and there is met by the bile and the pancreatic juice, as well as by other juices from the intestinal wall. All these are strongly alkaline, made so by alkaline salts of sodium and potassium. In a healthy individual the degree of this alkalinity is sufficient, not only to neutralize the hydrochloric acid of the gastric juice, but also to give a very marked alkaline reaction. Here the acid-loving bacteria that might have thriven in the acid stomach meet with a medium that is not favorable to them, and their growth is thereby checked. This alkalinity is gradually lost throughout the length of the intestine, not by the secreting of further acid, but by the reabsorption of the alkaline elements and by the action of bacteria which give off lactic or other acids as a product of their growth. Thus the lower reaches of the intestinal tract again become acid, which is the normal reaction of the healthy large intestine.

Obviously any serious disturbance of this scheme of alternating chemical reactions results in a loss of protective power against bacterial growth and produces an increase in the bacteria which may have serious consequences. In the condition of hyperacidity of the stomach, when that organ secretes too much hydrochloric acid, we do not have enough alkali in the intestines sufficiently to neutralize the excess of acid. The result is a more nearly neutral medium that is especially favorable for bacterial growth. This is the reason that gas-forming fermentations are such a frequent accompaniment of hyperacidity of the stomach. The immediate relief that may be secured by the taking of bicarbonate of soda, or similar alkaline salts, is due to the correction of this disturbed balance. A contrary, though more rare condition, is that in which there is an insufficiency of hydrochloric acid. In that case temporary relief may be obtained by the opposite course of taking dilute hydrochloric acid. However, such artificial relief is in no sense a cure, and may even be dangerous in that it may check natural function and render the condition permanently worse.

Effect of Hyperacidity upon Bacteria

To go at length into the problem of poisons that are formed in the body proper through wrong nutrition or the failure of normal functioning would be beyond the scope of this general survey of the subject of body poisons. Our purpose here is rather to make clear the necessity of proper nutrition as a means of preventing disease by showing how many and varied are the dangers to life that come from the presence in the body of poisons which are directly or indirectly of nutritional origin.

Broadly speaking, any food in excess of the body's need for it is a poison, because it is destructive of the normal healthy and life-giving balance of the body chemistry. In the case of soluble elements such disturbance results from comparatively slight departures from ideal proportions. An excess of a non-soluble element like fat is less dangerous, being rather a mechanical than a chemical disturbance. This can be serious enough, however, and in severe obesity may very materially shorten life. In rare cases, too, fat may be changed, because of the failure of complete oxidation, into the poisonous acetone, the usual cause of death in diabetes.

Overeating, Source of Poison

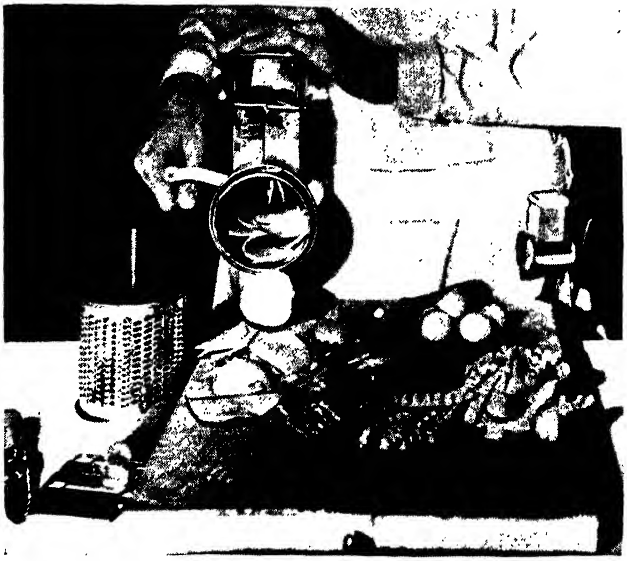
Ideal nutrition would require that we partake of every life element only in the exact proportions that the body requires. But no such state of nutrition has ever existed in man or animal. In order that we may be assured of getting enough of everything and suffering from neither deficiencies nor excesses, Nature has not only provided us with nutritive reserves but also with an elaborate system of safety-valves for disposing of surplus and waste. Within limits this system works very well, especially if associated with normal food instincts. These instincts probably work much better in wild animals on their natural diet than they do in the case of civilized man. But we can help them by intelligent cultivation.

The Value of Instinct in Eating

The matter of the regulation of our body chemistry by instinct and by the natural safety-valves may be illustrated by considering the preponderant element of every living body, which is water. When the proportion of water begins to run low in the body we feel the sensation of thirst, and if water is available we drink it. But Nature has provided that we shall drink enough water not only to keep the body moist but to have a surplus to pass off. We need water to keep us cool by the process of the evaporation from the sweat-glands of the skin and we also need it to carry off soluble waste salts through the kidneys. When we have eaten an excess of common salt we become thirsty, because more water is needed to dilute the salt in the blood and carry it out of the body through the kidneys.

Since a great deal of the water that passes through the body is for the production of perspiration, it follows that a man doing little muscular work and perspiring little will drink much less than a man engaged in physical labor. Indeed, the quantity he drinks may be so restricted as to provide less than is needed for best results in eliminating the soluble wastes through the kidneys. Therefore it seems a wise practice for those who are not exercising their muscles and who rarely sweat to make a point of encouraging the inclination to drink. There is little danger of drinking water to excess, for it does not accumulate in the body, being speedily eliminated through the kidneys. The proper elimination of surplus water is a function that rarely goes wrong; yet it may do so in the disease of dropsy, when water accumulates in the body with disastrous results. In this condition the excess water actually becomes a poison in that it seriously disturbs the normal chemical condition of the body. In such cases not only must

Water and Body Chemistry



Devices to cut vegetables into various attractive and appetizing forms are an aid in food preparation. All this helps in adding pleasing variety to the endless routine of the reducing salad. These devices are labor saving and are not expensive.

the drinking of water be checked but the use of salt is prohibited, because the presence of salt tends to retain greater amounts of water.

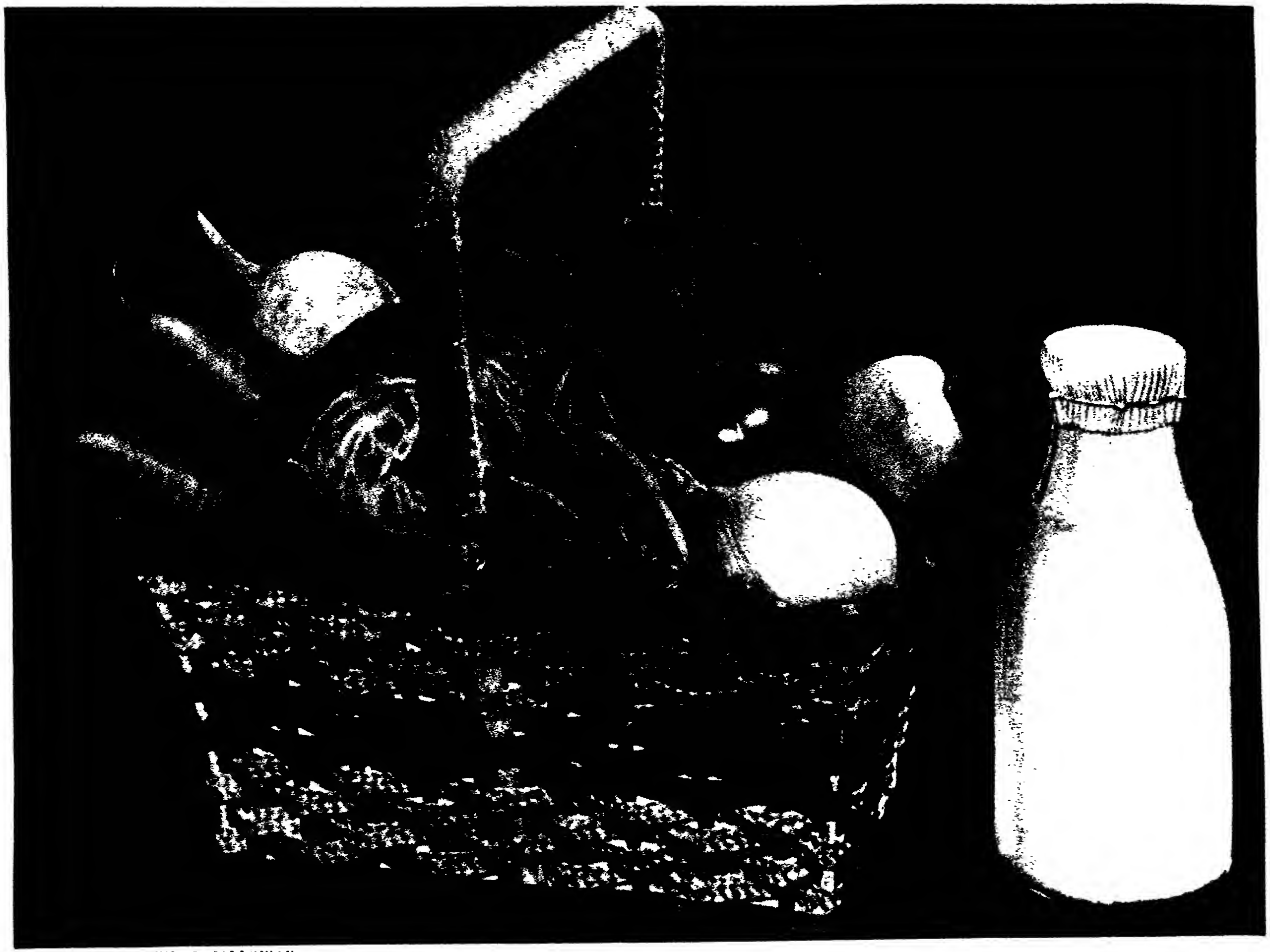
Of those poisons that are created in the body by chemical reaction not involving disease germs the most common source is protein in excess of the body's need. Both fats and carbohydrates when destroyed in the body are oxidized into carbon dioxide and water, simple substances that are easily eliminated when in excess. But the foods that contain nitrogen form a much more varied and complex variety of products, and many of these are quite poisonous unless promptly eliminated. The most abundant one is urea, which is excreted in the urine. Any condition in which there is a failure of such excretion causes the very grave uremic poisoning. Uric acid is another such product. It is normally produced in much smaller quantities than urea, but is much more difficult to excrete, as it is less soluble. When it accumulates excessively in the blood it may form crystals in the joints and tissues. The pains of gout are the results of such uric-acid deposits (crystals) and the remedy is to stop the formation of the poison by the use of a low-protein diet. These are only the simpler end-products of the complicated proteins, and many of the more obscure body poisons and diseases can also be traced to this source.

Elimination and Poisons

The last group of poisons in our list consists of those formed by actual pathogenic germs or disease-producing bacteria that live in the fluids and tissues of the body itself. There are always some bacteria in the digestive tract of man and animals, but there are none in the actual body of any creature in perfect health, and their presence is therefore always an indication of disease. According to the orthodox viewpoint the bacteria cause the disease, and it is certainly true that the destructive effects upon the body, often ending in death, are due to the poisonous excretions of such bacteria. But to make such a statement is to tell only half the truth, for it leaves out of consideration the conditions that make it possible for the bacteria to live in the body. Since the normal healthy body can resist the penetration of all except a few of the most deadly bacteria, it is evident that those who are susceptible to the invasions that others resist must have suffered some changes in the chemistry of their bodies.

Disease Germs in the Body Fluids and Tissues

This fact is emphasized by the physical culturist, who is interested in preserving health rather than in waiting till he has a disease before he combats it. Nutrition plays a very large part in the prevention of disease because it is only by perfect nutrition that perfect body chemistry can be maintained. This involves avoidance of both nutritional deficiencies and poisons. Either or both of these types of disturbance of normal body chemistry may contribute to that abnormal state which permits foreign organisms to breed in our bodies and produce their destructive toxins.



PHOTOGRAPH EWING GALLOWAY

PLATE 28. Vegetables which are adapted in raw and cooked forms for use with milk, are here shown, including: Carrots, parsnips, cabbage, spinach, peas, string beans, tomato, squash, turnips and onions.

COOKING AND ITS EFFECTS

Section 12

WHY do we cook food? The average cook-book will tell you that food is cooked to develop new flavors, to make it more palatable and digestible, and to destroy micro-organisms, and that changes which render a food a cooked one are brought about by heat in the presence of air and moisture. At the present time, however, the value of cooking is being questioned, and some go so far as to say that the way to health and long life is to be found in the use of uncooked foods only.

There are, no doubt, many foods which do not need to be cooked to render them more acceptable to the palate, and useful to the body, but an uncooked diet is an extremely limited one, and excludes many foods which modern science has discovered to be extremely valuable.

Cooking Processes

Science has gone still further and has shown us how the loss of organic material and vitamins, so great in the old cooking methods, may be reduced to a minimum. For this reason cooking has come to have a broader meaning. It consists in the preparation of food in such a way that the natural food elements are conserved. Cooking so viewed includes any process through which food passes before being served.

In this discussion the term "cooking" is used in this broader, more modern sense. Each method of cooking is discussed as well as the advantages of both the cooked and uncooked type of diet.

Wastes in Cooking

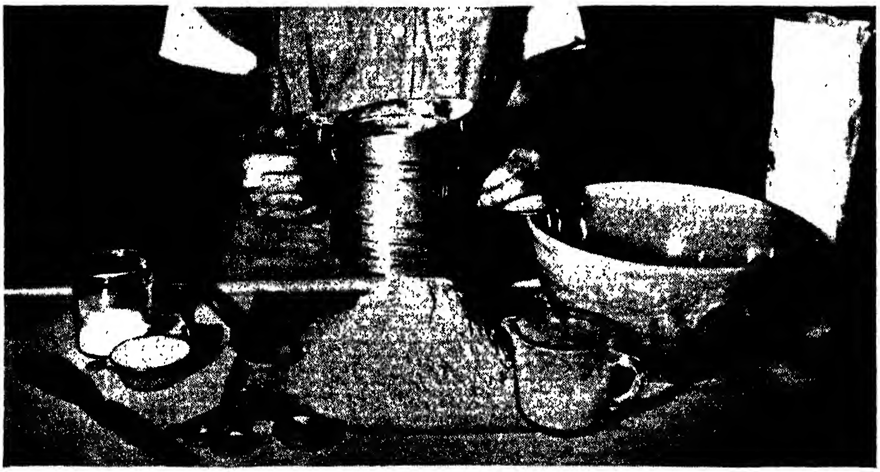
We shall first consider the various cooking processes and the advantages and disadvantages of each from the health standpoint. The most universal method of cooking is boiling, which consists of cooking in a bath of water at a temperature of about 212 degrees Fahrenheit. This method has serious disadvantages unless the purpose is to make a soup or stew, in which case the water in which the food is cooked is consumed. Then the purpose is to get the flavors and soluble elements from the food into the water, and this is best done by long slow cooking below the boiling point. When this is not what is wanted, boiling is a very poor method of cooking, for solution of material in the cooking water always occurs. This loss is most serious in the case of vegetables. In the case of fruits, fortunately, the juice or cooking water is always consumed, but in vegetable cookery it is often drained away, and even if served it is very likely not to be consumed.

Vegetables are valuable in the diet chiefly because of their high content of alkaline minerals. These minerals are soluble and when they are lost in the cooking water much of the value of the vegetables as food is also lost. The remaining material tastes washed out and flat and is made palatable only by the adding of much salt and other seasoning which is usually useless and sometimes harmful.

Steaming vs. Boiling

The steaming of vegetables, as against boiling, is a decided improvement. This is a method of cooking in steam generated by boiling water, and vegetables when so cooked do not lose nearly so much of the valuable solubles as when boiled. However, they lose some, as the steam condenses on them and trickles off as hot water. Roughly, this loss is about half that of ordinary boiling.

These facts have led, in recent years, to the invention of very clever utensils known as waterless cookers. The water-



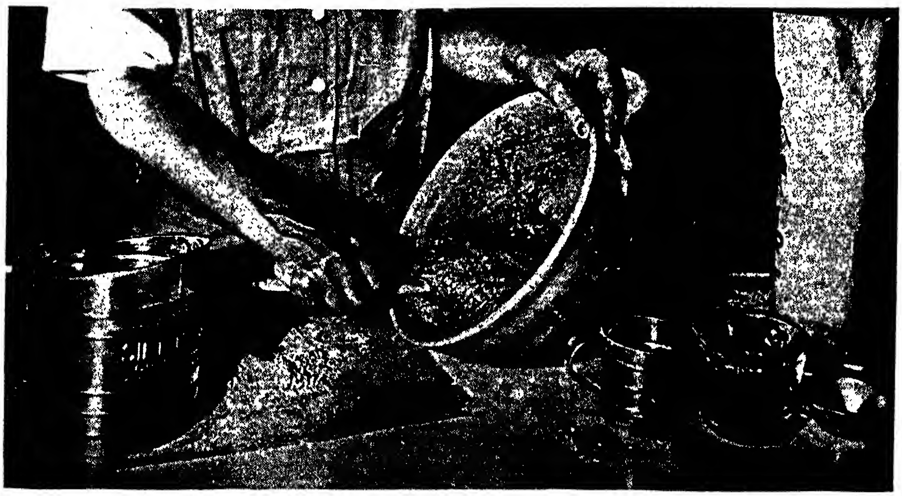
Whole wheat bread is essential to the ideal health diet. Sifting the flour, the first step for the home-made loaf.

less cooker is a vessel built to be set on top of the stove, but so constructed that the sides and top heat, as well as the bottom. With a little skill in handling the flame, vegetables can be cooked in such devices in a manner that heats them through without either immersing them in water or subjecting them to the too drying heat of an oven, as in baking. Waterless cooking is really baking at low temperatures in an atmosphere just moist enough to prevent the food drying out, but with no steam condensing on it and running off. The foods cook in their own juices without either water or minerals being added or lost. Thus they retain not only their full nutriment but also their flavor. Vegetables cleverly cooked in such devices have astonishingly delightful flavors and require little or no added seasoning. It is a style of cooking that is to be highly commended.

Waterless Cookers

Although it requires more fuel, somewhat similar results can be obtained by cooking food *en casserole*, that is, in a covered dish in an oven. In this case also nothing is allowed to escape from the food and all mineral values may be retained. In the covered dish, as in the waterless cooker, we have a baking process at comparatively low temperature in a moist atmosphere.

Ordinary baking is applicable to foods that are of such a nature that they do not dry out too much. While the tem-



The dough for the whole wheat loaf in process of mixing.

peratures of the air of the baking oven range far above the boiling-point, the temperature of food that retains its moisture does not exceed the boiling point of water, and cannot unless it is subjected to pressure. Therefore, the middle of a baked potato or a loaf of bread is no hotter than food that is being boiled. Only the crust of bread that browns or darkens in color reaches a higher temperature. It was formerly thought that this made it more healthful, but modern feeding experiments have proved that this is not true and that rats, for instance, will not live and thrive as well on the crusts of bread as upon the interior of the loaf.

Crust Over-valued

The food that is undoubtedly best when baked is the common potato. It should not be burned on the exterior and the skins should be eaten. Very few other vegetables can be handled in this fashion. As in the case of sweet potatoes, much of the food value of potatoes so cooked is often lost owing to the discarding of the skins. When it is not desired to eat the skin such foods can be boiled for a short time in water, when the thin outer skin may be removed and the cooking finished in the oven at temperatures that will not burn the outside.

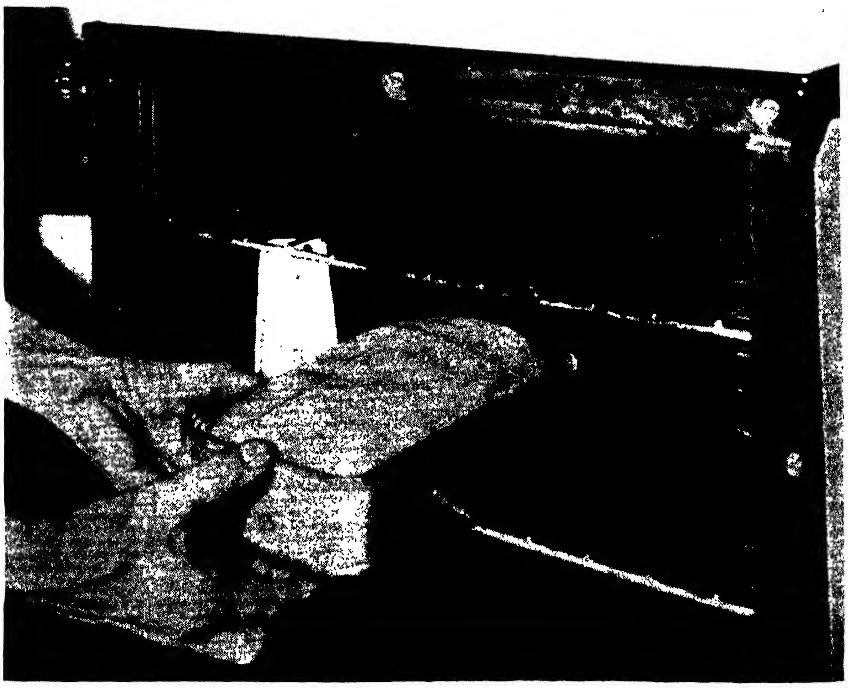
A method of cooking which has many advantages and is

Kneading the dough for the whole wheat loaf.

quite adaptable to various foods is that of enclosing the food in tough parchment paper. This idea was first exploited under the term "paper-bag cookery." However, the difficulty of getting any form of glue that would hold a bag together in boiling water makes the use of flat sheets of parchment paper preferable. Such sheets have many uses about the kitchen, as for the wrapping of foods in the ice-box, to prepare salad on, or to line cake-pans. The best grades may be used to line roasting pans in baking meats and are tough enough to retain the juices and gravy and keep the pan itself clean. The parchment paper made for this purpose is not only impervious to both water and grease, but is made tougher rather than weaker by being either oiled or wet, or both oiled and wet. A sheet of such paper when moist can be easily gathered around any mass of food and tied with cotton string, so that a completely enclosing bag without seams is formed.

Conserves Food Juices

Foods enclosed in this fashion may be cooked by either of threc methods: steaming, boiling, or baking. In all cases the



The whole wheat loaf ready for the oven. Whole wheat bread has many advantages over bread made of white flour.

Retaining Flavors in Cooking

enclosing parchment paper acts to retain flavors that would otherwise pass off as vapor or be dissolved in water, and it is presumed that such juices as escape from the food into the enclosing bag will be served with it, or otherwise used. The amount of such juices will depend upon the nature of the food.

Use of prepared parchment paper in cooking. The picture at the top shows sections of cabbage prepared for boiling in such paper, made wet. before using. The middle photograph shows the use of cord to tie up the package containing the cabbage preparatory to placing in the pot for boiling. The lower photograph shows the method of preparing fish for baking within this specially prepared paper, properly dampened. While baking, the food may be basted from time to time, the paper serving as a container for this basting liquid and natural flavor of the foods used.

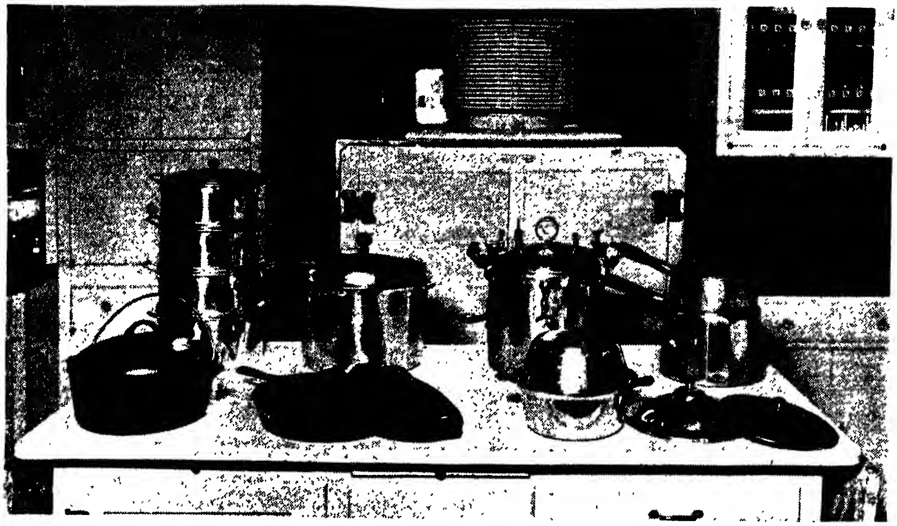
This method of cooking approaches the ideal of retaining all flavors and food values, whether the heating medium be steam, water, or the dry atmosphere of the oven. In the case of oven cookery or baking the use of the wrapping parchment reduces the tendency to drying or burning of the exterior. When the parchment is used to enclose foods for boiling the vessel containing the water should have a grid or false bottom that will prevent the paper coming in direct contact with the bottom of the pot, which might cause it to stick and burn. The best grade of such parchment paper is so tough and non-absorbent that it may be rinsed off after use and reused several times.

Cooking Meats

In the case of meats the various cooking methods have less effect on food value than in that of vegetables. Broiling is generally considered the best method. This consists of cooking over or under direct heat. Since meats are rich in protein, which coagulates on exposure to dry heat or boiling water, a coating is formed which prevents loss of juices, so that the flavor is retained in the meat. Meats are also pan-broiled; that is, cooked in a hot griddle or ungreased pan. Frying, which is the most objectionable way to cook vegetable foods, is less objectionable when applied to meat or eggs. This process consists of cooking in a bath of hot fat at a temperature of from 300 to 400 degrees Fahrenheit, the temperature being influenced by the food to be cooked. Meats generally contain fat and little is actually added by the frying process; moreover, the protein and fat are in intimate combination in the original meats, as indeed they are in nuts or in the yolk of egg, or even in milk. But in nature we more rarely find much fat combined with starch, and when hot fat penetrates starchy food, as in the case of fried potatoes, or crumbed or floured fried foods, like croquettes or fried oysters, an unnatural combination is produced. This type of fried food seems to be particularly trying to the digestion.

Objections to Frying

The doughnut belongs to this class of food, and so do pastries in general. The statement is often made that deep frying is not so objectionable as shallow frying, because the immersion in hot fat quickly seals the food and prevents the penetration of more grease. But certainly this does not apply to crumbed croquettes, doughnuts, or even French-fried potatoes, which are the most common types of foods fried in



Modern cooking devices. Top row: Steam cooker, covered kettle, pressure cooker, double boiler. Front row: Top oven, covered frying pan and covered sauce pan.

deep fat. Moreover, the fat, in such cases, is often heated to too high a temperature, so that irritating substances are formed.

The objection to fried foods is chiefly due to the difficulty of digesting grease-soaked starch and sugar combinations. But the increased fat in the diet is also an objection. We need some fat in our food, but the natural fats in nuts, milk, eggs and cheese, together with our free use of butter and salad oils, usually give us enough. When fat meats are added, and then fried potatoes and pastry, the diet becomes overloaded with fat, and one is obliged to overeat in order to get a sufficient amount of other essential food elements. Fried foods and pastries, as generally used in the American diet, are highly objectionable, except, perhaps, in the case of men doing very hard labor in cold climates.

Sautéing

Another method of cooking, somewhat similar to frying, is sautéing, which differs from frying in that the food is cooked in a small quantity of fat, the process being really a cross between pan-broiling and frying.

Braising

Two of the more unusual cooking processes are braising and fricasseeing. The former is really a combination of stewing and baking. It is an economical way of cooking and is usually applied to meats. The meat to be braised is first sautéd. This coagulates the protein, prevents loss of this element, and adds to the flavor as well. The meat is then placed in a covered pan with a small amount of water or stock to which vegetables are usually added. It is baked at a low temperature and the resulting product is extremely tender and has an excellent flavor.

Fricasseeing is also generally applied to meats, the process consisting of sautéing tender meats and serving with a sauce. If less tender meats are prepared in this way, they should first be stewed or boiled, then sautéd. A still further application of this method is to sauté the meat first, then cook slowly in a sauce. Such intricate processes, however, belong to the old school and simpler methods are more popular at present. **Fricasseeing**

The characteristics of the foods to be cooked will be an important factor in deciding the best manner of preparation, and, indeed, in deciding whether or not it should be cooked at all. A little has been said of the effect of heat on protein, that it is coagulated by hot water and dry heat, so that when meat is broiled the coagulated protein on the surface prevents loss of juices and flavor. This principle is observed when meats are prepared in other ways. The surface is always seared or exposed to heat, unless one wishes to extract the

Cauliflower and cheese in combination provide a rich source of calcium. Preparation begins with the breaking apart of the flowerets of the vegetable after the cauliflower head has been washed.

Milk, another important source of calcium, is here poured over the cauliflower.

juices as for broths or extracts. In the latter case the meat is put on in cold water, as this dissolves soluble proteins, especially if a little salt is added.

The action of heat on starch is also very interesting. Dry heat converts starch to dextrin at a temperature of 320 degrees Fahrenheit. This substance is easier to digest than the raw starch and does not have its thickening power. The change to dextrin is also brought about by acids. That is why lemon juice lessens the thickening power of starch. When starch is cooked in a liquid the heat causes the starch grains to absorb liquid, swell and soften, so that the liquid is thickened by them.

Raw or Cooked Starch

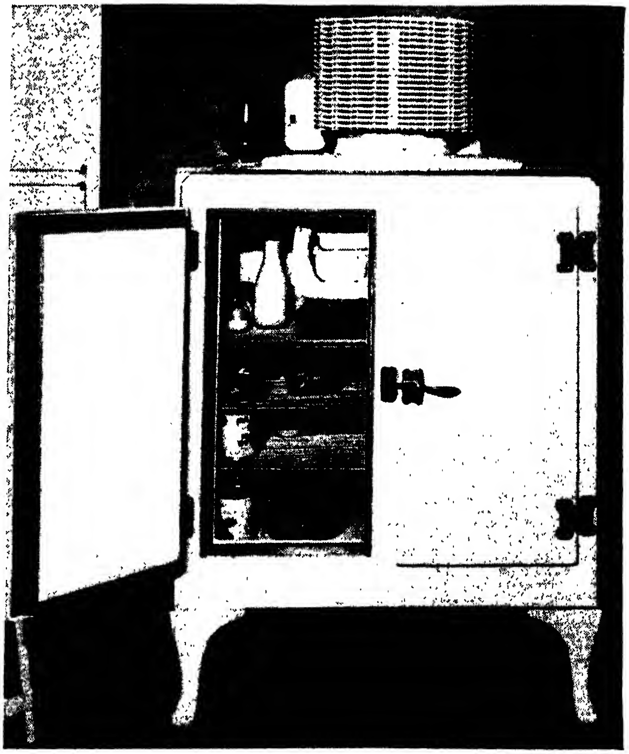
There has been much dispute as to the relative digestibility of raw and cooked starch and many interesting experiments have been made along that line. One of the earliest of such investigations was conducted by Milo Hastings at the Kansas Agricultural College in 1906. Mr. Hastings, while studying animal nutrition at this college, decided to broaden his studies of animal nutrition to include human nutrition. He therefore took the course in scientific cooking that was given to the girl students. In that course he found they were teaching that raw starch was indigestible by man. This seemed to him utterly inconsistent with the evidence of the animal feeding experiments, which proved that the cooking of grains and potatoes for live stock was no advantage, but rather a disadvantage in the production of either fat or milk.

Mr. Hastings therefore undertook a series of original experiments which proved that the cooking of foods for humans did not ordinarily increase their digestibility and that the idea that uncooked starch was indigestible by man was erroneous. In the case of beans, however, he found that cooking did materially improve the digestibility.

The digestibility of fats has already been referred to, and their reaction to heat is one with which we are all familiar.

Food Storage

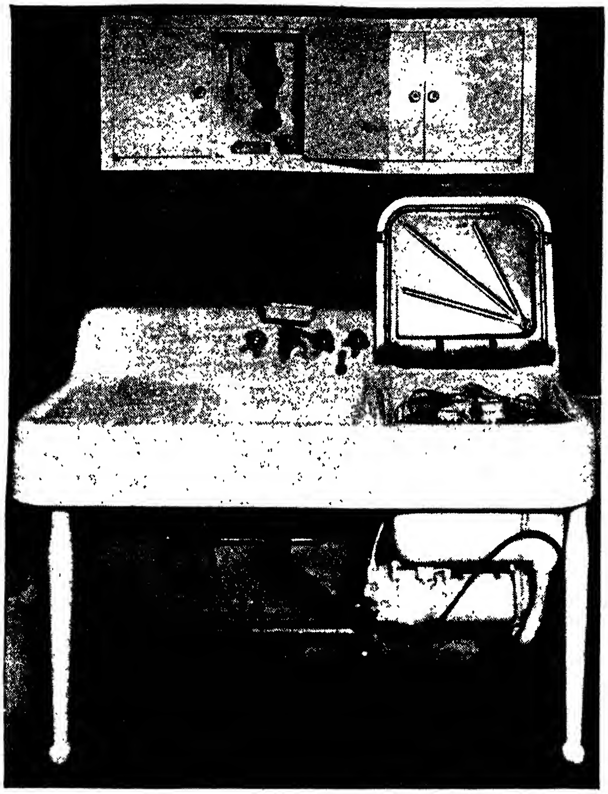
The knowledge of food constituents, besides forming a guide as to the manner of cooking, will help one to take proper care of food purchased both before and after it is cooked. Every home should have some adequate storage facilities, preferably in places which admit plenty of sunlight and air to antagonize the growth of molds and putrefactive bacteria. Ice, by producing temperatures unfavorable for the growth of micro-organisms, is also a valuable aid in caring for food, and, for this reason, forms a necessary part of the kitchen equipment.



The modern electric refrigerator is sanitary and, by maintaining a constant temperature, keeps food in good condition. In the model shown here the latticelike cylinder on top serves as an outlet for heat.

Refrigerators

The ice-box should be kept thoroughly clean and the most perishable articles of food, those with a high water content, should be placed in the coldest part. Milk should always be found in this section, as should



The equipment of the modern kitchen sink may include mechanical dishwashing appliances. In the sink shown in this photograph, the dish washer is electrically operated.

butter, uncooked meats or fish. When the latter is placed in an ice-box it should always be covered. Cooked meats, left-over foods, berries, cherries, fruits and vegetables with no decided odor, salad oils, cheese (covered), shortening and eggs should have second choice for the coldest part, or may be placed in the next coldest. Foods with strong odors are placed where circulation will not transmit them to other foods. That is the point where the warmest air in the cycle of circulation is about to pass over the ice. In the side-icing regrigerator this is the top shelf.

Labor Saving in Kitchen

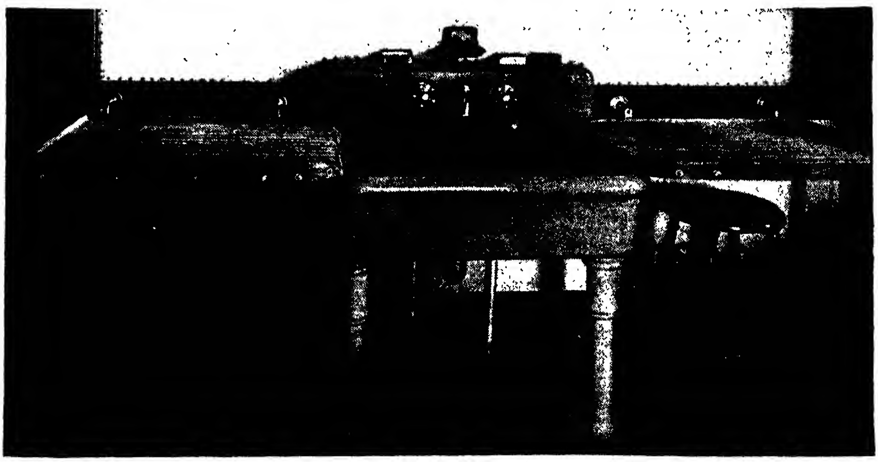
The refrigerator, in a modern conveniently equipped kitchen, is placed near the working center, as the articles which it contains are used frequently and every effort is made to save unnecessary steps. An ideal method of kitchen arrangement is to have a division of food preparation and serving-table areas. This means that the work table or kitchen cabinet which should be placed near the sink and stove is used only for food preparation and for the finished products taken from the stove. Then there should be a table near the dining-room from which the foods may be served and where the soiled dishes may be placed at the end of the meal. It is a very good plan to have such a table on wheels, if it is not near the sink, so that it may be easily moved thither, with its load of soiled dishes. This will save many steps. Of course the china cabinet should be near the sink, so that the dishes may be washed, dried and placed in it without loss of time and energy. If the china and silver are kept in the dining-room, it is a simple matter to place them on the movable table to be taken there all at the same time instead of in relays.

Modern Utensils

The smaller pieces of equipment are also important and include all the cooking utensils. For measuring, only accurate standard equipment should be used to secure the best results. The measuring-cup should hold one-fourth of a quart and should be divided into thirds and fourths. Besides this, one should have a quart measure divided into fourths, a standard tablespoon holding one-sixteenth of a cup, a standard teaspoon holding one-third of a tablespoon, and a tested scale. To measure dry ingredients accurately the cup or spoon is filled to overflowing and is then leveled off with a knife or spatula. When measuring flour it should always be sifted first. To secure an accurate half teaspoon or tablespoon of dry material, the spoon is filled, levelled off, and then divided into halves lengthwise.

Measuring

This measuring of ingredients and the collecting of the necessary cooking apparatus form two of the most important



Even when the equipment of the kitchen is simple, the housewife's energy may be conserved by various appliances.

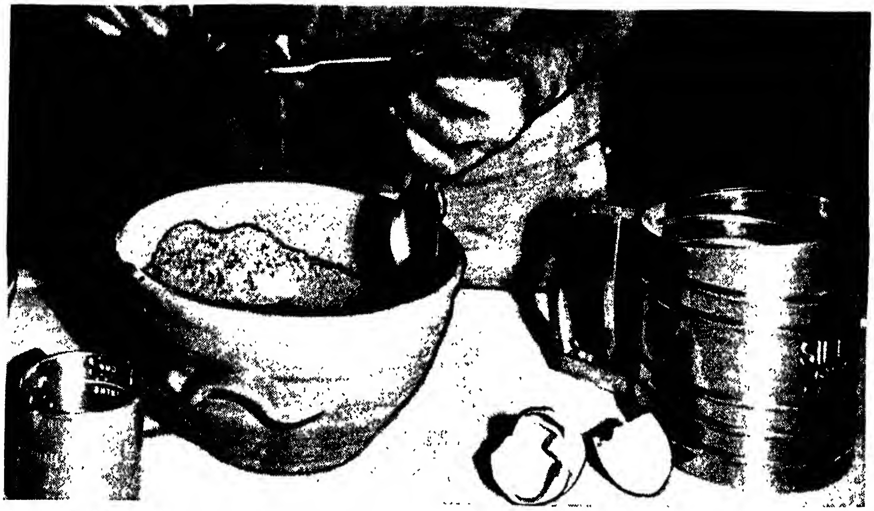
steps in food preparation, and these should always be complete before any effort is made to combine materials. One can hardly expect to have light muffins, for instance, if they are left to stand after mixing while the tins are being prepared.

Mixing Ingredients

For this reason it is a good plan to follow a recipe backwards instead of forwards. Suppose we take cake-making, in which the last thing done is to place the cake in the oven. To follow this recipe as advised the oven should be prepared first and brought to the proper temperature, unless one is so fortunate as to have a self-regulating one. The cake-pans should then be oiled and the necessary materials collected. The dry ingredients are first measured and the flour and baking-powder are sifted together three times. Then the butter and milk, if the recipe calls for them, are measured and one cup has served for both types of ingredients. When this has been done the various materials may be combined.

There are many different methods of combining or mixing the ingredients together. One of the most commonly used is stirring. This is a circular motion which is used to thoroughly blend the ingredients. Food is said to be "beaten" when a wheel-like movement is used, bringing the contents from the bottom of the bowl to the top. This is used to incorporate air.

The necessary utensils, assembled at the start, simplify the first steps in cake-making of any kind.



Accurate measurements, combined in the order given in the recipe, are most important if cake and pastry products are to be palatable and wholesome.

When we wish to combine two foods without losing air or gases that have already been introduced, as in the addition of beaten egg-white, we use a folding motion which consists of cutting down through the mixture vertically, turning it over and bringing up the spoon or knife used with a triangular motion. We also speak of the movement used in working shortening into flour (as in pastry-making) as cutting, and for this purpose two spatulas or knives are worked in opposite directions. A different type of movement is kneading, a stretching motion applied to doughs when more flour is to be added than can be either beaten or stirred into the mixture. This process incorporates air, blends the ingredients, and also makes the dough smooth and elastic.

Cake Mixing

Perhaps cake-making more definitely illustrates the use of the more common of these methods of mixing, especially since the two types most commonly made, butter and sponge cake, are combined in different ways. To make a butter cake the necessary cooking utensils are, of course, first collected, as advised, and the ingredients are measured. The flour is sifted three times with the baking-powder and salt. The first step in mixing the ingredients consists of creaming the butter, that is, working it until it is soft and creamy. When this has been done the sugar is added gradually and only a fine grade should be used. It is very important that the sugar should be dissolved as much as possible by mixing it and beating it with the butter until a smooth and creamy mixture is obtained. The eggs are next added, and these may be beaten together and then added to the butter and sugar mixture, or the yolks only may be added and the whites beaten separately and folded in at the last. After the addition of eggs, the flour which has been previously sifted with the baking-powder, salt or spices, if any, is added alternately with the milk. The flavoring is added and the whites are folded in as described.

The butter cake differs from a sponge cake in that it is placed in a buttered pan to cook, while the sponge cake, which is made without butter, is baked in an unbuttered pan. To make this type of cake the egg-whites are usually beaten until stiff and the sugar is added gradually, being thoroughly dissolved in the egg before the flour is is added.

Proportions in Cake

The proportions used in making butter cakes is as follows:

1. Butter should be from ⅓ to ½ the amount of sugar
2. Sugar should be from ½ to ⅔ the amount of flour
3. Milk should be from ½ to ¾ the amount of flour
4. 1 egg is used to ¾ to 1 cup of flour
5. ¾ teaspoon baking-powder is used to 1 cup of flour
6. As eggs are increased the baking-powder is decreased from ⅓ to ½ teaspoon for each additional egg. Too much baking-powder makes a dry, coarse cake.

Even when these directions are followed carefully, the ingredients carefully measured and mixed, the finished product will sometimes prove disappointing. This sometimes happens when different types of flours are used, as some flours absorb more liquid than others. When too much flour has been used for the amount of liquid, as in cake, for instance, it will be dry and crumbly. Too much flour will make bread solid and heavy, and sauces thick and pasty. A sticky cake with a hard crust is usually the result of too much sugar.

The proportion of liquid to flour varies, of course, with different types of batters. A batter to be poured, such as is used for popovers, for instance, is secured when equal amounts, by measure, of liquid and flour are used. For cakes or muffins twice as much flour as liquid is usually used, this type of batter being called a drop batter. When two and two-thirds as much flour as liquid is used, as in baking-powder biscuits, cookies and bread, we have a soft dough. A stiff dough is produced when four times as much flour as liquid is used, as in pastry-making.

Digestibility of Pastry

The digestibility of pastry has already been discussed, but other types of this group that need special consideration are the hot breads. It is the general impression that hot breads are indigestible and unhealthful. This effect has been too often noted to be doubted, but careful investigation shows that the fault is not in the freshness or warmth of the bread but in the nature of white flour. In other words, hot white flour breads are objectionable because, in addition to other faults of the white flour product, they tend to pack into doughballs. An extreme example of this condition is found in dumplings. Such doughballs will frequently give rise to acute indigestion, as many people have found to their sorrow.

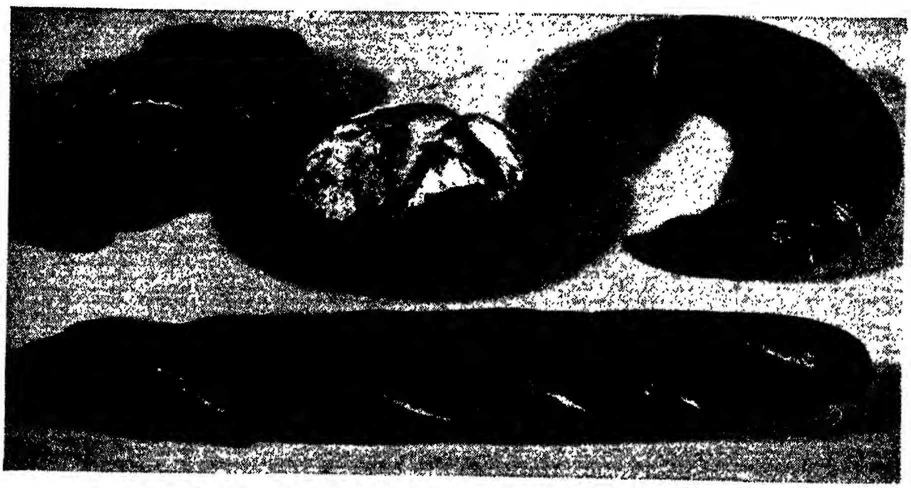
But when other types of flour are used no such objection exists. Hot corn bread is quite as wholesome and digestible

If cake is to be light and delicate, the eggs should be well beaten before they added to the other ingredients.

as cold corn bread, and is certainly more palatable. Hot bran muffins are also more digestible than hot white flour muffins just because the bran prevents this doughball formation. Whole wheat bread is decidedly less objectionable than hot white flour bread, yet whole wheat yeast bread still has enough of the doughball tendency to be better when allowed to cool before eating. In muffins, gems, pancakes and waffles, either whole wheat or cornmeal greatly reduces the element of objectionableness in hot bread. A mixture of the two is also better than either alone. Eggs can be used freely to get the adhesiveness supplied by white flour. Incidentally, some of the popular pancake flours on the market, while looking like white flour, contain considerable flour made from corn, rice and other grains to offset the gummy tendency of white flour.

Skill in Handling Dough

To conclude the discussion of cooking in relation to health, not only should the desirability of using more foods uncooked be emphasized but also the desirability of not overcooking the foods one does cook. A great deal of the popular belief that foods must be thoroughly cooked to be digestible comes from the very property of white flour that we have just discussed. White flour in any food makes a sticky, gummy mass, and if not most thoroughly cooked that effect is much worse. Just because of this objectionable doughiness in half-cooked white-



Some European types of white bread differing from the prevailing American loaf in form and texture but essentially the same in substance.

flour products the impression is created that all foods should be cooked for long periods. But generally speaking it has little foundation in fact. Potatoes must be cooked through to be palatable, and dry beans and peas must be thoroughly cooked. But in the case of most other vegetables, and certainly in the case of all fruits, often the less cooking the better. Cabbage illustrates the principle nicely. Cabbage cooked for two hours will cause indigestion in the majority of people, but if cooked for only ten or fifteen minutes is much less likely to have this effect. Even cereals do not need the long cooking formerly supposed. In old textbooks you will find instructions to cook oatmeal for two hours, but at present oatmeal companies put out three-minute oatmeal and people cook it so and find it healthful.

Cooking, Amount of

Another modern conception is that cooking should be made simple. The enormous complications of recipes and menus in the conventional cook-book can have no other purpose than the psychological appeal of variety. Those whose appetites are based on health and the avoidance of overeating do not need such trickery to make them enjoy their food. Complicated cookery enslaves woman in the kitchen for the ostensible purpose of holding her husband's love, when she would have more chance to attain that end by spending part of her time in outdoor recreation to preserve her health and physical beauty.

Simple meals of natural foods are more healthful, and to the really cultivated appetite more pleasing than highly-seasoned, complicated dishes and intricate pastries. Overcooking and complicated cooking lead to overeating and the loss of instinctive taste and natural appetite. It serves no purpose among intelligent people except to recall old ways and festive occasions. It may be justified occasionally for that purpose, but it certainly has no place in the daily health program. The time of the housewife is much better spent in the study of the different foods and the searching of the market for varied types of natural foods than in the searching of cook-books for intricate mixtures of the same old staples.

Simple Meals

FACTS ABOUT COMMON FOODS

Section 13

AFTER a survey of man's eating habits, the staple foods of the world resolve themselves to an extremely limited number. It is safe to state that grains and animal products are used in greater quantity than the combined amount of all other foods eaten by mankind.

Those seeking to insure man a healthful and effective diet, must insist upon his obtaining the complete undenatured nutritive qualities of grain and to stress the effects upon man's organic health of meat, as well as its relative economic cost as a source of energy.

Knowledge of this sort is also important with other foods. In the present volume, such an extensive review is not practicable. Instead, a list of foods in use by European, British and American peoples is provided. Certain foods not described in this present section, are included in the food tables in Section 15.

Almonds

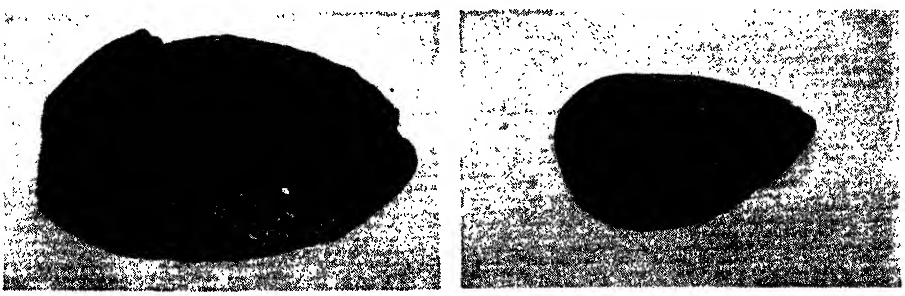
ALMONDS.—The peach and the almond belong to the same family. The wood of the almond tree is harder and the tree usually lives longer than the peach tree. The fruit is enclosed in a thin leathery covering which splits on ripening and generally opens when dry, exposing the nut in the shell. The almond contains no starch, the average protein content is 20 per cent., the fat 50 to 55 per cent. Like most nuts, almonds provide potassium, calcium and magnesium, but are deficient in sodium and chlorine. The carbohydrates include 6 per cent. sugar, 3 per cent. gum and 6 to 8 per cent. fiber and cellulose. Almond butter is easily assimilated and is preferred to dairy butter by many vegetarians.

Apple

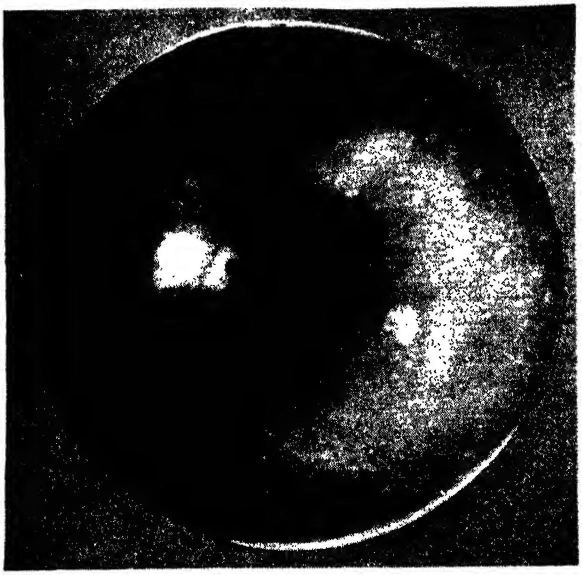
APPLE.—Of all fruits the apple is the most extensively used. It is a subacid fruit grown in the cooler temperate zone. All the cultivated varieties were derived from the crab, a wild apple, which, it is evident, was used in prehistoric times. With the exception of the cherry tree the apple is our largest fruit tree, and it often bears at the age of one hundred years. Apples are available at all seasons because they can be successfully kept in cold storage for a year. A large part of the annual apple crop of the United States is used in the form of dried apples, apple butter, apple jelly, apple juice or cider, and vinegar. Apples contain malic acid in quantities of from one-half of one per cent. to one per cent. The protein content is low, sometimes being less than the acid. The sugar content varies from 10 to 15 per cent. The fruit is especially rich in pectin, the jelly principle. Apples should form an important part of the diet because they have the general good qualities of all fruits, and are most abundant, economical and varied in flavor. They are excellent either cooked or raw, and cooking so changes the taste as to make them seem another food. The cooking process softens the cellulose so that much of its value as regulating material is lost, but, on the other hand, apple sauce is considered one of the safest fruit foods to give infants.

Apricots

Apricots.—The apricot is in the subacid fruit class. It originally came from Armenia, but thrives readily in warm and temperate climates, being grown extensively in China and Japan as well as in California. The sugar content of from 10 to 13 per cent. is similar to that of the apple or peach, but the acid content is greater than in either of these fruits. Apricots are used extensively both dried and canned and form the basis of many delightful salads, ice-creams and other desserts. There is also a growing demand for fresh apricots shipped from producing centers, to all points where fresh fruit is needed.



The almond nut, showing the relative sizes of the shell and kernel. Almond nut butter is very easily assimilated.



The apple is one of the best known and one of the safest fruits for childhood or old age. Calories per pound, 260; protein, 0.4; fat, 0.5. It contains vitamins A, B and C.

Artichoke

ARTICHOKE.—There are two vegetables known as *artichokes,* the globe or French artichoke, which is most commonly used, and the Jerusalem artichoke. They are both members of the thistle family, but one is a flower-bud and the other a tuber. The globe artichoke is a native of Africa and was introduced into England during the reign of Henry VIII. The Jerusalem artichoke is supposed to be a native of South America or Mexico, but it is grown in Canada and the United States as well. It is the best-known source of the sugar *levulose,* which is sweeter than cane sugar.

Asparagus

ASPARAGUS.—One of the vegetables known to the Romans was asparagus. It is rich in sodium, calcium, iron and sulphur, and also contains a nitrogenous principle called "asparagin," which has diuretic properties. The small, tender young shoots cut off beneath the ground are more palatable than the stocks exposed to the air. Asparagus, like other vegetables, is of value in the diet because of its mineral content and vitamins. Its use will prevent or counteract blood acidity. It may be eaten raw but is easier to digest when cooked. It should be steamed or cooked in a waterless cooker, unless the water used in cooking it is to be used for soup. Asparagus is cooked in boiling salted water, or dusted with salt and steamed, twenty-five to thirty minutes being required for boiling, thirty to forty minutes for steaming or cooking in a waterless cooker.

AVOCADO.—This fruit is also called the "alligator pear" because it is sometimes pear-shaped, though the shape varies from round to oval. It is a tropical fruit of unusually high caloric value, this being due to the presence of fat in greater quantities than are found in any other fruit except the olive. An average composition of the avocado is as follows: water 70 per cent., protein 2 per cent., fat 22 per cent., carbohydrate 6 per cent., mineral matter 1½ per cent. The amount of organic salts is greater than that contained in most other fruits. The avocado is not juicy, as are most fruits, and is neither acid nor sweet, having a rich, nutty flavor. When used as a salad its high fat content makes a fat-containing dressing unnecessary, lemon or other fruit juices being sufficient. Though this fruit is a native of Central America, Mexico and the West Indies, it is now being grown in increasing quantities in both California and Florida. **Avocado**

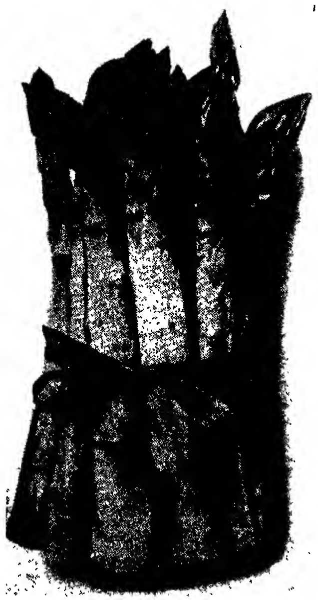
BANANA.—The banana is a tropical fruit which when green closely resembles the potato in chemical composition. Indeed, this fruit is used as extensively in the tropics as are potatoes or other starchy roots in the temperate zones, but it is distinguished from the latter by the fact that the starch changes into sugar as it ripens. Bananas are shipped to the United **Banana**

The artichoke is a food more valued for flavor than for nutritive qualities.

States from Central America and the West Indies. They must be picked green in order to stand transportation. As the fruit ripens and the starch changes to sugar the skin becomes yellow and then develops brown spots, at which stage it is in the best condition for eating, being then most easily digested. Baked bananas are also easily digested, but much of the delightful fruity flavor is lost in cooking. The larger plantain, a close relative of the banana, is more palatable when cooked and is usually served in this way. Bananas contain an average of 20 per cent. carbohydrate and 1.3 per cent. protein. The mineral matter, present up to 0.8 per cent., consists chiefly of potassium, sodium and chlorine. Bananas are deficient in calcium and iron. For this reason a banana diet would need to be supplemented by milk and leafy foods.

Barley

BARLEY.—Barley, because it is grown in semi-arid, subtropical and even in far northern countries, is called the hardiest of the cereals. It contains less gluten than wheat, so cannot be easily used for bread-making, but a wholesome flour is made from it which may be used with wheat or rye flours. *Pearled* or whole hulled barley is much used in soups and for infant feeding, but its chief advantage over other grains is that it helps to supply variety of taste.



Asparagus, being of low calorie content, is well adapted to the reducing diet. Also it is very rich in minerals and is an antidote for blood acidity.

Beans

BEANS *(Dry)*.—Under this heading we may consider all forms of dry seed beans in common use, with the exception of soy beans. The three types most used are the lima bean, the navy or white pea bean and the red kidney bean. The nutritive properties are quite similar, the most distinctive element being protein, of which there is about 20 per cent., equaling the amount found in lean beef. The mineral content of beans is strongly alkaline, however, while that of meat is acid. The lima bean is used freshly shelled from the pods as are peas. In this form they are more palatable as well as more quickly cooked than when dry. All dry beans require long and thorough cooking, by boiling, or boiling and baking; raw beans are unpalatable and nearly indigestible. At least two hours are ordinarily required for cooking, but baked beans are better if cooked slowly for half or even a whole day. The cooking process is greatly aided by prior soaking overnight. Beans form a substantial food and are often used as a meat substitute by vegetarians. They may be used extensively by workers requiring a substantial diet, but have little value for those who need a light one.

Beans (String)

Beans *(String)*.—The type of bean which is usually eaten as a tender pod is quite a different food from the mature bean seeds. Eaten at this stage, beans are alkaline in reaction and much more like green, leafy vegetables in their dietetic properties than like the mature seed beans. String beans are about as unpalatable raw as any vegetable and should be either steamed or cooked in a waterless cooker. They may also be boiled, provided the water in which they are cooked is used for soups or vegetable jelly. If boiled, they are cooked in boiling salted water, forty minutes being required for the young, tender pods, an hour for the older, more mature ones. The same amount of time is required to steam string beans, or to cook them in a waterless cooker.

Beans (Soy)

Beans *(Soy)*.—This bean was originally grown in Japan and China and was extensively exported from Manchuria; but it is now a crop of increasing importance in the United States. It differs from other beans in being rich in fat as well as in protein. In this respect it more resembles the peanut. Soy beans, however, have the highest protein content among vegetable foods and contain very little starch. Their chief use in this country is as a source of flour for diabetic breads.

The chief value of the string bean is in its lime, iron and vitamin content. Calories per pound, 180; protein, 1.7; fat, 0.3; carbohydrates, 7.2; vitamins A, B and C. Excellent in weight reducing diets.

In China and Japan the soy bean is manufactured into a great variety of products. It is used to make cheese from a vegetable milk made from the dried beans. An evaporated milk is also made using this vegetable milk, and a flour is made as well. These products are rich in protein. The dark soy sauce of the Chinese restaurant is also made from this bean. Soy-bean oil is used extensively in the Orient for cooking, but in this country more for industrial purposes.

Beets

BEET.—This is a succulent root vegetable which is found in the temperate and subtropical zones. Its main food substance is sugar, not starch. Beets are rich in alkaline elements and should form an important part of the dietary; they should be used more as a plain or buttered vegetable and less in the form of pickles. They may be baked, like potatoes, or they may be steamed, boiled, or cooked in a waterless cooker. An hour to an hour and a half is required for steaming young beets, two to four hours for older ones. The beet leaves form an especially valuable food, as they are similar in composition to other leaves that are used for greens. Thirty to thirty-five minutes are required to steam beet greens and they may be boiled in twenty to twenty-five minutes. It is not necessary to add water to leaves, even for boiling, as the water left on them when they are washed, plus that which comes from the leaves as they shrink, will be sufficient for the purpose.

Berries

BERRIES.—The typical berry consists of more or less watery pulp which contains a mass of small seeds. In composition berries average from 85 to 90 per cent. water, 8 to 12 per cent. fruit sugar, with very little protein, fat or pectin. The mineral matter, averaging from 0.4 to 0.7 per cent., is present chiefly as potassium, calcium and magnesium, though currants and strawberries contain a considerable amount of iron. The acid content, which is present as malic and citric acid, varies from less than one to over 2 per cent. in the different types. With the exception of the cranberry and the green gooseberry, all berries are used extensively uncooked, yet all are also good and are extensively used cooked, as plain sauce or in pies, jams and jellies.

Blackberries

BLACKBERRIES.—In the blackberry group we may include the dewberry and the loganberry. These are all typical berries in composition, containing about 8 per cent. of sugar and 1 per cent. of acid. Blackberries are most used uncooked, or in pies and jam. The expressed juice of the loganberry has been bottled and is used extensively as a beverage.

Blueberries

Blueberries.—These berries, blue in color, as their name implies, grow wild on small bushes throughout the temperate zone. Farms in New England which had been abandoned as unprofitable have been made extremely valuable by blueberries coming up like weeds when cultivation ceased. This berry is actually a larger variety of the huckleberry. They are similar in composition and both are much used in pies. Eaten uncooked they are said to be the best of berries for the relief of constipation.

Bran

Bran.—The outer fibrous coating of any seed, especially grain, is called *bran.* The bran from wheat has been largely introduced into the human dietary, its chief purpose being the prevention of constipation. This action is due primarily to the large percentage of indigestible cellulose it contains, but it is believed that the mineral elements, of which there is also a high percentage, have some laxative effect. The advantage of separated bran is that it makes it possible to vary the amount of cellulose in the diet without unduly increasing other elements. Bran is not, as some people believe, wholly indigestible. The average person digests about half the total bran substance. This includes a very high percentage of minerals, notably phosphorus, and a goodly supply of protein. Plain uncooked bran may be added to other forms of cereal food, or may be used in bread, cakes or cookies. The most popular form of bran, however, is as a pre-cooked, ready-to-eat cereal to which various flavoring elements have been added. We also have prepared cereals known as "bran flakes," which are richer in bran than whole wheat but not made exclusively of bran.

Brazil Nuts

Brazil Nuts.—These are a tropical product, coming chiefly from Brazil, as the name would imply. The tree that produces them is an unusual one, as it is only two or three feet in diameter and reaches a height of 120 feet. The fruit is globular in shape and about six inches in diameter. When it becomes ripe the seeds which it contains fall out. These are nuts triangular in shape, and about an inch and a half long. The fruit is so heavy that when it falls the natives dare not enter the forest without covering their heads and shoulders

Bread

While Brussels sprouts belong to the cabbage family, they have a distinct flavor and are richer in their iron content. Calories per pound, 208; protein, 4.7; fat, 1.1; carbohydrates, 4.3; vitamins A, B and C.

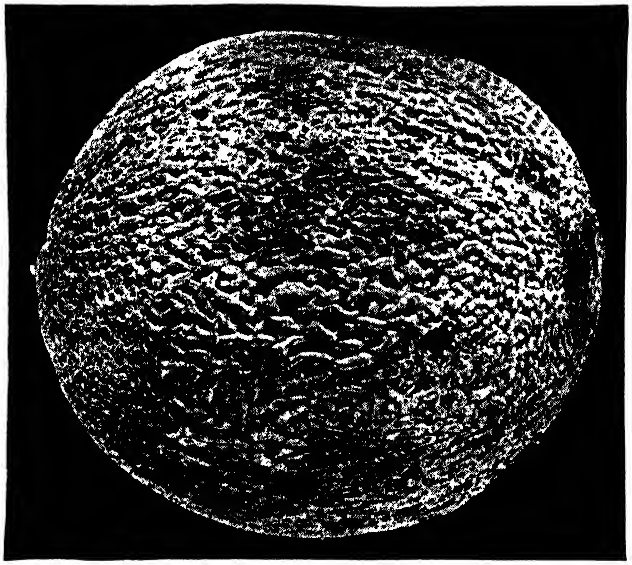
with wood. The nuts contain little starch and sugar, the protein content averages 18 per cent. and the fat 65 per cent. The same rules apply to the use of this nut dietetically, as to other nuts. (See *Almonds.*)

Bread.—Bread is made from flour, with the addition of water, salt and a ferment. Wheat is used most commonly for the purpose. Rye produces a heavy, sticky loaf, and it is best when combined with wheat. Corn, also, is seldom used alone for loaf bread, as it produces a rather crumbly mass. The exceeding lightness of the loaf made from the white flour which modern milling processes have made possible explains its popularity, but this type of bread does not have the nutritive value of that made with whole-wheat flour. Bread is usually made by combining flour with water, milk, or water and milk, with the addition of salt and yeast. Sugar may also be used to hasten fermentation. The dough is allowed to rise, at a temperature of about 80 degrees Fahrenheit, until it has doubled in bulk. This increase is caused by the alcohol and carbon dioxide produced by the growing yeast. These form gas bubbles which lighten the dough and increase its bulk. The dough is then kneaded a second, and sometimes a third time, shaped into loaves, allowed to rise again until doubled in bulk, and then baked. The baking kills the yeast or ferment, drives off the alcohol and carbon dioxide, and makes the bread more digestible and more attractive in appearance.

Brussels Sprouts.—Brussels sprouts, resembling miniature cabbages, have been cultivated from the wild cabbage or colewort. They are similar to cabbage in composition and contain even more minerals. The sprouts may be cooked in salted boiling water for thirty minutes, after having been previously soaked in cold water for thirty minutes to drive out insects, but of course it is better to steam them or cook them in a waterless cooker. **Brussels Sprouts**

Buckwheat.—Buckwheat is not cultivated so extensively as are the other cereals, being found most commonly in the northwestern countries of Europe, eastern portions of the United States, and in the mountainous districts of Japan. A flour is made from buckwheat which is used to make the popular buckwheat cakes. Unfortunately, however, it is seldom that we can procure a genuine buckwheat flour, as most of those on the market are mixtures of buckwheat with other cereals. **Buckwheat**

Butter.—Butter is an edible fat obtained from milk. It is now largely made in central creameries or butter factories, but at one time its manufacture was one of the chief household industries. To make butter the cream is first separated from the milk. This is done in two ways, by gravity or by centrifugal force, but the latter is the one most commonly used today. The milk or cream is also usually pasteurized, as a better grade of butter is obtained by so doing, and a more accurate ripening of the cream is made possible. The ripening of the cream is simply an acid fermentation which when allowed to proceed to a definite stage improves the flavor of the finished product. Cream so treated also churns more easily. The churning process accumulates the fat in masses large enough to be separated from the buttermilk. When this has taken place the buttermilk is run off and the butter is then washed, worked and salted. Salting causes butter to keep better and most people prefer the taste of such butter. Some, however, prefer unsalted butter, which must be fresh and of high grade to please discriminating palates. Cream containing from 25 to 50 per cent. of fat is used for making butter, and salt up to 4 per cent. is added. Sometimes coloring matter is used, usually in the winter months, about 2 ounces **Butter**



The average size muskmelon or cantaloup contains about 100 calories, and like all melons, is well suited to the reducing diet when eaten without sugar. Such melons are always eaten in a raw state, being one of the few foods never cooked.

to 100 pounds of fat being allowed. Butter is not pure fat, but contains about 16 per cent. of water. It is a valuable source of vitamin A, which, with the element of flavor, gives butter its high value as compared to other fats.

Buttermilk

BUTTERMILK.—Buttermilk is obtained as a by-product when butter is made. But the buttermilk now commonly sold in cities is separator skim-milk soured and agitated. There is no essential difference between this product and that of the churn, for the latter is only sour skim-milk. Buttermilk is especially valuable in a reducing diet because it is minus the fat contained in whole milk while the mineral content has not been diminished. This gives it a double value since reducing diets are so often deficient in necessary minerals. Buttermilk, and other especially fermented milks, are considered excellent for correcting putrefactive conditions in the intestines, since lactic-acid bacteria hinder the development of putrefactive bacteria. It is difficult to find uses for buttermilk in cooking except as a liquid for making hot breads.

Cabbage

CABBAGE.—This vegetable, at one time considered "vulgar," because of its cheapness, is now highly rated and considered especially valuable for its high mineral and vitamin content. Cabbage is unique in that the longer it is cooked the more indigestible it becomes. It is better not to cook it at all, but to eat it raw so that none of the minerals or vitamins will be lost. It may be cut fine and boiled, however, for ten to fifteen minutes. Twenty to thirty minutes will be required to steam it. Lemon juice should be served with cooked cabbage in preference to vinegar, though neither is necessary.

The cauliflower bears resemblances to the cabbage, but its flowerets are eaten instead of its leaves. It contains calcium and other mineral salts. Calories per pound, 135; protein, 1.3; fat, 0.5; carbohydrates, 4.7; vitamins A, B and C.

CAKE.—The term *cake* includes a large variety of food combinations, since cake-making is the most intricate branch of the cooking art. From the standpoint of health the essential ingredients are sugar, fat (usually butter), milk, eggs and flour. All these are highly nourishing food elements, and the dietetic criticism of cake is based rather upon the concentration of so many highly nutritive substances into one mass than upon the character of any one of them. Another objection is that its palatability and the habit of serving it at the end of a meal may easily tempt people, especially children, to overindulgence. If not eaten to excess, well-made cake is not difficult to digest. **Cake**

CANTALOUP.—Various members of the muskmelon family have been grown in hot eastern countries from time immemorial. The cantaloup is the form most popular in American markets, but is being partly replaced by the sweeter honeydew type. All this group of melons contains about 90 per cent. water, being somewhat richer in both solids and minerals than watermelons. All melons are eminently suited to reducing diets. Their mineral elements are strongly alkaline. **Cantaloup**

CARROTS.—The carrot, which has been cultivated for more

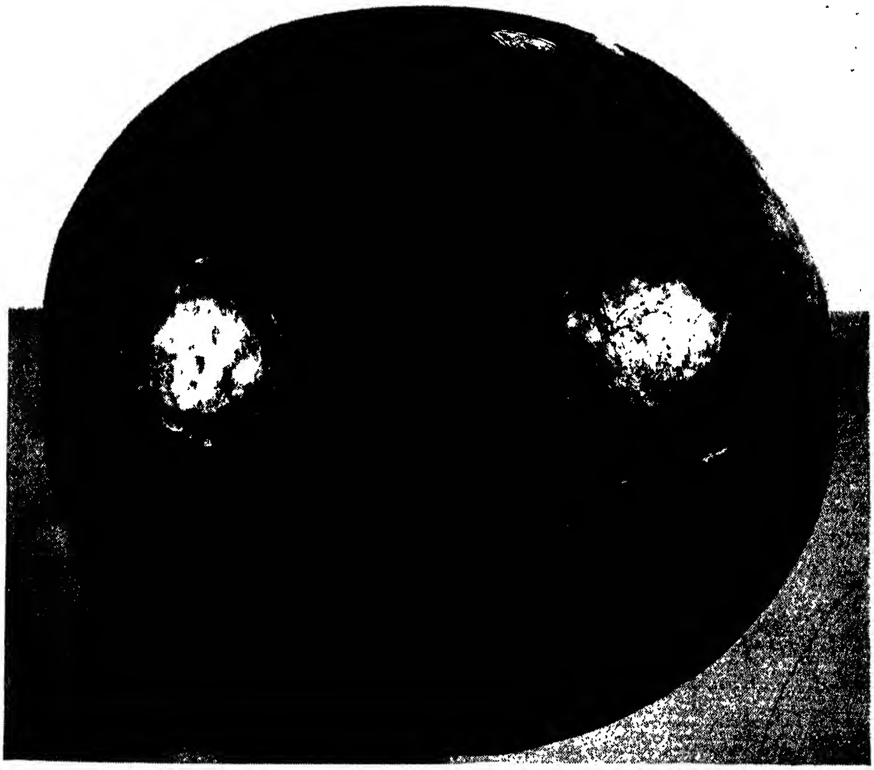
These three bunches of celery approximate 100 calories in content.

than two thousand years in Europe and Western Asia, was originally white and decidedly different in flavor from the

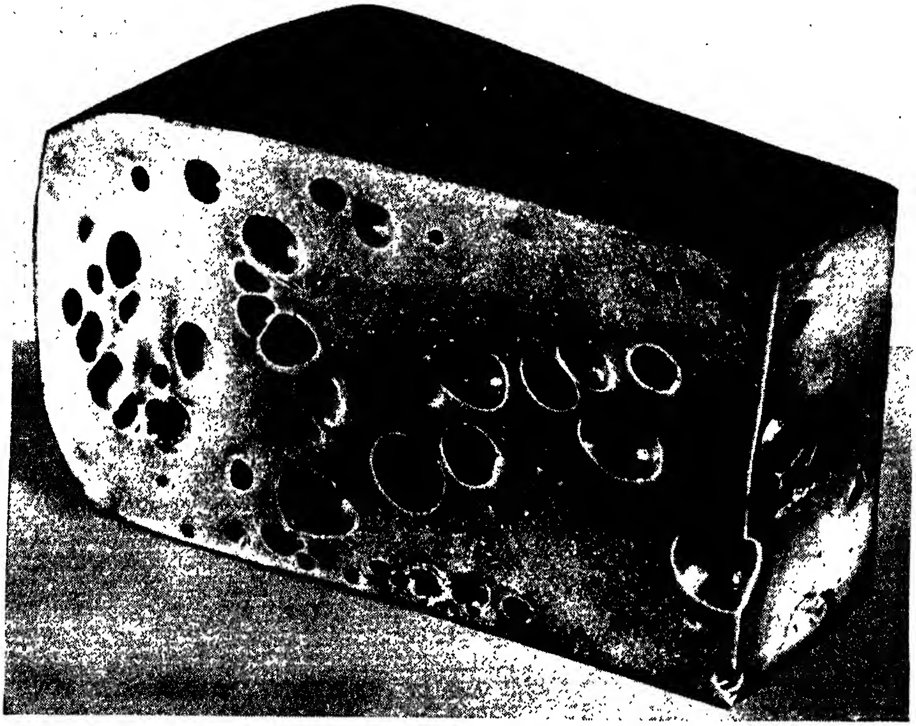
Carrots yellow carrot so popular today. The young carrots are more tender and palatable than the older ones, as these become woody as they mature. Carrots are rich in the alkaline elements, especially calcium, and should occupy an important place in the dietary. There is an old belief that carrots will improve one's complexion. This has been found to have some scientific basis as carotin, the coloring matter of carrots, serves to enrich the pigmentation in the human skin. Carrots are commonly cooked but deserve wider use in the raw state. If they are finely grated, carrots can be taken even by those with weak stomachs. The grated carrots cooked and strained are especially good for infants at the age when vegetables may be given. Carrots, like beets, may be baked or steamed. If boiled, they should preferably be cooked whole, unless the water in which they are cooked is used for soups or jellied salads. From forty minutes to one hour are required to steam carrots, but they may be boiled in thirty minutes.

CAULIFLOWER.—Like Brussels sprouts, cauliflower has been cultivated from the wild cabbage, but in this case the flower-head rather than the leaves has been developed for food. The chemical and nutritive properties are surprisingly like those of cabbage, but the flavor is more delicate. This vegetable is quite delicious and wholesome when eaten raw, and deserves wider use in that form. Twenty-five to thirty-five minutes are required to steam a small head of cauliflower, while it may be boiled in fifteen to twenty minutes. **Cauliflower**

CELERY.—Celery, which is now grown extensively in the United States and Canada, has been cultivated since the time of ancient Greece. The Greeks, however, used it, not as a food, but as a decoration. There are many different varieties. **Celery**



Edam cheese, the variety shown here, is a round, highly salted cheese from Holland, weighing on the average from three to five pounds, and usually having a red outside skin, the color of which is obtained by the use of carmine. Being a whole-milk cheese it is a highly concentrated food, which makes judicious use advisable.



Easily identified by its characteristic perforations, Swiss cheese, with its mild, rather sweet flavor, is one of the most popular varieties. It is made of whole milk and consequently its nutritive quality is high. While it originated in Switzerland, it is now duplicated in many other countries. Swiss cheese is medium in consistency, being neither hard nor extremely soft.

In Europe one variety, grown chiefly for its roots, is known as *celeriac,* and is the most common form of celery to be found there. Celery is especially valuable because of its tonic effect and is much used to add flavor to other foods. It is one of the favorite foods of the reducing diet. Raw celery has a crisp delightful flavor lacking in the cooked celery and deserves wider use in salads. Cooking probably renders the vegetable more easy of digestion, but when eaten raw there is less danger of loss of mineral matter or vitamins. It should not be cooked too long, a half-hour being usually ample time.

Cereals.—(See *Wheat, Corn, Oats* and *Rice.*)

Chard Chard.—This leafy vegetable, called "Swiss chard," is a form of beet cultivated for the leaf and leaf-stem rather than for the root. The stalks and midribs are cooked but may also be used uncooked in salads. The young, tender, crisp leaves are also used for salads, as well as for greens. The fault of chard is that of having a rather flat flavor, but it is one of the most easily grown and abundantly yielding of vegetables and has a long season. A few square yards will supply a family from June until November.

Cheese

CHEESE.—Cheese is the product secured when the curd is precipitated in milk by means of rennet. As a result of this process a rather clear liquid or whey is also obtained which is free from the fat and casein of milk but contains the milk sugar and is rich in mineral matter. Like butter, cheese was formerly made in the home, but it is now manufactured in large quantities commercially. There are two main classifications, hard and soft. Cheddar, Edam, Emmental (Swiss), Parmesan and Roquefort belong to the first group; Brie, Camembert, Gorgonzola, Limburg, Neufchatel and Stilton to the second. These are only a few of the more outstanding varieties, however, as there are not less than three hundred varieties of cheese known. Whole-milk cheese, on the average, contains one-third moisture, one-third fat, one-fourth protein. Cheese is usually well digested, but is a concentrated food and should not be eaten in too large quantities. Cheese is used in cooking as a flavoring element, but cooking renders it more difficult to digest. It should be used sparingly in cooking and in a manner that will prevent its presence in large masses. The soft, fresh cream cheese is made from cream and has more fat and less casein than other cheeses. It is readily digestible and may be used freely, especially for weight-gaining. Cottage cheese, made by curdling skim-milk by souring with heat, is the ideal cheese for the reducing diet.

Cherry

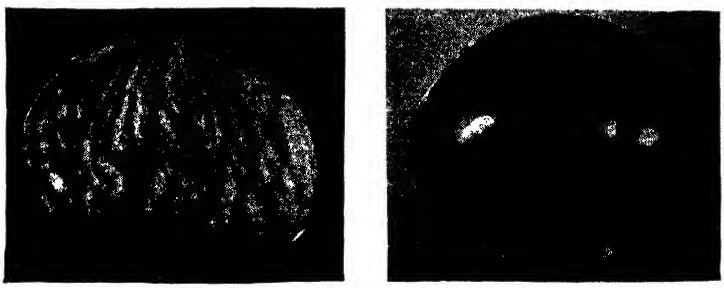
CHERRY.—Though this fruit is now cultivated extensively in the temperate zone, it came originally from the Caucasus and the southern shores of the Caspian Sea. There are some two hundred varieties of sweet and sour cherries. The trees begin to bear when four or five years old, and like the apple tree sometimes continue to bear until one hundred years of age. Though the composition varies greatly, cherries contain on the average 80 per cent. water, 1 per cent. protein, 0.8 per cent. fat, 10 to 16 per cent. sugar, 0.9 per cent. acid (malic) and 0.6 per cent. mineral matter. Cherries are more concentrated and have less water than most fruits, approaching grapes in this respect. Like most fruits they are palatable and wholesome either raw or cooked.

Chestnuts

CHESTNUTS.—The European chestnut is a native of Asia Minor, the Caucasus and northern Africa, and was introduced into Europe from these countries, where it is still extensively cultivated. The wild chestnuts of the Eastern United States have been nearly exterminated by a blight. Chestnuts contain on the average only 8 per cent. fat and 10 per cent. protein, so that they differ much in composition from the other nuts. They are richer in carbohydrates and similar to cereals in nutritive value. A flour is made from chestnuts which is used in Italy and may be found in Italian groceries in the United States. Chestnuts are usually boiled or roasted before eating, as they are rather unpalatable raw. Boiled chestnuts are sometimes used instead of potatoes or bread with green leafy vegetables and are one of the most popular stuffings for turkey.

Cider

CIDER.—Cider may be defined as unfermented apple juice, as we would hardly consider in a food list the "hard cider" which bears the same relation to fresh apple juice as wine does to grape juice. Cider is the cheapest of all fruit juices and deserves wide use. Unfortunately, the problem of keeping it in the unfermented form is a troublesome one. This is accomplished by sterilizing and bottling it, which changes the flavor and somewhat impairs the vitamin content. Such heated cider is sold under the trade name of "apple juice." Cider can be kept sweet by chemical preservatives, such as benzoate of soda, which the law allows and the use of which



The chestnut contains about 990 calories per pound, which is much less than most nuts. It has the least fat and most starch found in nuts in general use.

the prohibition law practically compelled. This employment of benzoate of soda in cider is to be especially condemned. It is probably more injurious than the alcohol which is prevented from developing by its presence. There seems to be no solution for this problem except the quick transportation and consumption of cider, as in the case of milk, or in the shipping of apples to the points of consumption and making the cider there. Cider is used as a basis of apple butter.

Citron

Citron.—This is a citrus fruit from a tree similar to the lemon tree, but the fruit itself is much larger than the lemon, and has a thick spongy rind. This rind is quite commonly used in the preserved or candied form. Citron is not grown to any extent in this country, but is found in large quantities in China, Persia and the Mediterranean countries. A small thick-rind melon from which preserves are made in imitation of the true citron is also known by this name.

Cocoa and Chocolate

Cocoa and Chocolate.—Cocoa is prepared from the seed of the cacao tree which is now grown commercially throughout tropical regions. When the fruit is gathered the seeds are removed from the pod and are allowed to ferment for from two to seven days. They are then dried, screened, roasted and shelled. The roasted beans, after the husk is removed, are known as "cocoa nibs." These are ground and sold as chocolate. This has a higher fat content than cocoa, which is made by extracting some of the fat or cocoa butter. Because of its lesser content of fat, cocoa will retain the form of a dry powder, which chocolate will not. Sugar is added to both products before using. Cocoa and chocolate contain an active principle called *theobromine,* somewhat similar to caffein, but not as habit-forming. Unlike tea and coffee, cocoa and chocolate are highly nutritious and are especially valuable when combined with milk. The better use of these products is as a flavoring for other foods, for which purpose they are hard to surpass. Chocolate-flavored malted milk deserves its great popularity and milk chocolate is one of the most desirable forms of commercial candy.

Coconut.—The coconut is a native of all tropical seashores and is one of the largest nuts known. This nut is used for so many purposes by the natives that it is only during the last fifty years that it has been exported extensively. As

PHOTOGRAPH UNDERWOOD & UNDERWOOD

The cacao bean as it grows in the tropics. It is the basis of the cocoa of commerce.

the nut ripens the shell becomes hard, but before this takes place the meat is found to be soft and creamy, the milk not having separated out. The coconuts are eaten in this state with a spoon. As the coconut has a high fat content, the natives also prepare a butter from the meat by grating it and boiling it in water. The oil, which rises to the surface, is skimmed off and churned. The result is a palatable white fat. The copra, or dried coconut, is shipped to Europe and the United States, where it is used in the manufacture of many products. Chief among these is nut margarine. The oil secured from the coconut is churned with peanut oil and milk into this imitation butter. Prepared shredded coconut is a convenient form that is sweetened and used extensively for cake coverings.

Coconut

COD-LIVER OIL.—The oil obtained from the liver of the cod

PHOTOGRAPH UNDERWOOD & UNDERWOOD

The dwarf variety of the coconut palm. The coconut is now one of the world's greatest sources of vegetable fat, and is used in the manufacture of many food products.

is very rich in vitamin D, the antirachitic vitamin, and is used extensively in infant feeding, either plain or emulsified. This vitamin aids in calcium metabolism and to this effect we must ascribe the occasional marked gain in weight that results from its use. The fishy odor of cod-liver oil is often objectionable but is less noticed when the oil is added to sardines or other strongly flavored fish. Cod-liver oil is now classed as a special food and not as a drug or medicine. **Cod-liver Oil**

Coffee.—Coffee is a stimulating beverage which is used over the entire world. Its stimulating properties are due to the presence of an active alkaloid principle known as caffein, a habit-forming drug having marked effects upon heart action and preventing sleep. Coffee is prepared from the seeds of **Coffee**

Collard

Commercial coffee bean. The green or raw bean is never used for food or beverage purposes until roasted. The roasting process produces a bitter taste and the aroma, but does not alter the drug caffein upon which the chief physiological effect of coffee depends.

the coffee tree, which is cultivated in tropical countries. The aroma and flavor of coffee are due to a volatile oil which is liberated on roasting the hard, almost tasteless bean to 450 degrees Fahrenheit. The best way to make coffee is by the filter or drip method. To do this boiling water is poured over the ground coffee and allowed to drip through some porous substance. The water is in contact with the coffee only a short time and a clear, sparkling extraction is obtained. Modern science has devised methods to remove most of the caffein from coffee, making caffeinless coffees. These should not be confused with coffee substitutes made from roasted cereals and resembling coffee in the bitter taste, but lacking its aroma. Cereal coffees are wholesome and are extensively used by those desirous of breaking the coffee habit. There is much dispute over the degree of injuriousness of coffee and it undoubtedly varies widely with individuals.

Collard.—The collard is extensively grown in France and in the southern states of America. It is really an unheaded cabbage, and ordinary young cabbage leaves can hardly be distinguished from it.

Collards can be grown almost anywhere in the United States and yield abundantly. The knowledge of the value of the green leaf should increase their use. The methods of cooking are similar to those used for other greens, especially kale. These plants require longer cooking than lighter greens, the time ranging from one hour upwards

COOKIES.—Cookies are made from a mixture similar to batter cakes, but more flour is added. The batter is then rolled on a board and cut in the desired shapes. Cookies usually contain more shortening or butter than cakes. When made from bran or whole wheat flour cookies are highly nutritious, but they should not be used to excess, nor should they be allowed to replace fresh fruits for dessert in the diet of children. Indulgence in cookies must be watched, not because they are unwholesome but lest they crowd more vital elements out of the diet.

CORN.—The word *corn* (Indian corn or maize)

PHOTOGRAPH UNDERWOOD & UNDERWOOD

Coffee berry, showing manner of flowering and the later berries as they cling in clusters on the twigs of the coffee tree. The thin pulp or covering of the berry dries up and is cracked and threshed off, leaving the half round beans or seeds which are the green coffee of commerce.

Cookies

means grain in England, where the American corn is known as "maize." Corn is the largest American farm crop, the product being three times that of wheat. However, it is grown chiefly as a food for animals. There are two types, the yellow and the white. The yellow is the better, as it contains more of the fat-soluble vitamin, this being associated with the pigment. Corn bread is still a staple in the South, though, strange to say, most of the corn is imported from the North. In the North and West and in the cities, corn bread is only occasionally used. This is a pity, as genuine corn bread is an excellent, appetizing food. Unfortunately, however, the cornmeal now commonly sold in the market is denatured and open to the same objections as white flour. The ideal form of cornmeal is the whole grain ground, but owing to its poorer keeping qualities this has been largely crowded out of the modern market. The commercial milling of corn is carried on by two distinct methods, whereby various commercial foods are produced. Dry milling cracks the grain and separates it into three parts. The bran is discarded for human use. From the germ the oil is expressed, making a salad oil, a very excellent and wholesome product. The remaining oil-cake, containing valuable protein and minerals of the germ, is used only for stock feeding. The third part is the endosperm, or the more starchy portion of the grain. According to the fineness of its grinding this may be called hominy, grits, cornmeal, or corn flour. By the wet process the bran is also discarded and the germ separated for the extraction of its oil, while the endosperm becomes a source of cornstarch, the protein which it contains becoming a stock food only. This cornstarch may be marketed as such, but the bulk of it is used for the manufacture of corn syrup and corn sugar. This transformation of starch into sugar is brought about by chemical means, but the chemical elements used are neutralized and leave nothing objectionable in the product. The glucose thus made has wide use in the candy industry. Because it is less sweet than cane sugar, the latter is usually added in preparing the corn table syrup. Dry corn sugar has recently been offered as a substitute for cane sugar, but it is not popular because of its lower sweetening power. It finds wide use, however, in the baking industry.

Corn (*Sweet*).—Sweet corn is a dwarf variety of the corn plant which has been cultivated for a greater content of sugar as compared with starch. The sugar content is greater also because the grain is used in the immature stage. This immaturity gives it a relatively higher percentage of minerals and a distinctive and pleasing taste not found in the ordinary mature grain. These nutritive differences, together with the manner in which it is served, cause such sweet corn to be thought of as a vegetable rather than a cereal. The soft grain, sliced or scraped from the uncooked ear, is used as a salad ingredient by people on a raw diet. Sweet corn requires but brief cooking of ten or fifteen minutes, and this is better performed by steaming rather than by boiling. When the grain is sliced off the cooked ears and dried it develops a distinctive and very pleasing flavor. This food, once popular on farms, is being reintroduced into modern markets. Sweet corn is also one of the most widely used of the canned foods. **Corn (Sweet)**

Cottonseed Oil.—Cottonseed, a by-product of the cotton industry, is used extensively for the production of oil, which is used in cooking and as a salad oil and is also hardened into more solid cooking fats. (See *Hydrogenated Fats.*) Cottonseed oil is quite as wholesome as other food fats and oils and the former prejudice against it, based upon the fact that the cotton plant is not primarily a food plant, has now been largely overcome. **Cottonseed Oil**

Crackers.—These are mixtures of flour and fat with water or milk, and are more thin and crisp than cookies. A sweetened cracker is similar to a cooky. Hardtack and the Hebrew matzoth are crackers without fat, and the latter must also be made without any leavening. This is the unleavened bread of the Bible. **Crackers**

Cranberry.—A fruit grown in the temperate zone of both Europe and America. It is a red berry found on vines or low bushes growing in swamps. Cranberries can rarely be eaten raw. They contain a high percentage of pectin, and for this reason are used extensively in the jelly form. The acid content is high and the sugar content low; hence the custom of adding large amounts of sugar in cooking them. It **Cranberry** would, perhaps, be wiser to use cranberries in a sourer form.

Cucumber

CUCUMBER.—The cucumber is a native of India and is closely related to the watermelon, gourd and pumpkin. Though it has little food substance, containing 95 per cent. water, it is very valuable in the diet, as it is rich in alkaline minerals, is refreshing and contains vitamins A and C. Cucumbers which are grown slowly are generally tough and less easy of digestion than the tender, juicy ones which are grown more quickly. There are different varieties of cucumbers, one of which is the small gherkin, extensively used for pickles, in which form the cucumber is, of course, of less value dietetically than when fresh.

Currants

CURRANTS.—A variety of small fruit of which there are three kinds: red, black and white. The sugar content of these averages about 7 per cent., the acid (malic) is mostly in the form of malate of potash. The dietetic uses are similar to those of other berries and small fruits. The so-called dried currant is really a small raisin.

Dates

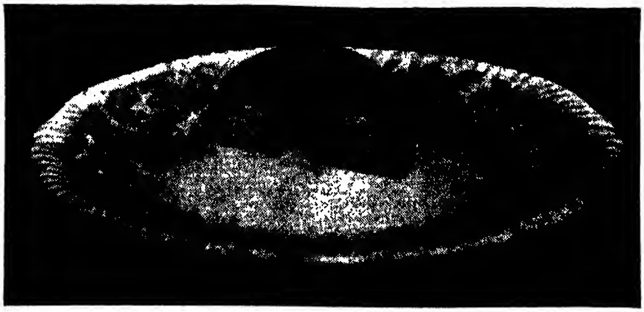
DATES.—The fruit of the date palm is a very important food in the deserts of Western Asia and Northern Africa. The date is now grown in California and Arizona, and the American growers have developed a fruit equaling or surpassing the imported varieties. Dates vary in color from a light golden or amber color to black and are composed chiefly of sugar and cellulose. The protein content is low and the mineral moderate. That dates may form an important part of the dietary is evidenced by the fact that desert natives of Western Asia and Northern Africa, whose diet consists chiefly of dates and camel's milk, are among the most virile and long-lived races. Dates are more frequently eaten raw than almost any other food. They are almost a perfect natural candy and one of the few fruits that ripen and dry on the plant.

Dandelions

DANDELIONS.—(See *Greens.*)

Doughnuts

DOUGHNUTS.—Doughnuts are made from a rich dough which is rolled and then fried in deep fat. They are considered indigestible, but if quickly cooked so that too much fat does not enter them, they may be used with discretion in the diet.



This half of a doughnut, three inches in diameter, contains approximately 100 calories.

Eggplant

Eggplant.—The eggplant is a member of the same botanical family as the tomato and pepper. It is a native of the East Indies, but is now used extensively throughout southern Europe and the United States. It is egg-shaped, as its name would imply, and sometimes as large as a coconut. The dark purple varieties are most common in the United States, but there are also cream-colored eggplants. This vegetable contains 5 per cent. carbohydrate, 93 per cent. water, about 1 per cent. protein and 0.60 per cent. mineral matter. The eggplant is sometimes stuffed, but is usually cut in slices and broiled or fried. It is delicious when scalloped, and this method is superior to frying.

Eggs

Eggs.—Eggs rival milk as a food of high biological value. They must contain all elements necessary to create and nourish life, since that is their purpose in nature. The egg, however, is more concentrated than milk, containing about twice as much food ingredients and proportionately less water. Moreover, the entire fuel substance of the egg is in the form of fat, whereas in milk the fuel supply is in sugar and fat. Considered as a human food the egg, like meats and nuts, is a fat-protein combination and too concentrated to make a balanced diet. It contains, however, a more complete and better-balanced supply of vitamins and minerals than any other single food known. Compared with milk, it is relatively weaker in calcium and stronger in iron. It is even better supplied than milk with vitamins, especially vitamin D, but, like milk, it needs vitamin C from fruit to complete the vitamin balance. The popularity of eggs rests quite as much upon their mechanical properties as upon their nutritional value. The egg-yolk is the basis of the emulsifying principle in salad dressings. The whole egg or the egg-white is exceedingly valuable for both binding ingredients together and for holding the lightness or leavening in baked products. There is much dispute concerning the digestibility of eggs raw, soft-cooked and hard-cooked. The yolk seems digestible in any of these forms, but egg-white is probably most digestible when soft-cooked, as in coddled eggs. Raw egg-white is more digestible if whipped or mixed with other substance to break up the tenacious mass. Hard-cooked egg-white is difficult to digest unless finely divided by thorough mastication.

Endive ENDIVE.—Endive has a long season which includes the winter months. It has a slightly bitter taste and is exceedingly popular as a salad green, having a more pronounced flavor than lettuce, from which it forms a pleasing variation.

Figs FIGS.—A fruit the cultivation of which goes back to Bible times. It is most commonly associated with Mediterranean countries, but is now grown extensively in America, especially in California. The best-known varieties include the black Mission fig, the Smyrna and the white Adriatic fig. The dried black Mission fig is especially popular as a health food. Fresh figs are little known outside the regions where they grow, but the use of canned figs is increasing. The dried fig, however, is still the most familiar one and the most widely used. Figs, raisins and dates constitute the group of "sweet fruits." The fig is the highest of the three in protein and calcium and is also considered most effective in counteracting constipation. Such sweet fruits and milk represent one of the simplest and best of all growth diets.

Filbert FILBERT.—The filbert, or hazelnut, is grown in all temperate regions. The wild nut found in the United States is usually referred to as the hazelnut, the larger one which is imported from Spain as the filbert. The cobnut is another variety from England, this being a broader, shorter nut than the filbert. The filbert is rich in fat, averaging 64 per cent.; the protein averages about 15 per cent. and the carbohydrates about 13 per cent. The mineral matter is rich in calcium, magnesium and iron.

Fish FISH.—There are two classes of fish—salt-water, as cod, mackerel, herring; and fresh-water, as trout, whitefish and others. In either group we find the white-fleshed fish in which the fat is mostly stored in the liver; for example, cod, halibut, haddock. Then there are the oily fish, in which the fat is distributed through the flesh, as salmon, mackerel, eel, herring. The richer a fish is in fat, the harder it is to digest. There are fewer extractives in fish than in meat and it is considered less stimulating than the latter. It is composed chiefly of protein, and as a rule it is more easily digested than meat. Fish has its best flavor if eaten as soon as it is caught, and it deteriorates rapidly. It may be kept by freezing, but should be used promptly after thawing, as decomposition then takes place quickly. The eyes of fresh fish are glossy, bulging and bright. The flesh is firm and elastic, as is the tail. The gills are bright red and full of blood. Cod is a salt-water fish and is found throughout the northern and temperate seas of both hemispheres. It is one of the cheapest and most abundant fish in use today. Herring is a salt-water fish which is usually smoked, or smoked and salted. It is very cheap and is an economical food. Salmon are salt-water fish that are caught in fresh water, where they go to spawn. The flesh is of a pinkish orange color, and since it is rich in fat, more difficult of digestion than that of some others. Fresh salmon is in season from May to September, but the frozen salmon may be obtained throughout the year and canned salmon is a universal staple. There are hundreds of varieties of food fish throughout the world, and in such countries as Norway and Japan they are more important foods than land meats. They are often cheaper than the latter.

Garlic

Garlic.—(See *Onion.*)

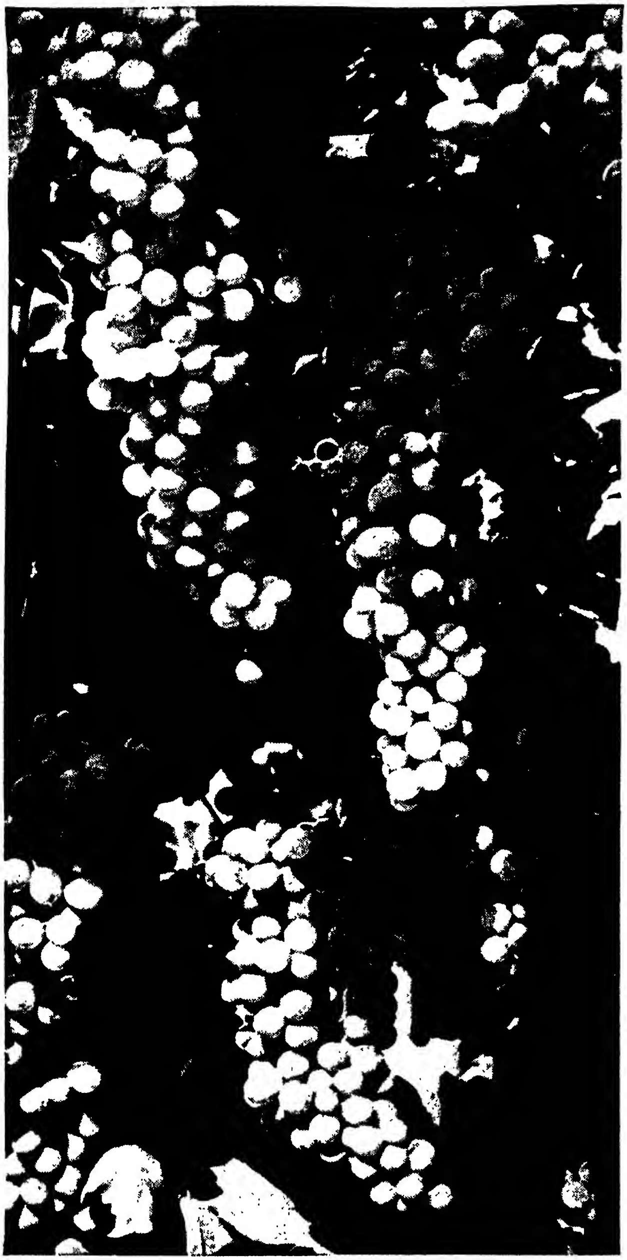
Gelatin

Gelatin.—Bones, tendons and ligaments contain collagen which, by hydrolysis, when treated with boiling water, is transformed into gelatin. Gelatin is a protein food, but is used in the diet chiefly for its mechanical effects. When added to milk a smaller curd is formed, rendering the milk more easy of digestion, for which reason this combination is now used extensively in infant feeding. The property of gelatin by which it sets—or makes a jellylike mass—gives it a wide use in desserts and other attractive food forms. It is also used to give body to ice-cream.

Gooseberry

Gooseberry.—The wild gooseberry has been much improved by cultivation. This fruit is rich in pectin, giving good jelling qualities. The wholesomeness of gooseberries is

Grape

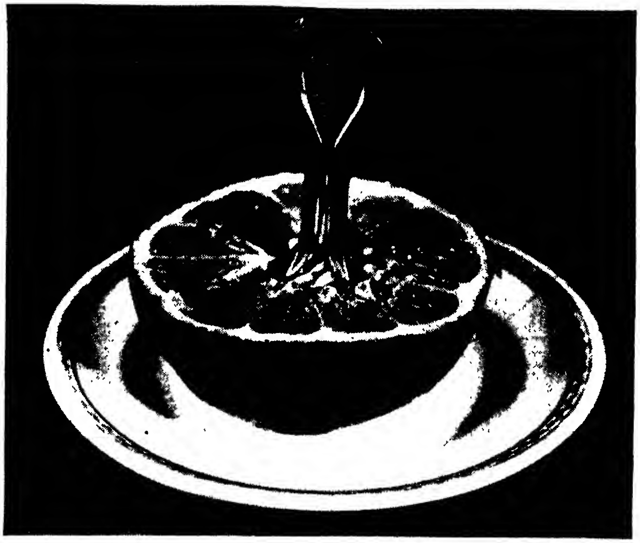


PHOTOGRAPH EWING GALLOWAY

Fruits of the grapevine, sharing with figs the most ancient lineage as cultivated fruits. The grape, taken the world over, is the greatest staple fruit, universally praised by all nations. Next to the orange the grape is the most frequently used as an exclusive fruit diet or fruit fast.

considered to be questionable, but this is largely because they are used green. The ripe gooseberry is similar to the currant. The immense amount of sugar needed for green gooseberries makes the fruit elements of little importance.

GRAPE.—The grape rivals the apple as the most popular fruit in the temperate zone. The history of the culture of grapes and the making of wine go back six thousand years. Grapes are still grown more extensively in the Old World than in North America, and a large percentage of the crop is used for the making of wine, the most prized of all alcoholic beverages. The value of the fruit sugar and a large part



The grapefruit is the most highly popularized fruit for a reducing diet, but should be eaten without sugar. By means of the little device here shown grapefruit may be quickly cored and seeded.

of the mineral salts are lost in the wine-making process, to say nothing of the objectionableness of the alcohol generated. The importance of grapes medicinally and as a food is shown by their popular use in what is called the "grape cure." People following this "cure" live on an exclusive diet of grapes, and their health is often benefited thereby. This is easily understood when we know that ripe grapes are very easily digested and contain vitamins and a large proportion of alkaline salts, so that a condition of blood acidity is reduced by their free use in the diet. The sugar content varies from 15 to 30 per cent., the acid content (tartaric) from 0.5 to 1.2 per cent. The purple Concord grapes are chiefly used for making grape juice while the white grapes, grown mostly in California, are becoming increasingly popular for table use. The table grape is sweeter and less acid than the wine or jam grape, and the skins are less tough and more readily eaten. The raisin is the sun-dried grape, and raisin consumption has grown enormously of late years, partly as the result of prohibition, which destroyed the wine market of the grape growers. Though the fact is not generally known, the dried currant of commerce is a true raisin, produced from a small grape growing in Greece and Asia Minor. Raisins are no richer in iron than the undried grapes or than several other kinds of fruit.

Grapefruit

GRAPEFRUIT.—This fruit of the citrus family is sometimes called the "pomelo," and came originally from China. It is now grown in large quantities in California, though Florida is the center of the industry. The grapefruit is the largest of the citrus fruits and contains a little more acid and less sugar than oranges. It is not necessary to eat this fruit with sugar, though that has been the general custom. Grapefruit is recognized as the most fashionable breakfast fruit. More recently it is being extensively canned, but this causes it to lose its most valuable vitamin C.

Greens

GREENS.—This term includes beet leaves, collards, dandelions, spinach, mustard turnip tops and other green leaves which are used as food in cooked form. Wild greens differ in various localities and contradictory names are applied to many of them. Greens contain only a small amount of food, but are valuable in the diet because of their high mineral and vitamin content. The leaves of spinach and dandelions are especially rich in iron. Kale and collards have the same properties as the cabbage and are members of the cabbage family. Mustard greens are the leaves of the mustard plant. They may be used for salads, or cooked alone or in combination with vegetables. Turnip tops are the leaves of turnips and make excellent greens of good flavor. Chicory is related to the endive and dandelion and is used mostly for salads. It has a rather bitter taste. Spinach was introduced into Europe during the sixteenth century, coming originally from northern Asia. Its use dates back to Biblical times. It is rich in calcium and iron and may be eaten raw or cooked. To boil greens place in pot, but do not add any water, as the water left from washing the leaves will be sufficient to cook them. Not more than one teaspoon of salt is

Having cut the grapefruit core free this little instrument lifts it out bodily.

required for two quarts of greens. Steaming is the better method of cooking them. From thirty to thirty-five minutes are required for steaming tender greens.

Hickory Nut

HICKORY NUT.—The hickory nut is a native of the United States. There are now said to be seventeen different varieties in the United States, of which the pecan is the most prominent. The hickory nut is rich in fat, containing sometimes as much as 67 per cent., but is otherwise similar to other nuts in composition.

Hominy

HOMINY.—(See *Corn.*)

Honey

HONEY.—Honey is the most concentrated sweetening found in nature. It is the evaporated nectar or sap from flowers gathered by bees and stored by them for their own nutrition. Chemically, honey is a mixture of glucose and levulose which collectively is called *invert sugar* and is the product of the hydrolizing or digestion of cane sugar. Only slight amounts of minerals and other elements are found in honey, but these account for its very distinctive flavor. Honey is practically a pure fuel food, but it is in a form more acceptable to the body than cane sugar because, being in the moist state, it is really predigested and is more immediately available for absorption by the blood. This fact, together with its flavor and the romantic appeal of its source, the flower nectar, with its accumulation by bees, is responsible for the great popularity of honey as a healthful product. Honey deserves wider use in cookery in the place of less desirable types of sugar. It may be used to sweeten fruits in cooking and to sweeten fruit-juice beverages, and many kinds of home-made health candies may be prepared by combining it with fruits and nuts.

Huckleberries

HUCKLEBERRIES.—(See *Blueberries.*)

Hydrogenated Fats

HYDROGENATED FATS.—Hydrogenation is a process for hardening fats which has recently been discovered and is now used to harden vegetable oils to form cooking fats. The oils are heated and hydrogen is introduced, with an agent like nickle or platinum, which hastens the speed of the reaction and which is removed by filtration at the completion of the process. During the process the hydrogen is combined with the oleic acid contained in the vegetable oil and stearic acid is formed, resulting in the formation of a harder fat. Cottonseed oil is the base of most hydrogenated fats used for cooking. Many cooks prefer such fats to lard, and they have come into general use. There is positively nothing harmful in the process of hydrogenation.

Ice-cream

ICE-CREAM.—Commercial ice-cream is a frozen mixture of milk with sufficient cream to raise the butter-fat content to 10 or 12 per cent. To this is added sugar, some flavoring element and usually, in modern practice, gelatin. The purpose of the last ingredient is to give the cream more body, so that it does not liquify so readily as it starts to melt. There is no objection to gelatin from the health standpoint, as a combination of milk and gelatin is very digestible and desirable. The usual objections to ice-cream are based upon its use between meals or in excessive amounts. As extra food it is much more wholesome than many of the confections and beverages that are used in similar fashion, but it is undoubtedly a better health practice to eat it as a dessert with a regular meal than to indulge in it at other times.

Junket

JUNKET.—Junket is a dish made by adding junket tablets, which contain rennet, to sweet milk and then allowing it to stand at about blood heat. The action is the same as the first step in cheese-making, or as the first step in the digestion of milk. A soft curd is formed which is easily digested. This dish may be made with different flavors and furnishes an excellent means of making milk palatable to those who need it in the diet but who cannot tolerate it as a beverage.

Kohlrabi

KOHLRABI.—The kohlrabi is called turnip-rooted cabbage and is a variety of the turnip and the cabbage family, with food properties similar to those of both these plants. The reserve food of the kohlrabi is stored in a tuber-like enlargement of the stem just above the ground. It has a delicate flavor, as have also its heavy green leaves, which are sometimes used as greens as well. Kohlrabi may be cooked peeled or unpeeled, whole or diced. It takes fifty minutes to cook whole kohlrabi, thirty minutes to cook it diced. When steamed it is sliced or diced, lightly dusted with salt, and cooked for at least thirty minutes.

Kraut

KRAUT.—In substance kraut is simply cabbage, but it must be considered as a distinct food because it is prepared by a distinctive process of fermentation. This changes the carbohydrate or sugary element into lactic acid, the process being very similar to that of the souring of milk. Kraut is not pickled cabbage, as some city people believe, for the term "pickled" is usually limited to foods soaked in vinegar, which contains acetic acid. Lactic acid is believed to be one of the most wholesome food acids, while acetic acid is of doubtful wholesomeness. The minerals of the cabbage are retained in kraut unless the juice is drained off. Salt is added as a necessary element to stimulate the proper fermentation and prevent other bacterial growth. The salt should not be washed out, as the other mineral elements would then be lost. The saltiness may be offset by serving kraut with foods that are unsalted. Kraut juice has recently been popularized as a "health drink," the large amount of minerals present giving it a mild laxative effect. Kraut or its juice is also believed to be corrective, like sour milk, of intestinal putrefaction. Kraut is now rated as an acceptable food in a health diet, and the old belief as to its indigestibility is thought to have arisen from its conventional use with heavy meats, like pig's knuckles and corned beef.

Leeks

LEEKS.—(See *Onion*.)

Lemons

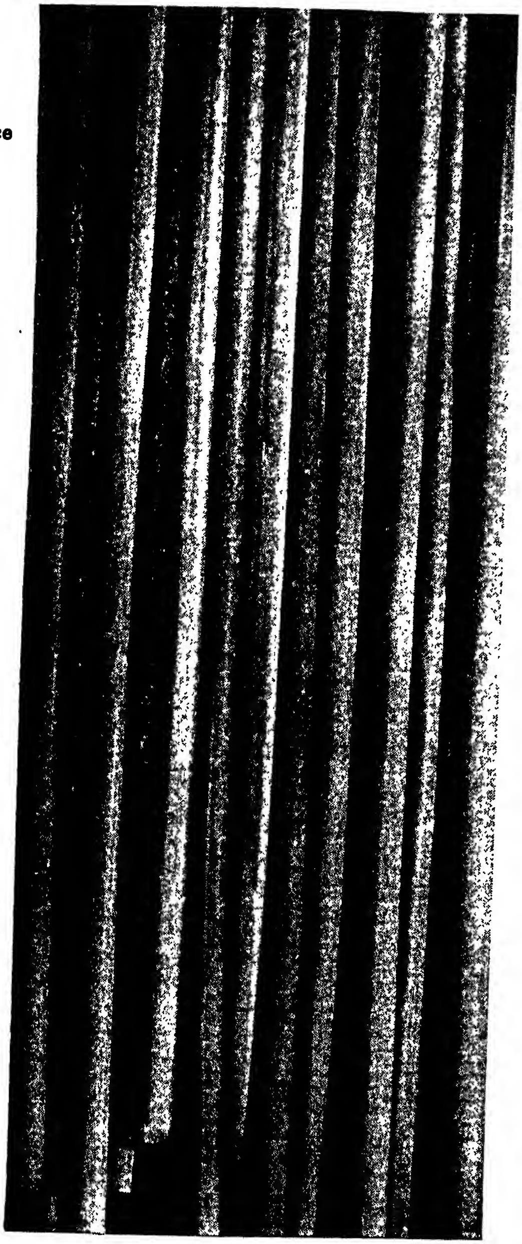
LEMONS.—The lemon is a citrus fruit native of the tropical and sub-tropical regions. Though lemons are now grown in the southern part of the United States, the crop has only recently reached a state of commercial importance in this country. They have been grown in California for fifty years and were introduced into Europe at the time of the Crusades and in to Palestine and Egypt by the Arabs in the tenth century. In Sicily lemons are grown extensively, and almost all our imported lemons come from there. The lemon is valued for its high content of citric acid (about 6 per cent.). It is also rich in alkaline minerals and the antiscorbutic vitamin C. Lemon juice is widely used in all health cooking to replace vinegar.

Lentils

LENTILS.—It is believed that the lentil is one of the first food plants to be brought under cultivation by man. This legume is fibrous and tough and is used most commonly in soups, purées and sauces. It requires long cooking, and like beans and dried peas should be soaked over night. Lentils are widely used by the Italian population in the United States and are also much praised by vegetarians as a meat-substitute.

Lettuce

Limes



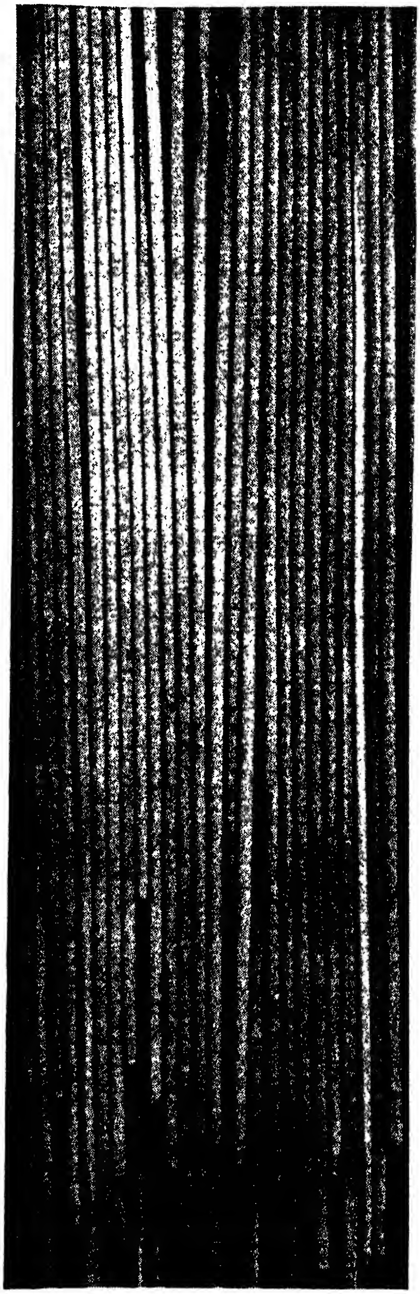
Macaroni is made for commercial use of white wheat flour with especially high gluten content. Although the presence of bran modifies the familiar white color of such foods, whole wheat flour of suitable gluten consistency also may be used for macaroni, spaghetti and similar products.

LETTUCE.—The lettuce is used more than any other salad plant, and was cultivated by the ancient Greeks and Romans for the same purpose. It is rich in calcium, potassium and iron. If possible, lettuce or similar salad leaves should be included in the diet at least once daily. The varieties of lettuce with which we are most familiar are the head or cabbage lettuce and the cos or celery lettuce which is known as "romaine." The leaves of romaine are long and heavy and not so wide as the rounder leaves of head lettuce. The value of lettuce eaten in large quantities is obvious for the reducing diet. Lettuce is more universally eaten without cooking than almost any other food.

LIMES.—The lime is a small, oval, green or yellow fruit about half as big as a lemon. It is grown in Florida, Italy and the West Indies. Limes are also found in California, but only in small quantities. Like the lemon, this fruit contains a large percentage of citric acid, 7 to 8 per cent., and the juice is especially valuable because of its high content of vitamin C. Lime drinks are popular at soda fountains and deserve greater home use.

LOGANBERRY.—(See *Blackberry.*)

MACARONI.—Macaroni, spaghetti and other similar paste products are made by forcing a stiff flour dough through metal plates under pressure. The resulting rods and tubes are cured, or dried, but are not cooked in the factory. The dough or paste used must be tenacious enough to stand this process, therefore a wheat high in gluten is used. This fact in part accounts for the reputation of macaroni as a meat substitute, and also the customary combination of macaroni with foods containing still more protein. The mechanical limitations of the process make it difficult to use whole-wheat flour in macaroni, also the whole-wheat product, when it is made, does not have the familiar texture when cooked and is not easily popularized. Macaroni is therefore subject to some of the same dietetic criticism as white bread, and if used should be combined in the diet with ample sources of cellulose, vitamins and minerals.



Spaghetti is identical with macaroni except for the mechanical distinction that macaroni is made in tubes and spaghetti in smaller but solid rods.

Macaroni must be boiled like rice, at least in the preliminary stage of cooking. The most tasty dishes are usually prepared by combining the tomato sauce, cheese or other flavoring elements with the parboiled macaroni and finishing the cooking in the oven.

Malted Milk MALTED MILK.—True malted milk is made by combining fresh whole milk with liquefied malt, then dehydrating or drying the mixture. Malted milk flavored with chocolate has become very popular as a home beverage. To meet this demand many products have been made by mixing dry milk powder (usually skim-milk), dry malt, cane sugar and cocoa. Such a mixture is not a true malted milk. The use of either of the above types of malted milk powder with fresh liquid milk to make a richer and tastier beverage is, however, to be highly commended. Their use is especially valuable in cases of undernutrition in children and underweight in adults.

Malt Sugar MALT SUGAR.—Maltose is a sugar produced in sprouting grains, usually barley, by an enzyme known as *diastase* which converts the starch into sugar. This enzyme or ferment is similar to the ptyalin found in the saliva. Malt sugar cannot be handled in the dry form, as it gathers moisture too quickly. The malt syrup contains other soluble elements from the barley which give it a strong flavor. A refined malt syrup can be obtained which is of more delicate flavor. Malt syrup is readily digested and is freely used in weight-gaining diets.

Maple Sugar MAPLE SUGAR.—Maple sugar is made by concentrating maple sap without refinement. Hence it contains the natural minerals of the sap. This and its excellent flavor give it a high place in a health diet. (See also discussion under *Syrups.*)

Meats MEATS.—Meat includes the muscular tissue of animals, the fibers of which are held together by connective tissue. On the average, lean meat contains about 72 per cent. water, 20 per cent. protein, 5 per cent. fat, 2 per cent. extractives and 1 per cent. mineral matter. Meat is rich in protein, but its iron content is not so large as is popularly supposed. Meat is not as conducive to growth as is milk. Fresh meat contains enough vitamin C to prevent scurvy in the Arctics. The content of vitamin A and B is very small. The extractives in meat are responsible for its flavor and its so-called stimulating effects.

Beef is the meat of cattle and is the most commonly used of all flesh foods. Good beef should be firm and fine-grained, bright red in color and well mottled and coated with fat. The fat of beef around the loins and kidneys is called "suet," is dry, yellowish in color and crumbles easily. Cuts from the loin, which is the most tender part, may be cooked by roasting and broiling. The cuts around the legs and neck are tougher, because of the greater motion of that part of the animal, but they are very juicy and when cooked slowly, as by stewing or simmering, have a delightful flavor and are quite tender. Steak one inch in thickness may be broiled in from four to six minutes, but when about one and one-half inches in thickness, from eight to ten minutes are required. A five-pound sirloin or rib roast may be roasted in one hour and five minutes; a ten-pound roast of the same type requires one hour and thirty minutes. If a well-cooked roast is desired, in preference to a rare one, the first roast should be cooked for fifteen minutes longer, the second for thirty minutes.

Suet

Veal is the meat of calves, which should be not less than three weeks old at the time of slaughter. It differs in flavor from beef and is by many considered more indigestible because of its immaturity. Veal is greyish pink in color, its fat white and firm. Veal is cut into fore and hind quarters, as is beef, but the fore-quarter is only divided into three parts, the shoulder, breast and neck; the hind-quarter into loin, leg and knuckle. Veal may be obtained throughout the year, but is in season in spring. Calves' liver is now being used extensively in treating pernicious anemia. Other liver is also used, but it is not so tender nor does it have the flavor of veal liver. Calves' brains are considered a delicacy and are easily digested.

Veal

Lamb is the name given to the meat of lambs, *mutton* to that of sheep. Mutton is more difficult of digestion than beef, but is similar to beef in nutritive value. Lamb and mutton are cut in the same manner as veal. The meat of lamb has a more delicate flavor than mutton. Mutton is fine-grained, of bright pink color, the fat white, hard and flaky. As the lamb grows older the blood recedes from the bones so that lamb chops may be distinguished from mutton chops by the redness of their bone as well as by their smaller size. Good mutton contains a greater proportion of fat than beef.

Lamb

Pork is the flesh of the pig, or swine. Hams are usually smoked and cured. The sugar-cured hams are considered the best, and are prepared by introducing a solution of brown sugar close to the bone. They are hung one week and then smoked with hickory wood. In the South, where this process is carried on extensively, the older hams are considered to have the finest flavor. The pork loin is almost always used fresh for roasts or chops. The flank, which lies just below the ribs, is salted and smoked, and furnishes bacon. Lard is secured when pork fat is separated from the flesh and membrane and fried out. Pork contains the largest proportion of fat of any meat, and for this reason is considered less easily digestible. It is found on the market throughout the year, but should only be used, if at all, during the winter months.

MELONS.—See *Cantaloup, Citron,* also *Watermelon.*

Milk

MILK.—Milk is so thoroughly discussed in other sections in this volume especially in relation to the milk diet that it need not occupy space in this list.

Milk, Condensed

MILK, CONDENSED.—This is milk treated in the same way as evaporated milk with the exception that sugar is added during the process of concentration. When sugar is added in the proportion of 50 per cent. or over it acts as a preservative, as in jams and jellies; hence the preparation does not need to be sterilized by heat. Condensed milk, therefore, will keep very well even after the can is opened, and is suitable for use in dishes where the sugar is not objectionable.

Milk, Dried

MILK, DRIED.—Milk reduced to the form of a dry powder is known as dried milk. This type of milk has excellent keeping qualities though skim-milk in this form does not become rancid as readily as does whole milk. When the water is restored milk dried by the best modern processes is nearly if not quite the equivalent of fresh milk. It has, therefore, great utility in regions where fresh milk is unavailable.

Milk, Evaporated

MILK, EVAPORATED.—This is milk from which the water is removed until one pound of the finished product is equal to two and a quarter to two and one-half pounds of fresh milk. This is an excellent product, but when such canned milk is used an abundance of fresh fruits, especially citrus fruits and tomatoes, are advisable to supply the vitamin C, which is destroyed in the sterilizing process necessary to make the product keep. With this precaution evaporated milk is safe and healthful and deserves wide use, especially in dishes where the milk is to be cooked anyway.

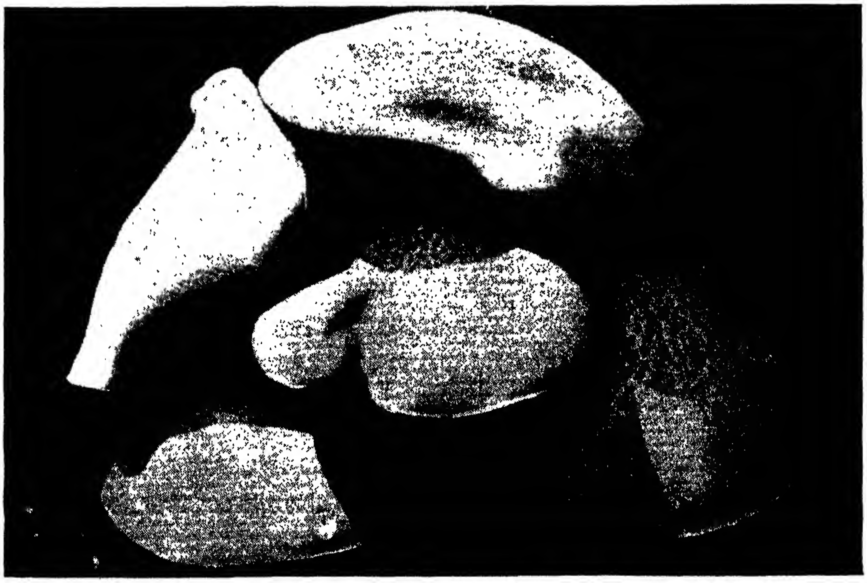
MILK SUGAR.—Milk sugar, or lactose, is found in the milk of all mammals. It is not so sweet as cane sugar and for this reason may be used in fever diets, as it will supply calories without nauseating the patient. It is easily digested by infants, but is rather expensive for popular use. It is the change of this sugar into lactic acid which causes the souring of milk. **Milk Sugar**

MOLASSES.—(See *Syrup.*) **Molasses**

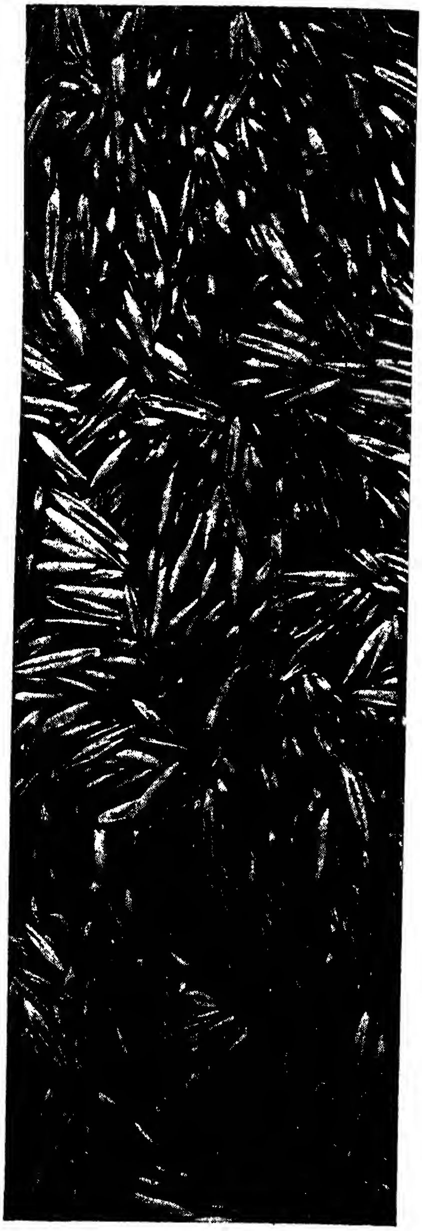
MUSHROOMS.—Mushrooms are edible fungi which grow in moist places. Some varieties are poisonous, but the cultivation of mushrooms has been so developed that there is now little danger of eating any of this type. Because of their flavor and fiber they are sometimes used in vegetable meals as meat substitutes, though they have little digestible protein and contain no vitamins. They are still considered a delicacy, just as they were in ancient Roman days. **Mushrooms**

MUSKMELON.—(See *Cantaloup.*) **Muskmelon**

MUSTARD LEAVES.—(See *Greens.*) **Mustard Leaves**



The mushroom is an edible fungus and a palatable food, and is highly favored by vegetarians as a meat-flavor substitute. Caution is necessary to distinguish the edible mushrooms from toadstools and other unedible fungi.



Whole oats which retain their non-edible husk. The husk or chaff of wheat and rye is removed by farm threshing but oats, like rice and barley, require a milling process to remove the non-edible husk, which should be distinguished from the edible bran.

Nut Margarine

Nut margarine.—This is an artificial or imitation butter similar to oleomargarine, but its fats are from vegetable sources, chiefly or wholly the coconut. As in oleomargarine these vitamin-poor fats are churned with milk or cream, making a very wholesome and palatable product, yet not equaling butter in flavor or vitamin content. The licenses and taxes placed on margarine products, and the rules against coloring are not due to nutritional faults but are considered necessary to protect the butter industry against the competition of a cheaper product.

Oatmeal

Oatmeal.—The oat grain as human food is chiefly used in this country in the form of rolled oats. This product is also called "oatmeal," though that term more properly applies to the granular or steel-cut form. All forms of oatmeal as used for food are similar in composition. The heavy hull of the oat grain is removed and in this process a little of the ends of the true grain are broken off, but the oat bran, which is very thin, is retained. No form of oatmeal is therefore in the class of a denatured grain analogous to white wheat products or degerminated cornmeal. The oat is the richest of all grains in fat, containing about five per cent. This gives it the highest caloric value of any grain. One dietetic objection to oatmeal is that it cooks into a somewhat gummy mass. The fault here lies in too long cooking, formerly believed to be necessary but now held to be unwise. Rolled oats are also quite palatable and wholesome when used uncooked as a breakfast cereal, in which case they are usually served with honey or sweet fruits as well as milk.

Rolled oats are prepared by removing the hull and then passing the whole hulled oat grain between rollers. The thin bran is not removed in any form in which oats are used as food.

Okra

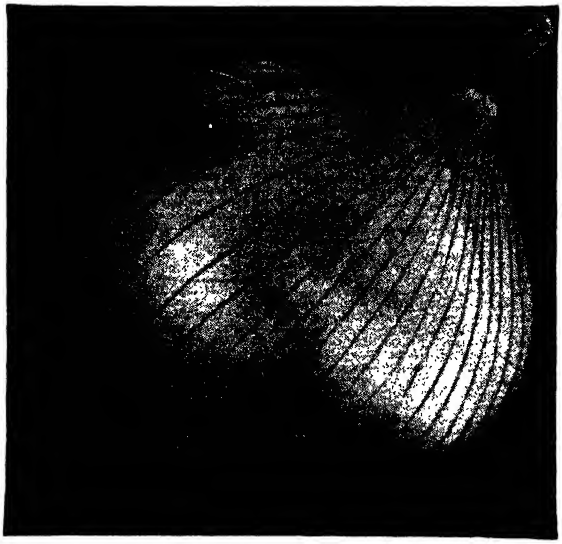
OKRA.—Okra, also called "gumbo," is a green pod that contains a muciaginous substance which is responsible for the jelly-like appearance of cooked okra. It is used principally in vegetable soups, but it may be eaten raw. Okra may be steamed or boiled. It is dusted lightly with salt, placed in the steamer and cooked for about forty-five minutes. Thirty-five minutes are required for boiling and salted water is used in the proportions given for other vegetables.

Oleomargarine

OLEOMARGARINE.—The word *margarine* means a blended or artificial imitation of dairy butter. The term *oleo* refers to the soft fat which is separated as a fraction of beef tallow by eliminating the very hard fat *stearin.* Oleomargarine is commonly made by blending this element of beef fat with some vegetable oils and in some cases with neutral lard. These blended fats are then churned with milk or cream to give the flavor and water content of dairy butter. In the better brands considerable milk fat is also introduced in this manner. Oleomargarine is a perfectly wholesome food. It is not equal to butter in flavor, nor does it contain as much of the distinctive fat-soluble vitamin, but otherwise it is its dietetic equivalent. The animal-fat margarine is in part being replaced by nut margarine, which is discussed under that heading.

Olives

OLIVES.—This fruit has been grown in California for almost two hundred years and its cultivation dates back to ancient times. We have records showing that olives were grown in Egypt four thousand years ago. They are extensively grown in southern Europe and western Asia. The large varieties are used for pickling, the smaller for oil extraction. The process of pickling removes the bitter taste which is characteristic of the ripe olive, and the best pickled olives are those which have not been treated with lye solution. The fully ripened sun-dried olive is, however, superior in nutritive value to the pickled variety. Olives contain, when dried, as much as 5 per cent. protein and 50 per cent. fat. It is evident that they are highly nutritious and similar to nuts in food value.



The onion, known by its flavor and its characteristic odor, due to an oil, allyl sulphid, which it contains. Calories per pound, 215; protein, 1.2; fat, 0.3; carbohydrates, 9.6; vitamins B and C. Its mineral ash is mostly phosphorus and calcium with a little iron.

Onions

ONIONS.—Onions, garlic, leeks and chives are all members of the same family. They all contain a

Peas, like other legumes, are used by vegetarians as a meat substitute. Calories per pound, 430; protein, 5.2; fat, 0.6; carbohydrates, 16.7; vitamins A, B and C. When dried, their protein content is raised to 17.3. They are a very valuable source of phosphorus.

volatile principle, a sulphur compound which is responsible for their strong aroma. The cultivation of the onion takes us back to remotest antiquity. It is supposed to be of Egyptian origin. The leaves of chives and leeks, which develop small bulbs, are used as well as the bulbs themselves. Chives are used extensively for seasoning. Garlic is the most highly flavored of this family and is used more in Europe than in the United States. This plant is peculiar in that it produces a collection of small bulbs, called cloves, instead of one large bulb. Forty-five minutes are required to steam whole onions, but they may be boiled in less time. The reputation of the onion as a health food, with even supposed medical qualities, seems to rest on its distinctive flavor. Modern scientists find no reason for believing it to be especially superior to other vegetables.

Parsley

Parsley.—Parsley is a relative of the carrot. Its leaves are used mostly for soups and salads, and as a garnish. It contains an oil which is responsible for its flavor and tonic properties.

Parsnips

Parsnips.—Parsnips are related to the carrot, and though similar in form are much lighter in color, usually cream-colored, and have a distinctive flavor. In parsnips the starch is present in exceedingly fine granules, and averages from 5 to 7 per cent. Parsnips may be steamed, boiled or baked. The process usually takes from one to one and a half hours.

Pea

Pea.—The pea is a member of the pulse or legume family. It is a native of Europe and has been cultivated for over two thousand years. The seed is usually eaten, but there are varieties with edible pods. In the South the cow-pea is grown extensively, is used both fresh and dried, and because of the ability of legumes to enrich the soil with nitrogen is used as a forage crop also. Green peas may be cooked by steaming for from thirty-five to fifty minutes. Of course, steaming or cooking in a waterless cooker is the better method. Dried peas must be cooked for longer periods, as must dried beans.

Peach

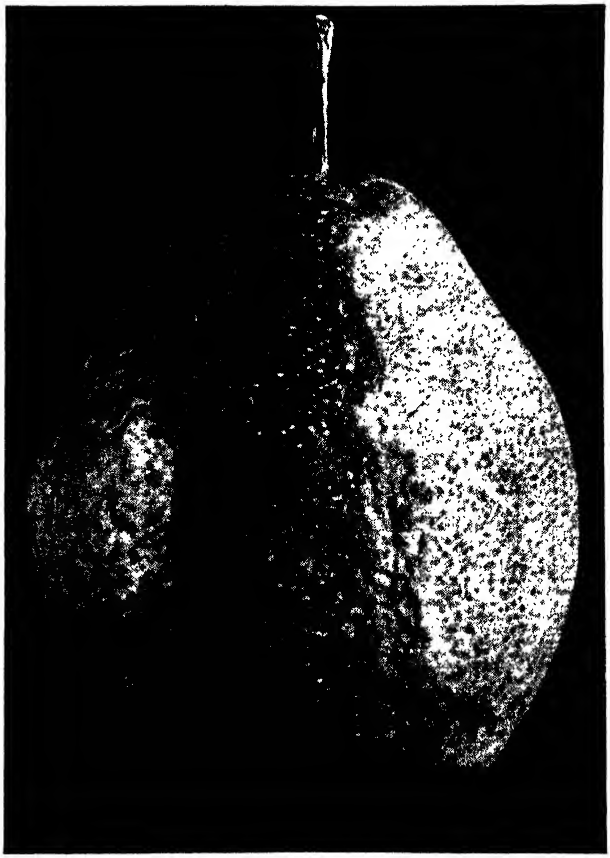
PEACH.—This is a subacid fruit of the temperate zone. It was known to the ancient Greeks and Romans. In the United States, though Georgia has a reputation for peaches, California leads in the production of this fruit. The peach does not keep well and loses its flavor in cold storage. Peaches are canned and dried in large quantities, but when the fruit is used in the latter form care must be taken to see that it has not been sulphured. There are two types of peaches, free-stone and clings, so-called because the pulp adheres more closely to the stone in one variety than the other. The peach is one of our juiciest fruits and contains on the average about 80 per cent. of water. The sugar content varies and is usually about 10 per cent. Peaches, like most fruits, are valuable in the diet for neutralizing blood acidity, as regulating material, and for their mineral and vitamin content.

Peanut

PEANUT.—The peanut is a legume, but like the soy bean contains oil, thus resembling the nuts in composition. It is raised in Brazil, Africa and in our southern States. The manner in which the peanut grows is extremely interesting. The ovary is at the base of a long tube, the blossom at the end. When the blossom falls the peduncle turns downward and pushes into the ground. The ovary then enlarges and the peanut pods are developed underground. The peanut is said to be richer in iron than true nuts. It has a high percentage of protein and contains about 40 per cent. fat. Peanuts are the source of many products. In Europe the nuts are used to produce oil, but in the United States they are eaten in large quantities, roasted and salted, as well as in candies and peanut butter. As with almonds, the better type of butter is that made from the nuts which have not been roasted at too high a temperature, and which have not been salted. Peanut butter is sometimes diluted and used as a salad dressing. Though peanut oil has a flavor slightly different from that of olive oil it is similar in appearance, and for this reason olive oil is sometimes adulterated with the peanut oil. Recently peanut oil has become a competitor of cottonseed oil.

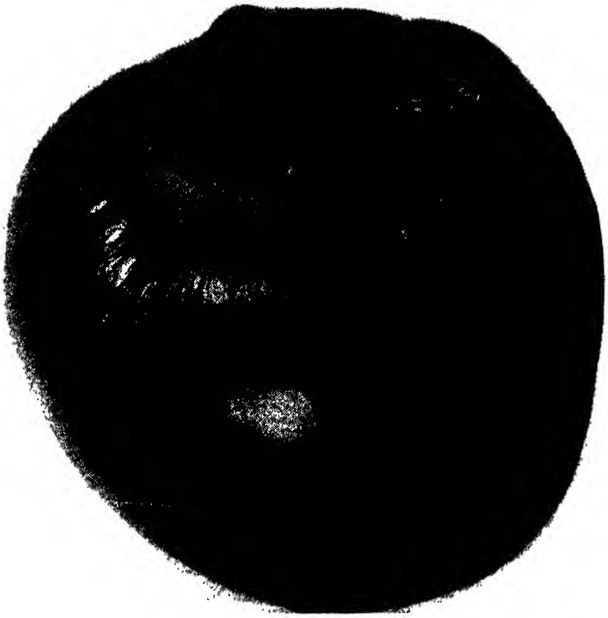
PEAR.—This is a subacid fruit of the temperate zone. Though the tree is a native of Europe and Asia it is now grown throughout the United States. The pear is related to the apple and is similar to this fruit in composition, but contains more sugar and less acid. Pears, like peaches, are used in the fresh state, dried and canned. The popularity of the pear as a raw table fruit is due to its low acidity, which calls for no added sugar. Pear

PECAN.—The pecan belongs to the hickory-nut family and is a native of the United States. It is grown extensively in the Southeast from Texas to the Carolinas, but it is one of the few nut trees not grown successfully in California. Of the many varieties the paper-shell is the most nearly ideal in every way. Its thin shell can be broken by gentle pressure, and only a thin partition separates the halves of the nut, so that they can be taken from the shell very easily. The pecan has the highest percentage of fat of all nuts, but its protein content is somewhat less than the average. It is perhaps the most finely flavored and is therefore the highest-priced Pecan



The pear, a fruit much appreciated by those who cannot tolerate the more acid kinds. Calories per pound, 225; protein, 0.5; fat, 0.4; carbohydrates, 12.7; vitamins B and C. It is low in iron as compared with its phosphorus content.

of all nuts.



The persimmon is as pleasant to the eye as the tomato which it resembles. It is becoming yearly more extensively used because of its sweet and piquant flavor; also because it is easy to assimilate and digest. It is very rich in mineral salts and vitamins.

Peppers

Peppers.—Peppers belong to the same family. as tomatoes. The pepper which is used most extensively in the United States is the bell pepper, of West Indian origin. It is a large green pepper and is used as a vegetable, either raw or cooked. A popular pepper now grown in California and Georgia is the pimento, of Spanish origin. Neither of these types of peppers have the hot or burning taste of the Chili and other seasoning peppers, but are vegetables of mild and unstimulating effects and very popular as a raw salad ingredient.

Persimmon

Persimmon.—The large cultivated persimmon is a native of Japan and China, but is now grown in orchards in the Southern States. It is a thin-skinned fruit, reddish yellow in color, and as large as a small tomato. The pulp has a sweet flavor and usually contains seeds, though seedless varieties have been found. During the ripening process tannin, which gives the unripe fruit a disagreeable flavor, disappears. This fruit is in season from October to January and is becoming more popular. In Japan persimmons are dried and when so treated somewhat resemble the dried fig.

Pineapple

Pineapple.—This is a tropical, sharply acid fruit. The pineapple plant yields but one fruit, and this is the sum of many small fruits whose number determines the size of the pineapple. Though most of the fruit for shipment is picked green, the pineapple, like other fruits, is of superior flavor when allowed to ripen on the plant. Partly because of the difficulty of removing the rough skin without waste, fresh pineapples are not so much used as the canned. In the canneries large fruit is used and the center stamped out. The juice is extracted from the remaining portions and used as a syrup to fill the cans. In Hawaii the canning of pineapple has become a leading industry. The sharp acidity of the pineapple suggests the addition of large amounts of sugar, as with cranberries.

PLUM.—This is a subacid fruit of the temperate zone. The sugar content varies and is sometimes as high as 20 per cent. There are many different varieties of plums varying in size. An interesting fruit is the plumcot, a cross between the plum and apricot produced by Luther Burbank. It is large and has a delicious flavor. **Plum**

POPCORN.—Popcorn is a dwarf variety of maize, with very small hard grains. When popcorn contains just the correct amount of moisture and is rapidly heated the generation of steam in the tight covering causes the grain to explode or pop. **Popcorn** This process has been imitated by more elaborate means and applied to wheat and rice grains, making of them interesting cereals. Popcorn differs from ordinary corn in its mechanical rather than its chemical properties, and therefore popcorn may be considered dietetically as a whole-grain product. Because of its bulk it is rarely eaten in excess, and its use as a between-meal or after-dinner food is not particularly objectionable.

POTATO.—The potato is botanically related to the tomato and is a native of South America and Mexico. It was brought to Europe by the Spaniards in the sixteenth century but did not come into general use until the eighteenth century. **Potato** In Ireland especially it was grown extensively, as the soil there proved ideal for its development. Potatoes yield prolifically and are now considered, next to cereals, the most important food product of the human race. Potatoes are rich in starch and minerals, but the quantity of calcium is small and they should be supplemented with green vegetables when used extensively. A large part of the nutritive material of the potato is commonly lost in cooking. They should be cooked in their skins by either steaming or baking. Forty-five minutes are required to steam or bake potatoes, but they may be boiled in from thirty to forty minutes. The water in which pared potatoes are boiled forms an excellent basis for vegetable soups and should by no means be discarded.

Poultry

POULTRY.—There seems to be a general belief that poultry is not meat. For this reason some people, when told not to eat meat, think they are obeying this order if they confine themselves to chicken. There is little or no evidence, however, that, from the dietetic standpoint, the flesh of birds is either better or worse than that of mammals. The chief dietetic advantage of chicken, as of oysters, is its exceeding tastiness, which gives a great taste satisfaction with comparatively little substance. This is taken advantage of in such dishes as chicken soup or chicken salad. The relative quantities of protein and fat vary widely with different types of poultry. Young chickens have less fat than older fowls. Duck and goose are usually much fatter than chicken and turkey and for this reason are generally held to be less digestible.

Prune

PRUNE.—This name is applied to a variety of plum which is dried without the removal of the pit. The industry is well

Chicken spread open and in buttered pan ready to broil.

developed on the Pacific Coast, where modern methods of artificial evaporation have replaced the sun-drying process. Prunes have been highly regarded for combating constipation, but are no better for this purpose than figs and raisins.

Pumpkin

PUMPKIN.—The pumpkin, squash and "vegetable marrow" are members of the gourd family. The pumpkin is a native of the United States, but the vegetable marrow is more commonly known in England. There are two types of squash: summer and winter. The summer squashes may, many of them, be cooked and eaten without peeling or removing the seeds. But the thick rind of the winter squash is inedible. This squash is best baked, as is the pumpkin. The vegetable marrow resembles the cucumber in shape, but is usually much larger. Summer squash and vegetable marrow may be steamed or boiled in forty minutes. The vegetable marrow is also delicious when baked until tender.

Quince

QUINCE.—The popularity of this fruit dates back to the time of the ancient Greeks and Romans, and it is still grown more extensively in southern Europe and western Asia than in America, where California leads in its production. This fruit is unusual in that its flavor is much improved by cooking, and the jams and jellies made from it are much more popular than the fresh fruit, which has an unpleasant taste and is extremely hard.

Radish

RADISH.—There are many varieties of radishes of different sizes and colors, the one most common in the United States being the small, red radish with white flesh. Radishes are tender when young but become woody and tough as they mature. They are eaten raw, but the leaves are excellent as cooked greens. The large win-

Among long-accepted and instinctive food combinations, are such customs as the stuffing of duck with apples and nuts before roasting. The service of applesauce with roasted duck is in the same category.

ter radish keeps well and is not injured by severe freezing.

Raisin

RAISIN.—The raisin is a dried grape. Therefore see *Grapes*.

Raspberry

RASPBERRY.—This berry grows wild in the United States and Canada, but it is also cultivated to a large extent. The cultivated berry is larger than the wild and approaches the blackberry in size. Raspberries have a delicate flavor and are highly prized, not only when fresh, but in jams and jellies, and for their juice, which makes a delicate fruit beverage.

Rhubarb

RHUBARB.—Rhubarb or pie-plant, as it is sometimes called, is of mysterious origin. Though the leaf-stem is used as food in America, in France and England rhubarb is grown chiefly for the root, which is used as a drug, while in Germany the plant is considered ornamental. The use of rhubarb as a substitute for fruit is now severely criticized because of its content of oxalic acid, which in sufficient quantities is a poison. There is more of this poisonous element in the leaves than in the stem, and these leaves should never be used for greens.

Rice

RICE.—Rice rivals wheat as one of the world's great food grains. It is to Asia what wheat is to Europe and America. But its lack of gluten makes it unsuitable for use as a bread grain. This fact accounts for the distinctive eating habits and customs of the Oriental. Rice is cooked by rapid boiling, which agitates the grains and prevents them massing together, and gives a much more pleasing form than the American method of cooking. This boiled rice is eaten with sauces, meats, vegetables and other foods much as bread is in our own meals. The modern process of polishing

The first step in the carving of fowl is the severing of the leg at the first or hip joint.

rice consists in rubbing off the bran and germ. This gives the rice a whiter appearance and makes it keep better, but it robs it of its vitamins and minerals. The discovery of this deficiency resulted in the reintroduction of brown or unpolished rice which is now considered throughout the world the more healthful form of this grain. The nutritive value of rice is very high. It is probably the most easily digested and completely absorbed of any grain. Supplemented by leafy vegetables and small amounts of animal protein, the rice diet seems capable of sustaining very vigorous health in the adult. In the case of children milk is undoubtedly necessary for the best growth and lowest mortality. The best cooking method for rice is undoubtedly that of rapid boiling, which should be so skillfully managed that the small amount of water left in the vessel is absorbed in the grain as the pot is removed from the fire. Polished rice may be cooked in this fashion in about twenty minutes. The unpolished or brown rice requires a little longer.

The contrast of whole and polished rice is here shown. The whole rice grains appear browner in color, longer and duller on the surface. Both bran and germs are removed in the polishing process as shown at right side.

Rutabaga

RUTABAGA.—(See *Turnip.*)

RYE.—Rye is grown in the

Polished or white rice magnified showing very clearly where the vitamin bearing germ has been milled off the end of the grain.

Rye

north temperate zone, and is extensively used as a bread flour in countries too cold to grow wheat. Rye contains less gluten than wheat flour and makes a darker, heavier and tougher bread. Its nourishing qualities, however, are quite similar to those of wheat. With the exception of pumpernickel, rye bread in America usually contains some wheat flour. A popular product now on the market is a whole-rye cracker.

Salsify

SALSIFY.—Salsify is sometimes known as "oyster plant," as it is supposed to resemble the oyster in flavor. It is a root and its leaves may be used as greens. Salsify is similar to the parsnip in that it contains a large amount of cellulose and unless carefully cooked will taste dry and woody. Salsify may be steamed in thirty-five minutes, but only twenty to thirty minutes are required for boiling.

Sea Foods

SEA FOODS.—The two main classifications of sea food other than true fish are the mullusks and crustaceans. *Oysters* and clams belong to the first class, lobsters, shrimps, and crabs to the latter. Oysters are chiefly used for their flavor, but there is danger from disease germs when they are used uncooked if they come from polluted waters. *Clams* are found below the surface of sand and mud, above low-water mark, and are, like oysters, bivalve mollusks. *Lobsters* live in sea water and the best species are found in Atlantic waters from Maine to New Jersey. The average weight is two pounds, lobsters of this weight being from ten to fifteen inches in length. Lobsters are seldom diseased, but they are difficult to digest. *Crabs* are in season during the spring and summer. Like lobsters, they change their shells at regular intervals. Soft-shell crabs, which are very popular, are those that have recently shed their shells. Another popular form is the canned crab meat from giant crabs imported from Japan. *Shrimps* are found in southern waters. They are covered with a thin shell, greyish in color, and turn pink when boiled. Shrimps are in season from May to October. They are also canned. All these sea foods—the crustaceans—are prized in salads. They are distinctively flavored, so that the taste for them must often be cultivated. Their chief dietetic value is in the iodine content.

SPINACH.—(See *Greens.*) **Spinach**

SQUASH.—(See *Pumpkin.*) **Squash**

STRAWBERRY.—This berry grows wild throughout the **Strawberry**

Three most used forms of dark or whole grain breads. The oval loaf is sold as whole rye, but rarely is made of 100 per cent. whole rye as is the square loaf of pumpernickel. Whole rye bread is darker and tougher in texture than whole wheat as shown in the loaf on the right.

United States, but is also extensively cultivated. It cannot be kept in the uncooked state; hence the season is very brief and can be lengthened only by imports from other climates. Fresh strawberries are among the world's delicacies. This fruit is distinctive, not only because of its unusual flavor, but because it contains a larger percentage of mineral matter, especially iron, than is found in other berries. Strawberries should be cooked only to preserve those that cannot be consumed in season.

Sugar, Cane

SUGAR, CANE.—Cane sugar is the common name of the chemical *sucrose*. It is commercially derived either from the sugar-cane or the sugar-beet. There is no chemical or dietetic difference between the refined sugar from these two sources. Until within comparatively recent times cane sugar was marketed in its natural brown form and, like maple sugar, still retained much of the minerals of the original sap. It also had a pleasing flavor in addition to its sweetness. The introduction of the granulated or pure white sugar was popularized by condemning these nutritive minerals of brown sugar as "impurities." The dietetic objections to sugar are based on this complete refinement, which makes it a fuel food only, and on its overuse in the diet, resulting in the development of an unnatural appetite for sweetness. Such an appetite must be met both by a more moderate use of sugar in cookery and by the substitution of brown sugar, honey, maple sugar, sweet fruits and other natural sweets for refined cane sugar.

Syrups

SYRUPS.—Syrups and molasses are overlapping terms. Used in its narrow sense the term *molasses* should be applied to the concentrated sap of sugar-cane as prepared and used throughout the South. Such natural molasses contains all the mineral elements of cane juice and in that respect is similar to maple syrup. Genuine cane molasses has a very distinctive and highly pleasing flavor and deserves a wider use. There are also types of molasses and syrup made as by-products of sugar refining which are inferior to the natural molasses made from the cane juice. Another type of natural molasses is sorghum, made by merely boiling down the juice of the sorghum cane. Maple syrup also comes in this class and is the most highly appreciated syrup in the market, sharing with honey the reputation of being an ideal natural sweetener. The chief artificial syrup is that made from cornstarch by the chemical changing of the starch into sugar as described under the heading *Corn.* Various other commercial syrups are made by mixing or blending these primary types. There is no objection to such blended syrups except that the blends are made for the purpose of cheapening the cost of the original pure syrups. For home use syrup made simply by melting brown sugar with a little water is quite as palatable and wholesome as most of the commercial syrups. No syrup contains any food ingredients except sugars and such mineral matter as may be retained from the natural sap.

Sweet Potato

SWEET POTATO.—Sweet potatoes are grown chiefly in the subtropical countries, and in the warmer temperate zones. In Spain and Japan they are now one of the principal root crops. The sweet potato is not a tuber, as is the potato, and it is not related to that vegetable. It also differs from the potato in that its carbohydrates include large quantities of sugar. The caloric, or food value, is the greatest per pound of any common root or other type of vegetable, and it is usually increased by the addition of butter at the table, or of sugar in the process of preparation. So this food belongs in the staple class of the worker's diet and has little place in a light diet. Sweet potatoes should be cooked in the skin and should also be cooked slowly. They require the same length of time as Irish potatoes.

Tapioca

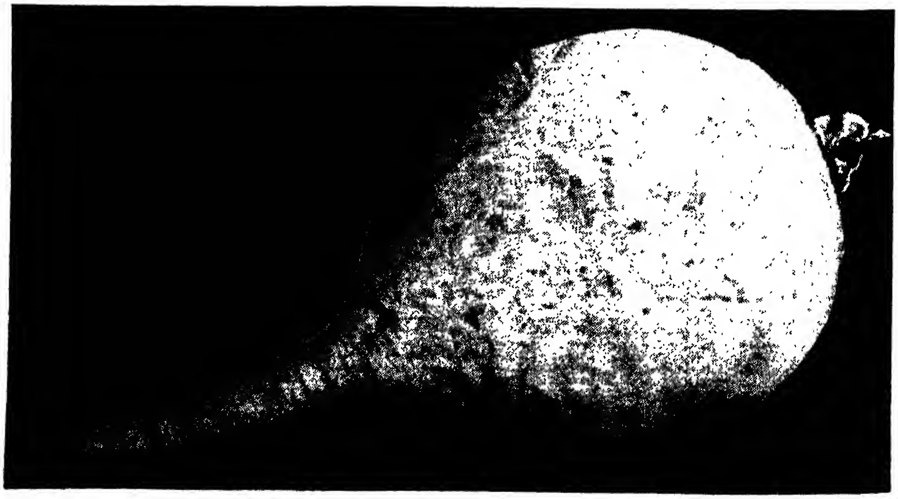
TAPIOCA.—Tapioca is the starch of the cassava plant. It is obtained from the grated roots, which are soaked in water and then filtered through cloth to remove the cellulose. The starch settles in the liquid. While it is moist it is heated until the starch granules are broken up and a firm mass is formed. It is obvious that this process robs the finished product of any food value other than that of starch. The form most commonly used is the pearl tapioca.

Tea

TEA.—Tea is prepared from the leaves of a shrub cultivated in Japan, China and Ceylon. Tea varies in quality depending on the leaves selected, the time of picking and the process of curing. Green tea is made by drying the leaves and exposing them to high heat soon after they are picked. This variety contains more tannin than others, but it has recently been credited with a vitamin content. The leaves from which black tea is made are allowed to ferment before they are dried and heated. Tea, like coffee and cocoa, contains an active alkaloid principal called *thein,* which is really caffein and which is combined with tannic acid. To make tea, hot water is poured over the leaves and should only be allowed to stand on them for a short time so that the tannin may not dissolve out. *Maté* is a tea substitute extensively used in South America. It has been exploited as a health tea, but there are no grounds for so regarding it, as its popularity also rests upon the caffein content.

Tomato

TOMATO.—We are all familiar with the story of "love apples" and the fact that the tomato, a member of the nightshade family, was at one time grown for ornamental rather than dietetic purposes. It is probable that the tomato originated in Central America, but it was brought to Europe in the sixteenth century, where it still grows on the Mediterranean shores. It is now grown to a large extent in the United States and Canada. In the South, in some places free from frost, it can be grown as a perennial. The tomato is valuable because of its mineral content and the presence of the antiscorbutic vitamin C, which is still amply present even in the canned tomatoes. Fresh tomatoes do not keep well and must be picked green for shipment, with the result that city-purchased tomatoes are usually of inferior flavor. Canned to-



The turnip contains calories per pound, 175; protein, 1.0; fat, 0.2; carbohydrates, 7.8; vitamins A, B and C. It is richer in calcium than the other root vegetables.

matoes, ripened on the vines, are of uniformly good quality and justifiably one of the most popular of canned foods.

Turnip.—The turnip, known to the ancient Romans, is now grown throughout the temperate zones. The white and yellow and the common rutabaga are most widely known. The white are more popular in summer, the yellow in winter. The tops are used as greens and have an excellent flavor. It requires at least forty minutes to boil or steam turnips. Overcooking should be avoided, however, or the vegetable will have a strong flavor. Turnips are one of the most economical foods to produce and were grown in large quantities in Germany during the war. **Turnip**

Walnut.—The walnut has been cultivated for over two thousand years. Of the eight varieties now known, three or four are natives of the United States. Walnuts are grown in Europe, China, Japan and Persia, and are now extensively produced in California where bearing walnut orchards are among the most highly valued of all agricultural lands. As with other nuts, the cultivated varieties differ from the wild in that they have a thinner shell and larger meats. The black walnut, and the butternut, which is sometimes called the "white walnut," grow wild in the central and eastern part of the United States. Walnuts vary in composition, the cultivated nut having less protein than the black walnut or the butternut. Walnuts are not used as much as the almond or peanut for nut butters, but when finely grated and used with salads they make an excellent substitute for dressing and add so much food value that the dish may become the main course in the meal. **Walnut**

Watercress.—Watercress is one of the most popular of salad plants, because of its attractive appearance and distinctive pungent flavor. It is especially valuable because of its richness in minerals and vitamins. **Watercress**

Watermelon.—This fruit is a native of Africa, but it is now being extensively cultivated on all continents. It is one of our largest fruits, sometimes weighing as much as one hundred pounds. The rind is thick and green, enclosing rose-colored or reddish pulp which is sweet to the taste. This melon forms an excellent summer dish, as it is refreshing and contains valuable mineral salts and vitamins. The food content **Watermelon** per pound is, however, low; hence its suitability for a reducing diet. Watermelon is one of the few foods never cooked, though preserves are made of the rind.

Wheat

WHEAT.—Wheat, its composition, nutritive value and the problems involved in its milling are so thoroughly discussed elsewhere in this volume that only brief consideration is needed here. Wheat is the most abundant single source of food used by English-speaking peoples. The greatest bulk is used in the form of breads, but the grain is also used for the production of most of our cereal foods. These come in two classes: those prepared or factory-cooked, and the raw products to be cooked at home. The prepared cereals are in many forms and bear many trade names. But at the present time all such are actually made of the whole grain of the wheat or are in the class of bran flakes with added bran. All such prepared whole-wheat cereals are wholesome and there is little choice in their food value except mere individual preferences. The raw cereals are also chiefly made of whole wheat but the white granular product sometimes known as *farina* is an exception. This is practically identical with white flour in its composition. One uncooked product is in the form of rolled wheat, mechanically similar to rolled oats. This is quite palatable when eaten uncooked. Coarse-ground or granulated whole wheat, which can be made in any simple grinding mill, is quite equal to any other form of wheat cereal. When still more coarsely ground, we have "cracked wheat." We can also use the uncracked grain as a cereal, but this requires rather prolonged cooking to make it tender enough to masticate. Such whole grains of wheat may, however, be bought cooked in cans. The time required for cooking these various forms of wheat depends almost wholly upon the fineness of the division of the grain. A porridge may be made of the whole-wheat flour by merely stirring it into boiling water, as in making cornmeal mush. The belief that any fixed cooking time is essential to wholesomeness has no foundation.

Zwieback

ZWIEBACK.—This is simply bread which has been slowly toasted or dried out in an oven. It is very easily digested and has an agreeable flavor, because the starch has been partly dextrinized. Melba toast is a form of zwieback but is usually found toasted in very thin slices.

MEASURING WHAT WE EAT

Section 14

THE subject of calories and food standards has been touched upon several times in previous sections, but in any thorough discussion of nutritional science this is not a matter to be considered in one spot and then dropped. The *calorie* we need to have always with us on the job, as a carpenter needs his rule. It is our yardstick for measuring food quantity, though it tells us nothing of food quality.

Knowledge of the Calorie Necessary

The important practical applications of the system of measuring foods in calories are as follows:

First.—The calorie is the best unit we have for the measurement of the quantity of food eaten.

Second.—Since the calorie approximately measures the food consumption, it also affords a convenient means of approximately measuring the economy of a given diet.

Third.—Men doing heavy physical work and consuming large quantities of food, are in comparatively little danger of running short of the rarer elements. Therefore, in calculating the diet for such men, or figuring its economy, the calorie is more important than in the case of those whose food requirements are smaller.

Fourth.—The calorie consumption is an important factor in the growth of children and in the problem of underweight in adults. Failure of growth in a child, or underweight in an adult, may be caused by eating an insufficient amount of food, although many other factors may be involved, and the calorie supplies a convenient method of measuring the food-intake.

Fifth.—The calorie consumption is the chief factor in determining the effect of food on excessive body weight. An excess of calories over the actual food requirements is the chief cause of obesity, whereas deficiency in calories is only one of many causes of underweight. Overweight is much more easily influenced by reducing calories than underweight by increasing them.

In common practice calorie calculations are used in reference to the control of body weight much more frequently than for any other purpose. For that reason much of the detail of the method of calculating the calorie value of food, menus and diets is reserved for the later section where the problem of weight-control is discussed. Any reader who wishes to make use of practical short-cuts in calorie calculations for any purpose is referred to that section, even though his personal problem is not one of weight-control. In this section only the general principles relating to the caloric values of foods and the caloric needs of the human body will be given. These are necessary to the better understanding and use of the complete food tables that will be discussed in the next section.

Calories and Weight-control

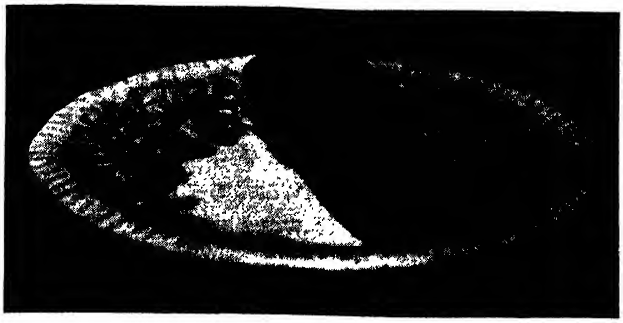
Let us now review the reasons why the calorie is the most satisfactory unit for measuring the amount of food eaten. You will recall that the calorie is a unit used for measuring the heat induced by the oxidation or burning of food or fuel. It is this process of the chemical combination of oxygen with some other element that creates heat in a fire or in the living body. Part of this heat energy may be turned into mechanical energy in the body as in an engine.

Carbon and hydrogen are the two fuel elements of the body, as they are also of such common fuels as wood, coal, gas or oil. There is no distinction between the elements carbon and hydrogen, or between the compounds, carbohydrates and fats, that makes one of them a source of heat and the other a source of mechanical or muscular energy.

Popular statements to the contrary notwithstanding, the idea that fat is a body fuel and carbohydrate (as sugar) a source of body energy, is unscientific and erroneous. The body can burn either fuel for either purpose, and under normal circumstances burns a mixture of the two. Also the body can burn protein; that is, the major portion of the protein molecule, and derive therefrom about the same fuel value as it does from carbohydrates.

Calories and the Fuel Elements

The only elements that are actually burned in the body are carbon and hydrogen, but in all normal foods these elements greatly predominate in quantity over any others. The carbohydrates contain nothing but carbon, hydrogen and oxygen, the latter two elements being set free as water when the



This section of apple pie contains approximately 100 calories.

carbon is burned. Fats contain the same three elements, but yield much greater amounts of heat because they contain not only more carbon but less oxygen and will therefore combine with more oxygen in the process of combustion in the body.

How Calories Are Determined

A brief statement of the way in which the caloric value of a food is determined in the laboratory may help to an understanding of this matter. The weighed sample is first thoroughly dried and then mixed with a substance that rapidly gives off free oxygen. This mixture is sealed in a small metal bomb which is immersed in a given quantity of water of a known temperature. The mixture is exploded or fired by an electric spark, and because of the excess oxygen is quickly and completely burned. The amount of heat developed is determined by the rise in temperature of the water.

Most of Food Is Fuel

These three main groups of food substances (fat, carbohydrates and protein) together form from 98 to 99 per cent. of the dry or water-free substance of most natural foods. The minerals, even in a complete diet, only run from 1 to 2 per cent., and the vitamins are in quantities too minute to be measured. About one-sixth of protein is nitrogen, which does not burn; but since only about 10 per cent. of the total food intake is ordinarily composed of protein, only about one-sixtieth of this amount is nitrogen. Some of the carbon and hydrogen is not oxidized, because it is required for the elimination of the nitrogen in the form of urea; but this is relatively little. Therefore about 95 per cent. of all digested food substance is fuel and measurable in calories. It is thus easy to see why the calorie requirement is an approximate measure of the total food requirement. When a man's body is supplied with all the fuel it needs, this condition usually checks the appetite and tends to prevent his eating more food of any kind.

In theory the natural reaction of appetite should, therefore, control the amount of food eaten, and it approximately does. Were this not so there would be nothing to stop a healthy man from eating to the capacity of his stomach. A man at hard physical work can eat, digest and oxidize, or burn up, two or three times what a man at light labor requires to support him, and if it were not for this appetite check most people would eat at least double the quantity of food they could oxidize. As a result the greater part of civilized humanity would take on fat like hogs in the farmer's fattening pen.

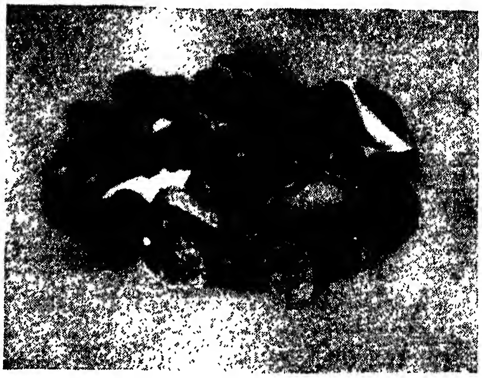
The Appetite as a Check

But while this adjustment of the fuel value of the diet to the body's need is the dominating factor in appetite, it is not the only one. A man on a diet that is deficient in protein or minerals may feel certain vague cravings for more food, even though he has eaten an ample amount as measured in calories. The result of this vague hunger may be that he will continue to eat; and since he cannot oxidize all the fuel, he stores part of it and becomes fat.

Until we learn to balance our diets more perfectly, these excesses and deficiencies, with their health-destroying effects, will continue. Because of the imperfection of civilized foods and the general overuse of pure fuel foods, we see very few properly nourished people and very many who are either suffering from food deficiencies, or from an excess of fuel food and consequent overweight. The appetite responses of all such people have gone wrong. Those who are overweight are those who feel the urge to eat more food because of an appetite aroused, probably, by the lack of certain food elements, but also from habit. Those who are underweight may be suffering from similar food deficiencies, but in this case the deficiencies have been such that they have impaired the powers of digestion and assimilation and thereby destroyed the appetite.

Unbalanced Diet and Hunger

For this reason the same normal and completely nutritious diet may tend to correct both underweight and overweight. In the one case it serves to restore the normal digestive powers and hence the appetite, and in the other case to check excessive appetite by satisfying the vague cravings that are caused by deficiencies. Neither condition can be corrected merely by increasing or decreasing the calories, as the case may be, and attempts to do so are often worse than useless. But with appropriate changes in the quality of the diet the study of the calorie content may be a valuable aid to weight-control. This becomes apparent as we examine the reasons for the differences in the caloric value of various foods.



The pistachio nut contains 2705 calories per pound. Because of its unique flavor it adds a piquant taste to candies and cakes.

Food Tables for Selecting the Diet

In all the commonly published food tables the caloric value of the various foods is stated in the form of the number of calories per pound. Foods that are high in fats show a far greater yield in calories per pound than others, whereas those high in water show comparatively low calorie figures. Either of these facts may lead us into serious error. If one selects foods exceptionally high in calories one will get a diet composed predominantly of fat, and an excess of fat is certainly an undesirable factor in any diet, whether intended for the reduction or the increase of weight. Likewise, if one avoids the foods showing low calorie figures, one will be avoiding the foods that contain water, and it so happens that many of our best foods in their best form are watery foods. This applies to milk, fresh fruits and fresh or green vegetables.

The facts just pointed out are responsible for one of the most frequent errors in the use of tables of food analysis such as have been published for many years in government bulletins and in many text-books. These tables give only the number of calories per pound of various foods. Undernourished people who are told that they need more calories look at the table and pick out foods that have high calorie figures. Overweight people pick out foods that have low figures. By considering this factor alone both may get very poor diets. They may also make ridiculous mistakes because the food as analyzed was in a form quite different from that in which it comes to the table.

For instance, one looks at the table and sees that figs contain 1290 calories per pound and cranberries 190. So one concludes that figs are fattening and cranberries are not, and, if on a reducing diet, abstains from the figs and decides to eat cranberries. But presuming that both the figs and the cranberries are to be stewed before eating, let us see what happens. The figs, containing no acid and a large percentage of natural sugar, will have no sugar added to them but, perhaps, three times their weight of water. Thus a pound of stewed figs will contain only one-fourth of a pound of fig substance and, therefore, only 322 calories. But because the cranberries are so sour there may be added to them in cooking a weight of cane sugar that nearly equals the weight of the berries, whereas very little water will be added. Consequently a pound of cranberries as served may contain nearly half a pound of sugar, which alone would supply 900 calories, and in the whole there may be a thousand calories, or three times as much as in a pound of stewed figs. Hence the actual effects of both foods would be just the reverse of what the food tables indicated.

Common Mistakes with Calories

So many errors of this kind are, in fact, possible, that many practical dieticians oppose the use of calorie calculations outside of scientific laboratories, believing that more harm than good can come from them in the hands of people not scientifically trained. These things, however, are no fault of the calorie system, but are merely due to a misconception and misapplication of it. Once the full importance of the quality of the diet is comprehended, then the figuring of the amount of calories is interesting and, in the

Knowledge of Calorie System Helpful

The delicious cashew nut is becoming more popular. The usual market form is the shelled roasted kernels now generally available in nut and other stores.

applications noted at the beginning of this section, also distinctly useful.

To throw further light on this problem let us consider a pound of hulled peanuts. Assume the caloric value per pound to be 2,500. Now suppose we grind these peanuts into peanut butter. This would in no wise change their food value, because all the substance would still be there with nothing added, and a pound would still contain 2,500 calories. But let us now proceed to make this peanut butter into peanut cream by mixing one pound of the butter with one pound of water. The original 2,500 calories are still there, but they are in two pounds of food instead of in one. Therefore the caloric value per pound becomes 1250. We might repeat this operation and add eight more pounds of water to produce peanut soup. The 2,500 calories of food would now weigh ten pounds, and the caloric value per pound would be reduced to 250.

How Caloric Value Is Changed

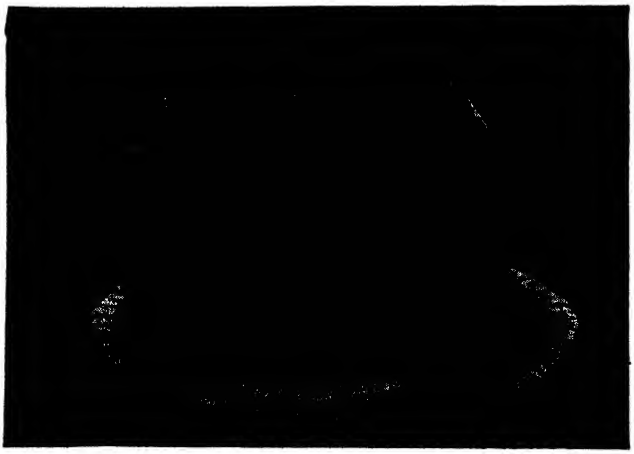
This may seem like a foolish sort of example, but it does help one to grasp the essential difference in the caloric values of many natural foods in the different forms in which they are eaten. The peanut cream, or peanut soup, may be just as good a food as the peanut butter, or even better. In fact, anyone eating dry food and drinking water produces something very like this peanut soup in the stomach, where all foods are reduced to about the consistency of thick soup. But the caloric value would be very different.

Thus we see that low caloric values per pound do not indicate that the food is of low value in the diet, but only that greater weights of it are necessary to get enough to eat.

As compared with a natural diet which a man might get directly from garden and orchard, the diet of a city civilization tends to run to concentrated and dried foods. The reason for this is primarily economic. Not only is it more economical to transport, store and handle dry foods than watery foods, but in most cases there is a further advantage in that dry foods keep better, while moist foods have to be preserved by relatively expensive processes like cold storage or canning. These facts give the dried and concentrated foods great commercial advantages in competing with moist fresh foods, and are of great importance in the economical feeding of the human race. If our city populations had to be fed exclusively on foods like fresh milk and green vegetables, which are about nine-tenths water, and perishable besides, the cost of living would be much higher. But concentrated foods have certain health disadvantages which we must offset by using some of the fresh, water-containing foods in our diets, even at a greater cost. There is no need of going to extremes in the matter, because there are good foods in both the dry and watery classes. A proper mixture of the two types is best.

Calories, not Weight, Must Be Determined

This difference between moist and dry foods has been mentioned because it helps to clarify the meaning of caloric values and shows why weight gives no basis on which all the values of the different foods can be compared. The quantity of food, as far as nutritional value is concerned, must be measured in calories. It cannot be measured in pounds, or ounces, or quarts, or bushels, although, unfortunately, foods are sold in these units which so little indicate either quantity or nutritional value. But the other values cannot be measured in this way, and there seems to be no way of finding a unit to measure all the varied values in food. Indeed, that would be much like trying to find a common unit of measurement for silk, coal and electricity. The elements of nutrition are as different in their uses in the body as are the various other commodities that minister to the needs of life. But unlike these commodities we cannot, or at least should not, buy them separately. A food product might be likened to an automobile or a furnished house. There are various elements of worth in both, all of which may be more valuable in their assembled form than when separated. The caloric value corresponds roughly to



Despite its bulk, the nutritive value of an average size cantaloup is approximately only 100 calories.

the main structure of the house or to the power of the auto. It is the most conspicuous factor, but is quite useless without the other things.

Some people have advocated the passage of laws to require foods to be sold in units of so many calories instead of by weight or measure. The world is hardly ready for such a radical change, and it is not certain that it would be a good thing. Such a law would put a premium on some of our poorest foods, which have high fuel or caloric value, but lack the vital non-fuel essentials.

Variations in Metabolism

Basal Metabolism.—A further term which we meet with in studying calories and their relation to health is *basal metabolism.* This term is coming into wider use in the medical world as interest in nutritional science increases. Many modern hospitals now make tests to determine the basal metabolism of certain patients. These tests are particularly useful in relation to weight-control and especially when it is thought that the abnormality is caused by disturbances in the functioning of the thyroid gland.

The term *metabolism* means the sum of chemical changes whereby the function of nutrition is carried on, and the *basal metabolism* is the minimum of such activity associated with the maintenance of the life processes. This minimum is quite constant for any individual, and is measured by the rate at which the body burns or oxidizes fuel, when not influenced by such circumstances as muscular exercise, the digestion of food, emotional excitement and activity of the thyroid gland. In order to eliminate the disturbing factors it is customary to make the test while the individual is lying in bed quietly resting, with no recently-eaten food in the digestive organs. These conditions are best approached in the morning before one rises or has eaten anything. Such a time is therefore chosen when possible, or these conditions are closely imitated.

The total metabolism of the human body can be measured quite accurately by determining the rate of oxygen absorbed from the lungs. If an accurate test is desired, therefore, it is made by means of apparatus contrived to measure the oxygen retained by the lungs. It happens, however, to be much simpler to measure the carbon dioxide in air than to measure the oxygen. This simpler method is sufficiently accurate for practical purposes, and may be used if the following facts are taken into consideration.

The body metabolism bears a direct ratio to the oxygen absorbed. But the amount of carbon dioxide given off varies according to whether fat or sugar is being burned. Therefore, to use the simpler carbon-dioxide test for metabolism it is necessary to know what proportions of fat and sugar are being oxidized in the body. If a person has gone from twelve to fifteen hours without food, the ratio of fat-combustion to that of sugar will be pretty constant. Therefore, the amount of oxygen burned and the energy thus released can be pretty accurately calculated by the method of collecting all the carbon dioxide expelled with the expired air. This condition is met in the way already described by making the test in the early morning while the subject is lying in bed and has not had breakfast.

Metabolism Determined by Amount of Oxygen Burned

The basal metabolism of a young man of average size is at the rate of about 1700 calories in twenty-four hours. For a young woman of corresponding condition it is about 1400 calories. But basal metabolism is measured by the amount of food fuel consumed and energy created when one is lying in bed and not eating. The energy required to digest and assimilate the ordinary amount of food increases the basal metabolism about ten per cent. The maintenance of a sitting position requires an expenditure of muscular energy. Standing "at attention" requires fifty per cent. more energy than lying in bed. Slow walking doubles the energy output of lying in bed, and very rapid walking, running or swimming may raise it four or five times as much.

Muscular Activity and Metabolism

It is because the amount of muscular activity in a twenty-four-hour day varies so widely for different individuals that food requirements are so hard to estimate. We say that nervous people or worried people do not get fat. But this is not because the actual nervous process consumes food and oxygen in appreciable amounts. It is because the nervous person is constantly tensing or moving the muscles. The action of the heart and of the chest in breathing requires a constant expenditure of muscular energy. Indeed, these two constant actions are what chiefly determine the basal metabolism. But individuals differ widely as to the manner of heart-action and the corresponding action of breathing. Furthermore, these actions are influenced by the emotions. Anger and fear, joy and hope, all speed up the heart. High-strung, emotional people, therefore, have higher rates of metabolism than those who are less easily excited.

Such are some of the factors that make people so individual in their food requirements and explain why some are fat and some are thin, even when they eat the same amounts and have the same occupations and major physical activities. It is these elements of difference that are largely responsible for the wide variations in food requirements and for the tendencies toward obesity or underweight that modern doctors like to blame on our glands. To say that glands instead of temperament and habits are responsible for these conditions makes them seem to be pathological and suggests the need of medical treatment. But the simpler explanation just given leaves it as a matter of personality and a man's own affair instead of the doctor's. This is not intended to mean that glands are not involved. Modern investigations show that the action of the glands is a controlling factor in our nervous, emotional and mental processes, as well as in our more purely physical life, and these glands are subject to disturbance and disease. But the facts have been used to inveigle a lot of people into imagining themselves to be medical cases when nothing was involved except those individual variations which may be considered quite normal to human beings.

Blaming the Glands

Because of the wide variation of individuality as it affects one's calorie requirements, all schemes for making up food standards according to sex, height, age, occupation and other such conditions, are worse than useless. One might as well try to standardize shoes and command every man of a given height to wear a given size. It would scarcely do any more harm than these foolish efforts to apply theoretical dietetic standards to people in any wholesale fashion. The determination of the ideal amount of food is always an individual problem. Amounts of food that are excessive or deficient for one person are not necessarily wrong for others, even though sex, height, age and occupation may be the same.

The calculation of calories and the study of food quantities are not therefore for the purpose of setting up a standard diet, but for that of helping each individual to regulate his own diet. For instance, many people make very grave errors when changing their diets because they have no sense of the caloric values of foods. A man may become convinced that his diet is wrong and decide to change it. He hears some diet recommended that has been helpful to someone else, and so he tries it. But maybe the other person has been suffering from overeating and has adopted a lighter diet, whereas his imitator may be high-strung, nervous and underweight and in need of more calories than he has been getting.

Diet Standards an Individual Problem

This type of error is very common. People who are in need of more food constantly change to less, while those who need less change to heavier diets. It not infrequently happens, therefore, that persons following supposedly reducing diets become fatter, while those suffering from underweight may adopt some food intended as an addition to the ordinary diet, as a means of increasing weight, and use it as a substitute for other food. The effect is to cut down on food quantity when it should be increased. Neither type of error could occur if people had any comprehension of food quantities or caloric values.

Therefore, if you have any reason to believe that you are not eating the right quantity of food, find out first how much you do eat. Then change from that basis, increasing or decreasing your food-intake as the case requires. This is easy enough, even without a knowledge of calories, if you make no changes in the kinds of food eaten. But in trying to improve the diet it is usually necessary to change both the quantity and the quality of the food at the same time. That is when a knowledge of calories is useful; without it one may, while improving the quality factor, neutralize the benefits of the change by changing the quantity factor in the wrong direction. Other problems sometimes enter into the matter, and these need to be gone into as carefully as in working out or maintaining the biggest construction project in the business world.

How Much Do You Eat?

The basal-metabolism test, for instance, reveals the activity of the thyroid gland and the percentage power of the body to utilize oxygen and get rid of carbon dioxide. The blood chemistry is one side of a triangle, the basal metabolism is another, and the third is the measurement of the voltage of the heart muscle. This is termed an electro-cardiogram. It reveals down to a twenty-fifth of a second and a ten-thousandth of a millevolt the horse-power, as well as the nerve-circuit of the heart mechanism. A healthy heart at twenty-five years of age lifts fifty-six tons one foot high every twenty-four hours! Today we can get the bodily mechanism under scientific control so that it can function properly. This means life—it means happiness.

The Human Mechanism Can Be Controlled

Even when the bodily mechanism has been damaged beyond repair, it may, if one understands how to operate it, give better service than a better machine badly cared for.

Thirty years ago a friend of mine was given but two years to live, on account of a defective heart muscle, angina pectoris and fibrillations that made the pulse run away at times like the buzzer of an alarm clock. The medical diagnosis was "coronary sclerosis," and every year for the past fifteen years he has had his blood chemistry and other conditions checked up. Through this knowledge he is able to regulate his life, so that his disabilities do not seriously interfere with his efficiency. He cannot box, nor wrestle, nor play handball any more, but his body chemistry is running along ideally, and with proper care is good for another thirty or forty years of happiness and health.

It is not necessary to wait until the ship begins to list, or until it begins to sink, before securing this engineering survey showing how the ship of life is handling the cargo of food daily taken aboard over the passing months and years. The survey should be made before any of these danger signals appear.

THE USE OF FOOD TABLES

Section 15

THE food table prepared for this volume assembles more facts about the composition of food than have ever been brought together before in any book or publication.

It will be noted that the table occupies two pages and that the same items extend across to the second page. This is merely because there is not room for all the facts on one page. The name of the food is repeated as a convenience to the eye. Let us now consider what the columns mean and why this particular selection of items has been made.

The amount of scientific data about foods is growing year by year, and all sorts of tables of food analysis have been published. Those of the early government bulletins and text-books gave the number of calories per pound and the percentage of protein, fat, carbohydrates and ash (minerals). The first four items are retained in the order just given. The item of "ash," or minerals, is not listed, having been dropped for the reasons following.

Facts Given in Food Tables

The figures derived from the old method of chemical analysis for minerals merely expressed the amount of material left after the food had been burned or incinerated to a white ash. This ash does not even represent the original minerals in the food, but includes the oxides of those minerals formed in burning it. The figures include, moreover, not only the significant minerals but also inert or unimportant ones. Thus all salted foods appear to have a very high mineral content, even though they are actually deficient in the vital food minerals. Such denatured foods may appear even richer in "minerals" than the natural foods containing the vital minerals. Therefore, instead of this item, there will be found on the second page of the table, the three important food minerals expressed in terms that show their relation to the problem of a sufficient supply of them in the diet.

The green outer leaves of lettuce and other leafy vegetables, frequently discarded in the preparation of salads, contain a richer supply of vitamins and minerals than the white inner leaves.

The old food tables often gave two analyses for each . food. One was the analysis of the food "as purchased" and included an item labeled "refuse." The other was the analysis of the "edible portion." All analyses here given are based on the edible portions only. This means peeled bananas and oranges, nut meats, not nuts in hulls and so on. Happily the modern food industries are each season giving us more and more foods in these all-edible forms, so that there are now fewer foods in which the weight of the food as purchased is different from the weight as eaten.

Table Based on Edible Portions

A further difference between this and other tables is that in addition to basing analyses only on the edible portion of foods, the indigestible elements are also taken into consideration. The average of such non-digestible elements is about five per cent. In high-cellulose foods like bran it may be much greater. It would seem that the digestible part of foods should be used for figuring percentages of nutritional elements for use in practical dietetics, although it means some discrepancy between the figures of the table itself, as well as disagreement with other tables.

Sensible people do not waste as much food as formerly. Often this waste is not only a foolish extravagance but involves the loss of the best part of the food. For example, the peeling of many fruits and vegetables is discarded, just as the bran of wheat is discarded, but not only do some of the best and most vital food elements often lie just beneath these outer layers, but the skins themselves may be a source of flavor while the indigestible parts furnish cellulose, badly needed by most of us. There are, of course, exceptions. Thus the outside peel of oranges is objectionable in large quantities, because of the pungent oil. A little of it is a good flavor element, but too much is irritating to the mucous membranes. But the white pith inside the outer skin is an excellent source of cellulose.

Food Wastes

Another foolish waste is the rejection of the green outer leaves of lettuce and cabbages. Only the leaves actually spoiled should be discarded. The green leaves contain a much better supply of vitamins and minerals than the white interior portion of the head. This fact has been demonstrated in feeding tests. The foolish fear of germs has been used to scare people into discarding much good food. Wash vegetables carefully and discard actual spoiled parts, but otherwise eat all of them that are edible.

An element of confusion in all food tables is the water content of foods. When the percentage of this element is high, the percentages of the nutritive elements are correspondingly lowered. All fresh fruits and vegetables are comparatively high in water and low in actual food elements. Dried milk, with only 7 per cent. of water, has 91 per cent. of nutritional elements; but fresh milk, with 87 per cent. of water, has only 13. Yet the figures do not indicate a low food value in the latter case. We rightly prefer the fresh milk, with its low caloric rating, and use the dried milk only when the other is not available, or the supply is not above suspicion.

How to Estimate Water

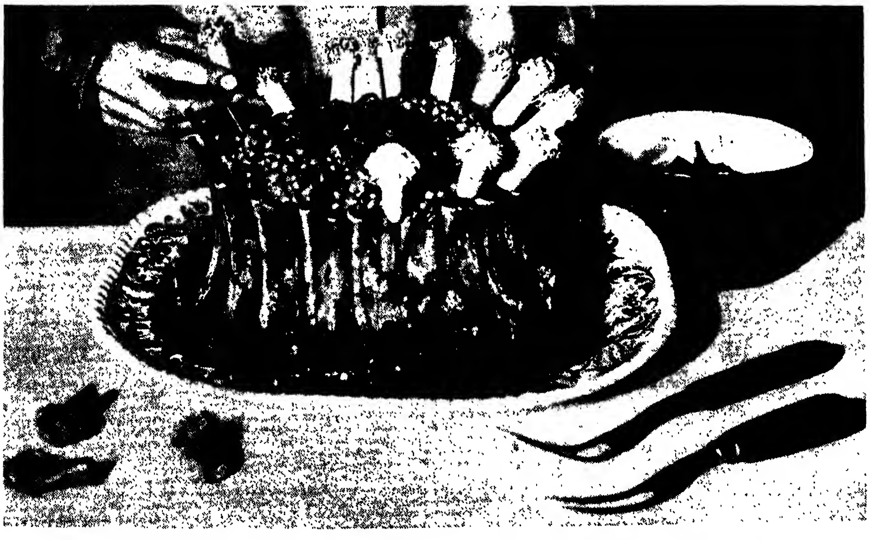
The amount of water in any food, while not directly given as such in the table, can be approximately estimated by adding the percentages of protein, fat and carbohydrates and subtracting this from one hundred. The figure will be approximate only, as both the amount of minerals, which is small, and the non-digestible portion, are needed to make the total one hundred per cent., and the figures for protein, fat and carbohydrates are, as already noted, based on the amount of these in foods that is commonly disgestible, not upon the actual weight of the edible part.

The number of calories per pound is not a percentage factor. Calories cannot be given in percentages which are based on weight. Calories are units of heat and cannot be weighed any more than the temperature of a kettle of water can be weighed. The caloric value of foods is chiefly influenced by the percentage of water and the percentage of fat. Where the water content is high, the caloric value is low, and where the fat is high the calories are high. The highest calorie-ratings are, therefore, for the pure fats and oils, containing no water, and the lowest are for products like cucumbers and lettuce that contain much water and practically no fat. Intermediate values may be found in watery fats like cream, or in dry non-fat foods, like sugar and cereals.

Calories in Meats and Fish

Meats and fish vary widely in caloric value. Watery, fat-free flesh, like oysters and codfish, is very low in calories. Drier lean meats come next. Thus beef free from fat has a value of about 600 calories per pound, while fat beef or pork is about equal to butter. Hence the caloric values of meat, as eaten, vary so much as to make food tables practically useless so far as meats are concerned.

The remaining three columns of the first or left-hand page of the tables are devoted to the three vitamins, A, B and C. As was explained in the section on vitamins, these elements cannot be chemically analyzed. Therefore, their relative concentration in foods cannot be given in definite figures. The method of vitamin determination is by feeding tests, and the



Meat when quite lean has a proportion of about 600 calories per pound. The appeal of roast meat to the palate of most people is undeniable. Here we have spare ribs evenly arranged in the form of a "crown roast."

results are comparative and approximate only. Therefore, food scientists have adopted a system of expressing the relative vitamin content of foods by the use of stars, or asterisks. The significance of these symbols is as follows: Three stars indicate great abundance of the vitamin, two stars moderate abundance, one star sufficient quantities for a diet of that food but not enough to supply the deficiencies of other foods. A cipher indicates that the food does not contain the vitamin at all; the blank or dash that no data is available on the subject.

Lest you feel that scientists are at fault in leaving us in ignorance of the vitamin values of so many products, it must be stated that each food has to be tested separately for each vitamin, and that each test involves tedious feeding experiments on large numbers of white rats or other animals. The table only includes the first three vitamins, and certain facts about vitamins, such as their relation to sunlight, and their destruction by heat, are not and cannot be included. For these facts you must consult the discussion of vitamins, cooking and heliotherapy.

Hundred-Calorie Portions

In the first column on the second or right-hand page of the tables an attempt is made to state in popular terms the amount of food required to yield one hundred calories, this hundred-calorie portion being used in many dietetic calculations. Such estimates are only approximate, however, and there is no way to give them more accurately, especially for the foods with the higher calorie-ratings.

Measuring the Foods

For measuring these quantities, in those cases to which it was adapted, the standard kitchen measuring-cup was used. It holds one half-pint, or one half-pound, or eight ounces of liquid or other food that can be packed tight in a cup without air spaces. Of course, the measurements of uncooked berries, nut kernels, grains, cereals and flours all vary according to the amount of air space and the tightness of the pack. In the case of high-calorie foods, when the hundred-calorie portions are small, tablespoons were used; and in case of oils, teaspoons. This usage is based on the level spoonful, with two tablespoons to an ounce and three teaspoons to a tablespoon.

In most cases the amount of the hundred-calorie portions is also given in ounces and the major fractions of an ounce. Remember that a standard cup is eight ounces and therefore an eighth of a cup is an ounce. A really better measuring vessel is a straight-sided tumbler or glass. If you have four such glasses and will divide a quart of milk (which weighs two pounds) equally between them, you can see just how full eight ounces makes the glass. Then you can use this glass to gauge the other ounce quantities.

For solid objects like fruit and potatoes the volume of four ounces, or the half of the glass, makes a useful size gauge that can be judged with the eye. A good-sized egg is two ounces. The half eggshell holds one ounce.

Judging Food Portions

Butter can often be bought in long quarter-pound or four-ounce prints. Halve this with a knife and you have two ounces. Halve these again and you have ounce portions that are just about inch cubes. This cut in two is the half-ounce pat, a trifle over a hundred calories. Cut it again and it gives you a fourth-ounce pat. These butter portions are very useful for the purpose of learning to judge small volumes and their approximate weights.

The law now requires the net weight of all foods sold in packages to be printed in pounds and ounces on the containers. The purpose is, of course, to prevent short weights, but the practice is a great help to those who are trying to keep track of their diets. Any such material can be very accurately divided into two equal portions and these divided and subdivided as often as necessary. Package cookies and crackers can be counted and the weight of each thus determined. These methods may be found simpler than the actual weighing of foods.

The remaining five columns on this right-hand page are all based upon the food unit represented by 2500 calories, which is the daily food requirement of the average man engaged at light or indoor labor. By using this unit we are enabled to bring out many facts in a clearer and more useful way than in the usual food tables.

In the second column of each right-hand page is given the weight in pounds and ounces of 2500 calories of each food under consideration. These are very striking figures, and it has been found that they give a much better idea of the extreme differences between the nutritive values of different foods than do the number of calories per pound. The statement that tomatoes contain 100 calories per pound and salad oil 4,000 calories fails to impress most people with the vast differences in the effect of the two foods on body weight. But when they understand that it would take twenty-five pounds of tomatoes a day to enable a man to maintain his weight, whereas he could maintain it on ten ounces of oil, and actually get fat on twelve ounces of this substance, they are likely to be duly impressed with the advantage of eating tomatoes without oil in a reducing diet.

Bulk Limits Consumption

The daily diet unit has great advantages for expressing comparative food values. Figures showing the weights of the different foods required for a man's daily allowance enable us to see at a glance which are economical. One can readily see how customary units of purchase compare with the man-per-day requirements. In other circumstances, such as reduction, the purpose is the opposite of economy, or getting more calories for less money. The idea is to get the most bulk and satisfaction with the least calories, and for this purpose the figures of the table are very revealing. One can go through the list of foods and pick out those of which one would have to eat over five pounds per day to get enough calories to maintain weight. Obviously, since one rarely eats as much as five pounds of food a day, such a list would help in the selection of reducing foods.

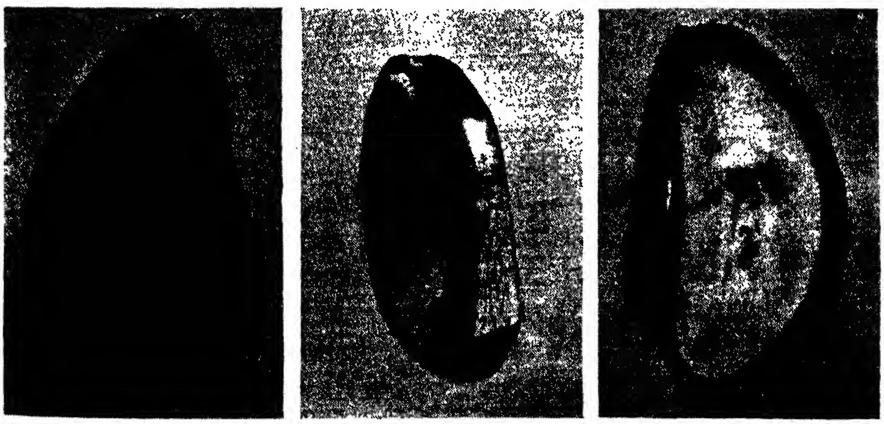
From this basis of the daily food requirements certain further important facts may be derived. In the third column you will find a second form of expressing the protein content of foods. It gives the number of grams of available or digestible protein in 2500 calories of each food. The reason for giving the protein in grams is that the protein requirement of the body is always expressed in grams per day per man, and not in percentages of the protein to the other food elements. A gram is a metric unit of measurement, and there is no unit in the English system of weights and measures that serves the purpose so well. There are 28.35 grams in an ounce and hence there are 453.59 grams in a pound. We cannot weigh protein, as it is not a substance we can buy in pure form, being always in combination with water and other food elements. Egg-white is the only approximately pure protein one finds in the kitchen, and egg-white contains much water.

We can, however, calculate the weight of protein in food.

In the section on protein it was shown that from 60 to 75 grams a day would supply the body's daily need. Therefore high protein foods may be considered to be those that yield over 75 grams of protein for 2500 calories of the food, while those that contain less than 60 grams should class as low-protein foods.

The Protein Content

This new form of expressing protein values has been adopted for the purpose of correcting false impressions regarding the protein element of food that have become prevalent owing to the misleading effect of the ordinary protein percentages which have been given in the first section of the tables. It has been customary to consider foods high or low in protein according to these percentage figures. Thus all nuts have popularly been considered high-protein foods, merely because the percentages of protein are near the protein percentages for lean meats. And yet, because nuts have little water and much fat and are high-calorie foods, their use does not give a high proportion of protein in the diet but in some cases quite the reverse. A contrary error has been to consider vegetables as low-protein foods because of the low percentages of protein in these watery, fat-free products. If you will study the two forms of expressing protein content for some of the leafy vegetables and compare them with the figures for nuts, you will see how this popular error became established. A vege-



The Brazil nut, like many other nuts, has been considered a distinctly high-protein food, but it is also very rich in fat. It contains approximately 3160 calories per pound.

table diet is not a low-protein diet, but a fruit diet is. Therefore fruits rather than vegetables are the offsetting element for a high-protein meat diet. Less conspicuous errors have been the classing of whole milk as a high-protein food and of cereals and bread as low-protein foods. The idea that using milk greatly increases the protein of the diet is erroneous. The contrary idea that eating bread with meat greatly lowers the protein proportion of the diet is also wrong. The study of this column will correct many errors that have, unfortunately, found their way into even supposedly scientific writings.

The Phosphorus, Calcium and Iron Content

The remaining three columns of the right-hand pages of the table give the amounts of phosphorus, calcium and iron in foods. To comprehend the significance of these elements and to understand why other mineral elements are omitted, you must review the section on mineral elements in nutrition. These three minerals are all given in relation to the unit of 2500 calories of the food. The rarer iron is expressed in milligrams or thousandths of grams, of which nearly half a million milligrams would be required to make a pound. Foods are valuable for these minerals, as gravel might be for its gold.

In the discussion of minerals certain quantities were estimated as safe daily allowances of each of these three. What this means in practice is that the use of such foods as exceed the standard amount tends to raise the proportion of the minerals in the diet and the use of the foods that fail to equal this figure tends to lower the proportion. Of course it is possible to secure all of a given mineral required from one or a few foods. Milk as a source of calcium affords a striking example of this sort. Two thousand five hundred calories of milk yield 435 centigrams of calcium; and since the daily requirements of calcium is but 67 centigrams, an exclusive milk diet would yield more than six times the needed amount. Or to put it in another way, as shown in the second column of the table, 2500 calories of milk is eight pounds (or pints) and therefore only a little over one pint of milk would be needed to supply our daily calcium ration. Hence in any diet using a liberal quantity of milk there is no danger of a calcium shortage. When milk is not used, this danger is quite serious.

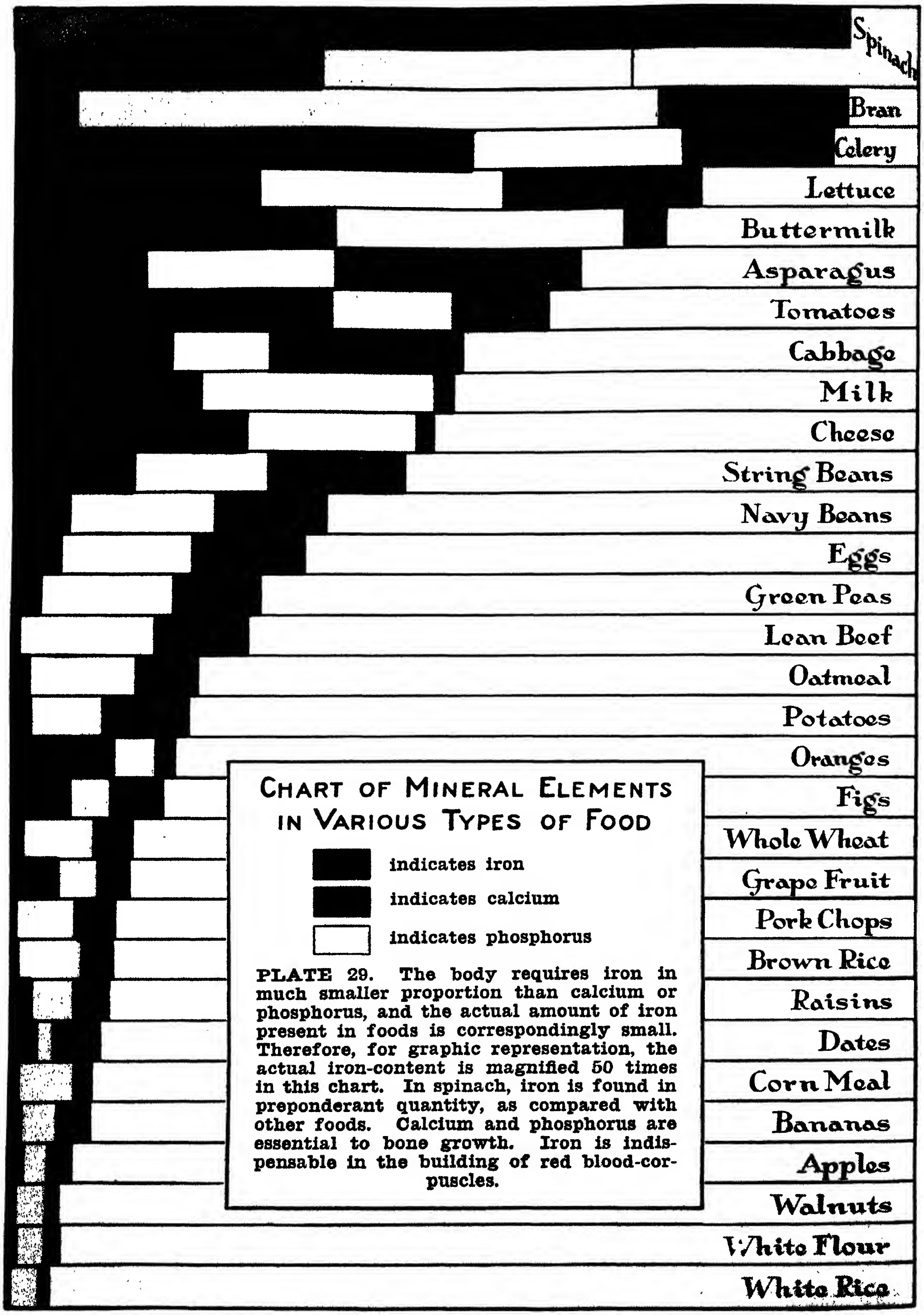


PLATE 29. The body requires iron in much smaller proportion than calcium or phosphorus, and the actual amount of iron present in foods is correspondingly small. Therefore, for graphic representation, the actual iron-content is magnified 50 times in this chart. In spinach, iron is found in preponderant quantity, as compared with other foods. Calcium and phosphorus are essential to bone growth. Iron is indispensable in the building of red blood-corpuscles.

This completes the explanation of the various columns in the tables. It should be stated in conclusion, however, that all food analysis is approximate only. Foods all vary somewhat according to the soil in which they are grown and many other factors. For that reason no figures carried out to several decimal places are given. For the same reason the different cuts of meat, such as are included in many food tables, are not listed. The composition of meat is so dependent upon what portions of fat and lean are included in it that this constitutes a much greater element of variation than the differences in different animals or different cuts. Also no two people partake of the same proportions of fat and lean when eating meat, even from the same platter. As for such foods as pie, cake, puddings and many other cooked dishes, it all depends on the particular recipe. The better way to figure food composition is to work from the raw materials as purchased.

Variations in Food Composition

The experienced student will make no effort to memorize the three thousand facts given in the comprehensive food table. He may not even read the table but use it only for frequent and ready reference. Perhaps, however, the best way to get a basic working knowledge of such facts is to scan through the table from time to time, noting in detail such particular foods as appeal to one's interest. When one is impressed with the composition of a particular food, that will suggest some other food to which he may turn for comparison.

A criticism is often made that such detailed chemical knowledge is merely confusing and useless. That indeed is a just criticism in so far that one could know every fact in these tables and still be at loss as to how to select a good meal. But all purely scientific knowledge must still have added to it the practical skill that comes from common sense and experience. There is, however, one very practical effect that the habit of referring to such a table gives. That is, checking up on, and safeguarding one against being misled by isolated facts or statements made about particular foods. Enthusiasts or commercial interests desiring to boost some favorite product make statements that sound very impressive when standing alone. Before being misled by them use this table to check up the facts and also to see if there are not other products that are equally potent in the qualities claimed.

Content in Foods of Protein, Carbohydrates,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Almonds	2685	17.8	49.4	15.6	*	**	0
Apricots	240	.9	.0	12.2	—	—	—
Apricots, canned	295	.7	.0	15.7	—	—	—
Apples	260	.4	.5	12.8	*	*	**
Apples, dried	1190	1.6	2.0	59.6	—	*	*
Applesauce, sweetened	675	.5	.8	36.5	—	—	**
Artichoke, French	285	3.2	.5	11.7	—	*	—
Artichoke, Jerusalem	320	2.2	.2	17.2	—	—	—
Asparagus	95	1.3	.2	3.3	—	***	—
Asparagus, canned	80	1.2	.1	2.8	—	—	—
Avocado	886	1.9	19.1	7.2	*	**	—
Bacon	2698	9.6	61.6	.0	*	**	—
Bananas	400	1.0	.5	19.9	**	**	**
Barley, pearled	1630	6.6	1.0	76.1	*	**	0
Bass, black	421	19.0	1.7	.0	—	—	—
Beans, baked canned	555	4.8	2.3	19.7	*	***	—
Beans, lima canned	335	3.0	.3	14.3	—	—	—
Beans, lima dried	1565	18.8	1.4	65.6	—	—	—
Beans, lima green	525	5.3	.6	21.6	—	—	—
Beans, red kidney canned	447	6.4	.2	18.1	—	—	—
Beans, red kidney dry	1520	23.0	.7	58.0	*	***	—
Beans, soy	1680	39.2	17.5	17.3	*	***	—
Beans, string	180	1.7	.3	7.2	**	**	**
Beans, string canned	90	.8	.1	3.7	—	—	*
Beans, white dried	1530	26.5	1.6	59.9	*	***	**
Beechnuts	2790	21.7	57.1	12.9	—	**	—
Beef, lean	800	20.0	9.0	.0	—	—	—
Beets	205	1.2	.1	9.4	*	*	*
Beet greens	220	1.7	3.1	3.2	**	**	**
Biscuits, home-made	1655	7.2	12.3	51.8	—	—	—
Blackberries	235	1.0	.9	9.9	—	—	—
Blueberries	300	.5	.5	14.9	—	—	—
Bluefish	382	17.8	1.1	.0	*	*	—
Bran, wheat	1000	8.0	2.0	45.0	*	***	0
Brazil nuts	3160	17.0	66.3	7.0	*	**	—
Bread, Boston brown	1278	5.5	6.0	53.0	*	**	—
Bread, corn (plain)	1170	6.5	4.2	45.2	—	—	—
Bread, rye	1160	7.3	.5	52.0	0	*	0
Bread, pumpernickel	1060	7.6	1.2	50.2	*	**	0
Bread, white wheat	1195	7.1	1.2	52.3	0	*	0
Bread, whole wheat	1125	7.5	.8	49.1	*	**	0
Breadfruit	470	1.6	.5	23.8	—	—	—
Brussels sprouts	208	4.7	1.1	4.3	*	**	*
Buckwheat flour	1600	5.2	1.1	75.9	—	—	—
Butter	3410	1.0	80.8	.0	***	0	0
Buttermilk	154	3.3	.5	4.7	*	**	*

Fat, Vitamins and Mineral Salts

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories *lbs. — ozs.*	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
12 nuts, 5/8 oz.	0—15	75	92	180	15	..............Almonds
7 apricots, 7 oz.	10— 6	41	56	110	13	...............Apricots
3/4 cup, 6 oz.	8— 9	27	—	—	—	.......Apricots, canned
1 medium, 6 oz.	9—10	17	30	50	12	...............Apples
1/4 cup, 1 1/3 oz.	2— 1	17	30	50	12	..........Apples, dried
3/8 cup, 2 1/2 oz.	3—13	8	—	—	—	...........Applesauce
6 oz.	8—13	126	—	—	—	......Artichoke, French
5 oz.	7—13	76	—	—	—	...Artichoke, Jerusalem
1 lb.	26— 0	154	300	440	113	.............Asparagus
20 oz.	31— 0	154	300	440	113	.....Asparagus, canned
1/4 cup, 2 oz.	2—13	25	—	—	—	...............Avocado
1 1/4 oz.........	0—15	40	—	—	—	................Bacon
1 large	6— 4	28	22	78	15	...............Bananas
1 oz. 2 tbs.	1— 9	45	—	—	—	.........Barley, pearled
4 oz.	5—15	508	—	—	—	............Bass, black
3/8 cup	4— 8	97	—	—	—	...Beans, baked canned
5/8 cup 5 oz.	7— 9	100	—	—	—	.....Beans, lima canned
1 oz.	1—10	135	118	363	57	......Beans, lima dried
3/8 cup 3 oz.	4—12	100	50	240	50	......Beans, lima green
1/2 cup (shy)	5—9 1/2	161	100	172	54	Beans, red kidney canned
1 oz.	1—10	170	18	343	50	...Beans, red kidney dry
1 oz.	1— 8	270	—	—	—	............Beans, soy
9 oz.	14— 0	106	270	315	65	..........Beans, string
2 cups	26— 0	111	270	315	66	....Beans, string canned
1 oz.	1—10	158	118	343	50	.....Beans, white dried
1 1/4 oz.	0—14 1/2	86	—	—	—	.............Beechnuts
2 oz.	3— 3	281	16	312	41	.............Beef, lean
8 oz.	12— 8	65	160	210	32	.................Beets
1 cup	11— 2	86	—	—	—	............Beet greens
1 oz.	1— 9	48	—	—	—	....Biscuits, home-made
7 oz.	10—11	47	72	145	26	...........Blackberries
1 cup (shy)	8— 5	18	67	28	30	............Blueberries
4 oz.	6— 9	530	—	—	—	...............Bluefish
1 1/2 oz., 1 cup	2— 8	90	135	1365	88	............Bran, wheat
1/2 oz.	0—13	60	—	—	—	............Brazil nuts
1 1/4 oz. (slice)	1—15 1/2	48	140	205	32	....Bread, Boston brown
1 1/3 oz.	2—2 1/2	62	—	—	—	.....Bread, corn (plain)
1 1/3 oz.	2—2 1/2	70	22	145	16	.............Bread, rye
1 1/2 oz.	2— 5	80	38	269	27	....Bread, pumpernickel
1 1/3 oz.	2—1 1/2	67	35	87	8	.....Bread, white wheat
1 1/3 oz.	2—3 1/2	75	50	180	16	....Bread, whole wheat
4 oz.	5— 5	38	—	—	—	.............Breadfruit
8 oz.	12— 0	253	215	950	88	...... Brussels sprouts
2 1/2 tbs.	1— 9	36	28	162	8	........Buckwheat flour
1/2 oz.	0—11	3	5	5	1	................Butter
10 oz., 1 1/4 cup	16— 4	225	735	680	18	............Buttermilk

Content in Foods of Protein, Carbohydrates,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Butternuts	2805	23.7	55.1	3.2	*	**	—
Cabbage	140	1.2	.3	5.5	*	**	***
Cake, cup	1878	5.4	8.5	67.1	—	—	—
Cake, chocolate layer	1665	5.7	7.7	62.8	—	—	—
Cake, fruit	1605	5.4	10.4	62.8	—	—	—
Cantaloup	165	.6	.0	9.1	**	**	—
Carob (St. John's bread)	1440	4.0	2.2	68.0	—	—	—
Carrots	200	.7	.4	8.9	***	**	**
Carrots, evaporated	1700	5.8	3.2	76.9	—	—	—
Cassava, fresh	540	.6	.1	31.0	—	—	—
Cauliflower	135	1.3	.5	4.7	*	**	*
Celery	80	.8	.1	3.2	—	**	—
Chard	164	2.9	.6	4.9	**	*	—
Cheese, American	1875	26.5	34.2	.3	**	—	—
Cheese, cottage	465	19.2	1.0	4.2	*	—	—
Cheese, soft cream	1470	8.0	32.0	2.4	***	—	—
Cheese, Roquefort	1545	20.9	28.0	1.8	—	—	—
Cheese, Swiss	1830	25.4	34.7	1.3	**	—	—
Cherries	320	.8	.7	15.1	—	—	*
Cherries, canned	365	.9	.6	19.1	—	—	*
Chestnuts, fresh	990	5.3	4.9	37.9	—	*	—
Chicken, broilers	468	19.8	2.4	.0	—	—	—
Chicken, fowl	966	17.8	15.5	.0	—	—	—
Chocolate	2630	11.9	46.3	29.7	—	—	—
Cider	235	—	—	14.7	—	—	—
Citron, dried	1340	.4	1.3	70.3	—	—	—
Clams	225	8.0	.9	2.0	—	—	—
Cocoa	2145	19.9	27.5	37.0	—	—	—
Coconut, fresh	2460	4.8	45.5	25.1	*	**	—
Coconut, prepared	2845	5.8	54.6	25.2	—	—	—
Cod-liver oil	4000	.0	100.0	.0	***	0	0
Cod, dressed	194	10.2	.2	.0	*	*	*
Cod, salt	449	23.4	.3	.0	—	—	—
Collards	210	4.2	.6	6.1	*	**	***
Cookies, average	1740	6.6	8.3	74.2	—	—	—
Cornmeal, whole-grain	1625	7.7	4.5	72.6	*	**	—
Cornmeal, degerminated	1575	8.5	1.8	73.9½	—	0	—
Corn oil	4000	.0	100.0	.0	*	—	—
Cornstarch	1715	.0	.0	90.0	0	0	0
Corn syrup	1515	.0	.0	81.8	0	0	0
Corn, sweet green	445	2.3	1.0	19.0	—	—	—
Corn, sweet canned	430	2.1	1.1	18.3	*	**	—
Cottonseed oil	4000	.0	100.0	.0	0	0	0
Cowpeas, dried	1472	19.7	1.3	59.0	—	—	—

FAT, VITAMINS AND MINERAL SALTS (*continued*)

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories *lbs. — ozs.*	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
½ oz.	0—14	100	—	—	—	Butternuts
12 oz.	17—14	96	358	230	87	Cabbage
1 oz. (shy)	1— 8	31	—	—	—	Cake, cup
1 oz. (shy)	1—8½	38	—	—	—	Cake, chocolate layer
1 oz. (shy)	1—9½	37	—	—	—	Cake, fruit
10 oz. large half	15— 4	52	110	95	18	Cantaloup
1 oz.	1—11¾	32	—	—	—	Carob (St. John's bread)
8 oz.	12— 8	39	310	250	33	Carrots
1 oz.	1—7½	38	310	250	33	Carrots, evaporated
3 oz.	4—9½	12	—	—	—	Cassava, fresh
12 oz.	18— 8	108	1008	500	49	Cauliflower
20 oz. 2 bunches	30— 0	110	1052	502	68	Celery
10 oz.	15— 4	200	982	262	164	Chard
1 oz. (shy)	1—6¾	159	530	390	7	Cheese, American
1 cup (shy)	5— 6	463	—	—	—	Cheese, cottage
1 oz. (shy)	1—11	62	—	—	—	Cheese, soft cream
1 oz.	1—10	152	—	—	—	Cheese, Roquefort
1 oz. (shy)	1— 6	155	—	—	—	Cheese Swiss,
5 oz.	7—13	28	63	78	13	Cherries
½ cup	6—15	27	—	—	—	Cherries, canned
1¾ oz.	2—8½	60	32	110	8	Chestnuts, fresh
4 oz.	5—5½	480	—	—	—	Chicken, broilers
2 oz.	2—9½	207	—	—	—	Chicken, fowl
½ oz.	0—15	50	38	187	11	Chocolate
1 glass	10—10	—	—	—	—	Cider
1¼ oz.	1—13½	3	92	25	25	Citron, dried
7 oz.	11— 2	400	712	705	242	Clams
¾ oz. 3 tbs.	1—2½	104	58	357	14	Cocoa
⅔ oz.	1— 1	22	15	45	7	Coconut, fresh
½ oz.	0—14	23	—	—	—	Coconut, prepared
⅖ oz. 2 tsp.	0—10	0	0	0	0	Cod-liver oil
8 oz.	13— 2	598	—	—	—	Cod, dressed
4 oz.	5— 9	573	—	—	—	Cod, salt
8 oz.	11—10	225	—	—	—	Collards
1 oz. (shy)	1— 7	42	—	—	—	Cookies, average
1 oz.	1—9¼	52	15	255	18	Cornmeal, whole-grain
1 oz.	1—9½	60	12	132	7	Cornmeal, degerminated
⅖ oz. 2 tsp.	0—10	0	0	0	0	Corn oil
5½ tsp.	1—7½	0	0	0	0	Cornstarch
1¼ oz. 2 tbs.	1—10½	0	0	0	0	Corn syrup
4 oz. ½ cup	5— 9	58	—	—	—	Corn, sweet green
4 oz. ½ cup	5—13	55	—	—	—	Corn, sweet canned
⅖ oz. 2 tsp.	0—10	0	0	0	0	Cottonseed oil
1⅛ oz.	1—11	149	72	330	—	Cowpeas, dried

Content in Foods of Protein, Carbohydrates,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Crab meat	331	14.5	1.4	.6	—	—	—
Crackers, graham	1900	7.7	8.5	72.5	—	—	—
Crackers, oatmeal	1785	10.9	10.6	67.6	—	—	—
Crackers, oyster	1905	8.8	9.5	69.3	—	—	—
Crackers, soda	1870	7.6	8.2	71.8	0	0	0
Cranberries	190	.3	.5	8.9	—	—	*
Cream, thin	860	2.5	18.5	4.5	***	**	—
Cream, thick	1720	1.8	40.0	3.2	***	**	—
Cucumbers	80	.6	.2	3.0	—	*	*
Currants, dried	1315	1.9	1.5	67.0	—	—	—
Currants, fresh	230	.6	.2	11.6	—	—	—
Dandelion greens	263	2.2	.9	10.4	**	**	*
Dasheen or taro	490	2.5	.2	25.0	—	*	*
Dates	1415	1.6	2.5	70.7	—	—	—
Doughnuts	1844	6.2	20.0	53.0	—	—	—
Eggs	695	13.0	10.0	.0	***	**	—
Egg, whites	210	12.1	.2	.0	0	—	0
Egg, yolks	1545	14.3	31.6	.0	***	**	0
Eggplant	120	.9	.3	4.9	*	*	—
Endive	80	.9	.1	2.4	*	—	*
Figs, fresh	330	1.0	.1	17.0	—	—	—
Figs, dried	1290	3.4	.3	67.0	—	—	—
Farina	1558	10.1	1.3	74.8	0	—	0
Filberts	2930	13.3	58.8	11.7	—	**	—
Flaxseed	2070	20.8	32.0	21.6	—	—	—
Flour, pure gluten	1630	81.2	.6	16.6	—	—	—
Flour, rye bolted	1580	8.3	.8	76.9	0	*	0
Flour, rye whole	1550	9.7	1.6	71.0	*	**	0
Flour, white	1590	11.2	.9	73.6	0	*	0
Flour, whole-wheat	1560	12.0	2.0	70.4	*	**	0
Garlic	586	6.7	.1	27.6	—	—	—
Gingerbread	1530	5.3	8.5	68.1	—	—	—
Goose	1665	15.0	34.4	.0	—	—	—
Grapefruit	233	.6	.1	12.0	*	**	***
Grape juice (sweetened)	445	.7	.5	20.5	*	*	*
Grapes	390	1.1	1.4	17.3	*	*	*
Haddock	308	15.8	.3	.0	*	*	0
Halibut	522	17.1	4.9	.0	*	*	0
Ham, fresh medium	1365	15.1	27.5	.0	—	—	—
Ham, smoked lean	1125	19.4	20.4	.0	—	—	—
Herring, fresh	612	17.9	6.7	.0	*	*	0
Herring, smoked	1249	34.0	15.0	.0	—	—	—
Hickory nuts	2980	13.1	70.7	10.3	—	**	—
Hominy	1625	6.8	.5	76.9	0	—	0
Honey	1407	.4	.0	79.6	0	*	0

Fat, Vitamins and Mineral Salts (*continued*)

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories *lbs. — ozs.*	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
5/6 oz.	7— 9	492	—	—	—	..............Crab meat
5/6 oz.	1— 5	50	—	—	—	.......Crackers, graham
1 oz.	1—6½	72	—	—	—	.......Crackers, oatmeal
5/6 oz.	1— 5	52	25	62	9	.........Crackers, oyster
5/6 oz.	1—6¾	45	25	62	9	..........Crackers, soda
8 oz. 2 cups	12—12	17	98	67	32	............Cranberries
2 oz. ¼ cup	2—14½	31	125	110	2	............Cream, thin
1⅙ oz. 1⅓ tbs.	1—7¼	11	58	50	1	...........Cream, thick
20 oz.	32— 0	84	223	480	24	.............Cucumbers
1⅓ oz.	1—14½	16	65	152	22	.........Currants, dried
7 oz. 1½ cup	10—14	29	110	165	22	.........Currants, fresh
6 oz.	9— 8	94	430	292	110	.......Dandelion greens
3½ oz.	5—1½	57	—	—	—	........Dasheen or taro
1 oz.	1—12½	12	48	40	21	................Dates
5/6 oz.	1—5¾	42	—	—	—	............Doughnuts
1 large egg	3—10½	210	112	305	51	..................Eggs
8 oz. 1 cup	11—14	648	50	55	5	............Egg, whites
1 oz.	1—11	104	90	290	58	.............Egg, yolks
15 oz.	21— 0	85	102	350	46	..............Eggplant
20 oz.	32— 0	126	—	—	—	................Endive
5 oz. 2 figs	7— 9	32	128	95	24	.............Figs, fresh
1⅓ oz. 2 figs	1—15	30	128	95	24	.............Figs, dried
1 oz. 3 tbs.	1—9¼	73	15	88	5	...............Farina
½ oz.	0—14¼	50	—	—	—	..............Filberts
5/6 oz.	1—3¼	117	—	—	—	.............Flaxseed
1 oz. 4 tbs.	1—8½	558	—	—	—	......Flour, pure gluten
1 oz. 3¼ tbs.	1— 9	58	12	205	9	.......Flour, rye bolted
1 oz. 4 tbs.	1—8½	66	38	269	27	........Flour, rye whole
1 oz. 4 tbs.	1—9¼	79	15	65	26	..........Flour, white
1 oz. 3½ tbs.	1—9¾	84	27	254	26	.....Flour, whole-wheat
3 oz.	4—4½	128	—	—	—	.................Garlic
1 oz.	1—10	38	—	—	—	...........Gingerbread
1 oz.	1—9½	101	—	—	—	................Goose
6 oz. ¾ cup	10—12	28	100	90	14	.............Grapefruit
4 oz. ½ cup	5—10	20	27	21	8	Grape juice (sweetened)
4 oz.	6— 7	31	47	80	8	................Grapes
5 oz.	8— 2	577	—	—	—	..............Haddock
3 oz.	4—13	368	—	—	—	...............Halibut
1¼ oz.	1—13¼	126	—	—	—	....Ham, fresh medium
1½ oz.	2—3½	194	—	—	—	.....Ham, smoked lean
3 oz.	4—1½	330	—	—	—	.........Herring, fresh
1⅓ oz.	2— 1	330	—	—	—	.......Herring, smoked
½ oz.	0—13½	48	—	—	—	...........Hickory nuts
1 oz.	1—8½	47	5	68	6	...............Hominy
1¼ oz.	1—12½	3	5	15	8	...............Honey

CONTENT IN FOODS OF PROTEIN, CARBOHYDRATES,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Huckleberries	300	.5	.5	14.9	—	—	—
Ice-cream	710	3.0	10.0	15.0	***	**	*
Jams and jellies	1200	.5	.1	65.0	—	—	—
Iceland moss	1120	4.0	1.2	60.0	—	—	—
Kaffir corn	1455	6.5	3.6	69.2	—	—	—
Kale	220	4.5	.6	6.3	*	**	***
Kohlrabi	133	1.8	.1	5.4	—	—	*
Lamb, chops	1500	20.0	28.4	.0	—	—	—
Lamb, leg	810	18.2	12.1	.0	—	—	—
Lard	4000	.0	100.0	.0	*	0	0
Leeks	135	1.1	.5	5.7	—	—	—
Lemons	180	.8	.6	7.7	*	**	***
Lemon juice	169	—	—	9.6	*	**	***
Lentils	1475	23.2	.9	58.1	*	**	***
Lettuce	85	.9	.3	2.9	*	**	***
Liver, beef	554	18.8	4.3	1.7	***	**	*
Lobster	346	15.1	1.7	.4	—	—	—
Macaroni	1640	10.4	.8	73.0	0	0	0
Macaroons	1826	6.0	14.5	63.9	—	—	—
Mackerel	495	17.4	6.7	.0	*	*	0
Mango	250	.6	.1	13.1	—	—	—
Marmalade (orange)	1471	.6	.1	82.8	—	—	—
Milk, acidophilus	150	2.8	.5	3.8	*	**	*
Milk, condensed sweetened	1460	8.5	7.9	54.1	***	**	*
Milk, evaporated	705	7.3	8.8	11.0	***	**	*
Milk, goat's	352	4.5	4.7	4.4	***	**	*
Milk, human	285	1.5	3.2	6.9	***	**	*
Milk, skimmed	170	3.3	.3	5.1	*	**	*
Milk, powdered skim.	1602	35.5	2.0	51.0	*	**	0
Milk, powdered whole	2267	25.5	29.0	36.0	***	**	0
Milk, whole	310	3.4	3.7	4.9	***	**	*
Mineral oil	0	0	0	0	0	0	0
Molasses, natural cane	1302	0	0	69.3	—	—	—
Mulberries	240	.3	.0	14.1	—	**	—
Mushrooms	194	3.2	.4	6.7	—	**	—
Muskmelons	160	.5	.0	8.4	**	**	—
Mutton, chops	1660	15.0	31.4	.0	—	—	—
Mutton, forequarter	1445	14.4	27.4	.0	—	—	—
Mutton, leg	795	18.6	11.8	.0	—	—	—
Nectarines	284	.5	.0	15.6	—	—	—
Noodles	1640	9.1	.9	74.3	—	—	—
Nut margarine	3335	1.2	78.9	.0	*	0	0
Oatmeal (rolled oats)	1795	13.4	6.6	65.2	0	**	0
Okra	163	1.5	.2	7.2	—	***	—
Oleomargarine	3335	1.2	78.9	.0	*	0	0

Fat, Vitamins and Mineral Salts (*continued*)

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories lbs. — ozs.	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
5 oz. 1 cup (full)	8— 5	18	67	28	30	Huckleberries
2 oz. ¼ cup	3—9½	46	145	112	3	Ice-cream
1⅓ oz. 2 tbs.	2—1¾	4	—	—	—	Jams and jellies
1½ oz.	2— 4	40	—	—	—	Iceland moss
1¼ oz.	1—11½	50	—	—	—	Kaffir corn
7 oz.	11— 6	230	—	—	—	Kale
12 oz.	19— 2	152	622	415	48	Kohlrabi
1 oz.	1—10½	148	—	—	—	Lamb, chops
2 oz.	3—2½	252	—	—	—	Lamb, leg
⅖ oz. 2 tsp.	0—10	0	0	0	0	Lard
12 oz.	18— 8	91	—	—	—	Leeks
9 oz. 3 lemons	13—14	31	202	123	36	Lemons
10 oz. 1¼ cup	14—14	—	150	—	—	Lemon juice
1¼ oz.	1—13	176	78	315	62	Lentils
20 oz.	30— 0	122	560	560	92	Lettuce
3 oz.	4—8½	381	—	—	—	Liver, beef
5 oz.	7— 5	490	—	—	—	Lobster
1 oz. ⅓ cup	1—8½	73	15	100	8	Macaroni
⅚ oz.	1— 6	36	—	—	—	Macaroons
3 oz.	5— 2	395	—	—	—	Mackerel
7 oz.	10— 0	27	—	—	—	Mango
1¼ oz. 2 tbs.	1—12	4	—	—	—	Marmalade (orange)
10 oz. 1¼ cup	16— 7	209	—	—	—	Milk, acidophilus
						Milk, condensed
1¼ oz. 2 tbs.	1—11½	65	240	180	5	sweetened
2 oz. 4 tbs.	3—10	117	472	365	10	Milk, evaporated
5 oz. ⅝ cup	7— 1	140	406	329	—	Milk, goat's
6 oz.	8—13	60	136	60	—	Milk, human
10 oz.	14—10	225	827	655	17	Milk, skimmed
1 oz. 2 tbs.	1— 9	248	827	655	17	Milk, powdered skim.
⅔ oz. 2 tsp.	1—2¼	126	435	335	9	Milk, powdered whole
5 oz. ⅝ cup	8— 1	119	435	335	9	Milk, whole
0	0— 0	0	0	0	0	Mineral oil
1½ oz. 2⅓ tbs.	1—14½	0	38	63	56	Molasses, natural cane
7 oz. 1⅛ cup	10— 6	14	—	—	—	Mulberries
8 oz.	12—12	185	198	101	—	Mushrooms
10 oz.	15— 9	28	108	95	20	Muskmelons
1 oz.	1— 8	104	—	—	—	Mutton, chops
1¼ oz.	1—11½	112	—	—	—	Mutton, forequarter
2 oz.	3—3¼	260	—	—	—	Mutton, leg
6 oz.	8—13	19	—	—	—	Nectarines
1 oz. ⅓ cup	1—8½	62	—	—	—	Noodles
½ oz. 1 tbs.	0—12	4	—	—	—	Nut margarine
⅚ oz. ⅓ cup	1—6¼	82	42	248	29	Oatmeal (rolled oats)
10 oz.	15— 4	103	—	—	—	Okra
½ oz. 1 tbs.	0—12	4	—	—	—	Oleomargarine

Content in Foods of Protein, Carbohydrates,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Olives, green	1289	1.0	26.2	11.4	—	—	—
Olives, ripe	1070	1.4	23.8	3.4	—	—	—
Olive oil	4000	.0	100.0	.0	*	—	—
Onions	215	1.2	.3	9.6	—	*	**
Onions, green	210	.9	.1	11.0	*	*	**
Oranges	210	.6	.2	10.5	*	**	***
Orange juice	225	—	—	13.0	*	**	***
Oysters	216	5.7	1.1	3.6	—	—	*
Oysters, canned	313	8.1	2.3	3.8	—	—	—
Parsnips	290	1.2	.5	13.0	—	**	—
Pawpaw	225	4.8	.8	6.7	—	—	**
Peaches	230	.6	.1	9.2	—	—	*
Peaches, canned	380	.5	.1	15.0	—	—	*
Peanut butter	2535	23.2	38.1	18.1	*	**	—
Peanuts	2255	21.9	34.7	22.0	*	**	—
Pears	255	.5	.4	12.7	—	*	*
Pears, canned	310	.3	.3	16.2	—	—	—
Pears, dried	1365	2.6	2.1	71.4	—	—	—
Pears, prickly	290	1.1	1.2	11.2	—	—	—
Peas, fresh	430	5.2	.5	16.7	**	**	**
Peas, dried	1508	17.3	.9	62.5	*	**	—
Peas, green canned	235	2.7	.2	9.6	**	***	*
Pecans	3120	9.6	67.0	15.0	*	**	—
Peppers, green	104	1.0	.1	4.5	**	**	**
Persimmons, fresh	585	.8	.7	31.5	—	—	—
Pickles, cucumber	80	.5	.3	2.6	—	—	—
Pie-crust	2018	6.0	32.0	35.0	—	—	—
Pie, apple	1215	2.4	8.8	41.8	—	—	—
Pie, custard	800	3.4	7.6	21.4	—	—	—
Pie, mince	1235	5.3	11.7	37.3	—	—	—
Pimentoes	104	1.0	.1	4.5	**	**	**
Pineapple	187	.4	.3	9.5	**	**	**
Pineapple, canned	660	.4	.7	35.7	—	—	—
Pine nuts (pignolias)	2619	33.6	49.1	6.8	*	*	—
Pistachios	2705	22.1	53.7	15.9	—	—	—
Plums	345	.8	.0	18.2	—	—	—
Plums, canned	395	.9	.0	19.7	—	—	—
Pomegranates	425	1.4	1.5	19.1	—	—	—
Popcorn	1710	9.6	4.8	78.5	*	**	0
Pork, chops, medium	1480	15.3	29.9	.0	—	—	—
Pork, fat salt	3330	1.7	81.9	.0	—	—	—
Pork, fresh shoulder	1485	15.9	29.6	.0	—	—	—
Potato chips	2460	6.5	39.6	45.6	—	—	—
Potatoes, sweet	545	1.3	.6	26.2	**	**	**
Potatoes, white	370	1.7	.1	17.7	*	**	**
Pumpkins	110	.7	.1	5.0	*	*	*
Prunes, fresh	325	.7	.0	17.1	**	**	—

FAT, VITAMINS AND MINERAL SALTS (*continued*)

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories *lbs. — ozs.*	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
1¼ oz. 6 or 7	1—15	8	102	10	24	..........Olives, green
1½ oz. 6 or 8	2—5½	14	102	10	24	............Olives, ripe
⅖ oz. 3 tsp.	0—10	0	0	0	0	.............Olive oil
8 oz. 3 or 4	11—14	63	172	232	25	..............Onions
8 oz.	11—14	48	172	232	25	.........Onions, green
8 oz. 1 large orange	11—14	32	220	100	9	..............Oranges
7 oz. 1 cup (shy)	11— 2	—	167	92	11	..........Orange juice
8 oz.	11— 9	296	265	765	223	.............Oysters
5 oz.	7—15	277	—	—	—	......Oysters, canned
6 oz.	8—10	46	228	292	22	.............Parsnips
7 oz.	11— 2	240	—	—	—	..............Pawpaw
7 oz. 2 large	10—14	29	95	143	18	.............Peaches
4 oz. 4 halves	7— 2	15	—	—	—	.....Peaches, canned
⅔ oz. 1⅓ tbs.	1— 0	102	32	183	9	..........Peanut butter
⅔ oz. ¼ cup	1—1¾	110	32	183	9	..............Peanuts
6 oz. 2 pears	9—14	23	60	102	12	................Pears
5 oz. 4 halves	8— 1	11	—	—	—	.......Pears, canned
1¼ oz.	1—14	21	60	102	12	...........Pears, dried
6 oz.	8—10	42	—	—	—	..........Pears, prickly
4 oz. ¾ cup	5—13	136	65	312	41	............Peas, fresh
1 oz. 2 tbs.	1—10½	120	65	312	41	............Peas, dried
7 oz. 1 cup (full)	10—10	128	65	312	41	.....Peas, green canned
½ oz. 12 meats	0—13	34	30	113	8	................Pecans
1 lb. 16 peppers	24— 0	108	85	362	55	.........Peppers, green
3 oz.	4—4½	15	—	—	—	.....Persimmons, fresh
20 oz.	30— 0	70	223	480	24	......Pickles, cucumber
⅚ oz.	1— 4	33	—	—	—	..............Pie-crust
1⅓ oz.	2— 1	22	—	—	—	.............Pie, apple
2 oz.	3— 3	47	—	—	—	...........Pie, custard
1⅓ oz.	2—0½	48	—	—	—	.............Pie, mince
1 lb.	24— 0	108	85	362	55	.............Pimentoes
8 oz.	13—10	24	102	160	29	............Pineapple
3 oz. 1 slice	3—14	7	—	—	—	......Pineapple, canned
⅔ oz.	0—15	144	—	—	—	. . Pine nuts (pignolias)
⅔ oz.	0—14¾	92	—	—	—	.............Pistachios
5 oz. 4 plums	7— 4	26	60	95	15	................Plums
4 oz. ½ cup	6— 7	28	—	—	—	..........Plums, canned
4 oz.	5—15	32	—	—	—	..........Pomegranates
1 oz.	1—7½	63	15	255	18	.............Popcorn
1¼ oz.	1—12	116	—	—	—	...Pork, chops, medium
½ oz.	0—12	6	—	—	—	.........Pork, fat salt
1¼ oz.	1—11	120	7	132	19	....Pork, fresh shoulder
⅔ oz.	1—0¼	29	—	—	—	...........Potato chips
3 oz. ½ medium	4— 9	27	40	92	10	........Potatoes, sweet
5 oz. 1 medium	6—12	55	40	173	39	........Potatoes, white
14 oz.	22—12	71	223	572	32	............Pumpkins
5 oz. 3 large	7—11	24	45	87	25	.........Prunes, fresh

CONTENT IN FOODS OF PROTEIN, CARBOHYDRATES,

NAME OF FOOD	Calories Per Pound	Percentage of Protein	Percentage of Fat	Percentage of Carbohydrates	Vitamin A	Vitamin B	Vitamin C
Prunes, dried	1230	1.6	.0	66.1	**	*	0
Quince	195	1.0	.0	9.0	—	—	—
Rabbit	550	23.0	4.0	.0	—	—	—
Radishes	130	1.0	.1	5.6	—	*	—
Raisins	1410	2.6	3.0	68.7	—	*	0
Raspberries, black	270	1.4	.9	11.4	—	—	**
Raspberries, red	285	1.7	1.0	12.4	—	—	**
Rhubarb	100	.4	.6	3.5	—	—	*
Rice, polished	1610	7.4	.3	76.9	0	0	0
Rice, unpolished	1590	8.0	1.9	74.6	*	**	—
Rutabaga	165	1.2	.2	8.5	*	**	***
Rye, whole	1515	10.9	1.7	71.7	*	**	0
Sardines, canned	1145	21.0	18.7	.0	—	—	—
Salmon, fresh	559	13.7	7.7	.0	*	*	—
Salmon, canned	877	21.8	12.2	.0	*	*	—
Sauerkraut	105	1.6	.5	3.6	*	*	—
Savita	480	19.5	.4	5.9	0	***	0
Shad	691	18.6	9.0	.0	*	*	0
Shad roe	553	20.7	3.5	2.6	**	**	—
Shredded wheat	1577	9.7	1.4	76.4	*	**	—
Shrimp, canned	480	23.4	9.5	.2	*	—	—
Spaghetti	1640	9.4	.4	75.0	—	—	—
Spinach	100	1.6	.3	3.2	***	***	***
Spinach, canned	110	1.7	.4	3.4	***	***	*
Squash	205	1.1	.5	8.6	*	*	*
Strawberries	160	.8	.5	6.8	—	*	**
Strawberries, canned	376	.5	.3	21.7	—	—	—
Sugar, brown	1700	.0	.0	95.0	—	—	—
Sugar, granulated	1790	.0	.0	100.0	0	0	0
Syrup, maple	1485	.0	.0	82.8	—	—	—
Tamarind	640	1.3	.0	36.0	—	—	—
Tapioca	1685	.3	.1	88.0	—	—	—
Toast, white bread	1434	8.7	1.4	62.8	—	—	—
Toast, whole wheat	1350	9.0	2.4	58.9	—	—	—
Tomatoes	100	.7	.4	3.8	**	**	***
Tomatoes, canned	100	.7	.4	3.8	**	**	***
Tuna fish	899	26.4	10.9	.0	*	*	—
Turkey	1254	20.9	22.8	.0	—	—	—
Turnip	175	1.0	.2	7.8	*	**	**
Turnip greens	195	3.9	.6	6.1	—	—	—
Veal, leg of	660	19.1	7.9	.0	—	—	—
Walnuts, California	2640	18.2	64.0	12.8	*	**	—
Walnuts, black	2961	27.4	56.0	11.5	—	**	—
Watermelon	125	.3	.2	6.0	—	—	—
Wheat, whole cracked	1553	11.8	1.7	70.0	*	**	0
Yeast	460	14.5	.5	10.0	0	***	0
Zwiebach (fat added)	1820	9.5	9.4	71.5	—	—	—

FAT, VITAMINS AND MINERAL SALTS

100 Calorie Portions Approximate Measurements	Weight of 2500 Calories *lbs. — ozs.*	Grams Protein in 2500 Calories	Centi-grams Calcium in 2500 Calories	Centi-grams Phos-phorus in 2500 Calories	Milligram Iron in 2500 Calories	NAME OF FOOD
1⅓ oz. 4 medium	2—0½	15	45	87	25	Prunes, dried
8 oz.	12—12	57	—	—	—	Quince
3 oz.	4— 9	466	—	—	—	Rabbit
12 oz.	19— 4	85	182	245	51	Radishes
1¼ oz. ¼ cup	1—12¼	20	48	95	15	Raisins
6 oz. 1⅛ cup	9— 4	58	—	—	—	Raspberries, black
6 oz. 1⅛ cup	8—13	67	185	195	22	Raspberries, red
1 lb.	25— 0	45	472	335	108	Rhubarb
1 oz. 2 tbs.	1— 9	51	2	67	4	Rice, polished
1 oz. 2 tbs.	1—9½	56	8	150	14	Rice, unpolished
10 oz.	15— 4	81	462	350	—	Rutabaga
1 oz. 2 tbs.	1—10½	75	38	269	27	Rye, whole
1⅓ oz.	2— 3	203	—	—	—	Sardines, canned
3 oz.	4— 7	275	—	—	—	Salmon, fresh
2 oz.	2—13	279	—	—	—	Salmon, canned
1 lb. 2 cups	24— 0	171	358	230	87	Sauerkraut
4 oz. ¼ cup	5—3½	456	—	—	—	Savita
3 oz.	3—11	302	—	—	—	Shad
3 oz.	4—8½	423	—	—	—	Shad roe
1 oz. 1 biscuit	1—9½	69	28	223	30	Shredded wheat
4 oz.	5— 4	509	—	—	—	Shrimp, canned
1 oz. ⅓ cup	1—8½	64	—	—	—	Spaghetti
1 lb.	25— 0	180	702	713	386	Spinach
1 lb. 2 cups	23— 1	180	702	713	386	Spinach, canned
8 oz.	12— 4	61	98	87	32	Squash
10 oz. 1⅓ cup	15— 7	56	260	180	51	Strawberries
4 oz.	7— 2	15	—	—	—	Strawberries, canned
1 oz. 2 tbs.	1—7½	0	—	—	—	Sugar, brown
1 oz. 2 tbs.	1—6½	0	0	0	0	Sugar, granulated
1¼ oz. 2½ tbs.	1—11	0	92	8	25	Syrup, maple
3 oz.	3—15½	22	—	—	—	Tamarind
1 oz. 2 tbs.	1— 8	2	—	—	—	Tapioca
1¼ oz.	1—13	68	42	104	9	Toast, white bread
1¼ oz.	1—13½	71	60	54	19	Toast, whole wheat
1 lb.	25— 0	79	125	283	44	Tomatoes
1 lb. 2 cups	25— 0	79	125	283	44	Tomatoes, canned
2 oz.	2—13	330	—	—	—	Tuna fish
1⅓ oz.	2— 0	186	—	—	—	Turkey
10 oz.	14— 4	65	402	290	31	Turnip
8 oz.	12—14	225	—	—	—	Turnip greens
3 oz.	3—14	330	—	—	—	Veal, leg of
⅔ oz.	0—15	78	32	38	7	Walnuts, California
½ oz.	0—13½	107	—	—	—	Walnuts, black
14 oz.	20— 0	27	95	25	24	Watermelon
1 oz. 2 tbs.	1—10	83	32	293	35	Wheat, whole cracked
4 oz. 4 cakes	5— 7	355	—	—	—	Yeast
⅚ oz.	1— 6	58	35	87	8	Zwiebach (fat added)

DIET FOR WEIGHT REDUCTION

Section 16

MODERN food science approves of three fundamental health-building methods of reducing weight. These are fasting, diet and exercise. The three methods are really related; in practice it is better to combine two or all three of them than to depend on one alone, as each has its advantages and limitations.

Reducing by Fasting

Fasting has the great advantage of rapidity in reduction. Indeed, fasting and exercise combined make the fastest of all reducing methods. However, only the well-developed physical culturist could safely combine fasting with any great amount of muscular exercise. Fasting alone, or with the continuance of the amount of muscular exercise to which the person is accustomed, will reduce the weight in this manner:

At the beginning of the fast there will be an amount of weight lost which is equal to the normal contents of the alimentary canal. This will range from two to five pounds and may include the weight of some water lost from the blood resultant upon the stopping of the daily intake of common salt. This initial loss gives an illusion of very rapid reduction during the first few days of fasting, but that part which is not fat will be regained when normal eating is resumed.

Rate of Reduction During Fasting

Real reduction during fasting will be due to the consumption of fat as body fuel in place of the customary food. Chemically pure fat has a fuel value of 4000 calories per pound. But fatty tissue in the body is about one-fourth moisture, so that a pound of body fat equals about 3000 calories. One whose size and activities require 3000 calories a day should therefore lose a pound a day in fasting. One whose caloric requirements were 2000 should lose two-thirds of a pound per day. The loss of weight in fasting averages a little greater than these figures, owing to the fact that some non-fatty tissues are also being consumed, though more slowly. In complete fasting the muscles, blood, liver, and other vital parts, also decrease in weight. Practical experience shows that the average man, taking a moderate amount of exercise and not engaged in heavy physical labor, loses about a pound a day during a fast. The average woman, not athletically inclined, should lose about three-fourths of a pound a day.

One disadvantage of fasting as a sole measure to reduce weight is that in the case of great overweight, too long a fast is required. Also the effect of fasting is to increase the body's power to utilize and build weight out of every bit of food when eating is resumed. For this very reason, a short term of fasting, followed by the milk or other body-building diet, is an excellent method of gaining weight. Therapeutic or curative fasting is a body housecleaning followed by body rebuilding. Therefore, when the rebuilding process is not to follow the fasting, much of the therapeutic advantage of fasting is lost. Also the normal appetite and high digestive powers that follow fasting make the struggle to prevent regaining weight rather difficult.

Factors in Fasting

The difficulties just enumerated would, in many cases, overbalance the advantages of greater speed in reduction. However, if the fasting period is not too long, say not more than one or two weeks, the refattening can be avoided if one exercises a reasonable degree of will-power. The diet in such a case, though highly vital to replace any non-fat elements that the body has eliminated during the fast, should be strictly limited in quantity. A program of intermittent fasting, with alternate periods of highly efficient revitalizing but limited diets, also constitutes a good program for reduction. The fasting periods may last one, two or three days, or even a week or ten days, with similar food-taking periods between.

Any such program properly carried out should give the body essentially the same amount and quality of nourishment as it would get on an ideal reducing diet. Any well-selected reducing diet might allow 1000 calories per day. If the diet between fasts gives 2000 calories per day, the effect in the long run will the same, as the same amount of food is eaten. In certain cases of digestive troubles the rest period for the stomach may be an advantage. Whether one uses such an intermittent fasting method, or a steady reducing diet, is, therefore, largely a matter of personal opinion or of personal

A twelve weeks' diet not only effected a weight reduction of thirty-eight pounds for this subject but brought about increased vitality and perfect health. Systematic exercise and bathing contributed to the success of the diet.

Exercise for Reducing

experience. Many people, however, prefer to start a reducing program with a few days' fast. This gives them encouragement, because of the additional weight losses that such a start involves. Perhaps also they so appreciate the food allowed them when they resume eating that it may help to reconcile them to a lesser amount. It is largely a matter of psychology which plan is adopted. The point is, if you want to reduce, the food intake must be decreased.

Exercise is a fundamental part of any intelligent reducing program. Athletes, like baseball players and boxers, who have intermittent periods of loafing, go into training to work off any accumulated fat. Often they pay little or no attention to diet;

yet they lose weight by exercise alone at satisfactory rates. They can do this because they have the muscular systems and muscular ability to take on sufficient muscular activity to burn up the accumulated fat.

But most people who want to reduce are not athletes. Often the same habits of overeating and physical laziness that have been responsible for their fat have been responsible also for their abandonment of exercise. The typical woman of today takes practically no real exercise, and neither does the fat middle-aged business man. When such people suddenly decide to reduce, unless they are under the supervision of an expert physical trainer, they are likely to overdo the exercise at first, strain their weakened muscles and become discouraged. They are really too weak muscularly to be able to burn up any great amount of fat in this fashion. Moreover, if they pay no attention to diet, the sudden increase of physical activity is likely to stimulate their appetites so that they will eat enough more food to offset any reducing effect of the exercise. Naturally they become discouraged with reduction by exercise. If intelligently combined with diet, however, exercise is a valuable aid in reduction. It should be begun gradually and gradually increased as the muscles develop strength and as the body lightens in weight. There is no better exercise for this purpose than walking. It is easy to gage the distance walked and to increase it a little each day or week.

Women and Exercise

In addition to its general health-building and reducing effect, exercise while reducing is valuable for the following reasons: As the fatty deposits are removed from the body the muscles are built up to replace them. Therefore, one improves in bodily appearance in two ways, and there are two factors of general health improvement instead of one. A person who has been quite obese, and who takes off the fat without any muscular upbuilding, may arrive at the correct weight and still not possess a good physical appearance. He will still carry excess fat, and if he eliminates all this excess fat he becomes skinny and baggy and apparently underdeveloped.

A well-planned diet is unquestionably the most important factor in reducing, and its disadvantages exist only in the minds of those who would rather remain fat and unsightly and imperil their health than learn correct reducing principles and curb their appetites sufficiently to enable the body to burn up its accumulated store of fuel. It is true that some temporary hardship is involved, but one should not expect to continue to enjoy the customary pleasures of eating while reducing. To a certain extent a reducing program is a punishment for past indulgences. Fat has been accumulated through an overindulgence in food and must be eliminated not only by discontinuing the habit of overeating but, while the fat is being burned up, by definitely undereating. This means that one must go hungry. With every possible artifice to decrease the symptons of this hunger, it cannot be entirely banished. The more quickly the fat person accepts this fact, the more quickly he will reduce. However, the idea of mere self-punishment can be overdone, as it frequently is by people who put themselves upon some poorly selected monotonous foods and make a sort of bread-and-water jail regimen out of their reducing program.

Hunger

The secret of successful weight reduction lies in the selection of a well balanced reducing diet and in the perseverance with which it is followed. The diet followed by the subject of these illustrations was composed chiefly of vegetables, fruits, whole wheat toast and buttermilk, with limited quantities of liver and eggs.

The most important and

essential principle of a reducing diet is that the total food-intake, as measured in calories, should be materially below the weight-maintaining requirement. Unfortunately this requirement varies with each individual. The figure of 2500 is commonly given as the average caloric requirement for a man at light indoor labor, or a sedentary man taking moderate exercise. The requirement of the average woman who is a housewife or office worker is placed at 2000. These figures apply for people of average height. Those of greater stature or of unusually heavy build would use more calories, and those of small stature or light build would use less.

Decreasing the Calories

In theory, any decrease below one's caloric requirements should result in reduction. In practice, reduction does not occur in a satisfactory fashion until the caloric intake is decreased considerably, say to one-half or less of the weight-maintaining requirements. The reason is that when the food-intake is lowered the body tends to utilize its supplies with greater economy. Therefore, if one lowers the food-intake only ten or twenty per cent., one does not reduce in proportion to this decrease. Thus, if a man on a complete fast reduced a pound a day, he should, on a food reduction of twenty per cent., reduce one-fifth of a pound a day. In practice he would not quite do it. A reduction of a tenth or a fifth of a pound a day would be discernible in a month and amount to a lot in a year, but it is discouragingly slow when considered by the day or week. The true weight of the body and changes in the same cannot be accurately determined for the following reasons: inaccuracy in scales, variation in clothing, variation in weight of contents of digestive organs, and variation in the amount of water in the body. These elements of inaccuracy cause weights to fluctuate from one to three pounds from the theoretically correct standard. Therefore, in following a slow reducing program one may first appear to be losing, then to be gaining, even with weekly weighings. This is invariably discouraging and confusing.

Fluctuation of Weight During Diet

People are impatient, and even reductions of from two to three pounds a week, which are the losses commonly recommended, seem all too slow. In a particular weighing such losses may appear to be wiped out by the type of errors mentioned above. If these collective errors cause one to appear to lose four pounds one week, one may become overconfident and relax the diet the next week, and if the next week there appears to be no loss at all one may get discouraged and throw up the whole venture. Such reactions are more likely in the case of a very gradual reduction than if the process is rapid.

Reducing and Psychology

At best, reducing is more or less psychological. One needs every encouragement possible. A New York physician who has specialized in reduction with great success insists upon making nude photographs of all patients when they start treatment under him, as the photo of an obese person has often proven effective in shocking him into persistence in his reduction treatment. Any such mental factors that will aid the will-power are important, and the avoidance of any factors of discouragement are even more so.

The second principle of reducing is that there are no reducing foods. Any true food has some fat-building properties. Even lettuce, celery or cucumbers, which represent our least fattening foods, contain 80 calories per pound. Although this is only one-fiftieth of the 4000 calories per pound contained in lard or oil, such a food is not positively reducing. There are also no foods which, eaten in addition to other foods, will cause the body to lose weight. The only substances which would do that are a few dangerous drugs, unless we wish also to count purges or physics in this category. The latter do not reduce fat, but by causing half-digested food to pass out of the body have a reducing effect.

No Foods Strictly Reducing

No foods can be considered as reducing foods, therefore, except in the sense that they are less fattening than other foods. The degree to which foods are fattening depends directly upon the caloric value of amounts actually eaten. The reason that lettuce is reducing is that one cannot possibly eat enough of it to get fat or even maintain weight. A cow might do so, as she has a stomach as big as a bushel basket. But a man would have to eat twenty to thirty pounds a day, and no man could do it. Hence any food of which a man could not eat enough in a day to meet his caloric requirements would in practice, be a "reducing food."

Assuming the caloric requirements to be 2500 a day, one can figure what the reducing foods would be from the table giving the weight of 2500 calories of each food. On the assumption that one would not eat over five pounds of a food per day we can figure foods having less than 400 or 500 calories per pound as reducing foods. However, this is not a wholly safe rule, as will be seen from the consideration of milk. On the milk diet one maintains and gains weight, even though milk only has 310 calories per pound. Also one can maintain weight on potatoes, but this is usually because they are eaten with butter or other added fat.

The foods of which one will rarely eat enough to jeopardize a reducing diet, even when eating freely are, first and foremost, the leafy vegetables. Next to these comes bran; tomatoes are third, and the pod vegetables, like string beans, peppers and okra, fourth. Root vegetables, if no fat is added in cooking, are rarely eaten in quantities to endanger a reducing diet, the exceptions being potatoes and sweet potatoes. Few would like carrots, beets, turnips or onions well enough to eat them in an amount to exceed 200 or 300 calories a day. **Vegetables**

Fruits are more palatable than vegetables. They generally run a little higher in calories, and some of them, like grapes, can be eaten in huge quantities. Therefore they are not so safe to eat freely in a reducing diet as are vegetables. Moreover, unless cautioned against it, people are likely to eat fruits with added sugar, which would double or triple the calories. If a fruit like pineapple or peaches is mentioned in the diet and it is only available canned, one eats the fruit soaked in a sugar syrup which greatly increases the caloric value. **Fruits**

About the only other products which can be freely and wisely used in a reducing diet with little danger of overuse are skim-milk, sour milk, buttermilk and whey. Outside of the list just mentioned one must figure calories and restrict quantities. The one-hundred-calorie portions in the food table give an approximate way to calculate calories. One can be as detailed and accurate in calculating calories as one wishes. A sensible compromise method would be to eat freely of the foods above discussed, subject to the cautions mentioned, and calculate other items. One can aim at a thousand calories per day, and if one hits it within twenty per cent. one is within a range of 800 to 1200 calories per day and will have a safe reducing program. **Dairy Products**

Besides the primary problem of restricting the amount of

PHOTOGRAPH EWING GALLOWAY

The grapefruit, rich in vitamins, is here shown amidst the thick foliage of the tree that bears it.

food, we have several other factors to consider which help to make reducing less of an ordeal or increase the factor of health safety.

Mastication

First among these are methods of decreasing the symptoms of hunger. Eat slowly, chew your food. Select foods that require and encourage mastication. Do not use highly seasoned dishes. Cultivate the pleasures of taste, as it may be developed for almost any edible product, if a man is really hungry. The way people on reducing diets come to enjoy foods previously disliked is amazing. One man who had always refused to eat bran, considering it "sawdust," was persuaded, in the midst of a reducing diet, to eat a dish of it and became a bran fiend, eating two or three bowlfuls a day.

Uncooked foods as compared with cooked ones have many advantages in reducing diets. Thus cooked fruits are rarely eaten without sugar, whereas almost all raw fruits can be enjoyed without it. Eating grapefruit saturated with sugar is a common habit, but anyone can learn to like unsweetened grapefruit.

Cooked vegetables have the disadvantage of being softer than raw ones and requiring little mastication, to say nothing of the custom of adding butter and other fats in cooking them. The keen appetite developed by a reducing diet will enable one to enjoy plain boiled potatoes or cabbage, with a little salt or even without salt. However, uncooked vegetables are better, because they require mastication and one rarely overeats on them. Most root vegetables can be grated or chopped or slivered and used with leafy vegetables to make an endless variety of salads, but one must not use oil with them.

Cooked Food Faults

The more foods are chewed, the longer the time taken to eat them and the greater the bulk in the stomach, the more easily is hunger satisfied with a lower amount of calories. Another element in the prevention of hunger comes from the retention in the digestive organs of considerable bulk throughout the process of digestion. The sense of hunger comes primarily from the emptiness of the digestive organs and not from any lack of nourishment in the blood.

A further factor in the ideal reducing diet is the prevention of constipation. This overlaps on the previous topic, because the non-digestible cellulose is not only essential to the prevention of constipation, but also decreases hunger by giving bulk in the digestive organs. Bran is the leading high-cellulose product in the market. Agar contains even more cellulose than bran, but it is more expensive and not very palatable, though it can be used as a substitute for gelatine. Almost all leafy vegetables, and even pod and root vegetables, contain considerable amounts of cellulose.

How to Prevent Constipation

The prevention of constipation is always important to health. It requires special consideration in a reducing diet, because the total amount of food is decreased; hence the total amount of bowel waste would be decreased proportionately unless specially augmented by foods containing an unusual proportion of cellulose. Moreover, if the bowels are kept active, even to the extent of some looseness, the movement of foods through the digestive tract is hastened, and not only is waste eliminated more promptly but the percentage of food digested is not so great. Indeed, this principle is sometimes applied in reducing by taking drug laxatives. Such laxatives are not generally to be recommended; yet their effectiveness in this respect cannot be disputed, and under the circumstances of reduction their use would be preferable to the opposite condition of constipation. However, the ideal method is to keep the bowels active with an abundance of cellulose, which can be supplemented by moderate amounts of mineral oil.

Cellulose in the Diet

Mineral oil is absolutely non-fattening, since it is completely indigestible. It lubricates the bowels in case of dry and hard movements. It has the further advantage, in a reducing diet, of being a substitute for salad oils. One can make mayonnaise by whipping cold mineral oil into egg-yolk and thinning with lemon juice. One can also use mineral oil and lemon juice with a little salt, in imitation of the French dressing. The taste of this oil on salads can hardly be distinguished from that of real salad oil. One caution only is important. The quantity of mineral oil used in any diet should be limited to the amount that the cellulose residue will absorb and retain. Otherwise leakage may occur. The mineral oil can be mixed with bran to the extent of about two tablespoonfuls of the oil to a cupful of the bran. If this bran is eaten at the same meal with salads, larger quantities can be used on the salad and the bran will absorb it during digestion.

Reducing Diet Should Be Palatable

Tastiness and variety are important aids to making reducing diets satisfying and enabling one to keep them up for longer periods. It is unfortunately true that much of the tastiness of our conventional cookery is due to the presence of fats, and unless fried foods, pastries, fat soups and buttered vegetables are abandoned, one cannot expect to reduce. However, apart from this one restriction, there is a wide possibility of variety in a reducing diet. Sweet foods need not be eliminated, but they must be restricted in quantity and natural sweets should be chosen in preference to foods sweetened with refined cane sugar. The reason for this leads us to our next topic.

It is important that a reducing diet, especially when continued for a long period of time, should contain a good supply of minerals and vitamins. Otherwise the lowering of the food intake over a long period would result in mineral and vitamin starvation. It is surprising to find that even intelligent doctors and teachers of nutritional science sometimes publish menus for reducing which are scientific and correct as to calories, but which are nevertheless made up of such foods as white bread, refined cereals, refined sugar and even added fats. Such diets lead to mineral and vitamin deficiency, even when eaten in ordinary amounts. When these amounts are cut in two the vitamins and minerals are also reduced by one half, though the body's need for them is not particularly affected by the process of weight-reduction. Such diets naturally lead to impaired health.

Vitamins in the Reducing Diet

It is not difficult to secure an ample supply of minerals and vitamins during reduction, if the proper types of foods are chosen. Leafy foods are relatively very rich in all vitamins and minerals, while tomatoes, whether raw or canned, are an excellent source of vitamins, and both these foods are especially adapted to reduction. Unsweetened grapefruit and oranges are nearly as good as tomatoes as a source of vitamins, though they have a slightly higher caloric value.

Iron is the most important mineral in reduction. Leafy vegetables and bran are both good sources. An egg a day, or the yolk of one used in a salad dressing, is an excellent source of both iron and vitamins, including the fat-soluble vitamin. It adds a little fat, but this is permissible because of its other advantages. Lean meat, if free from fat, is also a good source of iron, but liver, which is also free from fat, is the best iron source.

Calcium

Calcium is also important in reduction, and for this reason all prolonged reducing diets should contain some milk. A quart a day supplies a sufficient amount of calcium and skim-milk, sour milk or buttermilk, while containing quite as much calcium as whole milk, adds only half as many calories. Cottage cheese contains most of the calcium of the milk from which it is made.

A reducing diet should also contain a reasonable amount of protein. Some of the early European reducing diets were practically lean-meat diets, but meat is not necessary, and in any large proportion not advisable. It is acid-forming and deficient in calcium, while a useless excess of protein is especially injurious in reduction if there is any tendency to constipation. If all fat is carefully trimmed off and none added in cooking it may, however, be permitted in limited quantities, the acid-forming effects being offset by leafy vegetables. A small serving of meat not to exceed a quarter of a pound can be used once a day, though preferably should be alternated with cottage cheese and eggs.

Protein

Enough protein can be secured without meat if a quart of any kind of milk is used and an average of one egg a day. The leafy vegetables are high in protein, as the tables indicate. Bran also contains considerable digestible protein. The only type of reducing diet likely to result in protein deficiency would be one composed chiefly of fruits. These are all right for periods up to a month, and their use for such a period often has a good therapeutic effect. For longer periods, however, the diet should supply protein.

The "Don't" Diets

Many so-called reducing systems are constructed on a negative basis. People are not told what to eat but what to avoid. Thus we find people eliminating bread or potatoes, or substituting saccharine for sugar. Such methods are effective only in exceptional cases. If a person has been in the habit of eating an excess of bread, butter and potatoes, the elimination of this excess, provided it is not replaced by other food, may have a moderate reducing effect. The elimination of candies and highly sweetened foods, when these have been used to excess, may also be satisfactory, particularly when the omission of sugar makes other foods less attractive because of the lack of sweetening.

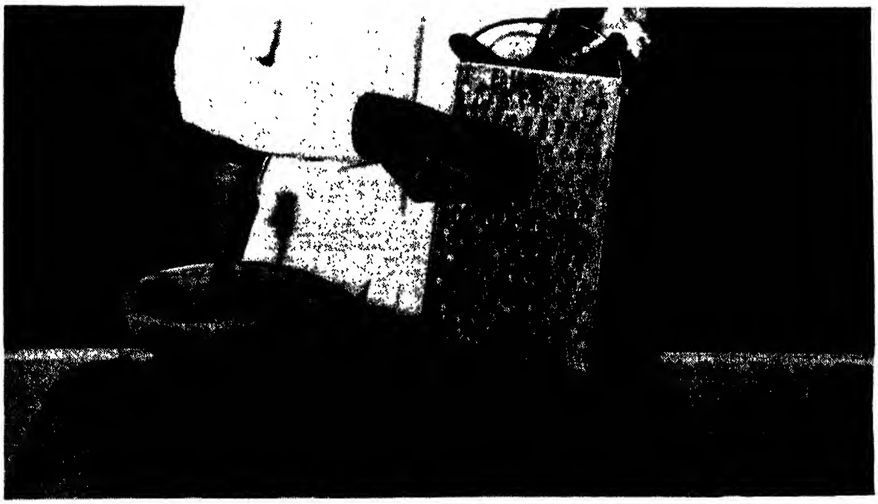
Abstinence from salt is sometimes prescribed for reducing. It has an immediate reducing effect of a few pounds, because it decreases the body's water content, but beyond that it would have no effect unless it discouraged overeating by making foods less tasty. Another reducing idea having but little foundation is that of restricting water, abstaining from all water at meals and from moist foods. Obviously this will dry out the body and reduce it a few pounds, but the weight is regained when the thirst is again fully satisfied. These dry diets may also have the secondary effect of reducing the appetite by making foods less palatable.

None of the above devices, however, will be wholly effective in reduction. There is only one kind of food that should be forbidden in a reducing diet and that is fat. Pure fat contains two and a quarter times as many calories per pound as pure sugar, which is the next-highest food in the caloric table. Therefore, fats in the diet increase the calorie count fastest, and their reduction most rapidly decreases it.

Avoid Fats

There are more fundamental reasons than these for forbidding fats in the reducing diet, however. The body continues to "feed;" that is, to metabolize, use up and destroy nutritional elements whether one is eating much food, little food, or no food at all. A man on a fast is feeding wholly upon his own body. The man on a reducing diet is feeding partly on the fat on his body and partly on the food eaten.

In the ideal reducing diet all needed elements are supplied except that which is supplied by the body; namely, fat. Therefore, if one is on half rations, half the needed calories come from body fat. This means that one-half of the total utilized nutrition is fat. Therefore, a reducing man does not need any more fat in his food and any fat eaten merely unbalances his nutrition. This, in extreme cases of prolonged obesity, may have serious results, as it does in the case of diabetic diets where carbohydrates are forbidden and almost all the body fuel is derived from fat. This abnormal condition is known as *acetone*



Raw vegetables are a mainstay of some reducing diets. By clever slicing and grating most root vegetables can be made palatable ingredients of salad.

Cause of Acetone Acidosis

acidosis, the body being poisoned because it fails to metabolize completely the excessive amount of fat, producing acetone instead of carbon dioxide.

While there is no great danger from acetone acidosis in an ordinary reducing experience, it is sensible to take precautions to avoid it and not to add to the job of oxidizing fat by adding more fat from the diet. It may be impractical to eliminate all fat in foods, as many natural products contain them, but other things being equal, the best reducing foods are those that contain the lowest percentage of this element.

A table showing the percentage of fat in various foods as expressed in the proportion of calories from fat to the total calories supplied by the food is given below. A number of typical cooked foods is included in the list given. The amount of fat varies according to the recipe and the fatness of meat also varies with the source of the product.

Selecting Foods with Less Fat

Lack of fat in foods does not necessarily make them ideal reducing foods, however. Certainly white flour and cane sugar are very poor reducing foods, though they have little fat. On the other hand, some vegetables contain considerable fat, and yet, because of their bulk, their power to satisfy the appetite while supplying few calories, and their high percentage of minerals and vitamins, they are good reducing foods. One great advantage of an uncooked over a cooked diet is that it is easier to keep it free from added fat.

PERCENTAGE OF CALORIES IN FAT FROM VARIOUS FOODS

Sugar	0	White bread	3	String beans	6
Molasses	0	Oranges	3	Onions	6
Cornstarch	0	Egg-white	3	Pineapple	6
Honey	0	Rice	3	Pears	7
Angel food cake	1	Codfish	4	Apples	7
Cantaloup	1	Turnips	4	Dates	7
Tomatoes	1	Watermelon	5	Carrots	8
Prunes	1	Whole wheat bread	5	Asparagus	8
Potatoes	1	Bananas	5	Cottage cheese	8
Macaroni	1	Cornmeal	5	Skim-milk	8
Lemonade	1	Sweet potatoes	5	Raisins	8
Beets	2	Celery	5	Figs, dried	9
Rye bread	2	Beans, dried	5	Cabbage	9
Beans, red kidney	2	Beans, lima, dry	5	Cherries	9
Grapefruit	2	Peas, green	6	Sweet corn	10

Squash	10
Bran, wheat	11
Cranberries	11
Whey	11
Buttermilk	12
Spinach	12
Strawberries	13
Lettuce	14
Grapes	14
Blackberries	15
Cauliflower	15
Custard	16
Corn bread, egg	16
Baked beans	17
Clams	17
Rolled oats	18
Crackers, soda	19
Crackers, graham	20
Gingerbread	20
Chestnuts	20
Oatmeal cookies	21
Milk, condensed	22
Oysters	22
Pumpkin pie	25
Cake, average	25
Lemon meringue pie	29
Apple pie	30
Liver	31
Beef, dry smoked	32
Rice pudding	32
Waffles	36
Biscuits, baking powder	37
Macaroni & cheese	39
Chocolate cake	42
Ice cream	43
Cocoa, beverage	44
Veal cutlets	46
Milk, evaporated, unsweetened	50
Milk, whole fresh	52
Beef tongue	52
Fowl	56
Salmon, canned	57
Pie-crust, plain	57
Whole-milk oyster stew	58
Beefsteak, medium fat	60
Eggs	61
Peanuts	63
Sardines	65
Mutton roast	67
Potato salad	68
Turkey	71
Chocolate	71
Roquefort cheese	73
Swiss cheese	73
American cheese	74
Lamb chops	76
Almonds	76
Hazel nuts	76
Country sausage	76
Cocoanut	77
Corned beef, average	77
Ham, medium	80
Pork chops	80
Egg yolks	82
Olives	83
Walnuts	84
Avocados	85
Cream	85
Pecans	86
Mayonnaise dressing	88
Bacon	93
Butter	99
Oleomargarine	99
Salad oils	100
Lard	100

The following menus are suggested as well-balanced meals, extending over a five-day period, for those undertaking rapid-reducing, moderate-reducing or slow-reducing diets:

MENUS FOR RAPID REDUCING

FIRST DAY

Breakfast

One Half Grapefruit (without Sugar)
One Boiled Egg
One Glass Skim Milk or Buttermilk

Luncheon

One Cup Bouillon
Large Salad — Cabbage and Shredded Raw Carrots with Mineral Oil French Dressing
One Pear or Apple

Dinner

Clear Tomato Soup
Small Lean Steak
String Beans
Skim Milk Junket

SECOND DAY

Breakfast

One-half Cantaloup (or One Apple)
Bran with One-half Glass Whole Milk
Cereal or Caffeinless Coffee with a Little Evaporated Milk (no Sugar)

Luncheon

Salad of Sliced Tomatoes, Cucumbers, Radishes and Lettuce With Lemon Juice and Salt
A Chopped Hard Boiled Egg with Salad
One Glass Skim Milk or Buttermilk

Dinner

Vegetable Broth
Codfish Gravy (Using Skim Milk)
Spinach
Lemon Gelatin

THIRD DAY

Breakfast

One Sliced Orange (without Sugar)
One Boiled Egg
One Glass Skim Milk or Buttermilk

Luncheon

Large Salad—Lettuce Endive and Cottage Cheese with Mineral Oil French Dressing
Watermelon

Dinner

Celery Skim Milk Soup
Oysters or Broiled Spring Chicken
Beet Top Greens
Skim Milk Junket

FOURTH DAY

Breakfast

One Dish Fresh Berries (Plain)
Bran with One-half Glass Whole Milk
Cereal or Caffeinless Coffee with a Little Evaporated Milk (No Sugar)

Luncheon

Stuffed Tomato Salad (with Celery and Mineral Oil Mayonnaise)
Spinach and One Hard Boiled Egg
One Glass Skim Milk or Buttermilk

Dinner

Consommé
Boiled Liver with Chopped Raw Onion
Asparagus
Fruit Cup—Orange and Grapefruit

FIFTH DAY

Breakfast

One Glass Orange Juice
One Poached Egg on One-half Slice Toast

Luncheon

Cabbage Salad with Green Peppers or Pimentos and Mineral Oil French Dressing
One Peach (or One Slice Pineapple)
One Glass Skim Milk or Buttermilk

Dinner

Onion Skim Milk Soup
Broiled Chopped Beef
Sauerkraut
Skim Milk Custard

MENUS FOR MODERATE REDUCING

FIRST DAY

Breakfast

One-half Grapefruit (without Sugar)
Bran with One-half Glass Whole Milk
Poached Egg with One-half Slice Whole Wheat Toast
Cereal Coffee

Luncheon

Cabbage and Apple Salad
Eggs Scrambled with Skim Milk
Sliced Oranges

Dinner

Creamed Celery Soup
Hamburger Steak with Chopped Raw Onions
Stewed Tomatoes
Cabbage Slaw
Raspberry Gelatin

SECOND DAY

Breakfast

One-half Cantaloup (or Baked Apple)
Puffed Cereal with Whole Milk
One Glass Orange Juice

Luncheon

Jellied Vegetable Salad
Corn Muffin
One Glass Buttermilk or Skim Milk

Dinner

Chicken Soup
Broiled Lamb Chop
Baked Carrots
String Bean Salad
Junket

THIRD DAY

Breakfast

One-half Grapefruit (without Sugar)
Flaked Cereal with Whole Milk
Orange Egg Nog

Luncheon

Lettuce Salad
Cottage Cheese
Fruit Cup—Bananas and Pineapple

Dinner

Pea Soup
Small Lean Steak
Mashed Turnips
Tomato Cucumber Salad
Watermelon (or Canned Pears)

FOURTH DAY

Breakfast

One Dish Berries (or Baked Apple)
Bran with One-half Glass Whole Milk
One Glass Orange Juice

Luncheon

Consommé
Green Pepper Omelet
Buttermilk or Skim Milk (One Glass)

Dinner

Tomato Soup
Broiled Fresh Fish
Corn Bread
Cabbage and Raw Carrot Salad
Lemon Ice

FIFTH DAY

Breakfast

One-half Grapefruit (without Sugar)
Puffed Cereal with Whole Milk
Poached Egg with One-half Slice Whole Wheat Toast
Cereal Coffee

Luncheon

Cabbage Slaw with Boiled Dressing
Pear or Apple
One Cup of Custard

Dinner

Asparagus Soup
Liver with Spanish Sauce
Lettuce and Cucumber Salad
Lemonade or Grape Juice

MENUS FOR SLOW REDUCING

FIRST DAY

Breakfast

Sliced Oranges
Bran with Whole Milk
Scrambled Egg
Whole Wheat Muffin
Cereal Coffee

Luncheon

Lettuce and Tomato Sandwich (Whole Wheat Bread)
One Glass Grape Juice

Dinner

Vegetable Beef Soup
Whole Wheat Macaroni with Cheese
Cabbage Slaw
Fruit Cup with Pineapple and Pears

SECOND DAY

Breakfast

One Dish Berries with Shredded Wheat
Soft Boiled Egg with Slice of Whole Wheat Toast
One Glass Milk

Luncheon

Salad of Lettuce, Pineapple and Cottage Cheese
Whole Rye Cracker
One Glass Buttermilk or Skim Milk

Dinner

Bean Soup
Small Lean Steak
Stewed Tomatoes
Orange Gelatin Whip

THIRD DAY

Breakfast

One-half Grapefruit
Oatmeal with Whole Milk (No Sugar)
One Poached Egg on One Slice of Whole Wheat Toast
Cereal Coffee

Luncheon

Spinach with Lemon Juice
Corn Muffin
One Glass Buttermilk or Skim Milk

Dinner

Potato Milk Soup
Broiled Chicken
Brussels Sprouts
Ice Cream

FOURTH DAY

Breakfast

One Baked Apple
Flake Cereal with Whole Milk
One Boiled Egg
Bran Muffin
One Glass Whole Milk

Luncheon

Salad — Lettuce, Bananas and Celery
Whole Wheat Cracker
One Glass Whole Milk

Dinner

Cream Tomato Soup
Baked Fish
Baked Potato
Spinach
Prune Whip

FIFTH DAY

Breakfast

One-half Cantaloup
Cooked Whole Wheat Cereal with Whole Milk (No Sugar)
Poached Egg with One Slice Whole Wheat Toast
One Glass Buttermilk or Skim Milk

Luncheon

Chicken Gumbo Soup
One Slice Whole Wheat Bread
Asparagus Tips on Lettuce with Mineral Oil Mayonnaise Dressing
One Glass Orange Juice

Dinner

Oxtail Soup
Lean Roast Beef
Brown Rice
Lettuce Salad
Pineapple Ice

TWO-MEAL PLAN FOR MODERATE REDUCING

FIRST DAY

Breakfast (or Lunch)

Cantaloup
Bran and Raisins with Whole Milk
One Glass Orange Juice

Dinner

Consommé
Boiled Liver with Spanish Sauce
Baked Potato
Salad—Cabbage with Cucumbers and Pimentos
Custard

SECOND DAY

Breakfast (or Lunch)

Stewed Figs
Sliced Tomatoes
Scrambled Egg
One Glass Whole Milk

Dinner

Vegetable Soup
Lean Steak
Spinach
Raw Cauliflower Salad
Ice Cream

THIRD DAY

Breakfast (or Lunch)

Grapefruit
Soft Boiled Egg
Bran Muffin
One Glass Buttermilk or Skim Milk

Dinner

Tomato Soup
Stuffed Green Pepper
Cabbage and Apple Salad with Mineral Oil Mayonnaise
Orange Gelatin

FOURTH DAY

Breakfast (or Lunch)

Pears (Fresh or Canned)
Omelet
One Slice Whole Wheat Bread
One Glass Tomato Juice

Dinner

Celery Tops Milk Soup
Fish or Chicken
Mashed Potatoes
Celery
Junket

FIFTH DAY

Breakfast (or Lunch)

Sliced Oranges
Bran or Puffed Cereal with Dates and Whole Milk
Egg Nog

Dinner

Chicken Soup
Chipped Beef Omelet
Sauerkraut
Peach Ice

GAINING WEIGHT BY DIET

Section 17

STRANGE, as it may seem, fasting, if intelligently used, is an effective preliminary to gaining weight. No weight is gained, of course, while the fast is in progress, for obviously the body must lose weight when it goes without food; but the changes produced by fasting may profoundly affect the body's ability to digest and assimilate food, so that when eating is resumed new tissue is rapidly built up, restoring not only the weight that was lost, but tending, if the food-intake is unrestricted, to go beyond that point.

Fasting for Weight-gaining

When fasting is used to reduce weight, this tendency must be carefully guarded against. Even those, in fact, who are not inclined to overweight sometimes have to guard against undue gain after a fast. But it is an ill wind that blows nobody good, and the tendency which is so troublesome to those trying to reduce is often very useful to those who wish to gain. Rarely if ever does the body subjected to a fast fail to gain more than was lost, if the appetite is fully satisfied during the reconstruction period. The gain is made, too, on smaller amounts of food than would otherwise have been required, and often at an astonishing rate. This is due to the increased metabolism resulting from the fast.

This phenomenon has been studied scientifically in its applications to both man and animal. Experiments with healthy subjects at the University of Chicago showed that the rate of metabolism was materially increased by a fifteen-day fast. This means that the cells were more active and oxidized more food. The appetite and assimilation were so much improved that enough additional food was eaten not only to support the increased metabolism, but to cause both the men and women subjected to the experiment to attain a greater weight than they had carried before fasting. Careful scientific observation showed that this effect lasted for many months after the fast.

Longer fasting experiments on dogs showed this rejuvenation effect more emphatically. The animals were fasted for about forty days, and their normal weights were regained in about three months time, at which period they showed from nineteen to twenty-eight per cent. increased metabolism over the pre-fasting period. As these were adult dogs, such a change in their fundamental body processes might be interpreted as an actual rejuvenation, or the restoration of the greater metabolism and growth-impulse of puppyhood. The rate of metabolism in proportion to body weight is highest at birth and gradually declines throughout life, being the lowest in extreme old age. The effect of a fast is to restore youthfulness to the cells of the body, and such youthfulness restores the power of growth. Of course, there can be no appreciable growth of stature among the higher animals whose bone-growing processes cease with adulthood, but in lower forms having no fixed skeleton, fasting can be shown to stimulate greater growth of the body.

The Rejuvenating Effect of Fasting

These influences, as applied to the problem of weight-gaining, are chiefly effective because they increase the digestive capacity and the appetite. This is the effect partly of the recuperation of the digestive organs through rest and partly of the demand of the body for more food. The chronically underweight adult has reached a stage where the digestive organs refuse to handle enough food. But any process that increases cell-activity creates a demand for more food, and unless the state of the digestive organs is impaired beyond remedy the demand of the body for more nutriment will increase the appetite and the powers of digestion.

Fasting for an Appetite

To attain these results long fasts are not necessary. A fast of considerable length might be effective, but for a person already underweight a further loss would be a source of alarm, and possibly of actual physical harm. A comparatively brief fast of from three to eight days is sufficient and within the limits of safety. If followed by a diet of easily digestible and highly nourishing food, the weight lost should be quickly regained and the tendency to go on gaining may be utilized to promote still further increase. In some cases it may be advisable to take a number of brief fasts followed by much longer periods of weight-gaining diet.

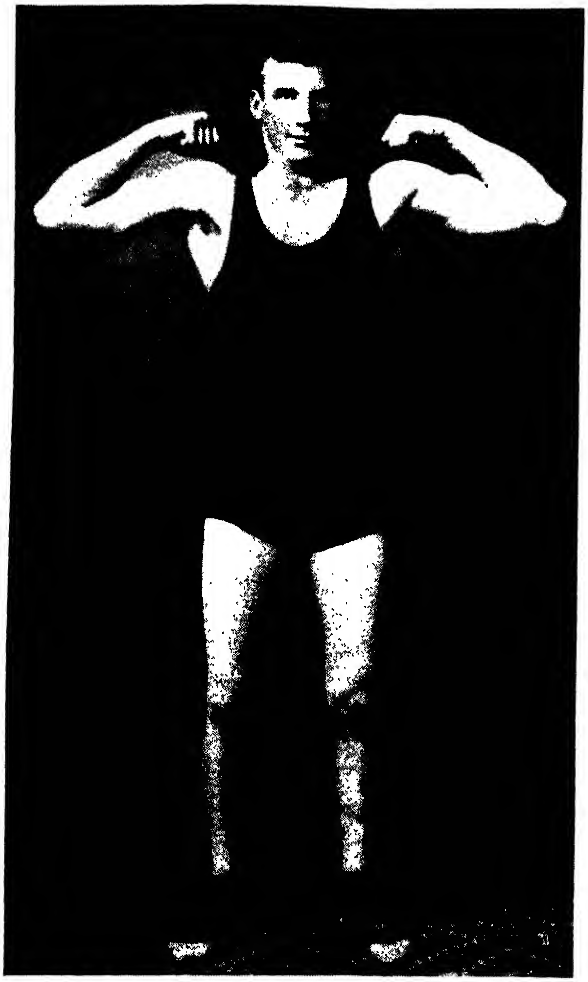
Prize winner in a weight-gaining contest conducted by *Physical Culture* magazine. At the beginning of the contest, when this photograph was taken, the weight of this subject was 133 pounds.

The danger of trying to gain weight by forced feeding is that the digestive organs may rebel, appetite be lost, and the gains sacrificed. Whenever such a condition develops, the best way to check it is by fasting, even if only for a few meals. This will allow the digestive organs to rest and regain their functional power.

Poverty and the Diet

Among poverty-stricken peoples undernutrition and underweight may be caused by insufficient food. In a prosperous country, even among the comparatively poorer classes, underweight is rarely due to lack of food; and yet a fairly large percentage of people in such communities are chronically underweight. This means that they are not able to assimilate enough food. They often believe that the more they eat the thinner they get; but when the facts are carefully investigated, it is usually found that they do not consume as much food as they think they do. They may eat heavily at times, but by so doing they overtax their digestive powers and destroy the appetite for succeeding meals.

Back of both the problems of obesity and of underweight



In this photograph, taken three months later than that on the preceding page, the subject had gained 27 pounds. During this period his diet was composed chiefly of vegetables, fruits, nuts, whole wheat bread, butter, cheese, eggs and an abundance of milk.

Same Foods Have Different Effects

are the problems of denatured foods, lack of minerals and vitamins and the overuse of sugars, starches, fats, fried foods and pastries. This explains why people eating at the same table, and sometimes even members of the same family, show cases of both underweight and obesity. Those who get fat on the conventional diet have by nature stronger, greater digestive powers and can continue to eat a poorly balanced diet and assimilate the fats and sugars, but the underweight individual cannot do this. His appetite is destroyed by the unnatural diet, and if he tries to force it, actual indigestion results.

The overweight problem is easier to solve than that of underweight. Weight can always be lost by eating less food, but in the case of the underweight person an attempt to eat more food will defeat its own end unless the foods are very carefully selected and great pains are taken to see that they are used so as not to overtax the already impaired digestion.

If an overweight individual simply cuts his habitual food-intake in half, he is bound to lose weight. But if the underweight individual attempts to reverse the operation and doubles his food-intake, the results of the experiment would probably be the exact reverse of what was desired. This was proved by some British food scientists who persuaded a group of healthy young men to attempt to eat 5000 calories of food a day, almost double the amount they required to maintain weight. Five thousand calories of food is not an impossible amount for a healthy man to digest and assimilate. Even greater amounts of food are used habitually by lumberjacks, stone quarrymen and others engaged in heavy physical labor. But this English experiment was tried with college students taking only a normal amount of exercise. Their digestive systems could not handle this amount of food, because their bodies did not need it and the digestive powers are regulated by the needs of the body. In every case, therefore, after a few days of forced feeding acute attacks of indigestion occurred, accompanied by diarrhea. And in every case, before their digestive powers were restored, the men lost more weight than they had gained from the stuffing process. While this experiment was an extreme case, it illustrates the element of difficulty which the underweight individual faces when he tries to get fat by eating more food.

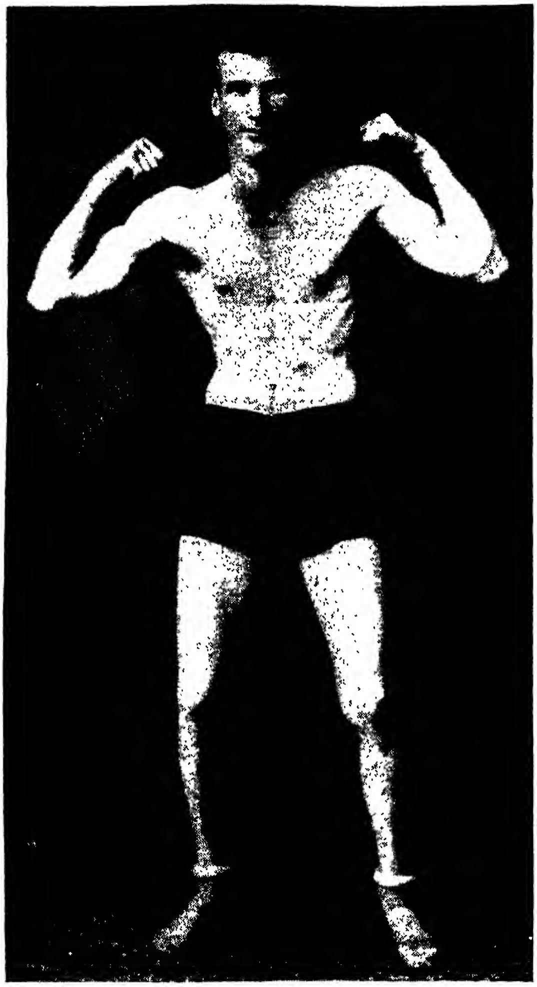
Overweight Problem Easier

The only way in which weight can be steadily gained and permanently retained is by carefully regulating the diet and increasing the quantity of the nourishment taken only a little beyond what had previously been used.

It is much safer and more effective to break the regularity of eating by an occasional fast than by any digression of the opposite nature. All overindulgence in food beyond the digestive capacity is dangerous and ruinous to the program of weight-gaining. Obviously, anyone who had the digestive capacity to stand the abuse of excessive eating would not be underweight in any circumstances where sufficient food was available.

Regulating the Diet for Underweight

Weight-gaining programs may be of two kinds. The simpler one we will call the qualitative, and the more complicated the quantitative method. In the qualitative method the nature of the food eaten is changed so that it will be digested



An additional gain of 8 pounds was made in the last three months of the weight-gaining contest, bringing the total weight up to 168 pounds. From a state of poor health and low vitality in which the mildest exercise was an exertion, the contestant attained such vigor that participation in the most strenuous forms of physical exercise became a pleasure.

The Qualitative Method

and assimilated with less strain upon the digestive organs. Such a change, if adapted to the individual, may result in a gain of weight through better digestion and the consequent stimulation of appetite to demand more nourishment than when the foods were badly selected. It is called the qualitative method because it is based on a change in quality, no effort being made to regulate the quantity, except as this is done by the demands of the appetite. An attempt to gain weight in this way must of necessity be somewhat experimental, as the exact nature of the digestive limitations varies with the individual. The problem is to find the type of foods which each one can best handle in larger quantities.

The Milk Diet for Gaining

The food that will be helpful in the largest number of cases is milk. The almost universal efficacy of the milk diet as a therapeutic measure proves this contention, and for purposes of weight-gaining it has been found that no single weight-gaining method is superior to this diet. There are those, however, who for one reason or another cannot undertake the milk diet and those who, having taken it, still have trouble in gaining and maintaining weight. Such persons may find help in the modified diets suggested for use upon the completion of the milk diet. These are also good diets for a permanent program of weight-gaining and weight-maintenance.

Milk Supreme Building Material

Assuming that one's general diet is correct, but that one does not take quite enough nourishment, milk is the simplest and best food for the purpose of supplementing the diet for weight-gaining purposes. The substitution of milk at the table for coffee or tea is the simplest of all weight-gaining measures. If one has been in the habit of taking any less nutritious beverages, milk may be substituted for it without disturbing the appetite or decreasing the amount of other food eaten. If this can be successfully accomplished the body must gain in weight because of the additional nourishment. But where one has not been in the habit of using a table beverage other than water, the addition of milk to the meal is more likely to check the appetite and cause one to eat less other food. If this effect is great enough to offset the additional nourishment taken from the milk, no gains can be expected.

The Time for Milk

This situation can often be met by taking milk at other than regular meal-times. Since breakfast is usually a light meal, it is probably easiest to introduce a glass of rich milk at breakfast without otherwise decreasing the food eaten at the meal. If one is in the habit of eating light lunches, milk may be introduced in similar fashion. It would be much more difficult to introduce milk into the heavier dinner menu. But the use of milk between meals is often the best plan of all. Drinking milk just before retiring is the usual procedure, because it is completely digested and out of the way before the next meal. If milk is taken between meals, these should be sufficiently far apart to allow at least three hours between the time of drinking the milk and either a preceding or a following meal.

There are very few cases in which whole milk cannot be digested and assimilated. If any difficulty, such as biliousness, results from its addition to the diet, it is well to find out whether the intolerance is due to the fat or the sugar content. If one has no idea of one's powers of fat digestion, the determination can readily be made by using milk enriched with cream. If this aggravates the digestive difficulty, the chances are that the digestive powers for fat are deficient, and that this has been a fundamental cause of the underweight. In such a case the obvious thing is to secure the milk elements without the fat, that is, by using skimmed milk, either sweet, or sour as in buttermilk.

Experimenting with Milk Diet

The non-fat milk elements, especially the minerals, are of great value. But skimmed milk has too low a caloric value to be very effective in weight-gaining. Hence the procedure is to supplement or enrich the milk with some form of easily digestible carbohydrates. Malted milk contains considerable sugar, though it also adds some fat. The addition of malted-milk powders to rich, whole milk makes a very nourishing food, and one easily assimilated by the normal digestion; it has a justifiable reputation as a supplementary food for weight-gaining.

Malted Milk

But where the fat-digesting powers are limited, more specialized products or combinations should be used. Among these especially worth a trial is skim-milk to which has been added additional milk sugar such as is used in modifying milk for infants. Milk sugar can be secured in any drug store, but unfortunately it is rather expensive. Ordinary cane sugar added to skim-milk or buttermilk is nourishing, but is not the best form of sugar to use. Honey is an ideal natural mixture of simple sugars and is a splendid addition to either whole or skim-milk. Malt syrup is another special type of sugar which is readily assimilable by many digestions that would not tolerate an equal amount of cane sugar, or even of honey. Corn syrup, which consists chiefly of simple glucose, is also a very valuable product to add to milk. Indeed, in recent years corn syrup has been extensively used in modifying milk for infants and certainly gives much better results than cane sugar.

Skim-milk with Added Sugars

Sweet fruits cannot be added directly to the milk, but when used in addition to it, probably meet the need of supplementing its carbohydrate elements better than anything else. For this purpose dates, especially when eaten between meals or before retiring, are the best of all sweet fruits. They contain very little besides natural fruit sugar. Figs are the second choice

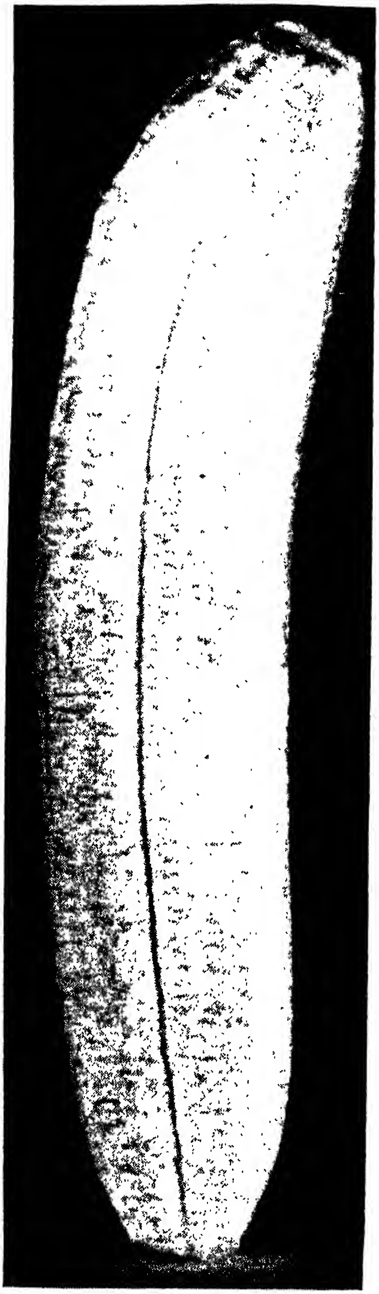
PHOTOGRAPH UNDERWOOD AND UNDERWOOD

The ripe prune on the tree. The breakfast dish of dried prunes is popular as a preventive of constipation.

and raisins third. Although these fruits are valuable additions to whole milk in any case, they are especially needed when skim-milk or buttermilk must be used because of the intolerance of fat. Very ripe bananas may also be combined with milk in fashion above indicated. Bananas originally contain much starch, most of which changes to sugar in the process of ripening. In rare cases the residue of starch will be objectionable, but where no such reactions are observed bananas are readily assimilable and impose only a very slight tax upon digestion.

Fruits as Supplements

When the dietetic program has been worked out to include ample milk elements, or their equivalent, in the regular meals, the principle of supplementary foods may sometimes be applied to other products. Any sweet fruits, either fresh or dried, are more adaptable for use in such supplementary feeding than



A yellow banana. When fully ripened the skin is yellow, mottled with brown spots, and the fruit is then at its best for eating in the raw state.

the general run of food products, such as starches or protein foods, or fibrous vegetables. The drinking of ample quantities of orange juice between meals will have very little disturbing effect upon digestion, though the total quantity of nourishment gained is not great. This can be increased by adding honey to the orange juice; corn syrup would also be good. Many excellent results have been secured in weight-gaining by the use of refined malt syrup eaten between meals, or even at the end of meals in the place of less digestible desserts.

Another supplemental food beverage is made by combining egg-yolks with orange juice. Here we are taking added fats and also getting an excellent combination of vitamins and minerals.

Studying Digestive Reactions

Thus far we have been concerned chiefly with food supplements to be used between meals, or as a fourth light meal before retiring, though many of these products may also be used at regular meal-times. When it comes to the problem of increasing the food-intake at regular meals without keeping track of the total amount of food consumed, we must make a careful study of the individual digestive reactions. When a record is kept of the amount of food eaten, the total nourishment taken will be determined by the reactions of appetite.

Success depends upon finding the type of food which the individual can digest and assimilate most readily. Obviously, the food that adds calories, and hence will add weight to the body most rapidly, is fat. Ordinary conventional cookery contains fat in the majority of recipes, and when a person with strong digestive powers eats such fat-containing food obesity quite frequently results. The thin man would like to imitate him, but he rarely can. It is quite possible, however, that a lack of capacity to digest and assimilate conventional foods in sufficient amounts is due to the nature of the admixture of fats with other food elements, as in fried foods and pastries. The thin man may also be unable to digest the fats of heavy meats. Yet other kinds of fat, and fats taken in less complicated forms, may give no trouble.

Red bananas are bulkier and shorter than the more common yellow varieties from the same locality. When green, the banana approximates the potato in chemical composition. The fruit is at its best when thoroughly ripe. In some of the tropical islands bananas comprise almost the staple diet of the natives.

Kinds of Fats to Use for Gaining

Among the types of fats most likely to be readily assimilated are cream and butter. Cream is merely added to foods and not cooked into them. Butter, as used on bread and on baked or mashed potatoes, is added after cooking and is also fairly acceptable. Therefore, success can often be attained by avoiding fried foods and pastries and using more cream and butter in these simpler fashions. Plain salad oil may also be used, not only on salads, but as a dressing for cooked vegetables. It is better to add fat to vegetables in this fashion than during cooking, as there is not so much danger of its penetrating the vegetable substance, but unless vegetables are fried, it is fairly safe to use oil or butter during the cooking process. Perhaps one of the best of all forms of added fat is mayonnaise, which is emulsified fat, similar in its mechanical condition to egg-yolk or cream. Mayonnaise may be used in this manner quite freely upon salads, or it may be used on sandwiches, or even eaten with cooked vegetables.

The Use of Mayonnaise

Using fat in the above forms, it is very easy to increase the total nourishment without increasing the apparent amount of food eaten. It is so easy, indeed, that there is a danger of its being overdone. One should, therefore, begin such methods of adding fat gradually, and check it at the first evidence of biliousness or indigestion. It is a most effective method of weight-gaining for those who can assimilate the additional fat.

Add Fats Gradually

Unfortunately, however, many who are underweight are so because of their limited capacity to digest fat. When this is the case, we are obliged to look for added nourishment to other sources. The most likely of these have already been mentioned when discussing the types of readily assimilable sugars suggested as supplementary nourishment.

The Digestion of Starch

Starch, derived from grain and potatoes, constitutes, of course, the bulk of the nourishment of the ordinary healthy individual. The digestion of starch is a more complicated process than the digestion of simple sugars. Hence the common idea that when the digestive powers are subnormal, there is likely to be difficulty in utilizing starch. However, the supposition that starch cannot be digested is sometimes an error due to methods of cookery, including the combination of starch with sugars and fats, as in fried foods or pastries. Often the trouble can be overcome by using one or a few simple starch foods. Plain whole-wheat bread is much more likely to be digestible and nourishing than the starches of the conventional diet.

Of the grain foods, rice is probably the most easily digested.

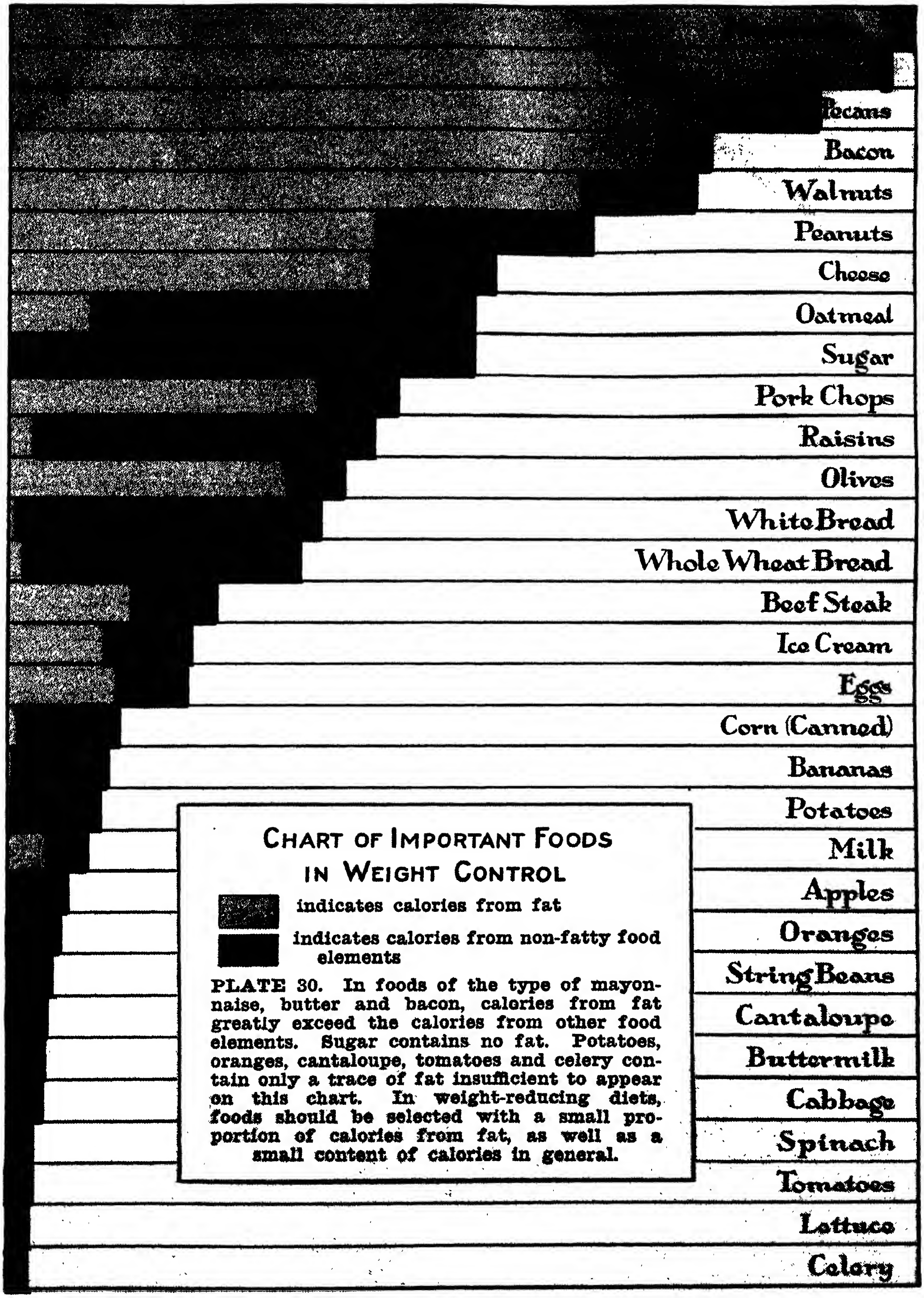


CHART OF IMPORTANT FOODS IN WEIGHT CONTROL

(dark gray) indicates calories from fat

(black) indicates calories from non-fatty food elements

PLATE 30. In foods of the type of mayonnaise, butter and bacon, calories from fat greatly exceed the calories from other food elements. Sugar contains no fat. Potatoes, oranges, cantaloupe, tomatoes and celery contain only a trace of fat insufficient to appear on this chart. In weight-reducing diets, foods should be selected with a small proportion of calories from fat, as well as a small content of calories in general.

Plain boiled rice, like plain potatoes, is one of the safest of starchy foods. Rice is more fortunate than most other cereal products in that it is served in the simple grain form and is not mixed with sugars or fats, in complicated dishes.

But even at their best the grain products sometimes offer difficulty which the potato does not. Potatoes are often thought to be responsible for digestive troubles or poor nourishment, merely because they are a conspicuous element of the conventional menu, and are often fried or served with rich gravies and meats. If the potatoes are either baked or steamed in their jackets, and eaten with plenty of butter, they are a very nourishing and digestible food. If the meal is otherwise simple, they may be used in this way by many who would have trouble in handling them in the conventional menu in which potatoes are only a supplementary element.

Potatoes and Digestion

The bulk of any added nourishment necessary to gain weight must come from fats, sugars, or starchy products. It is assumed that in any of the weight-gaining diets attempted, the menu will have a sufficiently complete basis to include enough protein, along with minerals and vitamins; but protein can rarely be safely used in sufficient quantities to form the chief weight-gaining element. The weight-producing effect of milk and eggs is commonly believed to be due to their protein content; and while they do supply excellent protein, the advantages of their use for the purpose in question are due to other elements as well. This is especially evident from the fact that egg-yolks are much better for increasing the weight than egg-white, though the latter is the dominating protein element of the egg. Milk protein is highly valuable, but for weight-gaining one would not recommend it in the concentrated form of cottage cheese.

Grain Foods for Starch

Meat may be used in moderation in a weight-gaining diet. The best form of meat for the purpose would be good beefsteak, and it is better to have a good steak once a day than to eat meat at every meal, even in lesser amounts. It may be cooked by frying, as this is much less objectionable than the frying of complicated mixtures including starches and sugars, and it should be supplemented by green vegetables and fruits, rather than by large quantities of bread, potatoes and heavier vegetables. Only the heartiest of digestions, as a rule, can

Meat for Weight-gaining

stand much fat meat, especially fat beef. It is better to use lean meat and secure one's fat from a salad dressing.

Effects of Increasing Calories

So far we have considered weight-gaining by means of supplementary foods or changes in the type of food used. Such methods are more simple and therefore more practical than figuring the exact amount of food used. To calculate calories involves considerable intelligence and effort, and food values cannot, of course, be measured by weight or volume. But theoretically the ideal way to gain weight is to find the type of food which the individual can most readily assimilate, and use a definite proportion of this food in addition to the previous weight-maintaining diet as measured in calories.

How Much to Increase Food Intake

The increase in the caloric intake must be moderate, not excessive. Thus, if you have determined that you are maintaining your ordinary weight while using 2000 calories of food a day, you can expect to gain weight if you increase the amount of food to 2500 calories, or twenty-five per cent. But if you increase it to 3000 or fifty per cent., the chances are that you would defeat your purpose by overtaxing the digestion. Except in the case of milk, which can be used, as in the milk diet, in greater quantities than other supplementary foods, it is never advisable to increase the food-intake more than twenty-five per cent. above the weight-maintaining level, and even twenty per cent. might be safer.

Occasionally persons in perfect health, with ample digestive powers, are underweight because of the influence of psychological factors. In such cases a deliberate effort to increase the amount of food by twenty or twenty-five per cent. will result in a gain of weight even though no change at all is made in the nature of the food used. In the majority of cases, however, there is sufficient lack of digestive capacity to make this mere change in food quantity difficult, unless a diet is selected that is especially acceptable to the digestion. When the right foods are found, there should be a natural increase of appetite which would cause the patient to eat more of them and hence to gain weight. But success will be more certain if you not only find the right foods, but also calculate the calories and see to it that the quantity of real food eaten is increased. The simpler the meals the easier it is to do this.

Those who wish to figure their diets will find many helpful examples and short cuts in the preceding discussion of weight-reduction. These instructions, therefore, need not be repeated. From the group of weight-gaining menus appended readers may select what best suits their needs. No definite rules can be laid down for the preparation of such menus, as the requirements vary greatly with different individuals. Each group will supply all essential elements, but the menus are intended only as suggestions for diets to be checked by actual trial by each individual.

Find the Right Food

In testing one of these groups of menus, no effort should be made at first to eat additional food, but only to eat for a few weeks the amount that the appetite calls for. Such a practical test will give approximately the weight-maintaining requirements. It can also be obtained more accurately if the calories of the foods ordinarily eaten can be calculated, for any radical change in the menu may, on the principle already discussed, create a new appetite response. Of course, the best test of the capacity of any diet to maintain or increase weight is that of its actual effect in so doing. This cannot possibly be ascertained in a single week. One has to keep track of the diet and weight for several weeks. If, after a month's record you find that you have just maintained weight on a known number of calories, then you can make a deliberate effort to increase the caloric intake by twenty per cent. This dietetic procedure will almost invariably result in a satisfactory gain.

Testing the Diet

Do not be impatient. On the milk diet, or after fasting, or when recovering from acute disease, very rapid gains, sometimes nearly a pound a day, may be achieved. But ordinarily no such gains are safe or even possible. Cases of underweight in which more than twenty or twenty-five pounds are needed to give a good healthful weight and appearance are rare. Therefore a gain of five pounds a month should be considered satisfactory, and such a slow gain is more likely to be permanent than more rapid ones resulting from forced feeding.

To meet different digestive requirements the sample menus given are divided into those containing a typical balance of nutritive elements, and those in which fats, or the starches, are limited.

NORMAL WEIGHT-GAINING MENUS

FIRST DAY

Breakfast

Berries with Cream
Whole Wheat Cakes with Honey
Glass of Milk

Luncheon

Fruit Salad with Dates and Nuts
Cream Dressing
Bran Muffins Butter
Chocolate Pudding
Whipped Cream
Glass of Milk

Dinner

Cream of Pea Soup
Steak Salad
String Beans with Butter Sauce
Stewed Apricots with Cream
Pineapple and Orange Juice

SECOND DAY

Breakfast

Baked Apple with Cream
Egg Poached in Milk on Whole Wheat Toast
Glass of Milk

Luncheon

Asparagus au Gratin
Buttered Beets
Corn Muffins with Honey
Dates with Cream Cheese
Hot Chocolate with Whipped Cream

Dinner

Cream of Celery Soup
Salmon Salad with Large Portion of Lettuce and Mayonnaise
Whole Wheat Bread
Butter
Prune Whip with Cream
Lemonade

THIRD DAY

Breakfast

Sliced Oranges
Uncooked Rolled Oats with Chopped Dates and Cream
Glass of Milk

Luncheon

Creamed Eggs on Whole-wheat Toast
Buttered Peas
Sponge Cake
Peaches with Cream
Glass of Milk

Dinner

Vegetable Soup
Pineapple Salad with Nuts and Cream Cheese
Mayonnaise
Bran Muffins Butter
Baked Banana
Grape Juice

FOURTH DAY

Breakfast

Sliced Banana with Cream
Bran and Raisins with Cream
Figs
Glass of Milk

Luncheon

Fruit Salad with Cream Dressing
Whole Wheat Bread with Peanut Butter
Butterscotch Pudding with Whipped Cream
Glass of Milk

Dinner

Cream of Corn Soup
Vegetable Omelet with White Sauce
Stuffed Baked Potato
Dates and Cream Cheese
Grapefruitade sweetened with Honey

FIFTH DAY

Breakfast

Orange Juice
Prunes with Nuts and Cream
Omelet with Bacon
Buttered Whole Wheat Toast
Glass of Milk

Luncheon

Cream of Celery Soup
Pear Salad with Lettuce and Mayonnaise
Cheese Whole Wheat Crackers
Rice Pudding with Cream
Grape Juice

Dinner

Mashed Potatoes
Creamed Onions
Carrots with Butter Sauce
Lettuce with Mayonnaise
Ice-cream Served in Cantaloup
Glass of Milk

SIXTH DAY

Breakfast

Berries with Cream
Whole Wheat Toast with Cream Cheese and Honey
Glass of Milk

Luncheon

Whole Wheat Macaroni with Tomatoes
String-bean Salad
French Dressing
Gingerbread with Whipped Cream
Glass of Milk

Dinner

Fried Chicken
Creamed Potatoes
Asparagus Tips with Butter Sauce
Chocolate Cake
Fruit Cup with Whipped Cream
Glass of Milk

SEVENTH DAY

Breakfast

Stewed Figs with Cream
Bacon and Eggs
Whole Wheat Toast
Glass of Milk

Luncheon

Banana Salad stuffed with Apple, Celery and Dates
Cream Cheese Whole Wheat Crackers
Cherry Pie with Whole Wheat Crust
Glass of Milk

Dinner

Cream of Spinach Soup
Baked Beans
Cabbage Slaw with Lettuce and Mayonnaise
Whole Wheat Bread
Butter
Baked Apple with Cream
Grapefruitade

WEIGHT-GAINING MENUS WITH FAT LIMITED

FIRST DAY

Breakfast

Shredded Wheat with Berries and Whole Milk
Poached Egg on Whole Wheat Toast
Glass of Milk

Luncheon

Potato Milk Soup
Green Pepper Stuffed with Cottage Cheese Salad
Boiled Dressing
Corn Muffins Honey
Figs
Orange Juice

Dinner

Oyster Stew
Stuffed Baked Potato
Carrots and Peas
Spinach
Boiled Custard
Glass of Milk

SECOND DAY

Breakfast

Baked Apple with Syrup
Grapenuts and Milk
Glass of Milk

Luncheon

Fruit Salad with Boiled Dressing
Bran Muffins with Honey
Dates and Cottage Cheese
Glass of Milk

Dinner

Vegetable Soup
Steak
Mashed Potato
Creamed Cauliflower
Sliced Peaches
Whole Wheat Cookie
Grape Juice

THIRD DAY

Breakfast

Stewed Figs with Bran and Milk
Baked Banana
Glass of Milk

Luncheon

Beet and Celery Salad
Boiled Dressing
Whole Wheat Bread
Prune Whip with Custard Sauce
Glass of Milk

Dinner

Celery Milk Soup
Omelet with White Sauce
Stuffed Baked Potato
Pineapple Salad with Cottage Cheese and Dates
Grapefruitade with Honey

FOURTH DAY

Breakfast

Melon
Uncooked Whole Wheat Cereal with Dates and Milk
Whole Wheat Toast with Honey
Milk, One Glass

Luncheon

Scalloped Cabbage
Carrots and Peas
Whole Wheat Muffins
Honey and Cottage Cheese
Orange Blanc-mange
Vanilla Malted Milk

Dinner

Cream of Onion Soup
Liver with Tomato Sauce
Baked Sweet Potato
Peas
Fruit Cup
Lemonade

FIFTH DAY

Breakfast

Grapefruit Juice with Honey
Stewed Prunes with Bran and Milk
Glass of Milk

Luncheon

Spinach Salad with Lettuce and Boiled Dressing
Beets
Sponge Cake
Baked Banana
Glass of Milk

Dinner

Carrot Milk Soup
Tomato Salad Stuffed with Egg and Celery
Boiled Dressing
Date Pudding
Orangeade

SIXTH DAY

Breakfast

Sliced Bananas
Oatmeal with Dates and Milk
Glass of Milk

Luncheon

Fruit Salad with Lettuce
Cottage Cheese
Whole Wheat Crackers
Tapioca Pudding with Lemon Sauce

Dinner

Baked Sweet Potato
Steak
Creamed Onions
Apricot Whip
Vanilla Malted Milk

SEVENTH DAY

Breakfast

Orange Juice
Stewed Figs
Whole Wheat Toast with Honey
Glass of Milk

Luncheon

Split-pea Soup
Pear Salad with Lettuce Fruit Dressing
Whole Wheat Bread
Dates with Cottage Cheese
Grape Juice

Dinner

Vegetable Omelet
Stuffed Baked Potato
Lettuce and Tomato
Rice Pudding with Caramel Sauce
Glass of Milk

WEIGHT-GAINING MENUS WITH STARCH LIMITED

FIRST DAY

Breakfast

Orange Juice
Omelet with Bacon
Whole Wheat Toast, Buttered
Hot Chocolate

Luncheon

Cream of Pea Soup
Pear Salad with Cheese Cream Dressing
Boiled Custard with Whipped Cream
Glass of Milk

Dinner

Cream of Carrot Soup
Asparagus Salad with Mayonnaise
Sliced Tomatoes
Cream Cheese and Nuts
Ice-cream with Chocolate Sauce
Grapefruitade

SECOND DAY

Breakfast

Baked Apple with Cream
Grapenuts with Cream
Glass of Milk

Luncheon

Beet and Celery Salad with Lettuce and Mayonnaise
Prunes with Nuts and Cream
Chocolate Milk

Dinner

Cream of Celery Soup
Fried Chicken
Spinach
Pineapple Salad with Cream Dressing and Cream Cheese
Glass of Orangeade

THIRD DAY

Breakfast

Berries and Cream
Bran with Cream
Glass of Milk

Luncheon

Lettuce Salad with Cheese Dressing and Grated Nuts
Whole Wheat Bread
Butter
Peaches with Cream
Glass of Milk

Dinner

Creamy Milk Oyster Stew
Carrots and Peas
String Beans with Butter
Fruit Cup with Whipped Cream
Grape Juice

FOURTH DAY

Breakfast

Grapefruit Juice
Puffed Wheat with Cream
Berries with Cream Cheese
Glass of Milk

Luncheon

Cream of Tomato Soup
Fruit Salad with Walnuts and Cream Cheese
Jellied Custard with Whipped Cream
Chocolate with Whipped Cream

Dinner

Cream of Onion Soup
Steak
Spinach with Cream
Lettuce with Mayonnaise
Apple Whip with Cream
Pineapple and Orange Juice

FIFTH DAY

Breakfast

Stewed Figs with Cream
Scrambled Eggs
Milk

Luncheon

Apple and Celery Salad
Cream Dressing
American Cheese
Whole Wheat Cracker
Sliced Peaches with Ice-cream
Grape Juice

Dinner

Creamed Cabbage
Bacon
Carrots with Butter
Baked Banana
Malted Milk

SIXTH DAY

Breakfast

Stewed Prunes with Cream
Grapenuts with Cream
Glass of Milk

Luncheon

Spinach Salad with Stuffed Egg
Mayonnaise
Cheese and Nuts
Fruit Cup served in Cantaloup
Glass of Milk

Dinner

Cream of Mushroom Soup
String Beans with Butter
Tender Roast Lamb
Peas
Berries with Cream
Orangeade

SEVENTH DAY

Breakfast

Sliced Banana
Puffed Wheat with Cream
Glass of Milk

Luncheon

Cream of Vegetable Soup
Pineapple and Nut Salad with Cream Dressing
Baked Apple with Whipped Cream
Chocolate Milk

Dinner

Omelet with Bacon
Carrots with Butter Sauce
Creamed Cauliflower
Jellied Fruit with Whipped Cream
Glass of Milk

DIET FOR PHYSICAL LABOR

Section **18**

THE fact that famous athletes, strong men and those doing exceptionally heavy physical labor seem able to eat almost anything without affecting their muscular powers is sometimes offered as evidence that dietetics is all nonsense, and that people should eat what they like and quit worrying about their food. It seems a natural assumption that if the world's strongest man, or best boxer, or fleetest runner eats in a certain fashion, his diet must be an ideal one to have produced such strength and physical perfection. From this perfectly logical reasoning the further conclusion is drawn that if a weaker man, with less muscular capacity, will imitate the diet of the strong man he will thereby favor the development of similar strength and muscularity.

Selecting the Ideal Diet

This type of reasoning has done a great deal of damage in the world and is quite as fallacious as it is to assume that the way to get high speed out of a low-powered automobile is to flood it with the same quantity of fuel that a high-powered car consumes. One of the first things that every boy learns about automobiles is that the fuel must be carefully adjusted to the capacity of the engine and the speed of the car, and that he loses power and speed quite as quickly from overfeeding his engine as from underfeeding it.

Athlete's Diet not Ideal for Laborer

Applied to the human engine the principle is not so readily grasped, because the problem is much more complicated, involving many things besides the simple matter of quantity. Because the relation of all these problems is not generally understood we have many conflicting and mistaken notions about the best diet for muscular work and the extent to which a diet which meets the needs of the professional athlete may be taken as a model for less muscular or less active men.

After a full study of this question we arrive at the conclusion that the success of an athlete on a possibly ill-balanced or deficient type of diet is very poor evidence that the same diet will be suited to other less active or less muscular people. This does not mean that an athlete does not need to be careful about his diet, but rather that the laws of diet that apply to him are not the same as those that apply to less muscular men. It happens, furthermore, that a number of things dangerous in the diet of less active men are not dangerous for the more active and more muscular man.

The Athlete and Circulation

The distinguishing feature in the type of men we are now discussing is that, compared with average men, they have vastly better muscular systems and use them more. It is the muscular energy expended that creates distinctive dietetic requirements, and it makes little difference whether the muscles are used in physical labor or in sports. In either case a demand is created for more food. This is the most conspicuous result of muscular activity, but there are a number of minor developments. One is that the circulation of the blood is quickened in exactly the same proportion as the increase of muscular activity. Hence all elimination of waste products from the blood, whether through the lungs, the kidneys or the skin, is speeded up.

The Athlete and Elimination

Owing to this increased elimination the muscularly active man can get rid of waste products and poisons much better than can the inactive man. This is one of the primary reasons for the benefits to the health resulting from muscular activity. Therefore, the athlete or worker who needs twice as much food for oxidation can also take practically twice as much of elements that he does not need and can successfully eliminate them. This does not mean that he is benefited by eating food elements he does not need, but only that his chance of being injured by them is decreased in proportion as his activities increase.

The principle just stated explains to a certain extent why powerful young athletes are able to eat excessive amounts of the wrong kinds of food and seem, for a time at least, to be uninjured thereby. But when the foolish weakling attempts to become strong by imitating the diet of these careless strong men, he merely doubles his own load of poisons without materially increasing his capacity to dispose of them. The results, naturally, are tragic. They are equally tragic when a once strong or physically active man attempts to keep up his former eating habits after he has ceased to keep up his muscular activity. This is the commonest of all dietetic blunders and accounts for much of the evidence that is brought out to prove that strenuous physical activity shortens life. It does, when the eating habits made possible by such activities are not changed when the activity has ceased.

Imitating the Athlete's Diet

Now let us apply the above principles to one specific type of food; that is, to lean meat. Lean meat consists of the muscles of animals, and it is a natural inference that such food should be a suitable one for nourishing the muscles of man. This inference, with certain observed effects, led to the idea, formerly general and still held by many, that large quantities of lean meat should be included in the diet of the athlete or of the physical laborer. Among the facts that supported this assumption was that such active men seemed to be able to handle large quantities of meat better than others. Another observation was that such heavy meat-eaters seemed to have more strength and muscular energy and more inclination to use them than did the vegetarian. It was also observed, however, that when it came to a prolonged endurance contest the meat-eater did not show up as well as the vegetarian.

The Athlete and Lean Meat

All these popular observations can now be explained scientifically. Lean meat is an efficient food for building new muscle, but this alone does not justify its use in anything like the ordinary quantities. The actual growth of muscle does require protein, but even in cases of the most rapid muscular development the amount of new tissue actually added to the body would amount to only a few ounces per day. After a certain amount of muscular development has been reached and is merely being maintained, very little protein is required over the amount needed to maintain the body with little or no exercise. Muscle substance is not destroyed and replaced by muscular activity. New muscle-cells grow only during youth, after long illness or long fasting, or during periods of developing exercise, when former puny muscles are actually enlarging in bulk. Hence meat, or large quantities of other protein, is not needed to maintain the muscles of a physically active person.

Protein, however, is capable of being utilized as muscle fuel. We know this to be so; otherwise the carnivorous animals, when fed exclusively on lean meat, could not keep up their activities. When protein is eaten in excess of the amount needed for building purposes it must be promptly eliminated from the body, for Nature makes no provision for storing protein, except in very small amounts. So what happens is that the protein molecule is immediately broken up into two fractions. The major fraction (by weight) is composed of carbon, hydrogen and oxygen and is essentially the same in substance as the sugars. This makes excellent muscle fuel, though no better than the sugars. The minor fraction contains nitrogen, some sulphur and sometimes phosphorus, and these elements cannot be oxidized and eliminated as carbon dioxide and water. So they must be eliminated through the kidneys as urea, uric acid, sulphates and phosphates.

Protein and Muscular Activity

As this elimination is essential to life and health, it must be speeded up by increased metabolism and increased circulation. So the natural effect of a high-protein diet is to increase the rate of the heart-action and the general level of metabolism and heat-production. These processes are aided by additional activity of the voluntary muscles. Hence the man on a high protein diet maintains a high state of metabolism and is supplied with muscle fuel that must be promptly burned. He needs to exercise to aid the eliminative process and hence is keyed up with immediate energy.

Such are the factors that account for the strength and energy of meat-fed athletes. Similar reactions account for the satisfactory health and general condition of meat-eating Arctic explorers, for meat gives immediate heat to the body by the increased circulation and metabolism as well as by stimulating muscular activity. It also accounts for the fact that men doing heavy muscular labor in a temperate or even a warm climate are able to thrive better on a heavy meat diet than are sedentary people.

Meat and Climate

The advantages of a high-protein or meat diet, however, become steadily less as the demand for endurance increases, or the environment becomes warmer. Physiologists are not altogether agreed as to why a high-protein diet shows to poor advantage when prolonged endurance is required; but the general belief is that prolonged effort results in some breaking down of the cells or in the formation of waste products which are more likely to produce fatigue and to accumulate in the blood if it is already charged with the waste products of meat.

The disadvantage of meat in warm climates is more obvious, since it tends to increase the body heat even when no exercise is taken. Thus we find the Arab runners in heated desert regions achieve their remarkable performances, not on meat (as in the case of the Arctic explorer), but on a diet in which dates, a food extremely low in protein, figure prominently.

Dynamic Effect of Meat

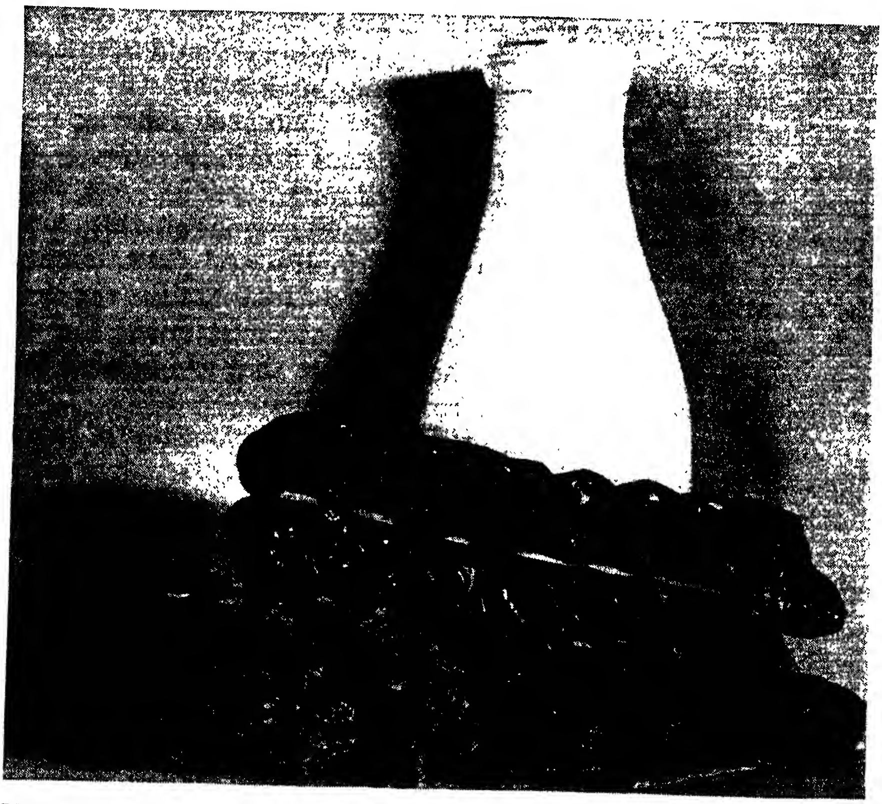
The specific or dynamic action of meat, or other protein, results in keeping the circulation and heat-production above the normal levels. It keeps a man warmed up and ready for action and it also stimulates the impulse to action; but there its advantages end. A man on a low-protein diet has a slower pulse and circulation until it is aroused by voluntary action. Hence, he has to spend more time warming up for an event before he can exert his best efforts. This is probably the true explanation of the supposedly greater immediate strength shown by the meat-eater. But with a proper though slower warming up to the event, the man on a low-protein diet can probably equal or surpass the meat-eater in strength and also have the advantages of greater endurance, because he does not waste as much of his energy in needless heat-production, or in the needless elimination of wastes from protein that has performed no useful service in his system.

Carbohydrate Foods for Athletes

In prolonged efforts of endurance lasting for more than one day, the body is liable to draw on its accumulated stores of fat because it cannot digest foods fast enough to maintain the enormous fuel requirements. But while fat previously digested and stored is, under such circumstances, an efficient source of fuel, it is not the best food for an athlete to consume just before or during severe muscular efforts. In such cases the most easily digestible and most available sources of muscular fuel are the carbohydrate foods. Starch and cane sugar supply such fuel, but require a transformation in digestion, whereas the natural simple sugar, dextrose, passes immediately into the blood. Therefore, this is the ideal form of extra food for athletic effort.

Dextrose can be had in the form of honey, or in the commercial form of corn sugar; but the natural sugars in the sweet fruits are still better, because these fruits also contain alkaline mineral elements that serve to neutralize any acid elements given off by poorly oxidized protein or fat. Therefore, the very best immediate fuel food for severe muscular effort is the dried sweet fruits, of which dates, raisins and figs are the commonest. The use of cane sugar and sweetened chocolate by soldiers on the march, or by long-distance swimmers, seems to be justified in that it supplies this carbohydrate fuel which is needed for muscular exertion. Sweet fruits, could they conveniently be used, would be still better for the purpose, which is to supply the greatest amount of muscular fuel with the least need for diverting any of the blood or nervous energy to the processes of digestion or the elimination of wastes from the body.

Fruits for Athletes



Milk with sweet fruits such as dates, raisins, or figs, forms the best possible readily digestible food combination. Cow's milk supplemented by such sweet fruits gives a very close nutritional approach to mother's milk. Such a combination is ideal for children.

In the case of those habitually engaged in heavy muscular work, these products are also ideal additional foods, but when it is not a case of getting out, in a brief period of time, the last possible ounce of bodily efficiency, but merely of keeping up a steady supply of fuel, then the grain products, the fats and the starchy vegetables should form the bulk of the diet (as indeed they do) of heavy laborers the world over. Practical economics must, of course, be considered, as well as actual dietetic needs.

The diet of the Chinese coolie, consisting largely of rice; of the laborer in tropical rubber plantations, consisting largely of bananas; or of the European peasant, consisting largely of bread and potatoes—all are examples of the cheapest form of carbohydrate diet available in the region, and all are much more satisfactory to these workers than the same diet would be to an indoor man. For the latter to attempt living on any of these diets of the world's hardest workers would result in nutritional deficiencies that would ruin his health.

Carbohydrates and the Laborer

This principle rests upon the fact that such laborers require and consume more food than does the indoor man. If the latter attempts to match them in quantity while not performing their more vigorous work, he will overeat and accumulate fat. But if he matches them in quality and yet eats only the quantity he needs for his lessened oxidation, then the diet will prove sadly deficient because the reduced quantities do not yield enough of some of the elements that are needed for bodily processes other than muscular action.

As a case in point let us consider the matter of non-digestible cellulose. An Italian ditch-digger might live on a diet consisting largely of white bread and macaroni, and yet, because of the enormous quantity of food eaten, there would still be enough waste, from food and digestive secretions, to give him free and easy bowel movements daily. But an office clerk, having need for only a third as much fuel, might on this diet become so constipated that serious illness might result. And the same principle holds good in the case of the essential minerals, or the vitamins. The need of the body for all these things is very little affected by muscular exercise. Any life-sustaining diet should contain some proportion of all these elements, and therefore the greater the quantity of food eaten, digested and oxidized, the less need is there to select foods that are high in any of these elements.

Thus we see that muscular activity aids in the elimination of any excess of food elements, and also indirectly aids in decreasing the likelihood of any food deficiencies. Hence the man engaged in hard physical labor thrives on many types of food that are destructive to the brain worker who takes little or no exercise. To assume, therefore, that because a diet seems effective for those doing hard muscular work it is a proper diet for idle or inactive men is very dangerous. This fact is abundantly illustrated in the case of the disease of pellagra which is caused by a deficient diet. Though all eat at the same family table, the more active male laborer generally escapes the disease, while the women, children and feeble old persons fall an easy prey.

Bread and Potatoes for Extra Carbohydrates

Both health and economy suggest that the heavy muscular worker should obtain the additional food he requires from products that are of the nearly pure-fuel type. He may have the same quantity of more complete foods that less active members of his family need, but his greater additional appetite requires additional amounts of carbohydrates. It is generally best to supply this extra fuel in the form of bread and potatoes. If it is provided in the form of cane sugar or cheap syrups, the children of the household are liable to overindulge in them, to the crowding out of the more essential milk, eggs, fruits and vegetables. Another course is to feed such laboring men more heavily on rather fat meats, which the children are much less likely to care for.

While it is true that the actual food requirements of the athlete are very similar to those of the ditch-digger, the athlete is likely to be more finicky in his tastes and much more concerned with the problem of getting the maximum of nourishment with the least chance of digestive or eliminative difficulties. His basic diet will be very similar to that required by less active types. That is, he will do well to eat all the ordinary life-sustaining foods, such as milk, eggs, meat in moderation, juicy fruits, green vegetables, raw salads, and bread or cereals in the whole-grain form. But he does not need to eat these foods in greater quantities than the average less active man. For the additional food which his special athletic activities require he should seek out the products which general experience, or his own personal experience, indicates as the best sources of additional muscle fuel, with the least burden on other bodily functions.

Sugar Foods for Endurance

Nothing can surpass the sugar foods for this purpose. These include the sweet fruits already mentioned; also honey, corn syrup and malt syrup and, in a more general way, any syrup or sugar. Candy and sweet soda-fountain drinks produce the immediate energy wanted by the athlete, but they might be harmful to those needing a somewhat smaller proportion of pure fuel in the diet.

Any fruit drink, such as lemonade or orangeade, is a splendid source of immediate added fuel. Such drinks should be taken during any endurance event in preference to solid food containing protein, fats or starches. An event continuing for a number of days could be best carried out on a diet of milk and sweet fruits, or even the various forms of sugar-enriched milk, of which the popular chocolate-flavored malted milk is a good example. Milk and well-ripened bananas would be another excellent diet for a prolonged endurance event.

HOW TO EAT TO LIVE LONG

Section 19

THERE is nothing more certain than that longevity is very largely determined by nutrition. When we make a study of men who have lived to be unusually old, or who have preserved their physical and mental vigor to an advanced age, we find one outstanding fact; namely, that they have all been temperate in eating.

Longevity and Nutrition

In regard to other habits there will be the most puzzling contradictions. Some very old men will be found to have been engaged all their lives in strenuous physical labor, while others, of equal longevity, have followed intellectual professions which call for very little muscular activity. Comparing the effects of outdoor and indoor living, equally puzzling contradictions are noted. Very old men are found among trappers, hunters and herdsmen who have spent their entire lives in the open air, and also among judges, bankers or tailors who have lived most of their lives indoors. Though the physical injury caused by the use of tobacco and coffee cannot be disputed, we find many centenarians who have used them for a lifetime. Even alcohol, if used moderately, does not seem to prevent some men living to very ripe old ages.

Some of the most irregular and supposedly most nerve-wracking professions, such as that of the actor, do not seem greatly to affect longevity or the power to maintain a youthful spirit and appearance to advanced years. In view of the sprightliness common among veterans of the theatrical profession, the rule, "Early to bed and early to rise" would seem to have less to do with health than the admonishers of our youth wished us to believe.

Nor can we find that the influence of sexual life upon longevity is at all marked, since among centenarians we find lifelong celebates, as well as men who have married young women and in advanced years begotten children. Heredity might be expected to have something to do with the matter, but does not seem to play as large a part as many people believe. While certain families show a much greater average length of life than others, there is probably not much more difference than would be accounted for by habits of eating, which are likely to be similar in members of the same family. Some races have shorter lives than others; but this is due primarily to the unfavorable conditions affecting such races, and even then there are many exceptions. Very aged Indians and negroes are not uncommonly seen. Races living in warmer climates average shorter lives than those living in cooler ones but there seems to be little difference in the capacity of the exceptional individual to reach the century mark. Some of the very oldest men and women are found among the Turks. This is true also of certain classes of Jews. The better classes of this race eat large quantities of sweets and rich food and are susceptible to diabetes, but Jews as a whole show a goodly proportion of centenarians.

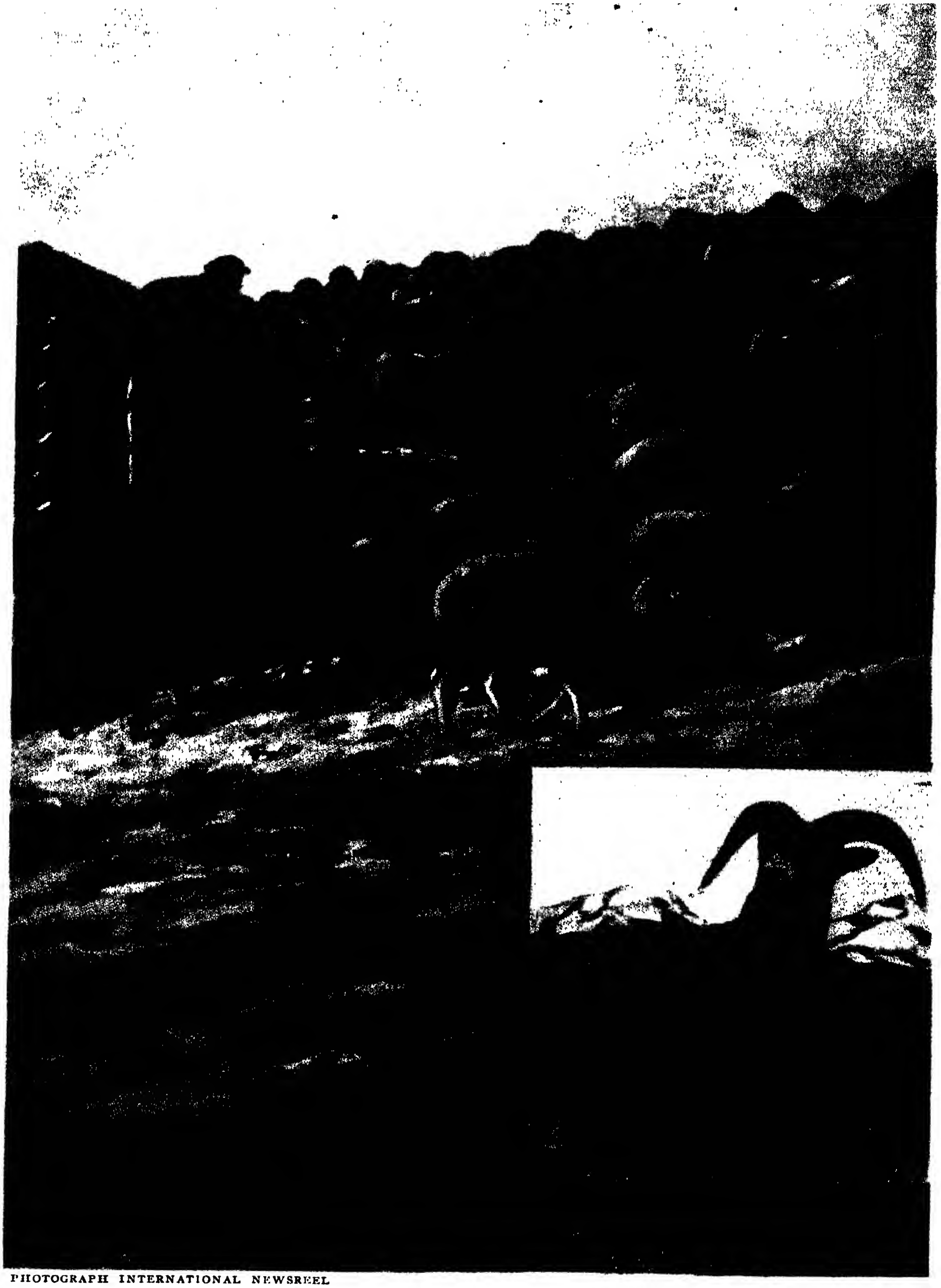
Sexual Life, Heredity and Longevity

The one thing, however, that does seem to be uniformly and invariably associated with longevity is the habit of abstemious or frugal eating. As a result of this habit we get, of course, slenderness of body and freedom from obesity. The greater age reached by thin, wiry individuals, as compared with those who are phlegmatic and obese, is a matter of common observation. It is also proved by life-insurance statistics. In the earlier years of a person's life, both overweight and underweight make for greater liability to disease and reduce the chances of a long life; but in these years underweight is the greater handicap. As one passes into the forties and fifties, however, the case is reversed, and overweight becomes the greater handicap and life-shortener. In old age, therefore, underweight, as compared with the average or so-called normal weight, is a distinct advantage. This is evidence that the average weights at such ages are really mild cases of overweight.

Slenderness Tends Toward Longevity

When very old men are asked about their eating habits they invariably say that they have always eaten sparingly. Heavy feeders do not live long no matter how much energy they appear to have.

When we turn from the question of the quantity of food to its quality the evidence is not so clear. Generally speaking,



PHOTOGRAPH INTERNATIONAL NEWSREEL

PLATE 31. Flock of domesticated sheep contrasted with wild sheep of Rocky Mountain breed.

abstemiousness in diet means both a reduction in the quantity of food and a restriction of the diet to the simpler and less highly flavored or highly seasoned dishes. Among prosperous overfed races, such as the English and the American, an abstemious habit of eating, as evidenced by a wiry body free from fat, would generally mean a reduction in the meat factor. This is not because lean meat in itself is fattening, but because it is stimulating to the taste and because the habits that lead to undue indulgence in food usually include the free use of meats. It is highly probable, therefore, that heavy meat-eaters are the exception among those who live the longest and that the low-protein diet is conducive to greatest longevity.

Low Protein Diet and Longevity

This can be carried to an extreme, however, and those who live too largely on starches, such as the inhabitants of India, are notoriously short-lived. It might be noted further that among the less advanced races those who attain the greatest ages are the ones who lead a pastoral life and, hence, live largely on milk. There are also a number of cases of extreme longevity on record in which the habit of using dairy products freely has been reported as the distinctive factor. A rather extreme case is that of a man who, while not yet really very old, maintains a remarkably fine state of youthfulness for a man of his years. This man is engaged in the manufacture of a special brand of dried milk, modified for infant feeding by the addition, before dehydration, of milk sugar. This man has such faith in his product that for many years he has been living upon it almost exclusively. He takes twelve ounces of this milk powder daily, liquifying it by the addition of water, and he maintains that he takes no other food with the exception of a little fruit. The excellent state of his health, his rosy, youthful color, his buoyancy of mind and body, are all very remarkable for a man of his years and certainly speak well for his marvelously simple ration.

Longevity and Dairy Products

While the evidence is too slight to prove that any particular type of food is best for longevity, there is nothing in it to disprove the assertion that the general type of food that gives the greatest degree of vitality and health in younger years is also the ideal food for old age. When we revert to the question of quantity the evidence is much more clear, because a thin, wiry condition of the body is in itself proof of the efficiency of a frugal diet in promoting long life.

As to why an abstemious diet should have the effect of prolonging life various theories have been advanced. Metchnikoff thought he had found the secret of longevity in the reduction, by the use of sour milk, of the putrefactive action in the bowel caused by constipation and a meat diet. Yet Metchnikoff himself died at a comparatively early age. Horace Fletcher believed he had found it in extremely thorough mastication of his food, but he came no nearer than Metchnikoff to demonstrating his theory by the length of his own life. Of course it is unfair to judge a general theory by the single example of the man who promulgates it, and yet it is hard to avoid an inclination to do so.

Metchnikoff's and Fletcher's Theories

There is, however, one striking fact, as to which we have undisputed scientific evidence, that seems to explain the greater longevity of those who live on a spare diet. During the World War, at the Carnegie Institute, a group of healthy young men, many of them athletes, were kept for months on a diet that reduced them to ten per cent. below the weight which they had maintained on an ordinary full diet, though none of them had ever been fat. They were, therefore, brought into about the same physical condition as the spare and wiry elderly men of the type who live the longest. To do this required a reduction of about one-third in their accustomed amount of food. On this more meager diet there was no uniform evidence of loss of physical power. Many elaborate studies and measurements were made of them without showing any marked physical changes, with one exception. This was that in every case there was a marked decrease in the pulse-rate, usually accompanied by a decrease in the blood-pressure. In other words, the most invariable and the most striking effect of a spare diet is that of decreasing the work of the heart and the circulatory system. Obviously this decrease, together with the lessened amount of waste to be excreted from the blood, also puts less work on the kidneys.

Reduced Diet Means Less Blood-Pressure

Modern vital statisticians have repeatedly called attention to the fact that while other causes of death are generally on the decline diseases of the heart, blood-vessels and kidneys are on the increase. And these are preeminently the diseases of

The term sweet fruits usually refers to dried fruits of high sugar and low acid content. Drying raises the sugar concentration and makes fruits taste sweeter but it has no effect on the food proportions. Dates contain the least acid and are the most nearly "nature's sweet" of any fruit.

old age. It would therefore seem justifiable to conclude that meager habits of eating promote longevity because of this lightening of the duties of the heart, blood-vessels and kidneys. One might even imagine that the custom of measuring the length of life in years is erroneous, and that the true measure of the length of life is in the number of heart-beats. By a spare diet the pulse-rate can be cut down by at least twenty per cent. of its figure on a full diet. If, therefore, we consider the heart-action as the limiting factor of longevity it would appear that life could be increased twenty per cent. in years by such lowering of the number of the heart-beats.

Checking the Causes of Death

The heart cannot, of course, be said to be wound up like a clock, with a capacity for so many beats, after which it must stop. If this were the case muscular activity would shorten life, and on this point the evidence is quite to the contrary. It is rather more likely that the true factor in the shortening of life is to be found in the fact that the more rapid heart-action, and increased rapidity of circulation through the kidneys which are induced by a too liberal diet is a pure waste of the body's energy. It is brought about in order to free the blood from the impurities that come from food for which it has no need and which it must get rid of lest it poison the cells. This theory seems to be in accord with what is known about the effects of food in increasing the blood-pressure and putting greater stress upon the organs of elimination. If this is the correct view, both high-protein and high-calorie diets are equally objectionable, for both are known to cause higher blood-pressure, more rapid metabolism, the generation of unnecessary heat and severe strain upon the kidneys.

Importance of Waste Riddance

We have good reason to believe, therefore, that longevity requires a diet low enough in nutritive units to prevent the accumulation of any visible fat, especially after middle life. The amount of food required cannot be stated in calories, since it will vary with the individual. The condition of the body as regards the presence of fat is the best guide.

A second essential would be to relieve all unnecessary strain on the kidneys. This will best be brought about by a diet in which milk and fruits are major elements. Diets of whole milk, with such fruits as dates and ripe bananas, are probably ideal for the aged. Meat should be decreased and so should fats and starches. Whole-grain bread, nuts and vegetables may be used in moderation. Eggs and cheese should be used only sparingly.

What Foods for Longevity?

It is probable that the regular practice of fasting would have the effect of further lengthening life, as this rests the organs both of digestion and elimination, and has an undoubted rejuvenating effect upon all the cells of the body. Fasting decreases both heart-action and waste metabolism. A man can live on less food if he fasts occasionally, because, when he resumes eating, the food economy will be so much improved that the weight lost while fasting can be regained with less food than would have been required to maintain the weight for the same period without the fast. Fasting one day a week, as well as taking one or two fasts of a week or ten days' duration each year, is usually advisable, both for promoting the general health and vitality and for increasing the prospects of longevity.

DIET, FASTING AND DISEASE

Section 20

IT IS unfortunately true that the majority of people who consult books on diet do not do it for the purpose of maintaining normal health, but in order to get relief from symptoms of ill-health. Therefore, the supposed distinction between normal diet and therapeutic or corrective diet is usually one that breaks down in practical application. We could theorize about a physically perfect man and consider the question of what would be an ideal diet for him, but such a diet would have very little application because there are few men who are even approximately perfect physically.

The Normal and the Corrective Diet

The food needs are modified by individual traits or circumstances, many of which have been discussed in the first part of this volume. To rename the more important ones, we have age, sex, growth, the size of the vital body (the body without fat), the proportion of body fat, the degree of muscular development, the extent to which the muscles are being used, nervous temperament and sleeping and resting habits. These factors do not take us into the realm of any abnormality such as would justify the name of disease. And yet adapting the diet to such individual differences does involve many of the same problems that we meet with in strictly curative dietetics. For instance, overweight or underweight would not ordinarily be considered a disease; yet everyone knows how frequently both are associated with disease.

In at least one weight-reducing contest (with many entries), nearly every contestant reported relief from diseases or symptoms as a secondary result of the primary purpose, which was to improve the physical appearance by reducing excess weight. A group of underweight people who had gone on special diets to increase weight would probably show equally gratifying secondary results. Indeed, a very similar batch of reports, for both underweight and overweight people, was brought in by a contest which *Physical Culture* magazine conducted for the most economical and healthful diets of both cooked and uncooked foods.

This evidence shows how rarely in practical life we can separate the problem of normal diet from that of corrective or curative diet. We can illustrate this still more forcibly by considering the problem of eliminating food wastes from the bowels. Civilized men are more likely than not to be suffering in some degree from constipation or overlong retention of these wastes. Constipation is abnormal and, therefore, a diseased condition. It also leads to or is a contributing cause of many other diseases, which fact is recognized by the phrase, "Constipation is the mother of disease."

Conditions Affecting Diet

Any food or mixture of foods has its particular influence in the elimination of waste from the bowel. This is true even of an individual who may be free from constipation. If he is able to maintain good elimination on the conventional diet, he may have trouble with looseness of the bowels, or too rapid elimination, when he adopts a menu which would be ideal in this respect for the man who would be badly constipated on a typical bread-and-meat diet. Even the healthiest man may need to consider the possible effect on bowel action of any change in his diet, while in some instances the relief of constipation may be an acute problem demanding immediate solution as a means of saving life or curing disease. Thus the problem of the effect of diet on the bowels is associated with all dietetic practice.

Bowel Action and Diet

The purpose of this discussion is not to make every reader believe he is ill, but rather to show him how closely linked is the problem of maintaining health with that of getting rid of ill-health. In either case it is necessary to understand nutritional effects and to be able to modify the diet according to individual conditions. A dietetic change which in one case may be suitable to a condition that is not one of disease, may in another be an important curative measure.

To illustrate this further let us take the problem of overeating. Let us consider this in a very typical case, that of a healthy muscular young man who has spent his youth at farm labor or other vigorous outdoor occupation. As he gets on in the world and succeeds financially he will be likely to get into a business where he sits all day at a desk. For a time his health remains good and his appetite fine, and he continues the hearty eating of his physically more active youth. Various things may happen to this type of man. He may begin to get fat and for a time continue to be the picture of health. He therefore begins to get interested in diet as a means of controlling weight. Or he may begin to get symptoms of indigestion after especially heavy meals and so become interested in diet from that standpoint. If his interest comes quickly enough and is applied with intelligence, he may correct his habits in time to save him from becoming a case for curative dietetics. On the other hand, if it is postponed too long, he may end with diabetes, kidney trouble, chronic dyspepsia, or one of many other forms of serious ill-health which may never permit him to return to the normal food habits of a healthy man. In such a case who could say just when the problem ceased to be one of a normal or health-maintaining diet and when it became a pathological case requiring diet therapy?

The Problem of Maintaining Health

A similar history and a similar change from a diet problem of health maintenance to one of diet therapy might be traced for any common dietetic error. It would certainly be true of constipation, or of an excessive use of protein, or of various mineral and vitamin deficiencies. Practically all nutritional blunders would have a similar history if continued long enough; but it is not always easy to trace them to their ultimate results, because they are not isolated, but associated with other blunders. Since there are dozens of such factors in nutrition, the combinations of possible dietetic errors are endless, and it is very difficult to trace the exact relation of any one of them to the final breakdown in health. For this reason dietetic therapy can never be an exact science in which a single and definite food prescription can be invariably applied to each specific disease. Indeed, we can go further and say that an absolutely isolated disease is most unusual, for practically all cases of ill-health involve complications of disease or disordered functions. The reason for this is that there are always complications of causes in all such histories.

Nutritional Blunders not Isolated

The large number of possible nutritional errors and the complication of the resulting symptoms might seem to make any dietetic treatment hopelessly confusing. This would, indeed, be true if dietetic therapy were analogous to the old drug therapy, with its idea of a specific drug for each disease and each symptom. But in actual practice the chief benefits of nutritional therapy are secured from two major procedures. One of these is the milk diet and the other is fasting. So important are these two measures in the natural method of healing that they are dealt with at length, the milk diet being separately discussed in Section 22 of this volume and fasting in Volume VII. At this point we shall discuss certain coordinations of these therapeutic measures with the general principles of nutrition.

Milk Most Perfect Food

It is perhaps easier to understand these relations in the case of the milk diet than in that of fasting. Milk from the breast of the mother is the only absolutely natural, complete and perfect food and body-building material for the human species. But cows' milk is for the human adult so nearly a perfect food that it serves in that capacity for all practical purposes. In fact, it is richer in the body-building proteins and minerals than is breast milk, and since the adult digestive and assimilative capacity is more vigorous than that of the infant these additional concentrations of nutritive building elements make it an even more rapidly acting body-building material. Hence for any condition of the adult body in which the lack of suitable or sufficient nutritive elements has been the cause of disease, its value should be at once apparent; while in conditions involving digestive weakness or failure, the digestibility and assimilability of milk, when taken in the proper fashion so as not to overload the stomach at any one time, make it equally valuable. Furthermore, an excess of milk is not harmful, as is an excess of most other foods, since any surplus is easily eliminated. These facts all combine to make the milk diet well-nigh a nutritional panacea, and the wide range of its application is truly marvelous.

The second basic means of nutritional therapy, which is fasting, is, in a way, quite the opposite of the milk diet in its principle of action. Obviously, the value of fasting must consist, not in supplying nutritional elements to the body, but in depriving it of all such elements. In other words, it is a means of bodily housecleaning, removing excesses of nutritive substances and accumulations of waste products. Fasting may seem contradictory to the idea of healing the body with foods, because it is a temporary denial of all food. But the body is not merely a reservoir to be loaded and crammed with nutritive substances. It is a very finely balanced coordination of many chemical substances and chemical processes, and this balance can be destroyed quite as effectively by poisons or excesses of nutritive elements as by deficiencies. The principle of fasting, furthermore, involves the principle of resting the functions of digestion and assimilation and partly resting those of excretion, giving the latter a chance to catch up with their work.

There is in fasting a further element of rejuvenation, or giving a renewal of life and youth to the cells, which is a well-established biological principle. That factor will be taken up more at length in the presentation of the full therapeutic principles and applications which will be thoroughly considered in Volume VII. Here we will consider only the somewhat puzzling question of why fasting is not dangerous, as a definitely deficient diet would be.

Fasting Is Not Starving

The fear of fasting in the minds of both the layman and many doctors is due to the confusion of fasting with starvation. Very little is actually known about the death of human beings by starvation in the absence of other destructive factors. Rarely have men been deprived of all foods and yet given water, warmth and all the other factors of healthful life. There have been innumerable deaths in the world in which starvation was a factor, but there are usually other factors at work also. Thus men shipwrecked at sea usually die of thirst instead of starvation, and so do men lost in deserts. Men lost in polar regions are likely to die of starvation combined with the destructive influence of cold, which is aggravated by the lack of body fuel. Men entrapped in mines are usually exposed to poisonous gases, or merely foul air, together with dampness and lack of sunlight. In all of these circumstances worry and fear are added to the destructive factors. This is also true in famines, such as have occurred so often in Asia and also in besieged cities during war. In a typical famine condition the population has for many months been subsisting on rations inadequate in quantity and quality. Fear, filth, vermin and exposure are always present. The food eaten includes offal and refuse of all kinds, as well as leaves, weeds and wild seeds, many of which contain unpleasant or poisonous elements that cause them to be refused as food in ordinary times. Under such circumstances the body's resistance to disease breaks down and pestilence is combined with famine. Famine sufferers, therefore, are not merely starving in the scientific sense, but are subject to a combination of destructive forces of which lack of food is only one. Even the cases on record in which men have been starved in jails—either because of being refused food by their captors or of refusing it themselves—can hardly be said to be pure cases of starvation, since emotional stresses and unhealthful surroundings are always present.

Therefore, the world really knows little about starvation in man when this is the only destructive factor, and the idea of abstinence from food is usually coupled with the thought of such misery as is experienced by famine sufferers, entrapped miners, lost explorers or prisoners.

Starvation of Animals

We know much more about complete starvation in animals. Experiments of this kind have been repeatedly conducted by scientists. Animals kept under otherwise healthful conditions have been deprived of food till death has actually resulted from starvation. The length of time that an animal can resist starvation depends on its size and the amount of fat present when the abstinence from food was begun. But a much more constant factor is the percentage of loss in weight. For an animal of normal weight this is usually about fifty per cent., or half of the normal weight. There are cases on record of fasting dogs losing as high as sixty per cent. of their weight, and then, on being fed, making a complete recovery.

Such extreme tests have never been made with men, but there is every reason to believe that the same general law applies, and that a healthy man would lose half or nearly half of his weight before actual death from starvation would occur, provided there were no other factors present to aid in his destruction. Since a man loses but about a pound a day in fasting, a 150-pound man might be expected to last about seventy-five days and reach a weight of about seventy-five pounds before he starved to death. There are many facts that point to the conclusion that this would be about what would happen in such a case. Now, supposing we have a therapeutic fast of thirty days, with a loss of thirty pounds. In the case of a 150-pound man this would be something less than half the loss of weight that would probably be required for death by starvation. This figure of thirty days is not to be taken as any particular goal to be reached in fasting, as other matters, which will be discussed later, should be considered in determining the length of a fast. It is given here merely to show that such a period of abstinence from food and such loss of weight are well within the limits of fasting as distinct from starvation.

Fasting, and Loss of Weight

One can apply this figure roughly, however, to different types of individuals in this fashion. If we take the loss of one-fifth of the weight of the body during a fast as a limit of safe fasting, then the weight from which to figure such loss would be the normal weight of an individual of a given build or stature. Obviously, overweight people can safely fast longer than underweight people, and those who are twenty per cent. or more underweight should not take any prolonged fast, though they might be benefited by short fasts sufficient to clear out and rest the alimentary canal and free the circulation from an excess of waste matter. This will occur in a few days and will not result in any appreciable loss from the tissues themselves.

So far we have been considering the loss of body-substance as a whole in starvation, and in fasting. Such loss would be apparent to the layman and is the usual basis of the fear of fasting entertained by the man who has given no thought to the subject of nutrition. There is another phase of the problem, however, that many scientists have considered and which those who have read the earlier chapters of this volume would also think of. That is the question of starvation for particular elements of nutrition as compared with starvation for all elements.

Starvation for Particular Elements

Indeed, at first glance the danger of such partial starvation for particular elements might seem to indicate that fasting would always be a dangerous procedure for anyone whose previous diet had been incomplete and who was, therefore, suffering from some nutritional deficiency. If this were true, fasting would be a very dangerous business, for many people in all civilized lands do suffer from such nutritional deficiencies. These, indeed, may be the cause of the very ills from which they would seek relief by fasting. How is it, then, that fasting is so frequently beneficial, and how can one already suffering from lack of a given food element benefit by taking no food whatever and hence getting none of the needed food element? The explanation is that there is never such a great deficiency of a necessary element in the body itself as in the diet that caused it, and when one ceases to eat the relative proportions of the different elements tend toward normality. The fasting body obviously lives on itself at the rate at which weight is lost. But it is common sense to expect, and scientific observation supports the expectation, that it should consume most rapidly the elements of which it contains a surplus while conserving and consuming very slowly those of which there is a deficiency. As the excessive elements are cast out and the deficient ones conserved, the balance or relative proportions of the two is brought into a more normal relation. Both excesses and deficiencies are corrected.

The Balancing of the Elements

The reason this conception is a little hard for some people to grasp is that they think of a deficiency as the lack of a definite amount, whereas the true vital deficiency is rather the lack of a relative amount or correct proportion.

Obviously, the body of a small man should not contain as much of any element as the body of a large man. For instance, the amount of iron in the body of a healthy man weighing 150 pounds is just about three grams. Therefore, the amount of iron in the body of a healthy man weighing 200 pounds would be four grams. But now suppose a man weighing 200 pounds was anemic and deficient in iron, having only three grams instead of four. If such a man should fast and lose fifty pounds, while conserving his iron, he would then have the three grams of iron which a healthy 150-pound body should have. Thus the deficiency of iron would be remedied without any additional supply.

The Loss of Various Elements

It is really impossible to conserve all of any element in the body in this fashion; but the elements that are most needed are better retained than those which are in excess. That this is not mere theory but what actually occurs is proved by the scientific studies that have been made of the rates at which various elements are lost from the body of a man during a fast. The following figures, giving the rate of loss of three elements on the first and twenty-first days of a fast, will serve as an illustration.

	Loss first day	Loss twenty-first day
Sodium	2.070	.066
Potassium	1.630	.644
Phosphorus	.725	.699

This faster, it will be noted, continued to lose phosphorus from his body after twenty days at about the same rate that he was losing it the first day. But the loss of potassium was nearly three times as great at the beginning as it was after twenty days, and the loss of sodium was actually thirty-one times as great.

Excess Elements Quickly Discarded

These are striking figures and very significant. They indicate that this man's body was charged with an excess of potassium when he began his fast and with a very great excess of sodium, but that there was no such excess of phosphorus. The body quickly cast off the excess elements, which it had not previously been able to do, because they were being kept up from the daily excess in the food. It is common knowledge that most foods are relatively higher in potassium than the body requires. The far greater excess of sodium obviously comes from the custom of adding sodium chloride or common salt to all the food we eat. For this reason the body is usually flooded with sodium and chlorine, and in all scientific studies of fasting men who have been eating such a salted diet the first few days show a rapid excretion of these elements.

It is further apparent that the relative proportion of sodium and phosphorus in this man's body would be changed by the fasting process. While the actual amount of phosphorus would be decreased the relative amount compared with the sodium would be increased. This is what happens not only between these elements but between numerous other elements of the body. Fasting, therefore, tends to bring about a more harmonious or better balance between the various chemical elements.

It is not to be understood that fasting is the only method of curing diseases that are caused by the deficiency of needed elements. Obviously, if such deficiencies were the only thing wrong with the body chemistry and the nature of the deficiencies were known, the proper remedy would be the use of a diet especially rich in the deficient elements. But too often the nature of the deficiencies is not known, and also diseases are commonly caused not by deficiencies alone but by deficiencies of some elements combined with excesses of others. Fasting is the best remedy for the troubles caused by excess accumulations or the presence of foreign matter in the body, and to that fact is due its remarkable results. That effect of fasting is easily understood, whereas, at first thought, it would seem that fasting would always make the disorders caused by deficiencies worse. The facts given above show that it does not necessarily do so.

Fasting Not a Cure-all

If a fast is followed by a completely nutritious diet, the better chemical harmony established in the body by its means will be maintained as the cells expand and the weight increases. But, of course, if it is followed by an inadequate and unbalanced diet, then much of its benefits may be lost. That is why the feeding after the fast is as important as the fast itself, and also why the milk diet is so often used in therapeutic practice to follow a fast of greater or less duration.

The Diet after Fasting

Indeed, these two great forms of natural treatment, which are so often linked in practice, may even be considered as one complete procedure of body rebuilding which first clears out the physiological debris, until the very cells of the body are cleaned down to the minimum vital essentials, and then builds up new life substance and vitality in these cells by a superabundant supply of nutritive substances very similar in nature to those from which the body of the young child is built. It is, indeed, a biological realization of the idea of a man being "born again" or of finding and drinking of the fountain of eternal youth.

SPECIFIC CHANGES IN DIET

Section 21

IN THIS section are enumerated thirty-four specific dietetic changes, with the purpose and effects of such changes, and suggestions as to how they may best be made in order to secure the best results.

Since numerous references will be made to these instructions in Volumes VI, VII and VIII, in which diseases and their treatment are discussed, these thirty-four topics will be numbered from 1A to 34A, for the purpose of ready reference.

No effort will be made in these discussions to give all the applications of the changes in question to diseased or disturbed conditions. Those mentioned are by way of illustration only, and anyone suffering from such disorders or symptoms should not depend wholly upon the suggestions given here, but should look up the more complete discussion of the disorder in Volume VII, or VIII.

When to Increase Calorie Value

1A. To Increase the Calorie Value of the Diet.—This is called for when the body needs to be fattened and the rate of metabolism increased. Low blood-pressure usually calls for such an increase of metabolism to be brought about by a combination of increased food and increased exercise. Certain types of physical weakness following disease and known as adynamia also call for an increase of the food-intake.

After a long fast or a wasting disease the amount of food must, obviously, be increased while the body is being rebuilt. The quantity of food in the milk diet (which is discussed in the next section) is greater than is ordinarily taken by the average individual.

That increased physical exertion creates a demand for more food is common knowledge.

The increase of the calorie value of the diet is usually considered synonymous with the increase in the quantity of food consumed, but this is not necessarily the case, as many bulky foods contain very little digestible material. There is no way to avoid this error except by becoming familiar with the calorie values of the various foods as given in the tables in the volume.

A mere increase in calories, moreover, is not all that is necessary. When such an increase is indicated, there is usually a state of lowered health which makes it difficult to assimilate sufficient food. Therefore, we search for the additional calories in foods that are most easily digested. Such foods have already been suggested in a preceding section on weight-gaining diets.

Methods of Increasing Calories

Calories can be increased with the least increase in bulk by using fats, or foods containing high percentages of fat, such as salad oils, butter, cream, nuts, and egg-yolks. Fat meats, with the possible exception of bacon, are not ideal for this purpose, because they are apt to aggravate digestive disorders and because they are likely to be associated with an excess of meat protein, which is rarely wanted in any health-building diet.

Next to the easily digestible fats, the best thing for increasing calories is the natural sugar of sweet fruits and honey. When the object of the increase is to supply energy for heavy physical labor, long-sustained athletic competition, or exposure to cold, the nature of the food chosen is not of great importance, as such conditions presume the existence of superior digestive power. Therefore the conventionally accepted "substantial foods" are all that are called for.

Methods of Reducing the Calories

2A. To Reduce the Calorie Value of the Diet.—Those who receive instructions from dietetians to reduce their calories are most frequently in the overweight class, or else people in the habit of eating heavily who have recently adopted a sedentary occupation. These people should consult our general discussion of weight-reducing and apply the principles there set forth with whatever degree of strictness is necessary for the purpose in hand. However, there are many disease conditions in which a reduction of the calories is for more immediate and specific purposes of relief, as in the case of boils and inflammations.

The fat content of the diet is almost invariably the element which should first be restricted. The exceptions to this rule apply to those who cannot digest or metabolize other normal food elements. Thus in the disease of diabetes the calorie restrictions are placed most heavily upon carbohydrate foods. In certain other digestive conditions specific food elements, such as starch or sugar or protein, are the ones to be cut; but these more specific restrictions will be discussed later in this section.

3A. To Increase Protein.—Protein is true body-building substance, therefore its increase is called for when the vital substance of the body—that is, tissue other than fat—is to be built up. This applies in any case of emaciation, in which the body not only lacks fat but other tissue as well. It applies after long fasts and after diseases having the effect of reducing weight to an abnormally low figure.

When Should Protein Be Increased?

In cases of normal weight and ordinary circumstances the advice to increase protein is not often given by modern dietetians, for the reason that conventional diets, in America at least, usually involve an overuse of protein. However, the fault here is generally the overuse of meat protein, with the resultant problems of acidosis and putrefaction. Therefore, the increase of non-acid and non-putrefying proteins is much more permissible. This is the basis of the milk diet and the modified milk diets which are so useful where general body-building is desirable.

However, the diets based on the combination of milk and fruits are only moderate protein diets and are not suited to cases in which a large amount of protein is called for. When more protein is needed, the straight milk diet is indicated, or the buttermilk and skim-milk diets, both of which are still higher in protein.

High-protein Foods

Occasionally vegetarians who exclude all animal products from their diet suffer from protein deficiency, owing to the low availability of certain types of vegetable protein. Some of these vegetarian extremists would undoubtedly be much benefitted by adding some milk, cheese and eggs to their diet. Those who persist in a refusal to use any animal products will find their richest sources of protein in the legumes (beans, lentils, peas and peanuts) and those nuts that contain relatively higher quantities of protein than fats. English walnuts and almonds rank well in this respect. Pecans, hickory nuts and Brazil nuts rank low in protein.

Attention should also be called to the fact that some of the vegetables (if eaten in sufficient quantities) are comparatively rich sources of protein. These are asparagus, Brussels-sprouts, cauliflower, chard, collards, kale, lettuce, green peppers and spinach. Mushrooms, while rating high for protein and commonly considered a meat-substitute, are a very unsatisfactory source of this element, because mushroom protein is of doubtful use to the body.

4A. TO DECREASE PROTEIN.—A reduction in the amount of protein in their diet would probably benefit ninety per cent. of the American or other heavy meat-eating peoples, and especially those of sedentary habits. Specific therapeutic indications for the low-protein diet include high blood-pressure, Bright's disease, rheumatism, gout and epilepsy.

Where the purpose of the diet is to decrease protein and to decrease calories, modified fasting regimens based chiefly or wholly on fruits, are ideal. The principle of decreased protein, however, may also be applied to weight-maintaining or even weight-gaining diets when the purpose is to increase the fat upon the body and there is no appreciable growth in the muscular tissue, such as is brought about by the combination of diet and muscle-building exercise.

Low-protein Foods

For the purpose of decreasing the proportion of protein in the diet fruits are by far the best group of foods, and unless the partial fasting effect is wanted the sweet fruits should be selected. Dates top the list, having the lowest proportion of protein of any common natural food. Raisins are a close second, and dried peaches and figs are also good. Of the fresh fruits that can be used in sufficient quantities to lower materially the protein effect in a non-reducing diet may be mentioned: bananas first, grapes second, and apples third. Plums, pears, peaches, oranges and melons are also good low-protein foods, though rarely eaten in sufficient quantities to maintain weight without the addition of foods of higher caloric value.

Among the non-fruit low-protein foods we have the fat-bearing olive and pecan nut. Of the starch-containing low-protein foods may be listed the banana, which, according to its degree of ripeness, consists of a blend of starch and sugar. The sweet potato comes next, and also contains both starch and sugar. Among the root vegetables carrots contain the least protein. Irish potatoes contain a higher proportion of protein than most people realize, but are still available in a low-protein diet, as are turnips and parsnips.

Among the cereal foods rice is the lowest in protein, and corn second. Oats and wheat, either in refined or whole-grain form, are not low but average in protein content. However, bread used with the usual percentage of butter gives a comparatively high proportion of calories to protein, because of the added fat.

Both fats and sugars may be used in a low-protein diet if enough vitamins and minerals are supplied by other foods. Honey would be the best item among the sugars. Maple syrup and natural cane molasses, also corn syrup, should be chosen in preference to refined sugar. Butter and cream would come first among the fats, though salad oils may also be used.

Whole milk may be used in moderate quantities in a low-protein diet, but the ideal dairy product for this diet would be whey.

Benefits of the Low-protein Diet

Any menu built from a selection of these foods as given forms a low-protein menu and, regardless of the total amount of food used, constitutes a partial fast as far as the element of protein is concerned. By this I mean that the use of such low-protein diets will cause the body to eliminate any excess of protein substances either from the bowels or from the blood, and the body generally. The low-protein diet is highly valuable for those who, due to underweight or other reasons, do not wish to undertake complete fasting or partial fasting in the sense of insufficient total food. Many of the benefits that are derived from complete or partial fasting, such as clearing the body of toxic substances, can be obtained from this low-protein diet which amounts to protein fasting and will therefore cause the reduction of any excess protein in the body.

The effect of excessive protein in the food and its decomposition in the bowels comes more properly under our next heading.

5A. TO COUNTERACT INTESTINAL PUTREFACTION.—By the term *intestinal putrefaction* is meant the bacterial decomposition of protein in the alimentary canal. This results in a group of highly poisonous substances which may be absorbed into the blood and which are responsible for the condition known as autointoxication or self-poisoning.

Results of the High-protein Diet

Intestinal putrefaction is one of the evil results of the high-protein diet, and hence the reduction of such putrefaction is one factor in the beneficial effects that may be expected from a reduction of the amount of protein in the diet. There are certain digestive disorders, however, in which the reduction of such putrefaction in the bowels is especially important. Among these conditions are diarrhea, enteritis, chronic appendicitis, reduced bile-secretion and biliousness. The avoidance of intestinal putrefaction is also very important in the case of tuberculosis, but in this case the reduction of such putrefaction must not be sought by a diet extremely low in protein.

It is impossible to keep the contents of the bowels entirely free from bacterial growth, either by natural or artificial means. In the early days of bacteriology, when scientists learned that certain poisonous drugs had germicidal power, it was hoped that medicines could be found which would kill bacteria in the alimentary canal. Even patent medicines were sold at one time which claimed to produce this result. However, no drugs have yet been found that will kill the bacteria without killing the man who takes them.

Eliminating Bacterial Growth from the Bowels

Therefore the only way of dealing with the problem is: (1) to decrease the amount of substance on which the bacteria may feed; (2) to reduce the time during which the bacteria in any given portion of the intestinal contents may grow and multiply; (3) or to create a medium unfavorable to their growth.

Because the objectionable bacteria can feed on protein only, a reduction of the protein-intake has the effect of decreasing the amount of this putrefaction. When the body is on a low-protein diet and the surplus protein in the blood has been used up, the digestion of protein will be more active and assimilation more rapid and more complete, thus leaving both less time and less substance for the action of the germs.

Meat proteins, including all forms of flesh food, are decidedly the most objectionable foods from the standpoint of putrefaction. Eggs are a close second. Milk proteins are the only animal proteins that do not putrefy, and, generally speaking, the protein of vegetable substances is less objectionable than that from animal sources. Among the vegetable proteins those from beans and legumes are decidedly more objectionable than proteins from the true nuts.

Next to a low-protein diet the best means of preventing autointoxication from this cause is the maintenance of a normal activity of the bowels. Constipation, however, should not be regarded as a mere mechanical difficulty in eliminating the intestinal wastes, which is usually the only symptom of the condition which is noted. Instead, the problem should be considered from the standpoint of the time required for the passage of food throughout the length of the alimentary canal. Bacteria multiply by geometrical progression, so that the extent of their growth increases in huge proportion with the increase of time available for it. Prompt evacuation of the bowels is, therefore, highly important in limiting such growth. Frequency of bowel movement indicates the time of passage through the bowels only in a rough way. Those who are severely troubled with constipation and suspect long-delayed movements should check up by taking half a teaspoonful of lampblack as a marker and noting the time that elapses before its first appearance in the stools. For the best results it should not be more than twenty-four hours.

Foods Most Likely to Putrefy

Methods of combatting slow elimination are not different from those commonly used as remedies for constipation, as there are practically no high-protein foods that are laxative. Bran, mineral oil and agar are all effective. In less severe cases a natural diet of leafy vegetables may be effective. The fruits, if effective, are especially desirable because of their low-protein content.

Keep the Bowels Active

The third method of combatting intestinal putrefaction forms our next topic.

6A. To Establish the Acidophilus Culture.—As the establishing of the acidophilus culture in the bowel is the most effective means of reducing intestinal putrefaction, it quite obviously follows that this procedure is to be recommended for the conditions named under the preceding heading. Disorders in which it has been found to be of especial benefit are: autotoxemia, goiter, skin eruptions and diabetes.

The term *acidophilus* is applied to a species of bacteria believed to be normal and desirable in the human alimentary tract. It is abundantly present in the bowels of the nursing infant and is always to be found in the adult digestive tract. It produces lactic acid which, although other bacteria can thrive in it, is unfavorable to the growth of the protein-feeding or putrefying bacteria, for which reason the bowels of the nursing infant are comparatively free from such organisms. It can be cultivated in ordinary milk, in whey, and in special solutions of milk sugar.

Benefits of Acidophilus Culture

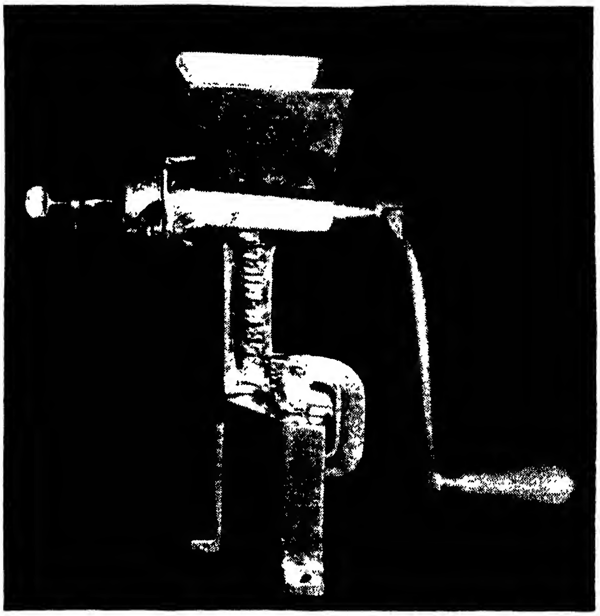
Lactic acid cannot be taken as a medicine. Being a food, most of it, when so taken, is absorbed from the digestive tract before it reaches the lower portion of the bowel. To be effective for the purpose of checking intestinal putrefaction, it must be generated in the bowel as fast as it is absorbed. This is what happens in the bowels of the nursing infant, which are, therefore, comparatively free from putrefying bacteria.

The above-stated facts are the basis of the modern use of the acidophilus cultures and acidophilus milk. When accompanied by the restriction of protein and the overcoming of constipation, it is a health-building factor of great value.

However, since acid-producing bacteria are always present in the digestive tract, although suppressed in number and rate of growth, many scientists hold that it is really not necessary to introduce additional cultures. They are "non-fighting" organisms and hence easily overpowered by less desirable ones; but if the food they thrive on best—namely, milk sugar—is given to them in large quantities, they will multiply rapidly and produce enough lactic acid to check the growth of the putrefactive bacteria.

Acidophilus Milk

This is exactly what happens when the milk diet is used. But a little acidophilus milk taken occasionally at the beginning of the diet will give greater assurance that the proper germs are present for the development of the desired condition of the bowels. The use of milk in any diet is also favorable to the growth of the acidophilus bacteria, and skim-milk and buttermilk are as good as whole milk. Whey, which is chiefly milk sugar and water, is most effective of all. But milk, in any of these forms, if used with a heavy protein diet, may not be sufficient for the purpose. The decrease of flesh



PHOTOGRAPH THE A. W. STRAUB CO.

This simple form of hand-driven grist mill may be fastened to a table or other accessible support by means of the clamp shown in photograph. Otherwise, it may be fastened by screws to any convenient wooden surface.

may not be sufficient for the purpose. The decrease of flesh proteins, along with the increase of milk sugar, is really essential to cause a change.

Milk sugar may be taken separately or added to milk, and a mixture of milk sugar and dextrin is also available. The effect of the dextrin is to delay the absorption of the sugar, causing it to traverse the entire length of the small intestine and improving the bacterial condition of the whole digestive tract.

7A. To Increase Cellulose.—Obviously, the primary reason for increasing the cellulose in the diet is to relieve or prevent constipation. However, there are many other diseases and symptoms of which constipation is a causative factor and, therefore, to which the increased use of cellulose would apply. For instance, the trouble diagnosed as chronic appendicitis is often little more than the result of chronic constipation.

More Cellulose Needed

Very severe digestive disorders which seem to be located higher up along the digestive tract may be due merely to constipation or stoppage of the bowel movement—peristalsis. Thus the symptoms due to the bile appearing in the stomach, from which it is sometimes vomited, may be merely the result of reverse peristalsis, brought about by bowel stoppage due to severe constipation. For the immediate relief of such symptoms the use of more cellulose in the food would not apply;

but the prevention of such disorders in the future should be brought about by establishing regular and prompt bowel-action through the habitual use of more bulky cellulose-containing foods.

The need of increasing cellulose in the diet has been fully pointed out in the third section of this volume. The two outstanding materials available for this effect are bran and agar. Agar classes as a drug commercially, and is sold in drug stores. It has not, however, the properties of a drug, its action being purely mechanical, owing to its non-digestibility and high water-absorbing power. Its use is generally limited to severe cases of constipation in which one cannot safely use bran.

Bran and Agar for Cellulose

Bran is now extensively used as a part of the diet. It is valuable both for its food elements, chiefly minerals, and for its non-digestible cellulose.

There is a wide variation in the constipation-relieving effect of the same food in different individuals. Therefore, make your meals simple, introducing various foods recommended for the purpose, and retaining the use of those which give the desired effect in your own case.

The list below comprises cellulose-containing foods. If you

CELLULOSE CONTENTS IN COMMON FOODS

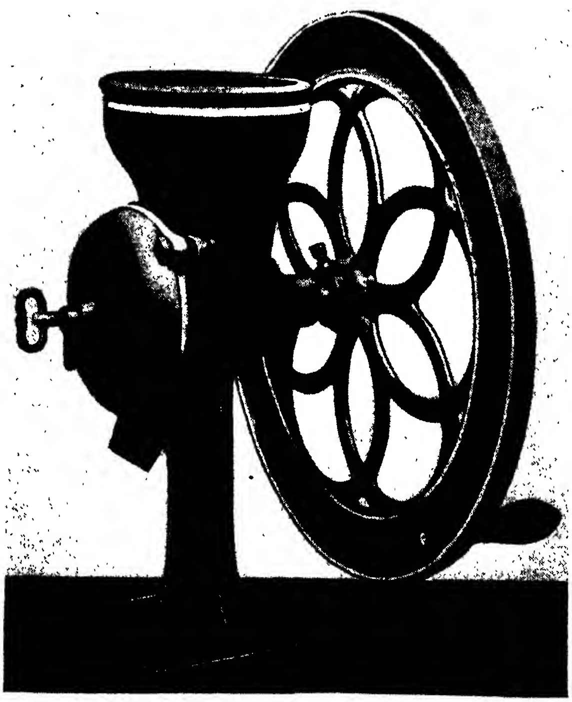
	Percentage of Cellulose		Percentage of Cellulose		Percentage of Cellulose
CEREAL PRODUCTS					
Bran	18	Whole wheat	2.6	Rice	0.3
		White flour	0.3		
VEGETABLES					
String beans	4	Turnips	1.6	Tomatoes	1.1
Beets	3	Carrots	1.6	Spinach	1.1
Lentils	2	Squash	1.3	Celery	0.9
Asparagus	2	Cauliflower	1.2	Watercress	0.7
Onions	2	Rhubarb	1.1	Potatoes	0.6
Parsnips	2	Mushrooms	1.1	Cucumber	0.5
Artichokes	2	Cabbage	1.1	Lettuce	0.5
FRUIT					
Huckleberries	12.2	Plums	4.3	Grapes	2.5
Raspberries	7.4	Cherries	3.8	Strawberries	2.2
Figs	7.3	Peaches	3.4	Oranges	1.5
Dates	5.5	Pears	3.1	Melons	1.0
Currants	4.6	Gooseberries	2.7	Bananas	0.2

will observe foods carefully and compare them with those listed on preceding page you can judge the approximate cellulose content of any food by the mechanical presence of the cellulose fiber. The items on this list are given in the order of their cellulose content.

8A. To Increase Bowel Lubrication.—In a normal state of health the bowels should be lubricated by the natural secretions from the mucous membrane. Unfortunately, however, the diet of civilized man has caused this function to deteriorate in most instances. No food product has yet been discovered that will reestablish such lubrication in any great number of cases; therefore the necessity of resorting to an artifice such as mineral oil, which is not digested.

Olive Oil as a Lubricant

Oil is the most efficient lubricator; and even digestible food oils, if taken in excess of the body's power to absorb them, may have this effect. It is sometimes achieved by taking straight doses of olive oil unmixed with other food. If there is a rapid forwarding movement of the bowel and the power to absorb fat is low, the unabsorbed oil may bring about the lubrication of the lower bowel. This procedure, however, is not often practicable, be-



PHOTOGRAPH ENTERPRISE MFG. CO.

This type of home grist mill is provided with a fly-wheel. It should be a most effective substitute in instances when a power driven mill is not obtainable. The grist mill for home use should be constructed to reduce the grain to a sufficient degree of fineness to insure a smooth flour for cooking purposes. This consideration is most important in the choice of a grist mill.

cause in so many cases it would be dietetically objectionable to take such an additional dose of digestible oil. In other cases, where the oil is needed nutritionally, it is completely absorbed and hence is not available for lubrication of the lower bowel.

Pecan Meal and Mineral Oil

Some lubricating effects of this type have in recent years been claimed for especially prepared pecan meal. This would be accounted for by the fact that nuts are slow of digestion and the pecan very oily.

The most universally reliable means of attaining this end is by the use of the specially refined form of petroleum commonly known as mineral oil. The base of this oil is the same as that of the machine lubricating oil, but it is very highly refined to remove any possible impure or irritating substances. The finished product is very bland and non-irritating and wholly without any direct chemical effect. It cannot be fattening, as none of it is digested and the entire amount taken is voided from the bowels.

How to Take Mineral Oil

The most frequent source of disappointment, or failure of desired effects, from the use of mineral oil is the erroneous notion that it is a purge. Many people seem to think that by taking a spoonful of this oil, as one would of castor oil, they can purge the bowels, but it rarely if ever has any such effect. Unless there is also a considerable amount of cellulose in the bowels, and unless the oil is taken at such times and in such a way that it will be absorbed by and mixed with the cellulose, it will merely pass through the bowels as free oil. The most effective way to use it is to mix it with dry bran. Amounts of from one to two tablespoonfuls of the oil to a cupful of bran is the best proportion. The second best method is to use it in the dressing of leafy salads. One is much more likely, however, to overuse it in this fashion. The salads look bulky, but are chiefly water. The amount of dry cellulose in leafy vegetables is small compared with an equal bulk of bran, and the oil should be used in such proportions that the cellulose residue will retain it.

In reducing and low-caloric diets the oil may be used in salad dressing to avoid the use of fattening oils, but the quantity must be carefully restricted. When the fattening oils are not objectionable dietetically but the constipation-relieving effect is desired, the correct quantity of mineral oil can be used in the salad dressing along with food oils.

The effect of mineral oil when combined with cellulose is both to soften and lubricate the bowel contents; and if the quantities are nicely balanced by experience, the results are very satisfactory, especially in the cases of a tendency toward dry, hard passages.

The above advice regarding the combination of mineral oil with cellulose applies to the ordinary case of constipation. However, there are special cases in which the increase of cellulose is objectionable, but in which the oil is quite safe. Among such are cases of ulcers anywhere in the alimentary tract, and of rectal diseases, especially fistula and bleeding hemorrhoids. The aggravation of any form of piles or hemorrhoids by straining at the stool is to be avoided, and mineral oil is very good for this purpose, while increase of cellulose alone may sometimes give too bulky passages. Lubrication of the bowel is also important in the case of spastic constipation in which the fecal matter tends to form in hard round lumps.

Various Uses of Mineral Oil

9A. TO DECREASE CELLULOSE.—People occasionally go to extremes and use entirely too much cellulose. This element should be used only to the point when it gives prompt bowel movement, but not to the extent of producing more than three actions a day. When such action is established there is no occasion further to increase the volume or frequency of the movement, nor should cellulose be used to the extent that it has a purging effect. When very voluminous or purging action is noted, the cellulose should be decreased accordingly.

Effects of Too Much Cellulose

In certain disorders, such as colitis and ulcers anywhere in the alimentary tract, cellulose in any amount may have irritating effects, and for the time the diet should be confined to foods that are practically free from fiber. After the condition has been overcome the diet should gradually be changed to include at least natural products, such as fruits and vegetables, that do have a normal amount of cellulose. In such extreme cases the best cereal to use is rice. Whole-wheat bread may, if necessary, be temporarily dropped and the starchy portion of the diet made up by the use of rice and potatoes. The use of white bread, even under these conditions, is not advisable, because of its other nutritional defects.

10A. TO INCREASE FAT.—The reasons for increasing fat in the diet usually are either that the individual cannot use sufficient carbohydrate foods or that it is desirable to increase the total caloric intake without increasing the bulk of the diet. Other indications for increasing the fat in the diet are neurasthenia and neuralgia, and also dryness and harshness of the skin.

When More Fat Is Needed

In a case of underweight in which the body requires more fat the easily digestible fats should, obviously, be supplied in abundance, unless there is evidence of inability to digest them. In cases of inability to digest or metabolize sufficient carbohydrates for the body's fuel needs fats must also be increased. Failure to digest starch and sugar, or bad symptoms of carbohydrate fermentation, would call for more fat to replace the carbohydrate. Of course, fat must be used extensively in diabetes to prevent starvation, since carbohydrates cannot be metabolized.

In any cases in which fat is increased in a diet other than that of a very robust physical laborer, we would choose the easily digestible forms of fat rather than fat meats. For one thing, very few forms of fat meat are palatable except when they contain large quantities of muscle substance. One notable exception to this, however, is bacon. Therefore, bacon may be listed among the acceptable fats, unless contradicted by a very delicate digestion.

A similar statement applies to the use of fats in fried foods. Fried foods, if permitted at all, belong only in the diet of husky laborers, or those exposed to severe degrees of outdoor cold, and are rarely suitable for those upon a corrective or curative diet.

We are limited, therefore, to the following selection: butter and butter substitutes, cream, soft cream cheese, egg-yolks, salad oil (plain or in the emulsified form known as mayonnaise) and, lastly, nuts and nut butters.

Very large amounts of butter can be used in cookery without making objectionable combinations. The use of butter for frying, or combining with sugar and white flour in pastries, is objectionable, but butter may be added to any soups, cooked vegetables or cooked cereals. Butter may also be freely used in making wholesome forms of bread. Its use on

Grinding mill and attachments, an excellent accessory in the kitchen for grinding many kinds of foods.

bread and on potatoes, if these articles are part of the diet, gives ample opportunity for consuming large amounts of it. As fats are high in calories, there is more danger of using too much than too little.

A quarter of a pound of butter contains 850 calories, which would be one-third or more of an ordinary diet. In any long-sustained diet (with the possible exception of the diabetic) not more than half the total calories should be derived from fats. Where such amounts are approached the remainder of the diet should contain very little starch and sugar, lest the fuel proportion of the diet be too high and crowd out the sources of minerals and vitamins.

Foods for Fat

The salad oils may be used in soups and vegetable cookery as a substitute for butter. There is no appreciable choice from the nutritive standpoint between the common vegetable oils, such as olive, cottonseed, corn, peanut and soy-bean oils.

Considered as a source of fat the pecan is the best nut and the peanut and chestnut are the poorest. Other nuts, such as almonds and walnuts, are intermediate in value. Nuts are a fine source of food oil and are preferable to the pure oils discussed above, unless the nuts are objectionable, either because of difficulty of digestion or their protein content.

This last caution applies particularly to peanuts, which are not true nuts but legumes and contain large percentages of vegetable protein like that of peas and beans.

11A. To Decrease Fats.—The decrease of fat is indicated in the diet either because of inability to digest fat or because of its high caloric content. Among the digestive disorders that call for reduced fats are hypochlohydria, achylia and retarded gastric motility.

Indications of Too Much Fat

In diets taken primarily for weight-reducing, or in any case in which it is desirable that the body should consume some of its own fat, the use of much fat is objectionable. The reasons for this are fully explained in the section on *Weight-Reduction,* and the foods or cooking methods to be avoided, because they contain or add fat, are fully listed.

12A. To Increase Carbohydrates.—The increase of carbohydrates is rarely recommended, because the typical American diet is usually too high in this element. However, in any diet in which the problem is that of maintaining or increasing weight and in which fats cannot be increased because of difficulty in digesting them, the total increase of foods or the replacement of fats must come from a carbohydrate group, either starch or sugars or a combination of the two, according to the individual digestive capacity.

Increase in Carbohydrates Seldom Needed

Diarrhea can usually be checked most readily by a diet of almost pure starch, such as plain boiled rice. However, it is rarely wise or necessary to select refined sugar or refined cereal products to increase the carbohydrate proportions in the diet, because we have too many natural foods which supply the same elements of starch and sugar in amply abundant proportions. Whole-grain products, on the average, contain only ten per cent. less starch than white flour and their value otherwise certainly offsets this slight difference, even when the purpose is to increase the starch content of the diet. Potatoes are also an excellent source of starch, containing as high a proportion as the refined cereals, but differing in having less protein, and slightly more cellulose and containing alkaline rather than acid-forming minerals. They therefore form one of our very best foods when more starch in our diet is permissible or desirable. On the other hand, when sugar rather than starch is wanted, we have sweet fruits, honey and maple syrup.

13A. TO DECREASE STARCH.—In recent times the idea of omitting starch from the diet has been overemphasized. This is chiefly due to the confusion of the effects of starch with those of white flour and refined cereals. There are, however, genuine cases in which starch must be eliminated or greatly decreased because of digestive disorders. Among these are some types of diarrhea, flatulency or intestinal gas, and starch dyspepsia. Lymphatic diseases and plethora, as well as diabetes, also call for a decrease of starch.

Indications of Too Much Starch

To decrease the starch in the diet there are two alternative methods that may be pursued. One is to eliminate all starch-containing products. The list contains cereals, both natural and refined, all foods in which flour is used in cookery, and potatoes. Sweet potatoes, bananas, turnips and a few other root vegetables contain some starch, but usually in a form less objectionable than in the foods just mentioned. In fact, the well-ripened banana, in which the starch is mostly turned into sugar, has been found to be an excellent product to be used when there is difficulty in starch digestion.

The second method is that of using starch in the predigested or modified form known as *dextrin.* This is the usual procedure in hyperacidity of the stomach when, from the nutritive standpoint, starch may be desired in the diet and the trouble is wholly due to difficulty in digesting it. In such case we may substitute for ordinary starch products those which have been dextrinized. Zwieback, which is bread subjected to long slow toasting, is the ideal form of dextrin. Certain commercial cereal products have been put through a similar process. Such dextrinized cereal substances may often be used when neither raw starch nor the sugars are acceptable.

Methods of Decreasing Starch

14A. TO DECREASE SUGAR.—Cane sugar must be decreased in many forms of indigestion and intestinal fermentations, and all sugars must, of course, be decreased in diabetes. In cases of colds and bronchitis a decrease of sugars is also advisable.

The decrease of sugar may be interpreted in two ways. One is to decrease the use of only refined sugar, and the other is to decrease the use of all types of sugar, both natural and refined. With the exception of diabetes we rarely need to eliminate all sugars from the diet. In case of weight-reduction

What Calls for a Decrease in Sugar?

we eliminate them in their concentrated form to keep down the calories. However, the fresh juicy fruits contain the simple fruit sugars and these are among our best products for use in limited diets, or modified fasting. The immediate stimulating effects of orange juice in case of the breaking of a fast or the exhaustion of athletes, or for diabetics who have been over-injected with insulin, is due to the fact that its dextrose or simple sugar passes directly into the blood. The effect is not so good if refined cane sugar has been added to the fruit, while the percentage of minerals and vitamins is decreased.

Foods for Less Sugar

15A. To Avoid Harmful Food Combinations.—Wrong combinations of food are often accused of being responsible for both digestive disorders and other disease conditions of the body. Considering the term in a broad way, it is obvious that correct food combinations would mean a correctly selected and proportioned diet and that wrong ones would mean an unbalanced and poorly selected diet. The term has been somewhat overused, however, by many dietetic writers.

Thus to say, "Do not combine two or more fats at a single meal, such as nuts, salad oils and butter," is merely to express in a popular way the principle that one should not overeat on fatty substances. The instruction not to combine two or more proteins in a meal, such as meat and fish, ham and eggs, or meat and beans, may be interpreted in the same way. The rule against combining meat and milk has dietetic sanction in the Mosaic laws. Scientifically, we may object to this combination on the ground that it provides too much protein; but the practical trouble with prohibiting it is that many people would avoid using milk altogether in order to have their meat at every meal. If the meat were eliminated rather than the milk, the objection to the combination would be more sound.

Objectionable Combinations

A similar principle is embodied in the advice not to combine two or more starches in a meal, such as potatoes and rice, or potatoes and macaroni. As bread is almost invariably eaten in the ordinary meal, it would be very easy to crowd out other needed types of food by such multiplying of starchy dishes. In cases where there is difficulty in the digestion of starch the prohibition would naturally be more important.

Combination at a single meal of too many "rich" foods, such as rich meat dressings and pastry, is certainly objectionable. The same might be said of fried foods and pastry. In these bad combinations we get both an excess of fat and fat combined with other food elements in such a way as to make it difficult to digest.

The objection to these combinations is based on the fact that they may lead to the overuse of certain food elements, or the unbalancing of the meal, and, if habitually used, of the diet. The more specific idea of the food-combination principle, however, presumes objectionable effects from foods when eaten together or at the same meal which would not result if the same foods were eaten at different meals, even though taken in the same quantity from day to day. When so considered the list of objectionable combinations would vary largely with the individual, because the harmful effect is usually, perhaps,

"Rich" Foods

Citrus fruit and milk—the two greatest health foods. Formerly much prejudice existed against the use of any acid fruit in combination with milk. More recently combinations of milk and orange juice have become popular.

brought about by some weakness or disorder of digestion. A few of the combinations which are most frequently found to create marked disturbance are as follows:

Fish and Milk

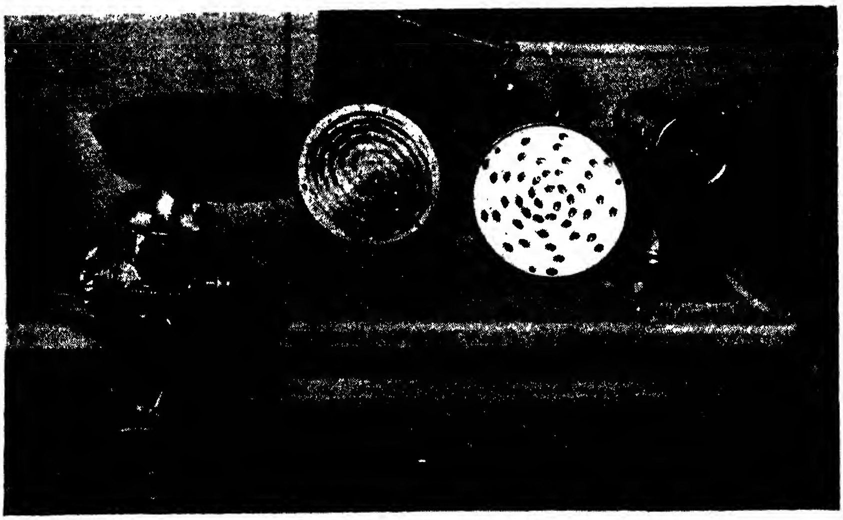
Fish and milk seem to be more particularly incompatible than other combinations of protein food, and this combination frequently produces indigestion or colic.

The belief that milk must not be used with any acid fruit is not well founded. Milk and orange juice can be used at the same meal, or even mixed together, with excellent results. This applies to the combination of most fruits with milk. However, there is certain evidence that some of the acid fruits are likely to make trouble when used with milk. Among these few should be mentioned gooseberries and cherries.

Starches and Condiments

A combination that has been found to be a frequent cause of gastric and intestinal fermentation is that of starch and condiments. The use of mustard, curry and other hot sauces is bad enough under all conditions, but with starch food, or a heavy starch meal, it is especially bad and results in immediate digestive trouble. Many people have such vigorous digestions that the incompatibility of these foods is not apparent at once; but eventually the hardiest digestive system would suffer from their continued use in combination.

The combination of starches and acid is a frequent source



An electrically operated food grinder and grater serves many purposes in food preparation.

of digestive disorders. The acid decreases the secretion of the starch-digesting enzyme in the saliva while it stimulates the flow of the gastric secretion. The combination of acid and starch, therefore, results in an unfavorable condition for starch digestion, and unless the digestive power is especially good this will make trouble. Illustrations of a bad combination of this sort would be potatoes and vinegar, as in potato salad, or grapefruit followed immediately by oatmeal.

Starches and Acids

The combination of starches and large amounts of cane sugar is a frequent trouble-maker, especially with those who have a tendency toward hyperacidity of the gastric secretion. Cane sugar tends to aggravate this condition of hyperacidity, which always makes trouble with starch digestion. In addition the use of large amounts of sugar and starches at the same meal makes for an overdose of carbohydrates and the crowding out of other types of foods, just as would be the case in the use of too many starchy foods at the same meal.

16A. TO INCREASE THE ALKALINE MINERALS.—The increase of alkaline minerals in the diet is called for to correct true acidosis, or lowered alkalinity of the blood and tissues. This condition is believed to be responsible for or to contribute to the development of many diseases, among them being toxemia, rheumatism and arthritis deformans.

Indications of Low Alkalinity

Those who are instructed to increase the alkaline minerals in the diet should review the section on Chemical Bases of Food and also the section on Minerals. Increasing the alkaline minerals of the diet involves the problem of eliminating the foods high in acid minerals and increasing those high in alkaline salts. To bring about this result intelligently one should have lists of the more important acid-forming and alkalinizing foods. Such lists follow:

TYPICAL ACID-FORMING FOODS

	UNITS		UNITS		UNITS
Fat-free meat or fish	12	Egg-white	9.5	White flour	2.7
Average lean meats (including poultry)	10	Egg, whole	7.5	Green corn	1.8
Fish, average	10	Egg yolk	7	Lentils	1.5
		Whole wheat	3.3	Cornmeal	1.2
		Oatmeal	3	Walnuts	1.1
		Rice	2.7	Peanuts	.7

TYPICAL ALKALINE OR ACID-NEUTRALIZING FOODS

Spinach	113	Lima beans	12	Skimmed milk	5
Cucumbers	45	Lemons	12	Sweet potatoes	5
Celery	42	Peaches	12	Navy beans	5
Chard	41	Oranges	11	Cranberries	3.7
Lettuce	39	Radishes	10	Asparagus	3.6
Figs	32	Watermelon	9	Chestnuts	3.2
Tomatoes	25	Potatoes	9	Dates	3.2
Carrots	24	Mushrooms	9	Onions	3.1
Beets	23	Cherries	8	Grapes	2.8
Olives	19	Prunes	8	Milk	2.7
Cantaloups	19	Raisins	7	Kidney beans	2.5
Cabbage	18	Plums	7	Currants	1.8
Parsnips	18	Turnips	7	Almonds	1.8
Cauliflower	17	Strawberries	6	Peas	1.5
Pineapple	16	Squash or Pumpkin	6	Cocoanuts	1.2
Raspberries	13	Pears	6	Cocoa	.1
String beans	13	Buttermilk	6		

When More Calcium Is Needed

17A. To Increase Calcium.—An increase in calcium is called for in case of bone-fracture and of osteomalacia, and during the periods of growth in children and of pregnancy and nursing in women a liberal supply is imperative.

The calcium content of common foods is given in the section on *Mineral Nutrition,* where you will find the subject fully discussed. The preeminence of milk as a source of calcium is obvious. Calcium is not present in the fat of milk, and hence, because of its smaller amount of calories, skim-milk and buttermilk are more concentrated sources of calcium than whole milk. The choice between fat-free milk and whole milk will depend on circumstances. Those who cannot or will not use milk will have more difficulty in getting a sufficient supply, and had best select a varied assortment of calcium-rich vegetables and not depend upon one or two such products.

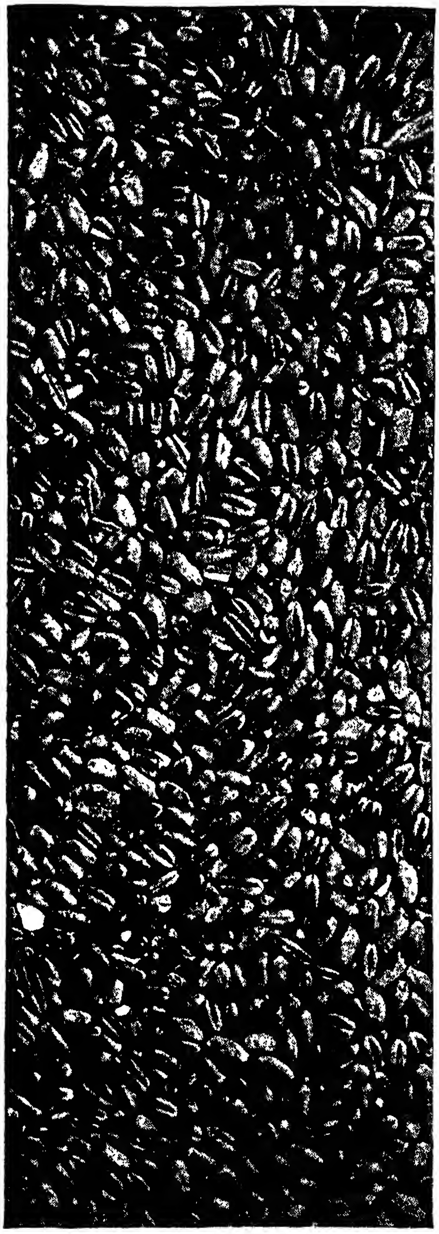
When More Iron Is Needed

18A. To Increase Iron.—An increase of iron in the diet is called for in all types of anemia, also usually in case of low blood-pressure and in adynamia. After any severe depletion, due to prolonged illness or to fasting, iron as well as protein is needed, because in the subsequent process of body-building the quantity of blood must be increased.

This subject is also covered in the discussion of mineral nutrition, and a table of food-iron values is given. Plenty of iron can be obtained from either a vegetable or a meat diet. Hence there is no excuse but ignorance for using permanently a diet deficient in iron. The only further caution that need be given here is that the disease of anemia may involve problems other than a deficiency of iron. Therefore, if that is the reason for an iron-food prescription you should not only master the subject of iron nutrition as described in this volume, but should refer to the discussion of anemia in the volumes on diseases.

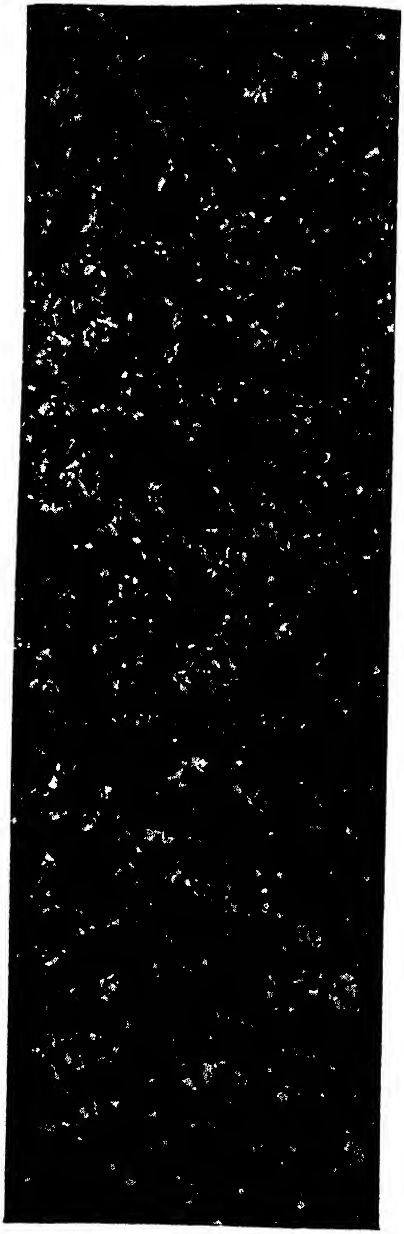
19A. To Increase Vitamin A.—The most emphatic laboratory demonstration of the value of vitamin A is that its absence prevents growth in young animals. This vitamin is, therefore, certainly indicated in cases of stunted growth in children. However, it is not solely a growth vitamin, nor is it the only vitamin necessary to growth. It is essential to the normal activity of many glands; in fact, all vitamins should be supplied in glandular failure, whether glands of digestion, metabolism, or sex.

The most concentrated known source of vitamin A is cod-liver oil. This fact



When Vitamin A Is Needed

Whole wheat, the greatest staple food of the white race. Almost all the controversy and confusion regarding the value of wheat as food rests not upon the grain itself but upon changes in composition, due to mechanical processes in the effort to make this food more attractive to appearance or taste.



Whole wheat after the first break or coarse grinding in the flour mill. Note that when coarsely ground the larger size of the bran flakes makes them more apparent and gives a darker color to the flour than when it is more finely ground.

should not be obscured by the still higher concentration of vitamin D in this remarkable oil. However, the usual reason for using cod-liver oil is for its vitamin D. Vitamin A can easily be secured in sufficient quantities for ordinary needs from more palatable foods.

Foods for Vitamin A

Butter-fat is our chief source of vitamin A in the ordinary diet. This applies whether the fat is in whole milk, cream, butter or cheese. The second best source is egg-yolks, and the next green leafy vegetables. This fat-soluble vitamin is much more concentrated in those vegetable products which contain the green coloring matter, *chlorophyl*, than it is in the blanched leaves. Therefore, while the parts composing the white interior of the cabbage-head are scientifically leaves, they are not more valuable than the pod of green beans.

The peculiar association of vitamin A with the coloring matter of plants is interesting. Not only do plant foods that contain green coloring rank high in this vitamin but also plants containing the yellow pigment, *carotin*, such as carrots and yellow turnips. Careful testing also shows that yellow corn is richer in vitamin A than white corn.

For fuller information on

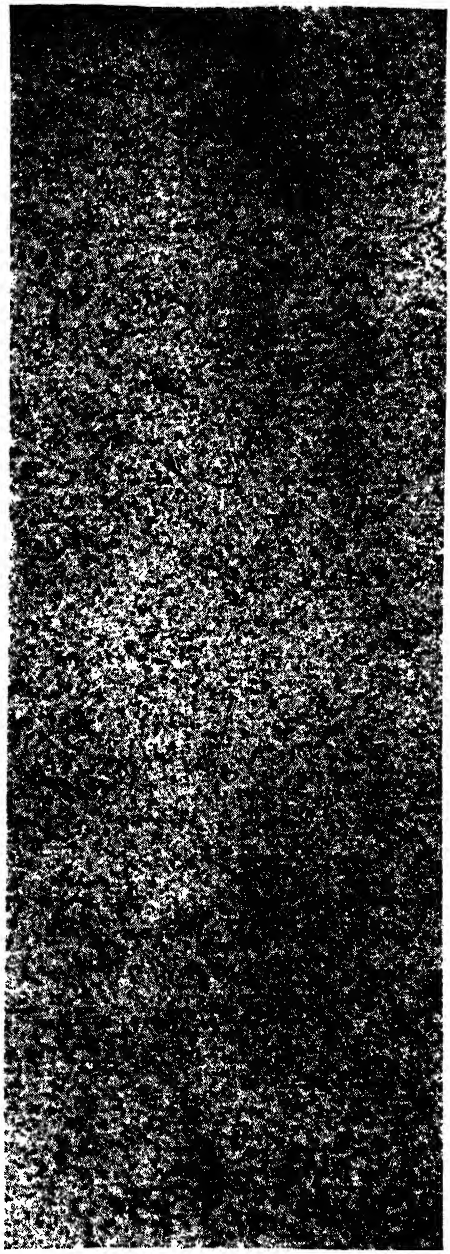
the vitamin content of foods see the discussion of this subject in the previous section, and also consult the tables under *The Use of Food Tables*, Section 15.

20A. To Increase Vitamin B.—Lack of vitamin B causes complete failure and paralysis of the nerves. This vitamin, therefore, is specifically indicated in neuritis and other nervous disorders. But without proper nutrition of the nerves we can hardly have health of any bodily function, which would account for the wide variety of benefits which this vitamin can confer. It is certainly an essential to all health-building processes.

When Vitamin B Is Needed

Any natural diet of fruits, vegetables and whole grains contains sufficient vitamin B for the body's requirements. The best source in this group is the germ of wheat which is included, of course, in whole wheat flour. Bran is also a good source. However, yeast is the richest known source, and when there is evidence of serious deficiency of this vitamin and a demand for quick reestablishment of the supply we turn to yeast products. These include both the fresh living yeast and the commercial yeast

Foods for Vitamin B



When it is finely ground, whole wheat flour appears lighter in color than coarsely ground flour from the same wheat. This often arouses a suspicion that the finely ground flour is not genuine whole wheat. The fineness of the grinding does not alter the food value.

concentrates. Those who for any reason cannot get or cannot use a diet of natural foods may wisely use these preparations as a source of vitamin B. With limited diets in which the total amount of food is low, such as long-continued reducing diets, or those necessitated by digestive difficulties, this procedure is often very wise. Therapeutic diets in which a high percentage of fat is required especially require a supplement of vitamin B, because fats do not contain this vitamin.

When Vitamin C Is Needed

21A. To Increase Vitamin C.—Vitamin C is very specifically the scurvy-preventing vitamin. But scurvy represents a final stage of complete starvation for this vitamin, which happily is not often reached in adults. In infants diagnosis of scurvy is much more common. All modern doctors, as well as modern mothers, feed infants orange juice to insure a supply of this vitamin.

Our susceptibility to many diseases is increased by lack of a sufficient supply of vitamin C. The value of citrus fruits as a preventative of colds, influenza and similar diseases is believed to be due to this vitamin. The greater prevalence of these troubles in the later winter and early spring as compared with the equally inclement fall and early winter months may be due to the body's depletion of this vitamin from lack of fresh fruits and vegetables in the winter.

Foods for Vitamin C

To increase vitamin C we rely chiefly on the fresh uncooked juices of citrus fruits. If these are not obtainable we go to the tomatoes, which are effective either fresh or canned. However, one should not overlook the fact that most fresh uncooked fruits and vegetables contain this vitamin. The relative rankings can be noted in the food table. The special provision of vitamin C is highly important in all cases in which people are forced to live on dry or canned foods. The sufficient retention of this vitamin in canned tomatoes then becomes highly important.

When Vitamin D Is Needed

22A. To Increase Vitamin D.—Vitamin D is specifically concerned with calcium metabolism. Hence its importance in bone-growth. This makes it essential to the normal growth of infants and children, and also in all cases of fracture or disease of the bones. It is positively curative for rickets, and bow-legs in children who have severe rickets may be made straight by providing an abundance of vitamin D and calcium.

It is also a cure for tuberculosis of the bones, and, in fact, in all forms of tuberculosis the vitamin is indicated, as all seem to be related to calcium nutrition. Tooth nutrition requires it, and pregnancy is another positive indication for it.

Foods for Vitamin D

Concentrated sources of vitamin D are cod-liver oil and any animal liver. The next best is egg-yolk, though the content here varies with the exposure of the hens to sunshine and the nature of their feed.

These food products were originally considered to be the only reliable sources of this vitamin, but it is now known that it can be created in the body by the action of sunlight on the skin, or of ultra-violet lamps. The final achievement of science in this problem was to discover that the vitamin could be created in ordinary foods by irradiating them with ultraviolet rays. Therefore, in connection with this dietetic requirement, you should consult not only the discussion of *vitamins* in this volume but the discussion of *light therapy* in Volume VI.

When Vitamin E Is Needed

23A. To Increase Vitamin E.—Because vitamin E is so closely associated in source with vitamin B it is hard to distinguish its separate action except in laboratory tests on animals. In these cases the specific failure of reproductive function can be definitely traced to lack of this vitamin and definitely restored by its use. Since it is also a general health-building factor we are certainly warranted in using it in cases of impotence, sterility and seminal losses. Applied to the female organism the evidence would indicate its use during pregnancy, especially if there was a history of miscarriage.

24A. To Decrease Common Salt.—Some of the specific cases in which the decrease of common salt in the diet are specifically recommended are eczema, high blood-pressure, arteriosclerosis, cancer, diabetes insipidus and dropsy.

Indications of Too Much Salt

This problem should require no great elaboration. There are no natural foods that contain an objectionable amount of common salt. This is true even of the sea foods, if salt has not been added in their preservation. The body fluid of fish swimming in the sea is not as concentrated a salt solution as the water of their environment. Therefore, when salt is forbidden it merely means that one should not add salt to food.

It is necessary to note, however, that many food products which we eat without added salt at home have been salted in the process of manufacture. This applies to bakery products and also to many prepared cereals. If whole or uncooked rolled grains are purchased, no salt will have been added. Further sources of salt that may slip into the diet are not only salt-cured meats, but sauerkraut, pickles, especially dill, and olives, condiments and canned vegetables. The yeast concentrates, unfortunately, are preserved with salt, and therefore fresh yeast should be used instead in a salt-free diet.

When to Avoid Condiments

25A. To Decrease Condiments.—The use of condiments has little to recommend it at any time, but would be more specifically condemned in dyspepsia, hyperacidity and Bright's disease—also in obesity, because the high flavoring of food encourages overeating.

In the case of at least ninety per cent. of civilized people the decrease of condiments is indicated. To say nothing of the fact that they irritate the digestive organs and are possible sources of poison, they destroy natural appetite, encourage overeating, and disguise natural flavors. The only reason for insisting particularly upon their disuse in remedial diets is that we are then dealing with cases in which the harmfulness of condiments has been demonstrated and the patient sufficiently frightened to be more willing to give up this artificial appeal to unnatural tastes.

Typical Condiments

The term *condiments* is used rather loosely, but certainly includes such substances as pepper, tabasco, chili, mustard, curry and horseradish, and also many hot spices. Such mild, non-burning vegetables as green peppers and pimentoes need not be forbidden merely because of their similarity in name to the foregoing. It is the hot, burning effect that is objectionable.

Acid Condiments

Vinegar may be classed as an acid condiment. The acetic acid, while organic, is produced by bacterial fermentation, and dietitians generally agree that it is objectionable. Therefore, when acidity is desired in salads and beverages it should be obtained from lemons or limes instead of vinegar. Rhubarb has sometimes been suggested as a substitute for vinegar, but should not be used, because its acidity is due to oxalic acid, which is poisonous to the human body.

26A. To Decrease Caffein.—Caffein is a specific drug used in medicine as a heart stimulant, and has no place in nutritional science. However, this drug has been more widely used as a dietary article than any other known to man. The popularity of the world's most extensively used beverages depends in part at least upon the caffein content. This includes coffee, tea and maté, the South American tea-substitute. One other extensive use of caffein is in the artificial beverage, coca cola.

Caffein, Most Widely Used Stimulant

As caffein is a habit-forming drug, some people give it up simply for this reason, without any evidence of particular individual injury; but usually this is not done until some symptoms appear that may be specifically charged to the drug. These include nervousness, insomnia, migraine and heart-disease.

In the problem of eliminating caffein we are dealing with a mild but often persistent drug habit which is supported by social customs. Therefore, we are usually inclined to deal indulgently with it and sympathize with the many attempts that have been made to render the elimination of the drug as easy as possible. For this purpose we have the decaffeinized coffees in which most of the caffein has been removed while the aroma has been retained. Secondly, we have the coffee-substitutes which have never contained caffein but which do not so closely imitate the coffee flavor.

Caffein Substitutes

There are no satisfactory caffein-free substitutes for tea. The South American beverage maté has been falsely exploited as a health tea, but its popularity rests on its caffein content. Tea, however, may be satisfactory in very weak concentration, whereas most people do not like weak coffee.

For those who are willing to deal more firmly with these caffein beverages substitutes of an entirely different type can be recommended, such as broth, hot milk, malted milk and the numerous fruit-juice drinks.

Frequent Eating Sometimes Necessary

27A. To Increase the Frequency of Eating.—Because overeating is a more common dietetic fault than undereating there are more people who will be benefited by decreasing the number of meals than by increasing them. This is true because with the less frequent eating it is easier to decrease the total quantity of food consumed. One should clearly comprehend, however, that the frequency of meals does not in itself determine the total quantity of food used. One can eat more frequently and not increase the total amount of food.

Gastric ulcer is a typical case in which increased frequency of eating is called for in order to avoid having large amounts of food in the stomach at one time. For slightly different reasons the same procedure is often indicated in hyperacidity of the stomach. Too great hunger may result in too great a flow of the hyperacid gastric juice, and when the postponed meal is finally eaten the large amount of food taken may prove too much for the stomach in its abnormal condition to handle.

Hyperacidity

Instructions to increase the frequency of eating may apply to cases of under-nutrition in which more food is wanted, as well as to those special cases in which the purpose is not to increase the amount of food, but to decrease the amount that is taken into the stomach at any one time. Therefore, in any suggested changes in the frequency of meals one should understand clearly which of these two results is desired.

Three meals a day is the conventional number but the omission of one of these meals, especially breakfast, is usually beneficial to the healthy adult with good digestive powers. In some cases, however, this plan is tried by people whose digestion and appetite are weak and results in under-nutrition. In such circumstances it is obvious that the two-meal plan should be abandoned.

Light Food before Retiring

In more extreme cases of the same type even three meals is insufficient, and additional food may be advisable at other hours of the day or between meals. Such additional food should not take the form of an additional meal. It is inadvisable in any case to eat what would ordinarily be called meals oftener than three times a day. With the meals at seven, twelve and six, or at similar intervals, it is obvious that the longest period without food is from the evening meal to the following morning. Therefore, the most logical time for taking extra food might seem to be just before retiring. It is not advisable to eat any heavy meal, or food requiring much digestive effort, at this hour. But additional food in readily assimilable form, and especially a liquid, such as milk or fruit juice, may be taken before retiring. Such products when so taken will have the least disturbing effect upon the digestion, or upon the appetite for regular meals.

A glass of warm milk taken before retiring is often advisable, and if the earlier evening meal has been cleared from the stomach such additional nourishment makes no trouble and adds to the day's total nourishment with the least possible disturbance. If a single glass of milk does not add sufficient nourishment as much as two glasses may be taken. Another way to increase the total nourishment to be taken before retiring is to enrich the milk with such substances as malted-milk powder, honey or milk sugar.

Fruit between Meals

Fruit, though a solid food, is so readily absorbed and requires such small digestive function that it may be used in the same way as the milk. This will, of course, apply to any fruit juice, and when more nourishment is wanted the soft pulpy fruits, such as very ripe apples, pears or peaches, may also be used. Still more nourishment is secured from bananas, and if very well ripened they come in this easily assimilable list. The most nourishment, however, is secured from the dried sweet fruits, dates coming first, figs second and raisins third. Any of these fruits may be combined with milk. Thus a glass of milk and a handful of dates make a very easily digested meal that can be taken just before retiring, with little danger of disturbing digestion during sleep.

When it is desired to increase the protein of the diet, milk-and-egg beverages may be used; or, to suggest another combination, an egg-yolk mixed with orange juice, with orange and grapefruit juice, or with orange and lemon juice.

If experience proves that eating just before retiring disturbs sleep, it would be better to take the additional nourishment between meals. The same principle of choosing foods that are quickly and easily absorbed would apply, and therefore the list of foods already mentioned would be most suitable.

Simple Diets for Continuous Digestion

The above suggestions are given on the presumption that what are called regular meals are being eaten also. In extreme cases of weakened digestion the regular meals are abandoned and foods more of the type under discussion are used as the mainstay of the diet. This, indeed, is one of the fundamental principles of the milk diet, in which the increased capacity of the body to assimilate foods depends on the avoidance of regular meals, giving the digestive organs much easier duty and making that duty continuous over a much longer period of time. If this principle is applied to diets other than that of milk the foods used should be very simple and usually of similar type. The idea is that the digestive process should be made continuous only when the functioning is both simple and similar. To eat solid foods of different types every hour or so would be disastrous to even a healthy digestion.

28A. To Decrease the Frequency of Eating.—It is rather difficult to name specific disorders which require a decrease in the frequency of meals as distinguished from the factor of decreased quantity of food. Yet it may be noted that the cutting down of the number of meals per day has been followed by marked improvement in gastritis, apoplexy, high blood-pressure and chronic diarrhea.

Effects of Fewer Meals

The usual reason for decreasing the frequency of eating is that this is the easiest way to avoid overeating. *Physical Culture* magazine once made a study of the amount of food eaten by a large group of people on the two-meal-a-day plan as compared with what had been eaten on a three-meal regimen. It was found that the most common effect of changing to two meals was to decrease the total amount of food eaten. The instructions were to eat according to natural appetite in either case. Upon the two-meal plan the amount of food eaten was somewhat greater per meal than on the three-meal plan, but it did not equal the total amount of food previously consumed in three meals. The comparison can best be expressed by stating that those who changed from three to two meals found that the appetite was then satisfied with about as much food as would have been included in two and a half of the previous meals. This evidence, based on the experience of many people, disproves the contention sometimes made that one will eat as much food with two meals as with three. That might be true in exceptional cases, but the general tendency is to decrease the total amount of food when the number of meals is decreased.

The Two-meal Plan

The two-meal plan, because of its simplicity, is therefore the easiest way to discourage overeating. It should certainly be made use of by those who have a chronic problem of keeping down their weight or preventing obesity. The tendency to decrease the food in changing from three to two meals is not sufficiently great to decrease weight. This fact should be clear from the data given, for half the quantity of food usually eaten at one meal on the three-meal plan amounts to only one-sixth of the total food-intake, and eating five-sixths of the habitual amount of food will not materially reduce weight. For reasons given in our discussion of weight-reduction it was shown that an effective reducing diet should contain but about one-half of the food previously eaten. But those who merely fear overweight or those who have reduced and wish to avoid increase can largely accomplish this end by the two-meal plan. Even then, however, if the fattening tendency is great, it will be necessary to curb the appetite for at least one of the two meals.

It is possible, in the case of a very healthy digestion and with the use of easily digested and very nutritious foods, to maintain the weight of the body on one meal a day. Considerable observation of efforts to apply this plan has convinced many, however, that it is not advisable.

The One Full Meal Plan

Because many people have an inclination to eat their fill when sitting down to a table with a superabundance of food, it is often advisable to provide only one such meal per day. This may be the typical conventional dinner, eaten either at noon or in the evening. Food eaten at other times must then be restricted in quantity and can be taken either in one moderately light meal or two very light ones. In exceptional cases one might even adopt the plan of eating but one full meal and using milk or fruit as suggested under the previous topic of how to increase the total food intake, instead of adding other meals.

In certain cases of digestive disorders digestion in the stomach is exceptionally slow, and three meals a day are undesirable because the stomach is not cleared of the previous meal in time for the following one. In these cases the two-meal-a-day plan should be tried, the meals being about equal and spaced as many hours apart as is feasible. As one rarely has an appetite for such a full meal upon arising, this program can be carried out by having the first meal promptly at noon and the second rather late in the evening. If other conditions were favorable, nine (or ten) and five (or six) would be good hours for such meals.

29A. To Increase Mastication.—The advice to increase mastication comes as near being universally applicable as any dietetic suggestion given in this chapter. Some of its more imperative applications are in cases of hypoacidity (in which there is a lack of gastric juice), dyspepsia, intestinal putrefaction, constipation and obesity. In the latter case habits of more prolonged chewing and slower eating are essential to train the appetite to be satisfied with less food.

Mastication for Disorders

The extreme idea of making the chewing of food the chief principle of health can perhaps be overdone, as it was in the case of what was popularly known as *Fletcherism.* Horace Fletcher, in the first decade of the twentieth century, achieved wide attention for his dietetic and nutritional ideas, which were popularly thought to be embodied in thorough chewing. This view, however, represented only part of the ideas advocated by Mr. Fletcher. Many of the beneficial results attributed to his principle of exceptionally thorough mastication were secondary effects. Eating in this fashion reduced the total amount of food required to satisfy the appetite to the actual minimum need of the body, and hence Fletcherism was a great defense against overeating. Furthermore, Mr. Fletcher advocated the use of very little meat, therefore his diet was a low-protein diet.

Fletcherism

The serious fault with Mr. Fletcher's idea, and one which really caused the abandonment of Fletcherism by most of those who tried to follow him completely, was that he insisted on the rejection of all foods that could not be reduced to a liquid in the mouth. This resulted in the elimination of all cellulose-containing foods and so had a very bad effect upon those who were constipated.

Methods of Increasing Mastication

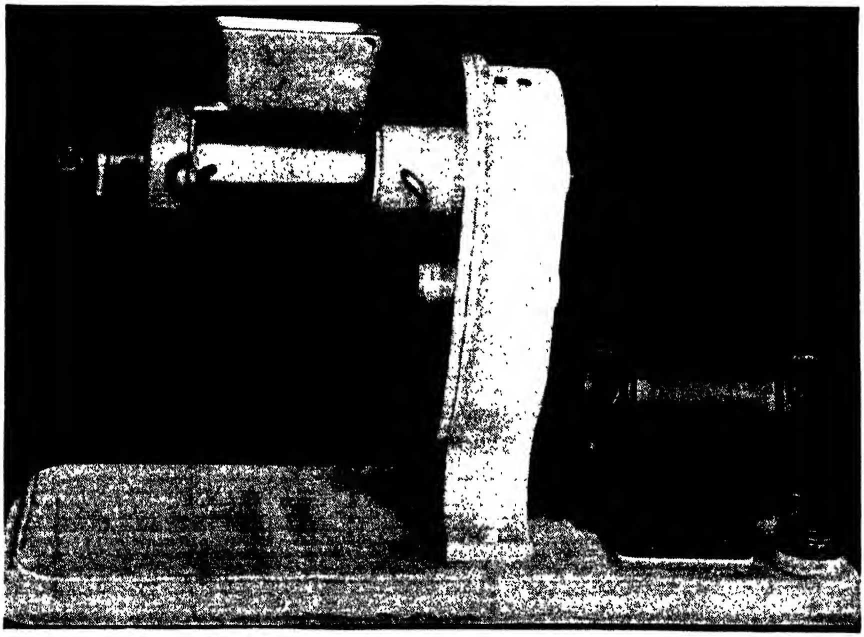
There are two means of increasing mastication. One is the deliberate prolonged chewing of one's food; the other is the selection of foods which from their nature require considerable chewing. Both methods are good and both should be applied. One advantage of raw fruits and vegetables over cooked ones is that they require more chewing than the latter.

It is also desirable to "masticate" liquid foods, by which is meant sipping or drinking them slowly and moving them in the mouth for a sufficient time to permit mixture with saliva. Obviously the nursing infant does this when taking his milk, and the adult should imitate the practice to a certain extent by sipping his milk slowly rather than gulping it down as a thirsty man would water. The same principle is applied in the taking of such liquid foods as soups, because they are usually served too hot to drink and are eaten with a spoon. When we use milk soups, or when milk is coagulated in the form of junket, it is eaten in this fashion, which is the way it should be eaten. Similar effects, however, can be obtained in taking milk or other liquid food from a cup or glass.

Masticating Liquid and Mushy Foods

The same principle can be applied to soft mushy foods which can be swallowed as taken into the mouth, but which are better prepared for digestion if one goes through the motion of chewing them. If the meal is made up wholly of such soft foods, however, the business of chewing, with no substance to chew on, can become rather monotonous and farcical.

Bread and cereals should be especially well masticated be-



PHOTOGRAPH THE A. W. STRAUB CO.

This power-driven grist mill is operated by a small motor to which power is conveyed by ordinary electric light current, whether alternating or direct. By its use, wheat, rye or other cereals, may be ground to flour for household use without loss of the nutritive qualities of the entire grain.

cause they contain starch, and the saliva is an important factor in the digestion of starch. Therefore, starchy foods are especially objectionable when made into porridges. The ideal cereal is one that stays crisp even when milk is added, so that it still encourages mastication. This is why certain prepared cereals have become so popular as health foods. With such products it is better to add only a little milk or cream at the side of the dish from time to time than to allow the whole mass to become soaked in the liquid.

Coarser Foods and Mastication

One advantage of coarse whole-wheat bread over fine-flour breads, and especially hot breads, is that the coarse bread encourages greater mastication. Hot breads are especially objectionable in that their substance packs together in doughy balls and is not easily penetrated by the digestive juices. The popularity of crisp whole-grain crackers, like some of the Swedish rye products, is well deserved, and the factor of encouraging mastication is quite as important as their healthful ingredients. An example of poor American culinary methods is the cooking of rice so that it becomes a soft mushy mass. The Oriental method leaves it drier and the grains retain their separate form thus encouraging mastication.

Most of the foundation for the idea that water should not be drunk with meals rests upon the habit of using it to wash down food instead of chewing the food until it is sufficiently liquefied by mixture with the saliva. Any beverage used at the table, whether water or a food beverage, should be taken only when the mouth is free from other food.

When to Decrease Mastication

30A. To Decrease Mastication—There are a few abnormal conditions that call for the decrease rather than the increase of mastication. Chief among these is hyperacidity, or the oversecretion of the gastric juice. The act of mastication stimulates the flow not only of the saliva but of the gastric juice. Hence, when this flow is already abnormally great it can be checked by using foods that require little mastication and which are swallowed quickly.

Since the digestion of starch requires saliva we have a contradiction in this situation that can best be overcome by the use of less starch and of starch that has been predigested by the process of dextrinization. Zwieback, or dextrinized toast, softened with milk or a little hot water, would be ideal for these requirements. If prepared toasted cereals are used we would, in this case, be justified in allowing them to soften in liquid.

Gastric and duodenal ulcer are frequently associated with hyperacidity. In these disorders not only should chewing be restricted, but coarse or mechanically irritating substances should be avoided as far as possible. Hence these diseases require the temporary use of diets of soft food which would be objectionable in a state of normal health. If this leads to constipation, mineral oil or the enema should be used.

31A. To Increase the Quantity of Water Taken Daily.—In the matter of water it is necessary to distinguish between the total daily amount and the quantity taken with meals. No special methods other than common sense are needed to increase the intake of water. Obviously, water should be taken at moderately frequent intervals rather than in huge amounts drunk at one time.

Water and the Occupation

The average man in a sedentary occupation should cultivate the habit of drinking water more freely than he ordinarily does. Our bodies are evolved under conditions of greater activity than civilized life usually calls for. Activity induces perspiration and hence thirst. Thus there is constant danger among comparatively inactive people that the quantity of this universal solvent taken into the body will be less than is required for elimination through the skin and other channels.

Increasing the amount of water will in many cases aid in the overcoming of constipation, since if the blood is too thirsty it is more inclined to absorb water from the bowel, leaving the contents too dry.

In addition to the above more generally applicable reasons for increasing the amount of water there are certain pathological conditions in which such increase is imperative. Among these are: gallstones, Bright's disease, rheumatism, diabetes mellitus, low blood-pressure, all acute fevers, chronic inactivity of the skin, colds and drug habits.

32A. To Decrease Water Taken Daily.—Very few individuals ever have any occasion to decrease the amount of water taken daily. There are some diseases, however, in which this is necessary. These include certain types of kidney disorders, diabetes insipidus, pyloric obstruction and dropsy. In all such cases, however, the patient should be under medical advice, since unguarded efforts to decrease the amount of water, even in these disorders, may be dangerous.

The popular notion that water should be severely restricted in weight-reducing is founded on the observation that abstaining from water will immediately decrease weight; but it has no effect in removing fat, which is the purpose of reduction. There are, of course, occasional genuine cases of overweight which combine obesity with a dropsical condition and in which part of the excess weight is due to excess water in the tissues.

Liquid Increase at Meals

33A. TO INCREASE THE LIQUID CONTENT OF MEALS.—Certain types of digestive disorders are decidedly benefited by the use of more liquid foods, or more water, with meals. This may apply in certain types of dyspepsia, also in emaciation and malassimilation. Hyperacidity, with the resulting symptoms of sour stomach and heartburn, may frequently be relieved by an increase of the proportion of water in the meal, because this dilutes the over-concentrated gastric juice.

34A. TO DECREASE THE WATER CONTENT OF MEALS.—Meals with less water, either in the foods or in addition to them, are desirable in a case of hypoacidity or insufficient gastric juice. The same statement will apply to slow digestion.

Decreasing the Liquid at Meals

The advice to decrease the water content of the meal is frequently given for obesity, and is usually a misconception on the grounds explained in the previous discussion of decreasing the water taken daily. However, there is some advantage in the use of drier meals in obesity, because dry foods taken without liquid encourage prolonged mastication and this in turn results in satisfying the appetite with less food and, therefore, tends to prevent overeating. Washing the food down with beverages, or using foods that may be swallowed quickly, obviously encourages overeating. Reducing patients may, therefore, do more of their drinking between meals and restrain their habits of using soft food or beverages at meal-time. The effect of the amount of water used at meals on constipation seems to vary with the individual. In some cases the addition of much water to the food results in the stimulation of peristalsis and hence tends to relieve constipation. In other cases the water is all quickly absorbed and has no such effect.

THE MILK DIET *Section* 22

THE milk diet is a diet including no other food than milk. This statement may seem superfluous, but anyone familiar with the prevalent ideas as to what constitutes such a diet will appreciate the importance of emphasizing this fact. It is true that slight modifications are permitted for special conditions; but the only other foods that are allowed are small quantities of fruit or bran. Some people think they are taking the milk diet if they drink a glass or two with each meal or between their meals, or if they live on bread and milk, or milk and eggs, or milk and something else that they happen particularly to like. Another common misconception is that the diet is equivalent to starvation and that one must necessarily become weak and lose weight on it, as though there were no difference nutritionally between milk and water. Many other erroneous notions in regard to the milk diet might be mentioned, but these will suffice to show that one should not judge it, nor attempt to take it, without fully understanding what it is, or how it should be used.

Milk Only Food in Milk Diet

The therapeutic use of milk is not new. Away back in the time of ancient Greece, Hippocrates, the "Father of Medicine," advised tuberculous patients to drink plenty of ass's milk. But the exclusive milk diet was not used to any great extent until about a hundred years ago, when Russian and German physicians began to prescribe it quite frequently. A Russian doctor published a book on the subject in 1857. In the United States it has been employed extensively for over fifty years. *Physical Culture* magazine has advocated it from its first publication, and its value has been proved in thousands of cases. It is now no longer an experiment, but an accepted form of therapeutics.

Origin of Milk Diet

In spite of its proved value the diet has been subject to attack for almost as long as it has been used. This is to be expected, because anything which can be so easily and effectively employed will be certain to be opposed by those who think that something mysterious must be done to cure disease, and by those who have some other form of treatment to offer. Patients who have taken the diet improperly and have failed to secure results will also line up with the opposition. Some of the arguments against the diet are quite nonsensical, while others appear superficially to have some reason in them; but they all can be easily disproved.

Probably the most common objection to milk, especially as a sole diet, is that it is food for calves and not for humans. No one will deny that cow's milk is food for calves, as the milk of all animals is designed for the feeding of the young of that species; but this does not prove that these various kinds of milk may not be used to advantage for the feeding of humans, who are, after all, animals as far as their physical bodies are concerned. Numerous instances are on record in which animals of one kind have nursed the young of another kind and the latter have developed normally and naturally; so why should not the milk of lower animals be good for the human animal? An analysis of the human body shows what elements are required to nourish it. An analysis of milk shows that it contains these elements and is free of objectionable substances; so there is no reason why it should not adequately nourish the body. Experience proves that it does.

Unsound Objections to Milk

If we are to object to the use of cow's milk by humans because it is the natural food of calves, we must also object to the use of nuts as being the natural food of squirrels, and to the use of grain as being the natural food of birds and other animals. And if we object to the use of cow's milk because it comes from cows, we must object to the use of eggs because they come from hens and are designed by Nature, just as milk is, for the nourishment of the newly hatched chick until natural digestion begins.

Milk Suited to Adults

A second objection arising out of this one is that milk is food for children and not for adults. This is clearly shown to be without basis by the fact that the rennin, a ferment secreted by the stomach glands for the express purpose of curdling milk, persists throughout life. It is also well to remember that an exclusive milk diet is intended for temporary use during the period when the body is being restored from a

PHOTOGRAPH EWING GALLOWAY

Milk serves as a staple food throughout childhood far beyond the period of infancy. It is generally accepted that even a child able to drink from a glass should not take milk in this manner before it learns to drink slowly. About two years is the age at which this usually may be expected.

pathological to a normal condition. It need not be used thereafter, though all normal diets should contain some milk. A person who is sick is not an adult in the sense that he is fully developed and able to care for himself. His digestive system and often other organs of the body are so deteriorated that they do not have a functional ability equal even to that of a child. People not infrequently find themselves reduced to such a state that they cannot take any food except milk without great distress. We would not expect them to refuse milk because it is a food primarily designed for the young.

Is Milk a Natural Food?

A third objection to milk is that it is not a "natural" food, since an animal must be specially bred and cared for in order that it may give milk continually instead of just during the nursing period. There is no denying that milk is not in this respect a "natural" food, but practical experience has proved that, natural or not, it is an excellent source of nourishment. Those who wish to confine themselves to strictly "natural" foods will have to limit themselves to wild plants and avoid all cultivated articles, such as paper-shell pecans, cultivated apples, navel oranges, celery, lettuce and sugar-corn.

An objection to milk which seems to have gained some headway in the last few years is that it is mucus-forming. Mucus is considered by these objectors to be quite deadly, in spite of its being a normal secretion of all mucous membranes. An excess of mucus is not normal; but if there is an excess it is because it is needed to increase elimination. This condition arises only when there is an excess of toxins in the body, regardless of the diet. Of course, some foods produce a lot of toxins, and hence may create a need for an excess of mucus; but milk is not one of these foods. It is the acid-forming foods which are mucus-forming, and not the alkalinizing ones, such as milk. If the body has formed the habit of eliminating by secreting more mucus, then the symptoms may be increased temporarily at the beginning of the milk diet, because such a diet stimulates elimination in general. As the diet is continued, however, and the toxins are reduced, the secretion of mucus will also decrease. This is the best proof that milk is not in itself mucus-forming. One can reduce the secretion of mucus very rapidly on a diet of fresh fruits and green vegetables alone, because such a diet produces no toxins and stimulates elimination; but this cannot be continued indefinitely, for it does not fully nourish the body. An excessive secretion of mucus may or may not return after such a diet, depending upon how thoroughly the body has been cleansed and upon the activity of the ordinary channels of elimination. Overcoming catarrhal conditions is as much a matter of increasing the vitality and functional ability as it is of cleansing the body. There may be a few cases in which even a temporary increase in the flow of mucus would prove objectionable; the milk diet would not then be advisable, but as a rule it is very good for catarrhal conditions.

Is Milk Mucus-Forming?

Some object to the milk diet on the ground that it supplies too much protein, and others on the ground that it does not supply enough iron. A full milk diet does supply more protein than the body needs under ordinary circumstances, but not so much more than is needed under the special conditions for which the diet is usually taken. The milk diet is essentially a building diet and is used when more tissue is needed. In such case the body can use a larger proportion of protein than would ordinarily be required, and whatever protein excess there may be is more readily eliminated than would be the case with protein from other sources, because the casein of milk can be more easily reduced to its primary elements by the body than can other forms of protein. As for lack of iron, no fear need be felt on this point. The full milk diet will supply about twelve milligrams of iron per day; and while this amount is supposed to be only the minimum requirement of the body, it is evidently enough, for in many cases of anemia the milk diet has been taken with great success. What iron there is in milk is completely absorbed and utilized.

Has Milk Sufficient Iron?

.Some strict vegetarians object to milk on the ground that it is animal product. Much might be said on both sides of this question, but such argument is largely a waste of time. Fortunately it is not necessary to kill the animal to secure this excellent food.

The most serious objection to milk is in regard to its purity. Cows give practically all the milk that is used by man, and since they are not always kept under the best conditions the milk is subject to variation in composition and to contamination both from the cow and outside sources. Goat's milk is used to a considerable extent in some countries, and this milk is supposed to be particularly valuable because goats are less susceptible to disease than cows, being kept under more natural conditions. There are other reasons for using goat's milk, which will be discussed later; but in the majority of cases cow's milk must be used, none other being obtainable. The present discussion will therefore be limited to cow's milk.

Type of Milk Preferred

If one using the milk diet is of a household keeping cows, he is in an ideal position, as he can then determine the quality and purity of the milk for himself. Persons who live in the country, but do not have their own cows, can usually make the necessary arrangements to get milk from a reliable source. The majority, however, will have to use a mixed milk; that is, from a large number of cows. This has some advantages, for if the milk of some of the cows is inferior, the mixing with that of other cows will bring the average composition up to standard.

The milk of diseased cows is a rare danger, for not only are the sources of the milk-supply under government inspection, but it is to the dairyman's own advantage to keep healthy cows and to maintain the quality of milk at a high standard. The milk from a diseased cow is not, however, as dangerous as it is popularly supposed to be, for Nature does everything possible to protect the young by causing the glands to secrete as normal a milk as is possible under the circumstances. If the cow is diseased to such extent that the milk is greatly affected, the supply is either much reduced or cut off entirely.

Milk is more likely to be poor in composition than it is to be dangerously infected. Cows which are not properly fed and are kept indoors all or much of the time, thus getting insufficient air, sunshine and exercise, will naturally not produce the best milk. It will be lacking in vitamins, and perhaps in mineral elements, even though it may be rich in butter-fat.

Health of Cows Important

The price which the dairyman receives for his milk is governed largely by two factors: the amount of butter-fat it contains, and the bacteria count. He therefore feeds his cows with the idea of increasing the yield rather than with regard to the mineral and vitamin content, and he keeps the cows mostly inside, so that they will be more easily kept clean and the bacteria count kept low. Even milk which is supposed to be the

PHOTOGRAPH EWING GALLOWAY

Cows at pasture produce milk better in every way than that of permanently stabled cows. The sun's rays have a potent effect on the physical condition of the cow and the quality of milk it produces.

best may, therefore, be low in mineral elements and vitamins. But nevertheless, any milk diet will be a more certain source of these valuable elements than an ordinary diet of solid food. Solid foods may also lack mineral elements, if the soil in which they are grown is poor. There is scarcely an objection which could be applied to milk which cannot be applied also to solid foods; and while a really high-class milk produces exceptional results in persons on the milk diet, the ordinary run of milk is good enough to give very satisfactory results.

People who live in cities cannot determine the sources of their milk supply and will have to be guided by the reliability of the companies with which they deal. Only the best milk obtainable should be used for the milk diet, but if such a diet is greatly needed and only a medium quality of milk is available, it will still be possible to get good results. Often an inferior quality of milk will do a person more good than the best of solid foods, if the latter cannot be normally digested and assimilated.

Fear of Germs in Milk

Those who fear to take the milk diet because of possible germs in the milk should remember that germs are to be found everywhere, that solid foods as well as milk can be and usually are contaminated by them; also that germs alone rarely if ever cause disease. Anyone who finds it necessary to his peace of mind to be especially protected can use pasteurized milk, in which most of the bacteria have been destroyed, and then, as a precaution, make up the deficiencies brought about by the pasteurization, and feeding and caring for the cows, by taking a little orange juice along with the milk. A person who really needs the milk diet should not be deterred from taking it by any exaggerated ideas as to its susceptibility to contamination or its lack of minerals and vitamins. Many have taken the diet with an inferior quality of milk and for diseases for which it would not ordinarily be recommended and still have secured satisfactory results, though, naturally, the better the milk used the better the results.

Some people object to the milk diet who do not object to milk itself. They claim that the diet involves overfeeding, or that it overworks the kidneys, or that it forces an increase in weight which later is lost, or that it produces constipation and biliousness or that certain types of individuals should not use it. It is true that it does mean overfeeding to a certain extent, but this is permissible under the conditions for which it is prescribed. It is taken when the body needs building up, usually after it has been reduced in weight and depleted of stored-up food through fasting or a very limited diet, so that it requires a large supply of all necessary elements. At such a time a superabundance of good food is an advantage. A larger amount and a better quality of blood will be produced than by a more limited supply of food, and the circulation will be accelerated, so that the various organs of the body will be well nourished and in a position to stand a little extra work. Whatever excess of food there may be can be stored up in the body as fat, or quickly eliminated through the bowels, kidneys, skin and lungs. Elimination is more active while the milk diet is being taken, as are the other functions of the body, and as the by-products of the metabolism of milk are not nearly so toxic as those from other foods, and it is free from the purin bodies which produce uric acid, less elimination is required than with other diets. Milk is strictly an alkalinizer, and the large quantities of the alkaline elements secured on such a diet is one of its chief advantages. It is worth while to risk the ingestion of somewhat too much protein and fat in order to obtain this extra amount of alkaline minerals.

Milk Diet Is "Temporary Over-feeding"

The milk diet does not overwork the kidneys. It requires very little effort for the kidneys to excrete water, and this is the only substance that passes through the kidneys in larger quantities with the milk diet than with a diet of solid food. It is body wastes, especially acids, which irritate and overwork the kidneys, and milk produces little if any such. What there is from this and other sources is greatly diluted by the large water content of milk. Because of this the kidneys really have an easier time on milk than on other diets. This fact is recognized by numbers of medical doctors who, though they oppose the use of the milk diet for other purposes, nevertheless prescribe it for kidney-disease. One of the symptoms of kidney-disease is albumin (a form of protein) in the urine, yet the milk diet has proved very helpful in spite of its supposed excess of protein. So this objection is over-ruled.

Milk and Our Kidneys

The milk diet usually does materially increase the weight; and some of this weight being water, it is promptly lost after the diet is discontinued. But this is no argument against the diet, because if one still needs to gain weight the accumulation of tissue will continue as a result of the improved digestion and assimilation after stopping the milk, and this gain will soon more than make up for any weight lost through the loss of water. If one takes little or no exercise while on milk, the tissues which are formed will be rather soft, and as exercise is resumed after concluding the diet some weight will be lost because of this. But here again the loss is only temporary, for with the improved digestion and assimilation and the demand for more weight created by exercise the solid-food diet will be sufficient to bring about a gain that will make up for and exceed any weight lost. Those who have been unable to continue gaining after a milk diet is discontinued, or those who have lost what they had gained, either have not fasted enough or taken the milk long enough, or have not adopted right habits of living after discontinuing the milk, or else their con-

Gaining Weight on Milk Diet

PHOTOGRAPH EWING GALLOWAY

Hand-milking in a modern dairy barn. This primitive process is still considered by many to be more desirable than the use of the milking machine.

dition is such that results by any method would be unsatisfactory. In the case of those who have difficulty in holding their weight it is generally advisable to follow a combination milk diet for some time after changing from the full milk diet. This, in fact, is such an excellent plan that it is advisable for many who have no weight-gaining problem to use such a diet indefinitely. The residue left from milk is smooth and non-irritating, and it does not positively excite peristalsis as does bran, or even the pulp of fruits and vegetables; yet it cannot be said to be constipating, because it is only those factors which interfere with the nutrition or nerve-supply of the intestinal glands and muscles which can be so considered.

Problem of Constipation

Milk supplies the mineral elements so necessary to the proper formation of the intestinal juices and to the nutrition of the muscles and nerves, and also supplies sufficient bulk for the muscles to work upon, especially when taken in large quantities, as when on the full milk diet. If the diet appears at first to be constipating it is, in most cases, because the subjects are already constipated and because they absorb the water from the milk too rapidly. A normal amount of mucus is not secreted to lubricate the intestinal tract, nor do the muscles and nerves work normally. As soon as the stimulation from the coarser foods is missed, peristalsis subsides to such an extent that the bowels either do not move at all, or only with great difficulty. This makes the enema necessary for a time. But as the milk is continued, more water is retained in the intestines, and the nerves, glands and muscles work better, because of which the bowel action will become gradually more normal, until finally it is better than on the previous solid-food diet. This is sufficient proof that the diet is not constipating. In fact, chronic constipation of thirty years' standing has been cured by fasting and the milk diet.

Relations of Milk to Biliousness

Milk does not cause the condition known as biliousness any more than it causes constipation. If it did, all children would be bilious. Biliousness is supposed to be caused by defective liver action, but it is not necessarily so caused. If a person's liver is not functioning normally it might be difficult to take the milk diet, unless modified to some extent, without causing some unpleasant symptoms; but the milk would not be the fundamental cause of the symptoms. Often, however, the milk diet can be taken without any trouble by persons who have been having quite severe disturbances of the liver, provided it is preceded by a fast of sufficient length to give the organ a rest and a chance to catch up with its work. If symptoms of biliousness do occur, a slight modification of the diet as hereafter described will give relief.

So far as individual types are concerned, no one need be deterred from taking the milk diet, if it is really needed, through fear of being of contraindicating type. For instance, no import is to be attached to statements that the "calcium" or "bony" type should not take the milk diet because it contains so much calcium. In hardening of the arteries, which is a condition accompanied by calcium deposits, the milk diet has been found very helpful. Extreme types are rare, and this factor is almost negligible in considering the advisability or the non-advisability of the milk diet.

Nutritional Completeness of Milk

Having thus answered the objections to the milk diet, its advantages may be considered. First let us take the composition of milk. Chemical analysis of all grades proves that it contains all the elements necessary for the diet of man. And not only does it contain the required protein, fat, carbohydrate, mineral elements and vitamins, but it also contains several ferments which aid digestion, such as diastase and galactose. These act in the same manner as the various ferments produced by the body itself. Milk is especially rich in the alkaline mineral salts, potassium, calcium and sodium, so that the milk diet has a strong alkalinizing effect. This is just what most people need, for the ordinary diet of meat, bread and various fats, with a minimum of vegetables, is strongly acid-forming, and its lowered alkalinity paves the way for many diseases. Milk also furnishes considerable phosphorus, and this, with the calcium, is important in promoting the growth of the bones and teeth. Phosphorus is needed for the nerves also, and all the chemical elements are necessary to insure the normal action of the endocrine glands. Milk also is one of our most dependable sources of the vitamins. It is true that the pasteurizing of milk lowers its vitamin potency, yet this is true also of other forms of food when subjected to cooking. Raw milk is always recommended for the diet, unless some citrous fruit juice is used.

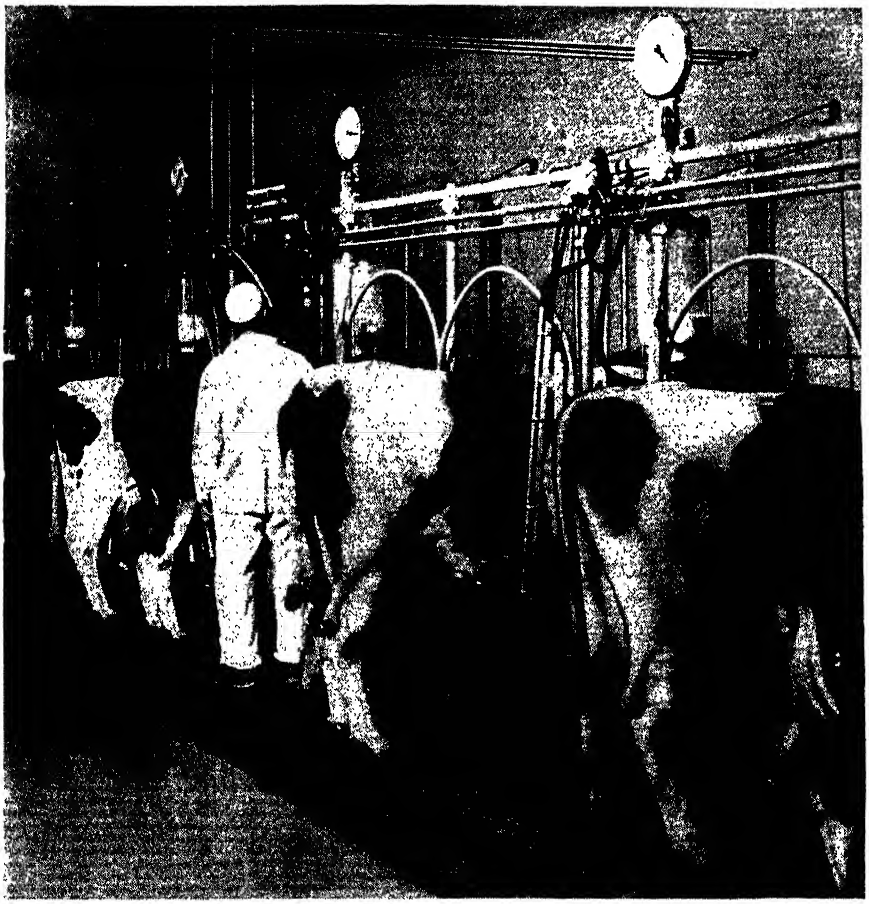
Milk not only contains the elements required by the body, but it is very easily digested and assimilated. Other foods will supply the needed elements, but very few supply all; and none supply them in a form so easy of assimilation. Protein, fat and carbohydrate are the elements which require digestion. Water and mineral salts can be immediately assimilated. The carbohydrate of milk, which is in the form of milk sugar, requires practically no digestion, as it is readily converted into an assimilable form. The fat of milk is much more easily digested than that from other sources. Owing to the large quantity of fat supplied by a full milk diet, however, all of it is not digested, because it is not needed; and since it is wise to avoid much of an excess, milk used for the diet should not be too rich in cream—but more of this later. The proteins of milk, consisting of casein and milk albumin, also are quite easily digested, and are not so likely to produce objectionable by-products as are other proteins, especially those of meat. The digestive ferments already mentioned as being present in milk add to its digestibility. It is always easier for the digestive organs to handle one article of food than a number of different ones, and this is a very important advantage of the milk diet. It is a mono-diet. The body can give its entire attention to perfecting its machinery for the digestion and assimilation of this one article, and it soon becomes quite expert at it. It is a common experience, while on the milk diet, to find that a quantity which at first seemed to cause an uncomfortable fullness will fail to satisfy after a time. This is due not only to the more rapid elimination of the liquid part of the milk, but to the more thorough digestion of the solid parts. But it is also common to find that in time, when one is on the milk diet for months, the body is amply nourished on a smaller quantity than was taken for maximum nutrition.

Ease of Digestion

Advantages of Mono-Diet

Most people, through practical experience, are quite familiar with the digestibility of milk, so much so that they are often inclined to think that their stomachs and intestines will not have the strength to digest solid foods if they stay on such a diet for a number of weeks. As a matter of fact, quite the contrary is the case. While milk may be considered a single food, it nevertheless contains all the food elements. Hence the body does not lack practice in handling any one; and, since the milk supplies such a superior quality of nourishment, the glands which secrete the digestive juices, the muscles which churn the food in the stomach and push it along in the intestines, and the nerves which control the whole process are themselves supplied with better and more complete building material with which to increase and maintain their efficiency. The large quantity of milk taken gives the digestive machinery plenty of exercise, even though the milk itself is very easy to digest. Therefore, solid food is preferable after such a diet.

Milk Restores Digestive Powers



PHOTOGRAPH DE LAVAL SEPARATOR CO.

The modern milking machine saves labor but its operation must be carefully watched by highly trained men and the machine removed and the final stripping of the milk from the udder performed by hand. If well cared for the machine protects against contamination of the milk in the barn.

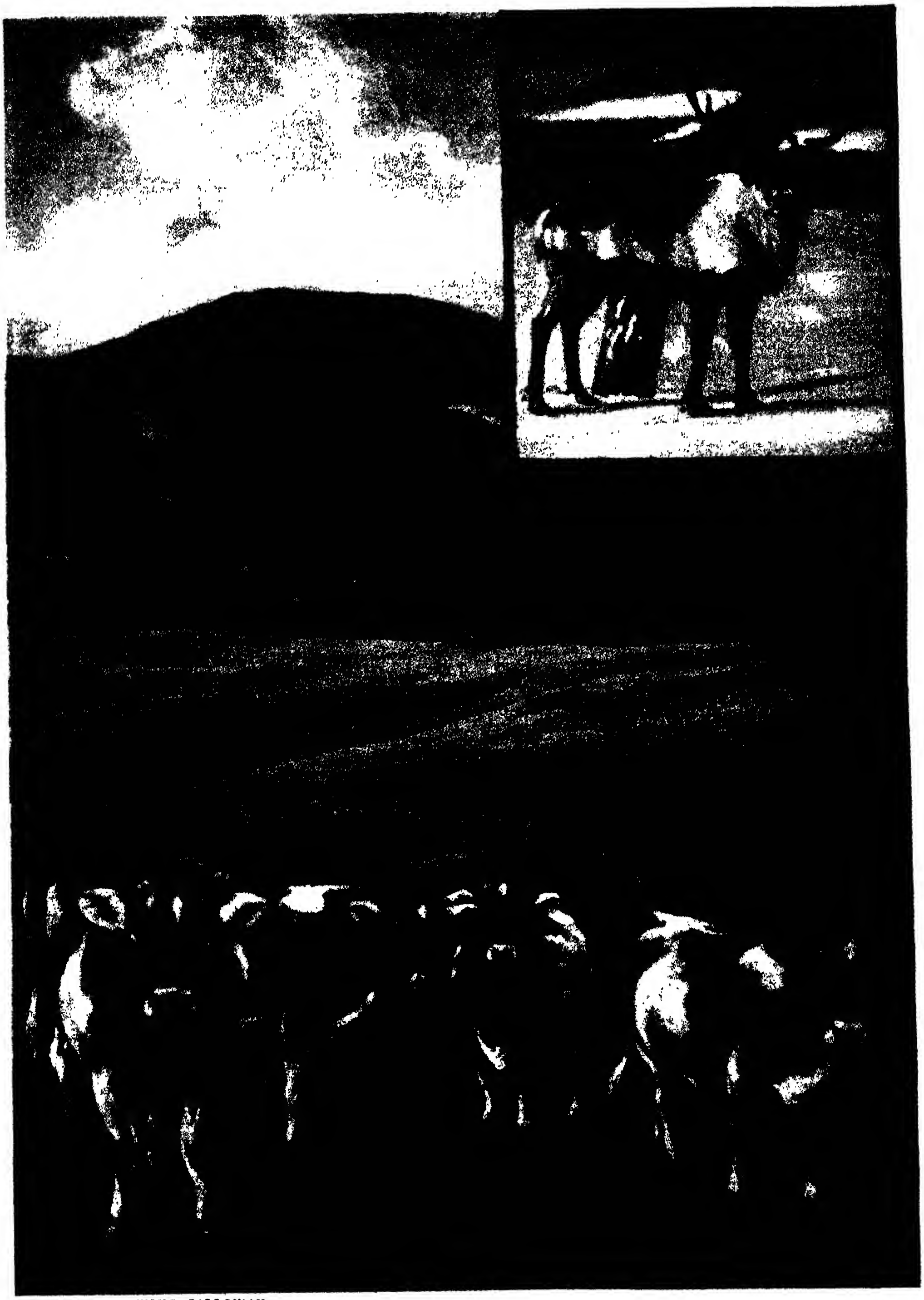
The superior quality and quantity of nourishment supplied by the milk diet is the chief reason for its usefulness in the treatment of chronic diseases. In these conditions the body is like the battered old hull of a ship, or a broken-down automobile. Long years of abuse have worn out or greatly deteriorated many of the cells, and the primary need is new cells—better cells, and more of them. These can be produced only when the proper building material has been supplied and when the body is in a position to use that material. The preliminary fast, or the fruit or fruit-juice diet, which should precede the milk diet, cleanses and rests the various tissues of the body and prepares them for the task of building new cells. Then the milk supplies an abundance of the needed elements in a readily available form, so that little of the scanty supply of energy which is on hand need be expended for digestion and assimilation. As the new material reaches the tissues and new cells are produced the various organs become stronger and stronger, and it becomes still easier for them to assimilate the digested milk and to build new cells, until they finally reach the point where they have been practically made over.

Vitalizing Effects of Milk

As the new cells are formed the old ones are used up and discarded. This is the process called *metabolism* and it is greatly improved on the milk diet. Children usually recover from their illnesses quickly because their metabolism is more active than that of an adult. A similar increased activity occurs in the adult when on the milk diet. The body is virtually re-built in a comparatively short space of time. This is proved by the youthful appearance of the skin, by the gain in weight, and by the general increase in functional ability. Naturally, when all the old diseased cells have been eliminated and new, fresh and more perfect cells have taken their place, health returns. The patient has been, in a measure, reborn, for all his tissues are youthful and vigorous.

Milk Diet Improves Circulation

The fact that all the functions of the body are more active on a milk diet is proved by the physical findings. The circulation almost immediately improves, and cold hands and feet become warm. The pulse-rate increases slightly, the blood-pressure rises if it has been too low, and the blood-vessels are seen to be more full of blood. The skin becomes more moist as perspiration increases, and the outer cells of the skin are



PHOTOGRAPH EWING GALLOWAY

PLATE 32. Typical dairy cows bred in temperate climates, with domesticated reindeer of the Arctic, shown in inset.

shed more quickly, the new cells soon making their appearance and the skin becoming soft, smooth and of a clearer, finer texture. There is nothing like the milk diet for improving the complexion. As the pulse-rate increases the respiration follows suit, and elimination through the lungs is therefore accelerated. The large quantity of water in the milk serves to dilute all the fluids of the body, permitting them to circulate more freely and dissolve foreign deposits in the body more quickly, thus making elimination more efficient. The kidneys are naturally much more active when plenty of water is taken. The specific gravity of the urine will be found to be decreased, showing that the solids are being passed in a more diluted state, which lessens the possibility of irritation to the kidneys. Perspiration may have an unpleasant odor for a time, because an increased amount of toxins is being thrown off through the skin. Elimination through the bowels is likewise increased, though it may take some time, as already explained, to produce this effect.

Milk Diet Increases Elimination

The whole theory of the milk diet is founded on the observed fact that all the organs of the body work better, toxins are eliminated and repair takes place more rapidly when the body is supplied with an abundance of a completely nourishing food, easily digested and containing an ample amount of water and alkalinizing minerals, with a residue not inclined to fermentation and putrefaction in the intestinal tract.

This being the case, it will be seen that milk diet is indicated whenever a rebuilding effect is desired. Hence it applies to practically all chronic diseases, for in all such cases new cells, better functioning and more vitality in general, are required. Most of these cases are also underweight and need the milk to correct this condition. Even those who are normal or slightly overweight will benefit from the milk diet, for treatment is always started with some fasting or fruit dieting, which takes off a few pounds. Only in cases which are much overweight will the milk be contraindicated, and even in these it may be well to take it for a time in limited quantities if it is specially needed, as, for instance, when stomach or intestinal ulcers are present.

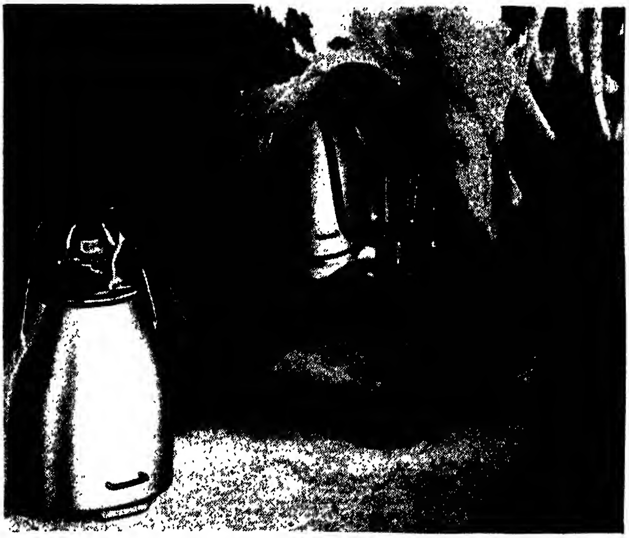
In some chronic diseases it may be necessary to modify the diet for one reason or another. In sinusitis and mastoiditis,

Diseases Requiring Modified Milk Diet

which are catarrhal inflammations in locations where even a temporary increase in symptoms may be very painful or even dangerous, it is well to use a diet of milk and acid fruit instead of the full milk diet, preceded by as long a fast or fruit diet as general condition will permit. If the general condition does not especially call for the milk and only a short fast can be taken, it may be well to use solid foods. In organic heart-disease it may also be advisable to limit the quantity of milk temporarily, in order not to bring about too great and too sudden an increase in the amount of blood in the vessels. The same modification applies in cases of high blood-pressure, especially if due to hardening of the arteries, though if patients take the diet in bed the quantity of milk can be practically the same for other cases. In cases of prolapsus of the stomach or intestines, where the patient cannot take the diet in bed, it may be well to use a milk-and-fruit diet or to combine a half a day of milk with one meal, in order to avoid too great distention of and weight in the affected organs. In chronic liver disorders it may be necessary to employ skim-milk or sour milk, or to use a milk-and-fruit diet, as the considerable quantity of fat contained in the full milk diet may be difficult for the liver to handle. However, after a suitable fast or period on fruit, these cases can often take the regular milk diet without trouble. Skim-milk is generally indicated in cases of diabetes, as such patients also have difficulty in handling fats. Moreover, when less fat is taken more of the sugar in the milk will be oxidized to produce the heat for which the fat otherwise would have been used, thus making the diet possible although comparatively high in carbohydrates. The fat can be restored to the milk gradually as the condition improves. The quantity of milk may also have to be limited for a time in cases of diabetes. One case of diabetes has been recorded in which the patient lived in good health for thirteen years while taking four quarts of whole milk daily, with an orange-juice diet one week each year. This patient eventually made milk his diet of choice, as it originally had been his diet of necessity.

Use of Milk in Diabetes

When there is dropsy the milk diet should be taken in bed, and the quantity should be limited in accordance with the general condition. When dropsy is due to heart-disease the quan-



PHOTOGRAPH DE LAVAL SEPARATOR CO.

Milking-machine at close range. The milk is drawn by intermittent suction action. One tube carries the milk away; the other supplies pulsations of the air suction.

tity will have to be limited, for reasons already given. If due to liver disorders in which skimmed or sour milk generally should be employed, a moderate limitation of quantity usually is sufficient. When the dropsy is due to kidney-disease, the full quantity can generally be taken after the first few days, so long as the patient is resting. In cases of hemorrhoids it will usually be necessary to take something with the milk so as to prevent even a temporary bowel stasis and to soften the feces if they are hard. Agar, added to the milk, is very good, and prunes, figs or even bran, may be employed. The enema will, of course, be required for a time.

Individual Adaptations of Milk Diet

While the modifications here mentioned have been classified according to the abnormality, because the changes required are necessitated by the nature of the symptoms of the disease, most modifications of the diet should be regulated according to the patient's reactions, rather than because he has this or that abnormality. Patients with the same disease may vary considerably in constitution; and, of course, there are the several different stages of all diseases to consider so that no hard and fast rules can be laid down that will apply to every case of a certain disease. The patient is always the most important factor in the problem, and his reactions must have first consideration. So the general method of taking the diet is the same for all diseases, with the exception of those noted, but not for all patients. As a rule all start with the plan which has been found to meet the needs of the great majority of patients, and then such modifications are made from day to day, or week to week, as may be indicated by the patient's reactions. All these will be covered in detail.

Milk Diet and Fevers

The milk diet should not be used for acute diseases when fever or marked eliminative symptoms are present. At such a time the fast or a very limited diet is the thing most needed in order to aid the body in the strenuous eliminative effort which it has inaugurated. The primary need at this time is cleansing, not upbuilding. In chronic diseases both cleansing and upbuilding are required. These ends are accomplished by the initial fast and the subsequent milk diet. The first eliminates the worst of the toxins and the latter completes this job while it is carrying on the upbuilding process. That is one of the great advantages of the milk diet; it increases elimination at the same time that it increases the weight and general vitality. There are many eliminative diets, but only the milk gives such a perfect combination of elimination and rejuvenation.

Cautions Regarding Cancer

There are a few chronic diseases in which it may be well not to use the milk diet. The word *may* is used advisedly, because, even in these diseases good results have been secured from the milk diet. It is only because such cases are in the minority that solid foods are recommended for first trial instead of milk. These diseases include arthritis, articular rheumatism and cancer. In the two first named milk seems inclined to bring on acute reactions which often are painful and discouraging to the patient. If these could be endured, the milk would no doubt benefit in the end; but few care to go through the acute states which sometimes are extremely severe. If the condition is not very advanced and the patient can take the diet in bed, it will be proper to try the milk. In cases of cancer the general flushing of the body with nourishment and the stimulation of all functions may stimulate the growth of the neoplasm also; the location of the cancer also may be such as to produce symptoms that would be aggravated by the milk diet. If possible for the patient to take a long fast before starting the milk, to reduce the growth and thoroughly purify the body, the diet may then be of advantage, especially in cancer of the stomach, when it is often difficult to use other foods; but since many such patients are greatly reduced in weight before they adopt natural methods, thus making a long fast difficult, the milk cannot often be used. As stated before, however, one must always be guided by the patient's general condition rather than by the disease present.

If the kidney structure is so badly damaged that little functioning tissue is left, or if there is a greatly enlarged prostate, or some other condition making urination difficult or impossible, then the milk diet cannot be used. If the patient has a great antipathy to the taste of milk, or is otherwise strongly opposed to the use of the diet, it would be better not to employ it. The taste objection seldom causes any trouble, however, as after a fast the milk is almost invariably relished. More trouble is caused when the patient develops some unreasoning fear of, or violent antipathy toward the diet, in which case the mental disturbance prevents normal digestion and the diet had better not be used.

Individual Antipathy to Milk

Occasionally a patient may be encountered who seems unable to take the milk satisfactorily, even though his condition indicates it and he makes an honest effort to do so; but these cases are very rare. Practically always it is possible to take the milk diet to advantage in chronic diseases if it is adjusted to the patient's special needs; and it is such a simple, uncomplicated, safe, agreeable and yet effective diet, that it is well worth a trial.

The cardinal principle in taking the milk diet is to drink small quantities at frequent intervals, so that a considerable amount may be consumed during the day. However, the environment, as well as the milk is important, and as regards the former there are two ways of taking the diet—in bed, and while up and taking moderate exercise. Good results have been secured from each method, and each has advantages and disadvantages. All the factors present in a case should be considered in deciding which method to use.

Milk Diet in Bed

The milk diet may be taken in bed when it is necessary to conserve all possible energy and to devote every bit that is available to the task of healing, as in tuberculosis. It is thus used in those cases where exercise would increase the symptoms, as in arthritis, prolapsus and high blood-pressure, and where activity would be contraindicated for reasons having little or nothing to do with the diet, as in cases of stomach or intestinal ulcers, and dropsy. The chief advantage of the bed method is that all the energy can be devoted to handling the milk, building up the internal organs and repairing tissues. Its disadvantages are that remaining in bed is monotonous and tiresome for the patient, and he is inclined to think too much about himself and his symptoms; also, it is often very inconvenient for the patient to remain in bed, and many would have to go without the benefits of the diet if this were the only method of taking it. The lack of exercise causes the muscles to weaken, though not to the extent that might be expected, and the weight gained is likely to be rather quickly lost when activity is resumed. Taking large quantities of milk while at rest is open also to the objection that it constitutes overfeeding, but this is minimized by the nature of the milk and the body's need for plenty of nourishment for repair work.

Milk Diet and Exercise

Taking the diet while up and around is much more convenient, and seems more natural, so long as one has no symptoms which cause prostration. All the benefits of exercise are then added to the benefits of the milk; and while weight may

PHOTOGRAPH EWING GALLOWAY

A millionaire's barn where the use of pretentious equipment is carried to the extreme. No less important to the health of the cow and the quality of the milk is proper outdoor pasturage.

not be gained so rapidly, it will be better retained. Also progress may be judged more accurately, for sometimes one may feel quite well while resting and taking milk, but as soon as activity is resumed and the diet changed many of the old symptoms will reappear because the causes were not completely removed. Changing from the milk diet to solid food requires some adaptation on the part of the body, and things will go more smoothly if it does not at the same time have to adapt itself to the change from rest to activity. The disadvantages of taking the diet while up and around are that more energy is required, and some cases have more difficulty in handling the necessary amount of milk.

Rest to Conserve Energy

The method used must always be adapted to the patient's individual needs. In only a few cases will bed-rest be absolutely required, as in the first stages of the treatment of tuberculosis; until pain is relieved in cases of gastric and duodenal ulcers; until dropsy is gone when this is present; and for the first three or four weeks of the diet when there is prolapsus. Of course, the bed method may be used in any case if desired, or it may be used to precede a period on the diet plus exercise. As the latter method has a wider application it is to be understood to be indicated when the milk diet is referred to in these volumes, unless the bed method is definitely prescribed. The milk diet is practically always a temporary diet, being taken only long enough to secure the desired results. It should always be taken long enough for this purpose, however, and if possible a little longer. Many make the mistake of not staying on the diet for a sufficient length of time. There is no harm in continuing it after the need for it has ceased; but considerable disappointment may be experienced if it is discontinued too soon. While the milk is not recommended for indefinite use, it has been taken for years in a number of cases and has demonstrated its ability to maintain health and strength. One classical case is that of a man who had a stricture of the esophagus due to an accident when a child, so that he could not swallow solid foods. He lived on milk for fifty years (from the age of two) and was strong and healthy all that time. He also married and had four healthy children. At last reports he was still doing well. Cases of diabetes who have found milk to agree with them have lived on it for several

Time Required for Diet

years. In the majority of cases, however, there will be no desire to continue the exclusive diet after the need for it has passed. Since the diet is continued only for a limited time, the patient should be willing to go to considerable trouble, if necessary, to take the diet in the proper manner and thereby secure the quickest and most perfect results.

Selection of Milk

The first and most important thing to consider in preparing for the milk diet is the milk itself. This must be of the proper quality and quantity if the best results are to be secured. The patient should therefore know about the different kinds of milk so that he can choose the very best that may be available to him.

The composition of the three kinds of milk in which we are chiefly interested—human, cow and goat—is about as follows:

	Water	Total Solids	Protein	Fat	Milk Sugar	Minerals	Calories Per Lb.
Human.......	87.58	12.6	2.01	3.74	6.37	.30	310
Cow.........	87.27	12.8	3.39	3.68	4.94	.72	310
Goat.........	86.88	13.1	3.76	4.07	4.64	.85	315

The composition of the various forms of cow's milk is as follows:

Chemistry of Milk

	Water	Protein	Fat	Milk Sugar	Minerals
Skim-milk....................	90.5	3.4	.3	5.1	.7
Cream......................	74.	2.5	18.5	4.5	.5
Buttermilk..................	91.	.3	.5	4.8	.7
Whey.......................	93.	1.	.3	5.	.7
Evaporated (unsweetened).....	71.3	7.4	8.5	11.1	1.7
Milk powder (skim)..........	3.	34.	3.1	51.9	8.

When evaporated milk has had water added to bring it to the consistency of fresh milk, its composition is about the same as that of the latter. Powdered milk with water added equals either whole or skim-milk, according to the powder used, as this may be obtained in various percentages of cream.

The analysis of the most important mineral elements in the various forms of milk, based upon 1,000 parts of water-free substance, is as follows:

	Potassium	Sodium	Calcium	Magnesium	Iron	Phosphorus	Sulphur	Silicon	Chlorine
Human....	11.73	3.16	5.80	.75	.07	7.84	.33	.07	6.38
Cow......	13.70	5.34	12.24	1.69	.3	15.70	.17	.02	6.38
Goat......	15.60	3.45	13.90	2.30	.6	21.05	.3	.2	13.50
Buttermilk	18.10	8.50	14.40	2.60	.6	21.80	1.3	.....	9.7
Cream.....	5.15	1.55	4.25	.6	.5	3.9	.45	.....	2.
Skim-milk.	22.60	7.1	15.2	2.2	.6	13.40	2.4	.....	10.2
Whey.....	21.85	9.75	13.65	.25	.4	12.	1.9	.....	11.2

These analyses show that the milk of the cow and the goat differ somewhat from human milk. Both cow's milk and goat's milk contain more protein and mineral elements and less milk sugar than human milk. The additional mineral content is an advantage. The other variations are not so desirable, but considering the particular purpose for which the diet is used they do not detract from its value. The chief difference between the cow's and the goat's milk is that the latter contains more fat and mineral elements. Here again the additional minerals are of value, but the excessive fat is not. For a milk diet it is best that the milk contain not more than three or three and one-half per cent. of fat. Goat's milk has other advantages, however, which do not appear in the analyses. This milk is more alkaline than cow's milk, and hence agrees better with persons who have particularly weak stomachs. The fat in goat's milk is in much finer globules and forms in the milk a more perfect emulsion; hence, it is digested more easily in many cases than the fat of cow's milk. Goats are less subject to disease, especially tuberculosis, than cows, having a higher vitality, and their milk consequently is more likely to be pure and vital. Goat's milk with part of the cream removed probably is the best to use for a milk diet; but since few people are in a position to obtain it, cow's milk will be used in the

Advantages of Goat's Milk

greatest number of cases. It remains to consider, therefore, the various forms of cow's milk that are commercially available.

Raw Milk

Raw milk, just as it comes from the cow (except for cooling and aerating) is best for the milk diet. Some people like it warm from the cow, but most prefer it cooled and, if necessary, artificially heated afterwards. The raw milk contains all the vital elements unchanged, is more likely to digest perfectly, and produces the best results. It does not especially matter whether it comes from one cow or many cows so long as the cream content is properly regulated. There are some advantages in taking a mixed milk from a number of cows, and most people will have to use this kind. There is, as previously stated, less likelihood of variation of elements in herd milk than in milk from a single cow. If possible, it is best to secure the milk of Holstein cows as they give a better balanced milk, with the proper quantity of fat. The milk of Jersey cows is too rich in cream; while it may be used in case of necessity, by removing about a third of the cream, the resulting product is not as well balanced as the Holstein milk. Guernsey milk is fairly good, but also may contain too much cream. Raw, fresh milk from a good herd of Holstein cows, therefore, may be considered as the best for the milk diet.

Pasteurized Milk

Unfortunately, not many more people can obtain such a milk than can get milk from their own cows. Even small villages now generally have their milk companies which handle all the milk. Such a milk will be mixed and seldom if ever will have too much cream, as this is, commercially, the most valuable part of the milk and the companies never leave any more in their product than the law requires. Most cities are supplied with three grades of milk: certified, pasteurized A and pasteurized B. The three grades are determined by sanitary inspection and the bacteria count. The certified milk has the lowest bacteria count and usually a high cream content; the pasteurized A comes next, and the grade B last. Certified milk is supposed to be unpasteurized, and in winter it generally is; but in summer, when raw milk sours easily, some companies pasteurize it lightly. This is to be regretted, for certified milk is the only raw milk available to the city-dweller and he has to pay such a high price for it that he should

PHOTOGRAPH EWING GALLOWAY

Promptly cooling and aerating the milk on the farm removes animal odors and checks bacterial growth. In this device the milk flows in a thin film over a corrugated surface chilled by a flow of cold water.

get the very best at all times. It is admittedly difficult to produce a very high-grade milk, collect it and then distribute it over a large area in an absolutely ideal condition. Many people are involved in the handling of the milk and they are not equally careful; nor do many of them have such consideration for the consumer. The milk problem is a big one, but like other such, it can be solved through proper education of the producer and consumer.

Milk Inspection

In most of the states regulations of the State Boards of Health cover the milk-supply from the farm to the table, and are very stringent indeed. The entire system is under constant and strict supervision and the condition of the cattle and the milkers, the care of the milk-cans and other utensils, the water-supply and drainage of the farm, refrigeration during transit, the condition of shops and of workers handling the milk at retail—all these are subject to regulation, and the result is a much better, purer and safer milk-supply than was available not so very many years ago.

Patients who live in cities should get certified milk for the diet. It is worth while to get the best available, even at greater cost, in order that the maximum benefit may be secured. If it is impossible to get certified milk, the pasteurized may be used; but it will be necessary to take one or more oranges a day to make up for the deficiency in vitamin C, and most cases will require four or more per day for the laxative effect, because pasteurized milk is more likely to bring about bowel stasis. The fact that vitamin C is partly destroyed by pasteurization is the chief objection to milk subjected to this process. Some also contend that the mineral elements are changed, and that that mysterious element in the milk which might be called its "life" or "vitality" is lost. These defects are largely overcome by the addition of oranges to the diet, and many cases have secured good results from the milk diet when pasteurized milk was used.

How Milk Is Graded

Grade A is to be preferred to Grade B, not only because of its lower bacterial count, but because it is more lightly pasteurized. Grade B, on account of its higher bacteria count has to be more thoroughly pasteurized, and sometimes has a definitely cooked taste. Milk that has been boiled is not suitable for the milk diet. Small amounts of it may be prescribed temporarily in cases in which the raw milk produces diarrhea; but it should not be used if it can be avoided, and an entire diet of such milk would be very unsatisfactory. Boiled milk is like pasteurized milk with all the objections intensified, and since it is not sold commercially, except in the evaporated and condensed forms, it is easily avoided. Canned milk is not advisable for the milk diet, especially the condensed variety, which contains a large percentage of refined sugar.

Powdered Milk

One other form of milk remains to be considered—the powdered. There are various methods of drying milk, all of which interfere with its valuable properties to some extent, but not so much as do the usual condensing methods. All such milk is pasteurized before it is powdered. Some producers expose the powder to ultra-violet rays to increase its vitamin D potency, and the process of manufacture is constantly being improved, so that some day we may have a dried milk practically equal to the fresh. In the meantime it is much better to use the fresh milk diet, though the powdered form may be employed if nothing else can be obtained. It is perhaps equal to the evaporated and condensed varieties. Results from the powdered milk will naturally not be as good as from fresh raw milk, but if the milk is badly needed and no other satisfactory product can be obtained the powdered form will serve until solid food can be taken.

The use of milk which has been changed in composition by skimming, souring, culturing with certain bacteria, or by the addition of malt, baby foods, or gelatin, will be considered in discussing modifications of the diet required by certain symptoms. The real milk diet is one of whole sweet milk; but some cases would be denied its benefits if they could not, at least temporarily, employ some of the modifications mentioned.

Preliminary Fast Advised

For best results, the milk diet, whether taken in bed or while up and around, should always be preceded by a fast or partial fast of some kind. The milk is essentially an upbuilding diet, even though it does stimulate elimination; and it is well to secure as much cleansing of the body as possible before starting on it. In every diseased condition there is an accumulation of toxins in the body and a lack of nerve-energy and the fast gives the body an opportunity to remove the worst of these toxins and at the same time save up a little energy, since it does not have to expend the usual large amount in digesting and assimilating food. Hence the body is in a much better position to absorb the large quantities of milk required. At least one day of fasting, or of an orange or broth diet, should precede the milk, and it is much better if from three to five days, or even longer, can be taken. In diseases where elimination is the primary requirement, fasts of two weeks or more should precede the milk. Detailed reasons for this and instructions for properly conducting and breaking the fast will be found in Section 20, this volume. With the fast completed and an adequate supply of the proper kind of milk arranged for, one is in a position to start the diet. If it is to be taken in bed the following plan is adhered to.

Patient's Environment

THE MILK DIET IN BED.—The patient retires to a comfortable but not too soft bed in an airy, well-ventilated room, and resigns himself to a period of rest. Some will be glad of the chance to rest, while others will not; but all should accept it philosophically. The ventilation of the room is an important factor. If a sleeping-porch is available and the weather is suitable, the patient should make this his bedroom. The more air, the better, as oxygen is needed to carry on all the functions of the body and especially to improve the blood and increase elimination through the lungs. Warmth, of course, must be maintained, but no more clothing or bed-covering should be used than is absolutely necessary. The milk will so improve the circulation that the patient can get along with surprisingly little covering.

Toilet and bath facilities should be available close by the bedroom, in order that as little energy as possible may be expended upon these necessary duties. Some cases may have to stay strictly in bed except when taking the bath. In no case should one get up unnecessarily, because there is no use taking the diet in bed if one is going to get up every now and then. The milk should be supplied to the patient at regular intervals and at the proper temperature. If no particular temperature is required, a quart of milk at a time may be kept at the bedside, but in hot weather care must be observed to keep the milk chilled sufficiently to prevent souring. Completely soured milk may be taken, even if it is not specially indicated; but when only partially soured it is very likely to upset the patient's stomach, besides being unpleasant to the taste. Glasses should be kept clean and all other sanitary precautions observed, particularly as regards the bed-linen.

How Milk Diet Is Begun

The quantity of milk and the frequency with which it should be taken on the first day will be governed by the length of the fast. (See *Fast-Breaking Regimens,* Vol. VII.) The method of drinking the milk is the same, regardless of quantity or of whether the patient is in bed or up and around. The best way is to use a straw, the upper end of which has been punctured in half a dozen places with a fine needle. The holes in the straw slow down the speed with which the milk enters the mouth and necessitates greater suction, thus stimulating the flow of saliva. Suction is the baby's method of taking milk, and the adult should emulate the infant when taking the milk diet. If the suction draws much air in with the milk through the holes in the straw, however, and this air is swallowed, inducing belching, it will be better to use an unperforated straw. Either paper or glass straws may be used, but the former are preferable since they can be perforated and are more sanitary. Glass straws are convenient when it is necessary to use hot milk that melts the paper ones, but it is seldom necessary or advisable to use such hot milk. If glass straws are used strict cleanliness is necessary.

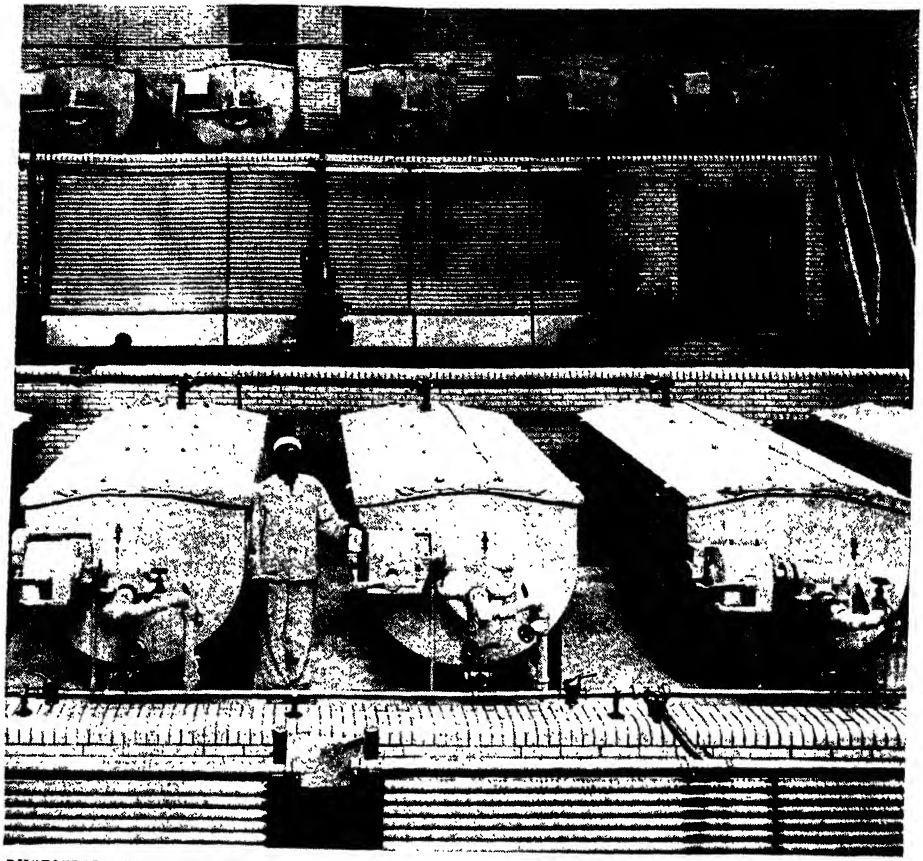
Method of Taking Milk

Milk is a food, and not merely a beverage like water. It should be taken slowly and masticated, much like solid food. After the milk has been sucked into the mouth it should be moved about long enough to mix it thoroughly with the saliva before it is swallowed, and it should be swallowed in small amounts. When this is done the curds which form in the stomach will be smaller and, consequently, easier of digestion. The curdling of the milk is the first thing that takes place when it enters the stomach, and is a necessary process in its digestion. The rennin, which is secreted by the stomach glands, has this sole duty to perform. So no one should remain opposed to taking milk, or to using acid fruits with it for fear it will curdle in the stomach.

When, for one reason or another, straws cannot be obtained at all, the milk may be taken direct from the glass by placing the lips over the edge and sucking it in as one does when drinking water from a brook. This may make some noise, but it is excellent for stimulating the flow of saliva. The rest of the process is as just described. The milk may be drunk from a glass in the ordinary way if it is necessary, but the sucking should be practiced whenever possible. Some have even taken their milk through a nipple, but most persons will not care to do this, and it is not at all necessary.

Temperature of the Milk

The best temperature at which to take the milk is about seventy degrees Fahrenheit, which is the usual room temperature. It can be taken cooler if desired, but it should never be ice-cold. The colder it is the longer it should be held in the mouth and the more slowly it should be taken, so that it may be warmed considerably before it enters the stomach. If warmed by any part of the body, however, a corresponding



PHOTOGRAPH DE LAVAL SEPARATOR CO.

A large pasteurizing plant at a milk-receiving station. After the required period of heating (usually thirty minutes at a temperature of 140 degrees), the milk is then promptly cooled to near the freezing point.

amount of energy is consumed; so it is best not to take it very cold. It may also be taken warmer than seventy degrees if it is better relished or seems to digest better. Anywhere up to ninety-eight degrees, which is body temperature, is quite permissible. Higher temperatures should be used only when the extra heat seems to be required for proper digestion or assimilation, or when the patient is especially "cold-blooded" and feels the need of additional warmth. Even in these cases it is best that the temperature should not exceed 120 degrees, and the milk should be heated only as used. It should not be allowed to boil, and if, by accident, it should do so it had better be discarded. It is not necessary that the tempera-

Heated Milk

ture be always the same. It may be varied during a single day, or from day to day, in accordance with the desires and needs of the patient. On a hot day, cool milk will be preferred, and on a cold day, warm milk, but when a temperature above that of the body is used it should be reduced to ninety-eight degrees or less as soon as the condition permits.

Unless a fast of more than a week has preceded the milk diet it is well to work up to the full amount by the second or third day. When taking the milk in bed it is possible to increase the quantity somewhat more rapidly than when up and around, as the body has little to do but digest and metabolize it. Under these circumstances it is also possible to take somewhat more milk, but the amount for a woman should not exceed six quarts a day, and for a man seven. Ordinarily the maximum for women will be one pint less, and for men one quart less. A very large man may be able to consume more than seven quarts, but there is no advantage in doing so. The body should be supplied with all the nourishment it can absorb and utilize, but no more, as an excess will overtax the digestive and eliminative organs; or it will collect in the digestive system and cause one to "turn against" the milk.

Quantity of Milk Advised

When on full quantity the milk should be taken regularly every half-hour during the day, eight ounces at a time. If the patient is inclined to forget the matter and has no one to remind him of the time, an alarm clock should be used. However, most patients soon get so into the habit of taking the milk on schedule that they feel a desire for it at the proper time; and when in bed there is little to distract the attention, for the patient should not do much reading nor occupy himself in any way that requires the expenditure of any considerable amount of energy. The main reason for taking the milk in bed is to save energy, and what energy one has should not be dissipated. It is not generally advisable to take any milk during the night, as the digestive organs should be allowed a rest period practically equal to their heavy working period. At the end of the day the stomach soon empties, but the intestines are full of milk and must continue working for some hours. Time should be allowed for them to recuperate a little before starting the next day's work. The best plan in most cases is to drink milk for twelve hours and rest for an equal

Resting Digestive Organs

length of time, and by starting at seven o'clock in the morning this can easily be done.

If the patient has uncomfortable symptoms after taking the milk, an effort should be made to continue taking it at regular intervals in spite of this fact. The stomach will usually adjust itself in a short time and accept the milk without protest. If it does not, and the symptoms become worse, follow the directions that will be given later in discussing the taking of the diet while up and around. If there is merely a lack of desire for the milk it should be taken anyhow; as the digestion, assimilation and elimination improve, the appetite for it will develop. If there is constipation or diarrhea, treat as advised in Volume VII. After about a week on the diet most cases will have adjusted themselves to it, and can continue uninterruptedly for the four to six weeks that it should be taken. It may be continued longer if necessary, but less than four weeks would not have much effect.

Baths During Milk Diet

Aside from drinking the milk, the only thing the patient has to do on this diet is to take a warm immersion bath every day. This bath not only removes the foreign matter that has been eliminated by the skin during the day, but it further increases the activity of the skin, equalizes the circulation, relaxes the muscles, calms the nerves, lifts the weight of the abdominal contents from the spinal nerves and plexuses, and gives a general feeling of ease and comfort. The bath should be taken in a large tub, so that the patient can lie at full length, completely relaxed and entirely submerged except for the front and top of the head. The head is supported on the slanting end of the tub, on a rubber pillow, in a canvas sling, or by some similar arrangement. Plenty of hot water should be available so that the temperature of the bath can be kept constant, as determined by a bath thermometer. The water should at first be 95 degrees Fahrenheit and after a few minutes should be raised to 98, which is practically body temperature. This degree of heat is continued until within a few minutes of the time for the end of the bath, when the water is made hot enough to give a feeling of thorough warmth. Thus the bath is really a neutral bath finished with a warm bath. In very hot weather the bath may be started as low as 90 degrees, but it should soon be raised to 98. The bath should last fifteen minutes the first day, increasing about five minutes per day until its duration is one hour. The bathroom should be well ventilated, but not so much as to make it cold, and it should be warm enough when the patient gets out of the water to prevent any feeling of chill. The room may have to be shut up for a while before the end of the bath for this reason. No cold water is applied at the end of the bath, as it is desired to keep the blood-vessels near the skin relaxed, and the patient should not do any vigorous rubbing when drying, as too much energy will be expended. Of course, toward the end of the diet, when there has been much improvement in the health, a little exercise of this kind may be permitted. The bath need not and should not interfere with taking the milk at the regular time, as this may be done in the tub.

The method of changing from the milk diet and the required aftercare are the same whether or not the milk is taken in bed, except that when the patient has been resting in bed activity will have to be resumed gradually and special exercise will not be started for about a week, gradually lengthening walks being sufficient for this period. Further directions will be found in the course of this section which completely treats of all phases of the milk diet.

Milk Diet While Active

THE MILK DIET WHILE UP AND AROUND.—The environment for the diet under these conditions is as important as when taking it in bed. The patient should, if possible, be in a position to give all his time and attention to the diet. Since the milk must be taken frequently and regularly, and the various other items of the regimen must be attended to, the days go by rapidly. It is possible to take the diet while working part or even full time; and if the milk is especially indicated and there is no other way in which it can be taken, it is much better to take it in this way than not to take it at all. Special regimens will be given for those who find themselves in this position. However, those who can arrange to take a little vacation, even at considerable inconvenience, will find it worth while in the end.

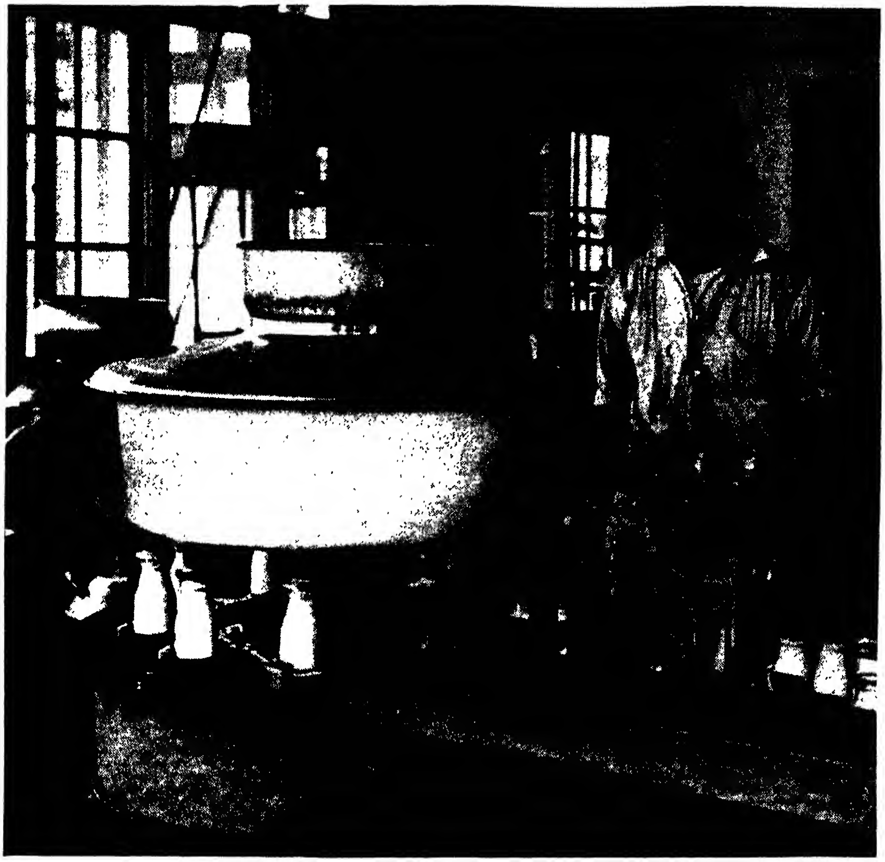
The diet should be undertaken with a calm, free mind, in full confidence that good results will be secured. It is well said that "contented cows" give more and better milk, and if a person takes that milk in the same frame of mind better results will be secured. Destructive emotions can soon upset the digestion and poison the body.

Regular Habits Essential

Regularity in all habits of life is especially important at this time. There should be a definite rising and retiring hour, and if possible a rest hour during the afternoon. Nine hours of sleep should be secured every day and a special effort should be made to relax when not actually doing something. The degree of activity permitted will depend on the exact state of the patient and his reactions to exercise. In many cases it will be well to limit exercise to walking, and it will be necessary to take this in several periods, as one cannot go further than a mile or so at a time when milk has to be taken every half-hour. If there is only one period of walking, however, it should be in the early morning before starting the milk for the day, at which time whatever distance is desired may be covered. If there are two, the second period may be in the evening from half an hour to an hour after the last milk is taken. Walking can be done also during the morning or afternoon, but if the energy is low, if the diet is taken for stomach disorders, or if there is prolapsus of any part of the digestive system, one should not start until ten minutes after the glass of milk has been taken. Any general exercise should always be taken in the early morning before starting the milk, and sometimes an hour or two after discontinuing it in the evening. This exercise consists of light calisthenics. Heavy exercise is not advised except occasionally for particularly muscular and vigorous persons. If corrective exercise is needed, as for instance in cases of prolapsus, it may be taken in place of or in addition to the calisthenics. Most cases will not find it too much to take both. Exercise should be stopped, however, as soon as slight fatigue is felt. The purpose of the milk diet is to build up the internal organs and involuntary muscles rather than the skeleton muscles; but the physiological benefit resulting from exercise of the latter will assist in producing the former effect. Thus the exercise should be constitutional rather than developmental.

Amount of Exercise

Deep breathing of fresh air is just as important as when taking the diet in bed. The patient should stay out of doors as much as possible, and should either sleep out or have a very well-ventilated bedroom. Whatever exercise is taken will



PHOTOGRAPH EWING GALLOWAY

A model sanitary bottling machine. The sooner milk is bottled and the less it is handled in bulk the better for it, provided the bottles are kept evenly cold.

naturally increase the rate and depth of the respirations, but special attention must be given to deep breathing while walking. No rapid or forced deep breaths should be taken, however, especially when the stomach is full of milk. The idea is to deepen each respiration rather than simply to take a few exaggerated deep breaths once a day.

Baths May Be Varied

The warm baths may be used to advantage by those up and around, as well as by those remaining in bed. In the former case, however, they should be taken just before retiring at night. For those who are up, however, these baths are not so essential as for those remaining in bed, and unless particularly indicated by the patient's condition it is permissible, if one has not the facilities or the time for taking them, to substitute a sponge-bath. This should be warm followed by cool. Patients who are fairly vigorous may take a shower daily, but they should not remain in it more than five minutes. Two or three minutes for the hot and one minute for the cold is generally ample. Such a bath requires energy, and to remain in it longer than necessary to secure the cleansing and stimulating effects is to waste energy. Steam, hot-air or electric-cabinet baths may also be taken if they are particularly needed. For these twice a week is generally the maximum, and no other bath should be taken the same day with any of them, except, of course, the rinsing warm bath and the terminating cold one. When able to take sun-baths no other form of bath will be required, except the terminating cold bath. Those who can arrange to take these will be fortunate. The sun-bath gives the relaxing effect of the warm bath and the eliminative effect of the steam-bath, while the cool bath at the close gives stimulation. In addition, it produces those vitalizing effects on nerves, glands and blood that come only from the sun. The regular method of taking the sun-bath is to be used, but some arrangements should be made for getting the milk regularly during its progress. None of the baths mentioned need interfere with taking the milk, except the different sweating baths.

Milk Diet with Sun-Bath

The method of drinking the milk is, of course, the same as when taking it in bed, and the same rules as to temperature apply. The quantity of milk and the frequency with which it is taken must be regulated according to the condition of the patient. Most cases, after a short fast, will start with an eight-ounce glass of milk every hour the first day, increase to a glass every three-quarters of an hour the second day, then a glass every half-hour the third day and thereafter. After a longer fast, the first day's quantity will be limited to a glass every two hours, beginning the regimen just described on the second day. As the feeding period is limited to twelve hours, the first day's quantity will be from a quart and a half to three quarts, and the maximum quantity six quarts. There are four glasses to a quart.

However, these quantities are not always vigorously adhered to. Some cases may find that three quarts seems to fill them quite full, and they may have to remain on this quantity for several days before they can take more. Some small women, no matter how they try, cannot take any more without making themselves sick, as by any form of overeating. Cases have gained weight and secured very satisfactory results on three quarts a day, though four quarts is generally considered to be necessary for the mere maintenance of weight. The important point to remember at all times is that it is the milk which is digested and assimilated that does the work, and not that which is merely passed through the alimentary tract. A moderate excess of milk is desirable so as to keep all functions working vigorously and to give sufficient waste to produce good bowel-action; but there is no advantage in taking more than can be handled with comfort.

Adapting Quantity of Milk to Patient

Some patients with very weak stomachs may have to start with a half glass of milk at a feeding, increase to three-quarters, then to a full glass, keeping the feedings two hours apart. A few very severe cases have had to start with teaspoonful doses. In all cases it is well to work up to the usual quantity as soon as possible, as this has been found to produce the best results. The maximum quantity, however, may be subject to as much variation as the beginning quantities. The size of the patient is always an element that must be taken into consideration. Generally speaking, the larger the body the more milk can be taken, but this does not always hold true. For the average-sized woman five quarts is a good maximum, and for a man six quarts. The man can take more, as a rule, because he is ordinarily larger and more heavily built, but his metabolism, also, is said to be usually at a higher rate. Those below average height (five feet eight inches for men and five feet four inches for women) should usually take less, but if there is a definite appetite for more milk and it can be taken without any bad effects, the usual amount may be given. Quite a few average-sized women can assimilate six quarts. There is a limit to the leeway allowed, however. Many average-sized men, especially after a fast, can take eight quarts of milk a day with relish, but there is no advantage in doing so. In some cases fifteen quarts have been taken for several days, but invariably the weight reduced or it became necessary to discontinue all milk for a time to give the digestive organs a rest. Seven quarts should be the absolute maximum for all

Excess Milk—Effects

men, even those who exceed six feet in height, unless these latter have very broad and heavy frames. These may be able to take eight quarts, but must never take any more than can be handled with ease.

Judgment must be used in limiting the quantity of milk, as well as in increasing it. Some seem to have little appetite for it, especially at first, and if they have taken only a short fast, will not take much unless they make a special effort. Such persons should try to take the usual quantity so long as it does not produce nausea or a strong distaste for the milk. If only a small quantity can be taken and the patient is not making satisfactory progress, more fasting is generally required. Many find it helpful to take a day on fruit every two or three weeks while they are on the diet, though this should not be done so long as everything is going well. After six weeks on milk, however, fruit should always be taken for several days if the condition requires continuing the diet longer. If more fasting or fruit-dieting does not enable the patient to take more milk, lemon juice or orange juice, taken while continuing the milk, will often assist the digestion. If this fails, skim-milk, or whole or skimmed sour milk, may be tried instead of the sweet whole milk. The inability to take the proper quantity generally results from a full feeling or a tendency toward nausea or biliousness.

Means to Improve Appetite for Milk

The full feeling is quite common when starting the milk. It usually disappears of itself as the body becomes accustomed to absorbing the large quantities of water and the increased nourishment. The skin, lungs and kidneys all help to excrete the water, and the solid material is transformed into tissue, stored in the body fat, or passed rapidly through the bowels. If the full feeling does not pass of itself, acid fruit juices, by assisting coagulation of the milk, will help. Lemon is particularly beneficial for this purpose. It is taken by sucking a little of the juice from a section of lemon whenever one feels uncomfortably full. The best time is just after a glass of milk, though it may also be taken just before the milk or with it. As much lemon as desired may be taken, but no more than necessary. One patient who took his milk a pint at a time, every hour, took the juice of one whole lemon with each pint, but this is several times the amount usually required.

Lemons in Milk Diet

PHOTOGRAPH DE LAVAL SEPARATOR CO.

The farm separator reduces the haulage cost where the cream is sold for butter-making. The skim-milk remains on the farm, where it serves chiefly for animal feeding. Lest dishonest dealers substitute it for whole milk, the distribution of skim-milk is forbidden by the Health Boards of most cities.

Patients who cannot handle lemon juice may be able to secure results from orange juice. The juice of half an orange is usually taken at a time, four to six times a day. Grapefruit juice is likely to be more efficacious than orange juice. If no fruit juices can be taken on account of their acidity, which condition would contraindicate the sour milk also, the quantity may have to be limited. If the inability to take milk is due to nausea, the fruit juices are generally very effective; but some cases may have to change to skim-milk or a soured milk. These are taken the same as the sweet milk, except that from a pint to a quart less a day may be considered a satisfactory quantity. Constipation also may interfere with the ability to take milk. Diarrhea may make it necessary to limit the quantity of milk, but it seldom interferes with the appetite or produces any nausea.

Constipation, or intestinal stasis, is quite common when starting the milk diet. The reason for this has already been explained. In these cases the enema should be used until the bowels begin to move of themselves. Enemas will have been used while on the fast or fruit diet, and they may be continued daily as long as necessary. Generally the quantity of water injected during the fast is about two quarts. This is reduced on the second day of the milk diet to three pints, on the next day to two pints and on the third day to as little as will produce satisfactory action. The temperature should continue warm for the first three days and then be gradually lowered until, by the end of a week, it is about seventy-five degrees. This small cool enema assists in restoring normal action by its tonic effect. Most cases will not need to continue the enema more than a week, but if they do, no harm will come of it.

Constipation in Milk Diet

A few cases may have to continue the enema during the entire diet; but these cases are rare, especially when the full quantity of milk is taken, and they invariably find that on resuming solid food their bowels move better than they ever did before, thus showing that the milk was not producing constipation, but actually correcting it.

When the bowels do start to move the first actions will probably be somewhat difficult. In this case a small amount of water may be injected to assist. If great difficulty is experienced, it is well to take an enema of two ounces of olive oil, or some cooking oil, just before retiring, and retain it all night. This helps to soften the feces. Such an oil enema taken just before a water enema is also helpful. This assistance should always be given when it is needed, for very difficult actions are painful and may produce hemorrhoids.

The Enema in Milk Diet

If some such condition is already present, making it advisable to avoid even slight straining and pressure, or if some condition is present making it inadvisable to continue using the enema, something must be taken with the milk to soften the feces and stimulate peristalsis. The best thing for this purpose is agar. It may be taken dry, in a little water or in the milk. As soon as it comes in contact with water it absorbs so much of it that its own substance becomes jelly-like, and this smooth, moist, non-irritating mass mixes with the milk and makes its residue more nearly like that of solid food in consistency. The usual quantity of agar is three tablespoonfuls a day, but more may be used if very necessary. It is non-digestible and does not interfere with the digestion of the milk.

If agar cannot be obtained, or if it should prove ineffective, prunes may be tried. Three or four raw, soaked prunes are taken between milk feedings three or four times a day. These require digestion and to some extent interfere with the beneficial effects of the milk, so they should be used only in emergencies. The same applies to raw figs and bran. These may be employed in extreme cases, but should be discontinued as soon as the intestinal activity has improved sufficiently to warrant it. No more of these substances should be taken than is necessary to produce the desired results. If bran is taken, it should be raw. Psylla seed is also permissible, but no drug nor even herbal laxatives should be employed.

Agar as Laxative in Milk Diet

When the milk is properly administered and the enemas employed there will seldom be need for any further assistance, and in this connection it is well to state that rigorous regularity in taking the milk aids in maintaining active peristalsis, while some cases find it helpful to take a little less at a time and continue over a period of fourteen or fifteen hours instead of twelve.

The very opposite of constipation—diarrhea—may occur. This indicates a greater degree of abnormality in the intestinal action than constipation. It is more difficult to handle than the latter, but less frequent in occurrence. As a rule it does not appear until more than three quarts of milk are being taken. If one can take a sufficient amount of milk to gain two pounds or more a week without having more than four bowel actions a day, no attention need be paid to the diarrhea. Some cases have even five or six actions without any untoward results. Sometimes the diarrhea will disappear of itself after a few days as the milk is continued. If it does not do so after four or five days, or if the movements are very frequent and associated with much gas and discomfort, modification of the diet is necessary. The first thing to do is to reduce the quantity of milk to three quarts, which will seldom cause any trouble, wait a few days and then gradually increase it again. Activity also should be considerably restricted. If diarrhea again oc-

Diarrhea in Milk Diet

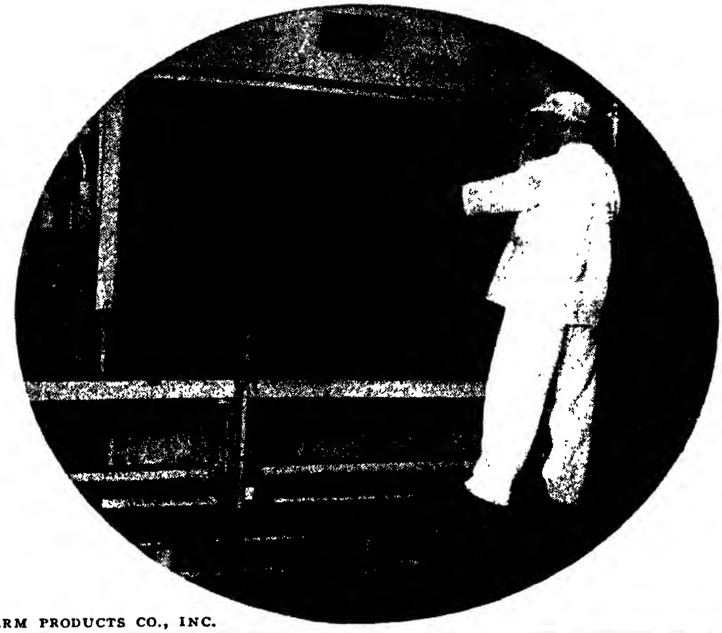
curs, a fast, or a diet of orange juice or vegetable broth, should be instituted for several days. The milk is then tried again, the quantity being increased only two glasses a day after three quarts has been reached. Sometimes it helps to take the milk cold, and to drink two glasses at a time instead of one, allowing a longer interval between. If things do not go better, a change should be made to some form of sour milk, preferably ordinary clabbered milk made by allowing raw whole milk to sour in a covered vessel at room temperature. Other

Special Kinds of Milk

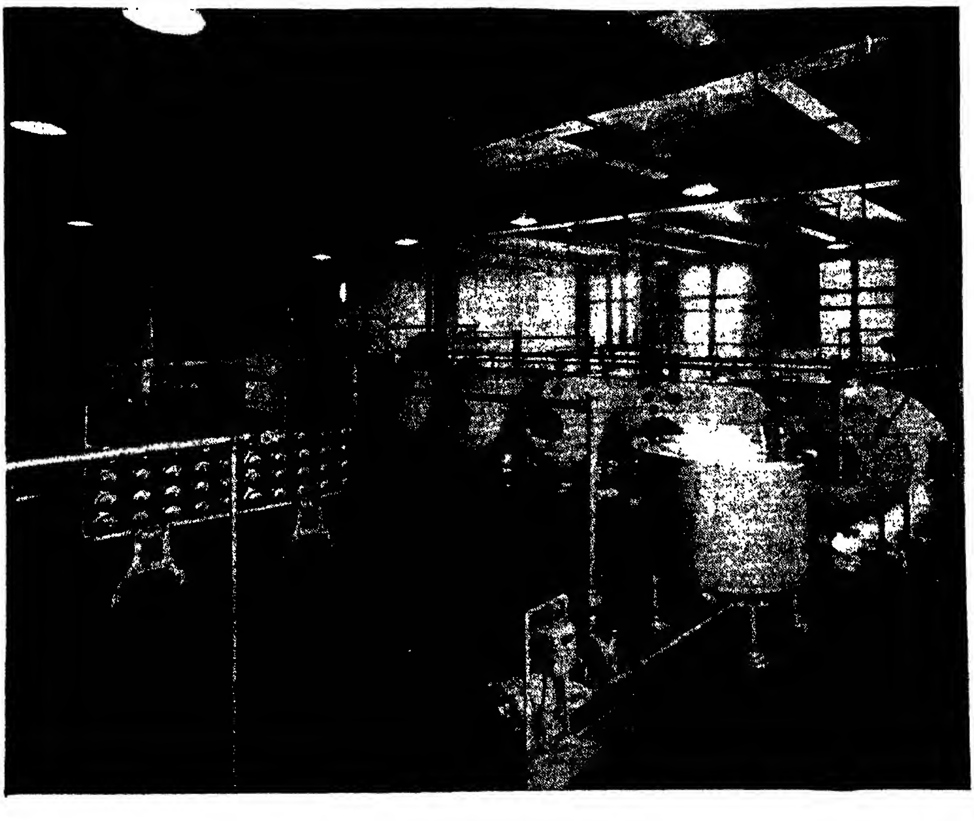
forms that may be used include buttermilk, and various cultured milks, so long as they do not contain more than a trace of alcohol. Acidophilus milk cannot be used for an exclusive diet, as it is sterilized by heating beyond the boiling point; but it may be used as part of the diet, just as boiled milk may be so used. One of these forms of milk practically always produces satisfactory results. After a week or so on this treatment, sweet milk may be resumed in part, the quantity being gradually increased until it is found just how much of each kind is required to maintain normal bowel action. Sometimes it will be possible to return entirely to sweet milk. If the sour milk does not check the diarrhea sufficiently, dates may be added to either sweet or sour milk. Two dates at a time, thoroughly masticated, may be taken four to six times per day, with or between milk feedings. Severe cases may need to take a date or two with every other glass of milk. No more should be taken than is actually necessary. One woman patient, on six quarts of milk a day, took ninety-six dates a day—four with each glass. This held the bowels in check and the patient improved remarkably. However, this is far too much nourishment even for the average *man.* One and one-half to two dozen dates per day should, ordinarily, be the maximum.

If there is such an extreme dislike for all forms of sour milk that none can be used, a certain amount of boiled milk may be employed for diarrhea. A start is made with a quart a day, spreading it out over the day instead of taking it one glass after another. The quantity may be increased to two quarts, and dates added if necessary, but the boiled milk should always be discontinued as soon as possible. Occasionally the use of lemon juice with sweet milk will help to over-

The higher rate of infant mortality a generation ago was in large measure a result of the inability of poor parents, particularly in cities, to obtain healthful milk. Modern methods of pasteurizing, and clean and wholesome bottling of milk are in no small measure responsible for the safety of our milk supply.



PHOTOGRAPH BORDEN'S FARM PRODUCTS CO., INC.



come diarrhea, but orange juice will not have this effect. Another plan that may be tried is to use agar. It may seem strange that this should be effective for both constipation and diarrhea, but this is because of its water-absorbing qualities. By absorbing the extra fluid in the intestines it checks the tendency to diarrhea. In an occasional case an ounce of ordinary store cheese may be taken from two to four times a day, this often helping to hold the bowels in check. Patients who cannot take milk without diarrhea when up and around sometimes can do so if they remain in bed. Perhaps once in a hundred cases there will be a patient who does not respond to any of these measures. Then it will be necessary to change to a diet of milk half a day, with one meal of solid foods, or perhaps to abandon the milk altogether.

Milk and Hyperacidity

Another symptom which may develop is difficulty in digesting the milk owing to the formation of large hard curds. This generally occurs when there is a hyperacid condition of the stomach, but it may arise from other causes also. The gastric juice is slow to act on the hard curds, and as a result the milk remains in the stomach too long, giving a full feeling and lack of appetite. There may be regurgitation of the milk, either with or without nausea. If there is hyperacidity the acid fruit juices will not help, though curdling milk with lemon juice or by other means before it is taken will sometimes be useful. If the stomach is very acid it may be impossible to use any form of soured milk. In this case and sometimes in others, it helps to modify the milk with malt or some special food, such as the various baby foods. These keep the milk from forming such large curds. The use of such foods, however, so adds to the total quantity of nourishment taken that from a pint to a quart less of milk per day will be sufficient. Only part of the milk should be thus modified if that will produce the desired results. If these preparations do not agree on account of their starch content, the milk may be gelatinized.

Gelatinized Milk

A plain, unflavored gelatin is used. A level teaspoonful is soaked in cold milk for ten minutes, then dissolved in warm milk and added to each quart taken. This increases the protein content of the milk, hence the total quantity should be somewhat reduced, as above suggested. Boiled milk does not form such large curds as does the raw, but it is objectionable for other reasons, and it cannot be used for the full diet. None of these modified milks are quite as satisfactory as the plain raw milk; but generally it is possible to omit the modification after a week or so, by which time the condition of the stomach will have improved and the larger quantity of milk taken will use up the excess acid. Later the excessive secretion of acid will cease, and the gastric juice as a whole will become more effective through improvement in the function of the gastric glands.

Various pains and uncomfortable feelings may be felt here and there throughout the body when first starting the milk diet, especially if only a short fast has preceded it. This is because the milk is so stimulating to all the functions of the body that elimination and repair are going on more rapidly, and the increased metabolism and circulation naturally produce some disturbances. It is like spring housecleaning. While it is going on the house is not so comfortable to live in, but after it is done everything is much more pleasant. It is seldom necessary to pay any attention to these symptoms, as they disappear of themselves when the condition improves. If they are very uncomfortable they may be treated with heat or cold or manipulation, according to their nature. Sometimes it may be necessary to discontinue the milk for a few days, but this should not be done unless it *is* necessary. This same rule applies to the reappearance of symptoms experienced previous to the fast and start of the diet. Attention has already been called to the fact that the symptoms of catarrh may temporarily increase while on the milk. This may occur also in cases of acne and other skin eruptions. Such symptoms do not indicate that the milk is unsuited to the condition, but that it is doing the work for which it is being taken; namely, stimulating all the organs of the body to increased activity. If such symptoms are persistent another fast may be required.

Discomfort During Milk Diet

If there is chronic inflammation of the uterus or ovaries, there may be an increase in pain during the menstrual period, due to the larger amount of blood in the body and the more active circulation. The milk should be continued if at all possible, but if the pain is very severe, a fruit diet may be adopted for two or three days. As a rule it is only during the first period that any particular trouble will be experienced. By the time the next period arrives the body will have become so much more nearly normal that pain will be greatly relieved, if not entirely eliminated. If the reproductive organs are normal no discomfort will be experienced, and even those cases which are not normal to begin with do not always have trouble.

Unfavorable Symptoms Rare in Milk Diet

By far the greater percentage of those who take the milk diet will go through with it without any difficulty whatever, except possibly a little bowel stasis during the first week or two. So long as all goes well the diet should be continued uninterruptedly until the desired results have been obtained, unless it is necessary to continue more than six or eight weeks, in which case there should be an interval of a few days on an orange or grapefruit diet. In practically all cases there will appear after from five to eight weeks indications that the milk is not having further beneficial effect. A few days on the citrus fruit will put the body in condition to make further progress on the milk, and it may then be returned to with benefit, provided it is needed longer. In most cases six weeks will be sufficient to produce results, especially if an adequate fast precedes the milk. To take the diet for less than four weeks would not be giving it a fair trial. Even if the desired results are obtained before this time it is well to continue for the month. If circumstances make it impossible to take the milk as long as needed, it is worth while to take it as long as possible, even though it be but a few days, though one cannot expect much noticeable benefit in this short time. When ready to change to solid foods it is well to do so gradually. This is not absolutely necessary if the milk has been continued long enough to restore the patient to a normal condition, but unfortunately this is so seldom the case that the gradual plan is almost always recommended.

Returning to Normal Diet

This plan is as follows: On the first day the milk is taken as usual until about one o'clock in the afternoon, thus getting in about half the full quantity, after which nothing is taken until six o'clock, when a meal of solid foods is eaten. This first meal should consist of a vegetable soup with a raw vegetable salad and one cooked vegetable, such as carrots, beets, eggplant or summer squash. On the next day the milk is taken the same way, and whole-grain bread and butter may be added to the evening meal. On the third day this meal may be amplified by the addition of a simple dessert, such as some sweet fruit, junket, custard or gelatin. After a week, if considerable exercise is being taken and the appetite warrants it, eggs, cheese or nuts may be added. Any vegetables may be used after the second day, and the soup may be omitted when desired. If it does not seem to agree with the patient to take the meal in the evening, or if this plan is very inconvenient, it may be taken in the morning, say at seven o'clock, and the milk during the afternoon, starting at one o'clock; or the meal may be taken in the middle of the day with half the milk during the early morning and the other half during the late afternoon. In most cases the evening-meal plan is preferable and will be found to work out very well.

Modified Milk Diets

If the patient cannot arrange to take the milk every half-hour, as when on the full diet, a pint may be taken every hour, or, if necessary, a quart may be taken slowly for breakfast, a second quart for lunch and a pint sometime between these two meals. If unable to arrange for the additional pint, and the two quarts do not provide sufficient nourishment, fruit may be taken at both milk meals, using acid fruit at one meal and sweet fruit at the other. Care must be taken, however, not to overload the stomach, and it may be better to take only three glasses of milk instead of four at such a meal. The digestion and assimilation are so improved after a milk diet that most people can get along with much less than their usual quantity of food. The evening meal should be regulated in size in accordance with the amount of milk, or milk and fruit, taken during the morning.

Some one of these combinations of milk and solid food should be used for at least a week before going on an all-solid diet, and it is much better to follow such a plan for a month. Some people will want to continue indefinitely, and there is no objection to doing this. If necessary to adopt solid food after the first week, it is well to have one meal a day—either breakfast or lunch in most cases—of nothing but a quart of milk. When a breakfast and lunch of solid food are taken, the menus should be governed according to the individual condition. If the milk has been continued long enough to restore a normal state, then a normal mixed diet of natural foods may be resumed. Care must be taken, however, that one does not go back to old dietetic errors that may have been responsible for the trouble in the first place, for what produced trouble before will do so again.

Use of Water During Milk Diet

After returning to solid foods it is important to drink plenty of water. The body has become accustomed to having a liberal supply of water while on the milk diet, and, since this is so helpful, it should be continued. It is not necessary to drink water while on the milk, though it may be taken if there is a definite thirst; but at least eight glasses a day should be taken after changing to solid foods. The best time to drink the water is between meals, but a glass may be taken at meals if there is thirst. With plenty of water, a strictly natural diet and due attention to every phase of right living, all the good results obtained from the fast and milk diet should be maintained indefinitely. Some people, after they have experienced the benefits of this diet, like to take a few weeks on milk every year, and there is much value in such a plan. It helps to maintain youth and to counteract any bad influences, apart from diet, which may be present in the environment.

PHOTOGRAPH INTERNATIONAL NEWSREEL

To provide wholesome milk for the growing youngsters at a minimum of cost to its parents, is an important and profitable practice for school or playground.

Milk Diet for Children

Children can take the milk diet like adults, except in regard to the quantity and modification in the preceding fast or fruit diet. The total quantity of milk taken will depend on the age, and, to some extent on the size, of the patient, and the amount taken at one time and the frequency of the feedings will depend on the total daily quantity. A child of from one to two years of age will require around three pints of milk a day. By the age of five years, up to three quarts can be taken. It is seldom necessary to increase this quantity until eight years of age, when an additional pint to a quart may be added. From the age of thirteen to sixteen, boys can take about the same amount as an adult woman, namely five quarts, while girls will take from a pint to a quart less than this. After the age of sixteen, both boys and girls can take approximately the same quantities as men and women. The quantities in the case of children must be more finely graduated than for adults, a glass more or a glass less a day often making quite a difference. There will be a greater variation in the digestive ability of children in accordance with their age than there is in adults in accordance with their size.

In all cases up to the age of thirteen it is well to take only four glasses of milk the first day, and in children around one year of age it may be well to reduce this to three glasses. Four ounces at a time should be taken the first day, increasing from two to four ounces the next day, depending on the age. The feedings should be at equal intervals over a period of twelve hours. In those cases taking only three or four pints of milk a day, the quantity taken at each feeding is usually limited to six ounces. Those who are administering the milk should be guided by the patient's reactions and use the plan of feeding that agrees best. The other modifications of the diet and the various factors involved are regulated as in the case of adults. Children generally take the milk diet with the greatest ease and success.

DIET AND EXERCISE

Section 23

THE next volume of this encyclopedia treats of exercise. It deals with a matter vitally important to the health builder. Food and exercise are the twin pillars that support the temple of health. If either be neglected the structure may fall.

Food cannot be substituted for exercise nor exercise for food. This should be self-evident to anyone who comprehends the general laws of the physical life of man. Yet in practice this is frequently ignored. Various conditions of age, temperament and circumstances lead individuals to take up either diet or exercise to the neglect of the other. The results in health improvement in either case may be so pleasing that the person may think he has found the key to health. He becomes an enthusiast for either diet or exercise, as the case may be, and ignores or under-rates the other factor.

Diet and Exercise Complementary

It is usually young people, and especially young men, who go in for exercise to the neglect of diet or the intelligent control of one's eating habits. For a time the results from exercise alone may be so gratifying that they give the impression that exercise alone is a sufficient health-building factor. This is particularly true in the case of successful athletes whose inherited gifts of muscular prowess, plus enthusiastically followed exercise, result in fine appearing and powerful bodies. It also develops huge appetites and powerful digestions so that the athlete seems capable of eating and assimilating anything. But if the laws of diet and nutrition are ignored, failure in health in such cases is only too likely to ensue after the first flush of youth is past.

Athletics and Milk Diet

By creating large demands for food, the superior muscular system increases tendencies toward the habit of overeating. All goes well for a time but the moment the natural energies of youth begin to flag, poisons from excess of food, or badly selected food, begin to accumulate in the body. Disease and sometimes premature death result. When this happens in middle life to men who have been distinguished as athletes the critics and skeptics have good excuse to decry the worth of exercise, although the neglect of the laws of diet really has been to blame. Had the same men eaten as gluttonously without taking any exercise they would not have lasted even as well.

On the other hand many other people become obsessed with the idea of the supreme importance of diet and come to the conclusion that proper food control will solve all health problems without physical exercise. They may restrict their diets to the minimum quantities, lack of exercise making this feasible. They rarely avoid those foods with which muscular exercise enables the body to cope because these create a need for a larger volume of energy—creating substance that they feel they have.

Diet Without Exercise

If one is not to take exercise, he is right in thus limiting his food intake. But the error lies in the assumption that the strict limitation of food to the minimum needs of the non-exercised body is the ideal state of human existence. Rather the ideal state that best maintains all of the vital functions is one in which man performs a considerable amount of muscular labor and consumes just enough food to support that degree of activity.

When physical activity is neglected and a limited diet is followed, it is more difficult to avoid excesses of food elements without courting the opposite danger of nutritional deficiencies. Danger of failure of the proper elimination of body wastes is also increased.

Between these two alternatives of superabundant exercise with unrestrained eating and no exercise with careful eating there is small choice. Both are certainly more desirable states of existence than the murderous combination of overeating with muscular indolence. But the ideal method of living is more easily attained with well-developed and well-exercised muscles combined with a careful supervision of the diet. It is then much easier to avoid both dietetic excesses and dietetic deficiencies.

Likewise the benefits of exercise are both greater and more permanent when the body is properly and carefully nourished.

Diet and Exercise Enthusiasms

To become an enthusiast for either diet or exercise to the exclusion of the other is to be a badly balanced example of a physical culturist. Not only may it lead to later failure and disappointment for the individual, but it may discredit the cause one sets out to glorify. Only by a well-balanced understanding and application of both of these great supports of superb health is lasting success and satisfaction in life to be secured.
