MACFADDEN'S ENCYCLOPEDIA *of* PHYSICAL CULTURE

A work of reference providing complete instructions for the cure of all diseases through physcultopathy, with general information on natural methods of health-building and a description of the anatomy and physiology of the human body

By

BERNARR MACFADDEN

assisted by

Specialists in the Application of Natural Methods of Healing

COMPLETELY REVISED—1926 EDITION

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VOLUME I

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GUIDE TO MANIKIN

I. Outer Skin.

I. Skeleton.

1. Frontal Bone (Forehead).
2. Parietal Bone (Side of Head).
3. Zygomatic Process (Arch of Cheek Bone).
4. Malar Bone (Cheek Bone).
5. Orbital (Eye) Cavity.
6. Superior Maxilla (Upper Jaw).
7. Nasal Bone.
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16. Corpus Sterni (Body of Breast Bone).
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66. Metatarsus (Middle Bones o the Foot).
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(Including Some Nerves and Muscles.)

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5. Right Auricle (Ante-chamber).
6. Left Auricle (Ante-chamber).
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12. Right Innominate (Unnamed) Vein.
13 Left Innominate (Unnamed) Vein.
14. Right Subclavian Vein (Right Collar-bone Vein).
15. Right Innominate (Unnamed) Artery.
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18. Left Inner Jugular Vein.
19. Right Inner Jugular Vein.
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60. Palmar Cutaneous Nerves (Skin Nerves).
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77. External Saphenous Vein (Vein of the Leg).
78. Nerva saphena (Rose Nerve).
79. Cutaneous Peroneal Nerve (Nerve of Leg).
80. Cutaneous Plantar Nerve (Cutaneous (Skin) Nerve of the Leg).

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25. Orbicularis Oris (Sphincter Muscle of the Mouth).
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28. Trachea (Windpipe).
29. Left Brachial Plexus (Left Nerve Plexus of the Arm).
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67. Rectus femoris (Longitudinal Muscle of the Thigh).
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69. Tibia (Shin Bone).
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75. Flexor longus pollicis (Long Extensor of Large Toe).
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77. External Saphenous Vein (Vein of the Leg).
78. Nerva saphena (Rose Nerve).
79. Cutaneous Peroneal Nerve (Nerve of Leg).
80. Cutaneous Plantar Nerve (Cutaneous (Skin) Nerve of the Leg).

IV. Muscles of the Back.

1. Frontalis (Muscles of the Forehead).
2. Orbicularis palpebrarum (Compressor (Closing) Muscles of the Eyes).
3. Auricularis superior (Muscles of the Temples).
4. Occipitalis (Back Head) Muscles.
5. Masseter (Masticating) Muscles.
6. Sterno-cleido-mastoid (Nodding) Muscle.
7. Splenius capitis (Muscles of the Head).
8. Splenius colli (Muscles of the Neck).
9. Levator scapulæ (Levator Muscle of Angle of Shoulder Blade).
10. Trapezius (Table-shaped Muscle).
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12. Infra-spinous (Lower Spinal) Muscles.
13. Deltoid (Triangular Muscle).
14. Rhomboideus (Rib and Collarbone) Muscle.
15. Teres minor (Small Round Arm Muscle).
16. Teres major (Large Round Muscle).
17. Triceps (Three-headed Arm Muscle).
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19. Serratus (Jaw Muscle).
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    b. External communis digitorum (Mutual Extensor of Fingers).
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22. Gluteus medius (Middle Muscle of Buttocks).
23. Gluteus magnus (Large Muscle of Buttocks).
24. Pyriformic (Pear-formed) Muscles.
25. Obturator internus (Inner Muscle of Hip Socket).
26. Quadratus femoris (Four-cornered Thigh Muscle).
27. Head of Extensor longus (Leg Extensor).
28. Adductor magnus (Large Adductor of the Leg).
29. Gracchi (Twin Thigh Muscle).
30. Biceps (Two-headed Leg Muscle).
31. Semi-membranous Muscle.
32. Semi-tendinous Muscle.
33. Gastrocnemius (Two-headed Calf Muscle).
34. Soleus (Muscles of the Sole of the Foot).
35. Tendon of Achilles.
36. Tibialis posticus (Back Shin Muscle).
37. Peroneous (Calf) Muscle.
38. Extensor longus digitorum (Long Extensor of the Toes).
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2. Frontalis (Forehead) Muscle.
3. Temporal Muscles.
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5. Levator labii superioris alaeque nasi (Levator of the Nostrils and Upper Lip).
6. Levator labii superioris proprius (Individual Levator of Upper Lip).
7. Zygomaticus (Cheek) Muscle.
8. Risorius (Laughing) Muscle.
9. Depressor anguli ori (Triangular Muscle).
10. Orbicularis oris (Sphincter of the Mouth).
11. Depressor labii inferioris (Quadrangular Muscle of the Under Lip).
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15. Trapezius (Table) Muscle.
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19. Clavicle (Collar Bone).
20. Pectoralis major (Large Breast Muscle).
21. Pectoralis minor (Small Breast Muscle).
22. Subclavius (Muscle Under Collar Bone).
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26. Linea alba (White Line).
27. Sheath of Rectus abdominis (Division of the Longitudinal Abdominal Muscles).
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30. Biceps (Two-headed Arm Muscle).
31. Brachialis (Tendon of the Two-headed Arm Muscle).
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47. Iliacus (Inner Hip-bone Muscle).
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49. Poupart's Ligament (Fallopian Ligament).
50. Pectineus Muscle of the Thigh.
51. Adductor longus (Long Adductor of Thigh).
52. Gracius (Slim) Muscle.
53. Sartorius (Tailor) Muscle.
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55. Inner Head of Median quadriceps femoris (Leg Extensor).
56. Outer head of Median quadriceps femoris (Leg Extensor).
57. Extensor longus digitorum (Tendon of Leg Extensor).
58. Crural Ligament (Tensor of the Broad Leg Ligament).
59. Patella (Kneecap).
60. Ligament of Patella (Kneecap Ligament).
61. Tibia (Shin).
62. Gemelli (Twin Muscle of the Calf).
63. Soleus (Push Muscle).
64. Tibia anterior (Front Shin Muscle).
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73. Thyroid Gland (Shield-shaped Gland).
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88. Liver (cut in half).
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90. Stomach.
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92. Spleen.
93. Pancreas (Sweetbread).
94. Duodenum (Intestinal Canal).
95. Mesentery (Small Intestine).

96. Cecum (Blind Gut with Worm-like Appendix).
97. Ascending Colon.
98. Transverse Colon.
99. Descending Colon.
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PREFACE TO SEVENTH EDITION

MORE than fifteen years have elapsed since the preface to the first edition of this Encyclopedia was written. Its publication at that time was considered a bold venture. Nothing like it had ever been issued. Many of my associates strongly advised against the undertaking.

I am glad to say that my judgment as to the value of the undertaking proved to be sound. There has been a wide demand for the information the work contains. More than forty thousand sets or two hundred thousand volumes have been printed.

The present edition contains numerous revisions. Time effects many changes. We have tried to bring up to date in every way the various subjects discussed.

This series of volumes might appropriately be said to constitute an encyclopedia of personal efficiency. For from beginning to end we have endeavored to present such information as is essential to those who wish to maintain the body in a state of high physical excellence. And it has been our aim to so arrange the contents of several divisions that each individual may be able to find, easily and quickly, the treatment best fitted for his or her particular needs.

Aside from the attention given to the treatment of various ailments, the book is devoted to the object of interesting the reader in becoming vitally stronger, both physically and mentally.

The absurd idea that the mind is a separate entity from the body is no longer tenable. Everywhere the mental worker now realizes the tremendous importance of nervous energy and vitality to the success of his endeavors.

Since the first edition of the work was published, Physical Culture has come into its own. The world-wide war made the public realize the importance of this momentous reform. There is an ever-increasing need for knowledge as to how to gain and how to keep health and fitness.

Consequently, in presenting this revised edition of the Encyclopedia, we feel assured that the difficult task entailed by its very extensive revision will be well repaid.

It would take up too much space to give special reference to the many changes which have been made in this series. I am certain, however, that the publication as it now stands will be keenly appreciated by every investigator in the field of health-building and allied subjects.

The work is sent forth with this message:

Pulsating health is your rightful heritage.

Dominating efficiency can be developed if you are willing to make the necessary efforts.

Ill health is inexcusable. It is due to ignorance, carelessness, laziness.

Make the best of yourself.

Develop all attainable powers of mind, body and soul.

It is only thus that you can become a super-man or super-woman.

And herein you will find the information essential to the attainment of glorious rewards.

Bernarr Macfadden

CHAPTER I.

HEALTH AND EFFICIENCY.

THE superlative degree of human attainment comes only through efficiency. Efficiency brings success, wealth and happiness. And without superior health you cannot be efficient. Efficiency and health are boon companions. They are closely entwined. You cannot separate them.

To be splendidly efficient is the one desire of every ambitious human being.

Human tragedies are strewn all along the pathway of life; and the cause of these failures is usually ill health. If you desire to succeed, if your life is to be worth while, you must be vitally efficient.

Hard work brings efficiency, but the ability to labor with such concentrated effort depends upon the possession of superior physical force. Your nerves must be in good working order, your stomach, heart, lungs and every part of your physical organism must be vibrating with the power of health.

To live the life of achievement you must be exhilaratingly healthy. This characteristic, associated with ambition, enthusiasm and persistence brings efficiency.

If one were to build a house without a secure foundation, and then proceeded to decorate it in a very costly manner, his mentality would be considered defective. Some men try to build their human house without a foundation of vigorous health. They spend years of valuable time in improving their mentality. They "decorate" their human house by cultivating manners and habits that establish them in a superior class. Yet the necessity of developing superior health is rarely considered.

It is no exaggeration to say that such men are mentally unbalanced. They fail to consider life in all its phases. They have not been able to separate the important from the unimportant things of life.

Men and women in perfect health will be strong, vigorous and splendid. Health is not a privilege granted to the few—

it is every man's inalienable right. It is not only everyone's right, but everyone's duty.

If you are a weakling, life will be meaningless to you, regardless of your mental achievements. Weaklings are cowards. But with strength a man acquires courage, persistence, ambition and enthusiasm. He is able to dominate every difficulty. He is master of every emergency.

If you have health, life will be full and complete. The broad avenues of opportunity will open up before you and your experiences will become splendidly satisfying. Everyone who has lived the life of achievement can furnish proof as to the truth of these statements. Throughout history the value of strength has been proved.

The late ex-President Roosevelt was a weakling in youth. But he determined to become a strong man. And through his own untiring efforts he finally developed unusual physical hardihood. He became so splendidly vigorous that when he was at Harvard College he was the champion boxer of that institution. Colonel Roosevelt's whole life is a magnificent example of what can be accomplished through superior health. And everyone can acquire it.

It is related that Woodrow Wilson took up the duties as President of the United States while far from well, and yet developed energy and endurance to meet the tremendous problems that confronted him by well-directed methods of health building.

David Lloyd George, the statesman upon whom Great Britain was forced to depend time and time again through crisis after crisis of its history, exemplified stanch, unwavering adherence to the simple life. His capacity for work was in great measure the outcome of his replenishing of his energies by outdoor life and wholesome living.

M. Georges Clemenceau, former Premier of France, spent many years of his life as a physician, practicing in America as well as in Europe. His experience taught him that effective human endeavor is largely dependent upon physical condition. The acute mind that earned for him lofty station in the seats of the mighty, the energy and endurance that enabled him to carry himself and his beloved France through terrific ordeals, were possible only to one having a superb physical equipment, the approach of his eightieth year proving no obstacle to his vigorous usage of his physique. The work performed by him in behalf of humanity stands as enduring evidence of the efficiency that attends the sane use of the sound mind in the sound body.

Nowadays efficiency is recognized as a quality that can be developed to greater or less degree in all men and women. The first step forward is universally conceded to be the development of that physical energy upon which the accomplishments of the individual must be based, first, last and always.

Though the great World War has already begun to take its place in the perspective of history in men's minds, it nevertheless taught mankind one supreme lesson which the world can never forget: the supreme value of keeping physically fit.

America, a land in which national efficiency had received scant attention, productive efficiency not a great degree more, and personal efficiency least of all, faced far-reaching changes in the performance of its share of the task to which its hand was set. Its initial task in the training of men to take up the tremendous exertions and extraordinary ordeals of modern warfare was to develop the health of these men to the highest degree practicable in every individual.

A few brief months of intensive physical training effected a great transformation in hundreds of thousands of young men. The colorless, inert weakling became the alert and vigorous man, physically and otherwise fit for the performance of herculean tasks.

The most stirring chapter of all history tells the story of this demonstration of the relation of health and efficiency.

To gain the master-key to good health it is imperative first of all to equip oneself with knowledge of the construction of the body, of the means by which life is sustained, and of the laws that govern physical well being.

By far the greater percentage of diseases is preventable.

The best equipped and most eminent authorities have demonstrated the truth of this statement—a statement that applies to those living even under favorable housing and hygienic conditions. Hundreds of thousands of men and women die before the body is actually worn out, and millions more are weak, suffering, unhappy and inefficient because of lack of knowledge of how to care for the body and how to conquer the forces of disease.

To bring home this knowledge, lack of which is so costly to men and women, is the chief message of the pages before you. In plain, everyday language they convey to you facts on the construction and care of the physique that are of obvious importance, or that may seem at first glance trivial—for physical facts apparently trivial in theory often become matters of life and death in practice.

The spirit of accomplishment, the power of persistence that mark the efficient man, are almost always the direct results of health. Those men who have initiated, persevered and achieved while lacking in physical strength have succeeded *in spite* of their ill health, not *because* of it. Had they been imbued with the same spirit of accomplishment no one can measure what they might have accomplished with robust health.

Such health is not the right of a chosen few. It is not an exclusive privilege bestowed upon the favored. It is free to all—the birthright of all—within the reach of all.

CHAPTER II.

HOW TO KEEP HEALTHY.

A PRACTICAL working knowledge of how to keep well is the best form of life insurance one can possess. It is more than that; it is the best form of *health* insurance that one can purchase. To understand the laws of health is to have taken a long step toward knowing how to keep healthy.

Hygiene, that single word that covers a multitude of health laws, is a subject that will well repay the health seeker for the time he devotes to the study of it. Let us review some of the most important of those rules of hygiene upon which health in great measure depends.

AIR.—Few persons realize that pure air is a food just as much as bread, meat, fruit and vegetables, yet such is the fact. Indeed, as we shall show, it is the most essential and important of food elements, for, while the human body can healthily subsist for several weeks without food, it cannot live if deprived of air for even a few minutes. This fact should constantly be borne in mind: that everything that enters into the composition of a healthy body is a food, and as oxygen is the chief element in giving life and strength to the blood stream, its importance as a food cannot be over-estimated. Yet because air is free and does not appeal to a man's appetite, he does not, as a rule, appreciate it. If a man does not secure a satisfactory supply of good, pure, nourishing food, he becomes dissatisfied and is liable to get the impression that he is starving himself to death, but the same individual will breathe enclosed air over and over again and imbibe the poisons that remain in such air in a wholesale way and yet make no complaint.

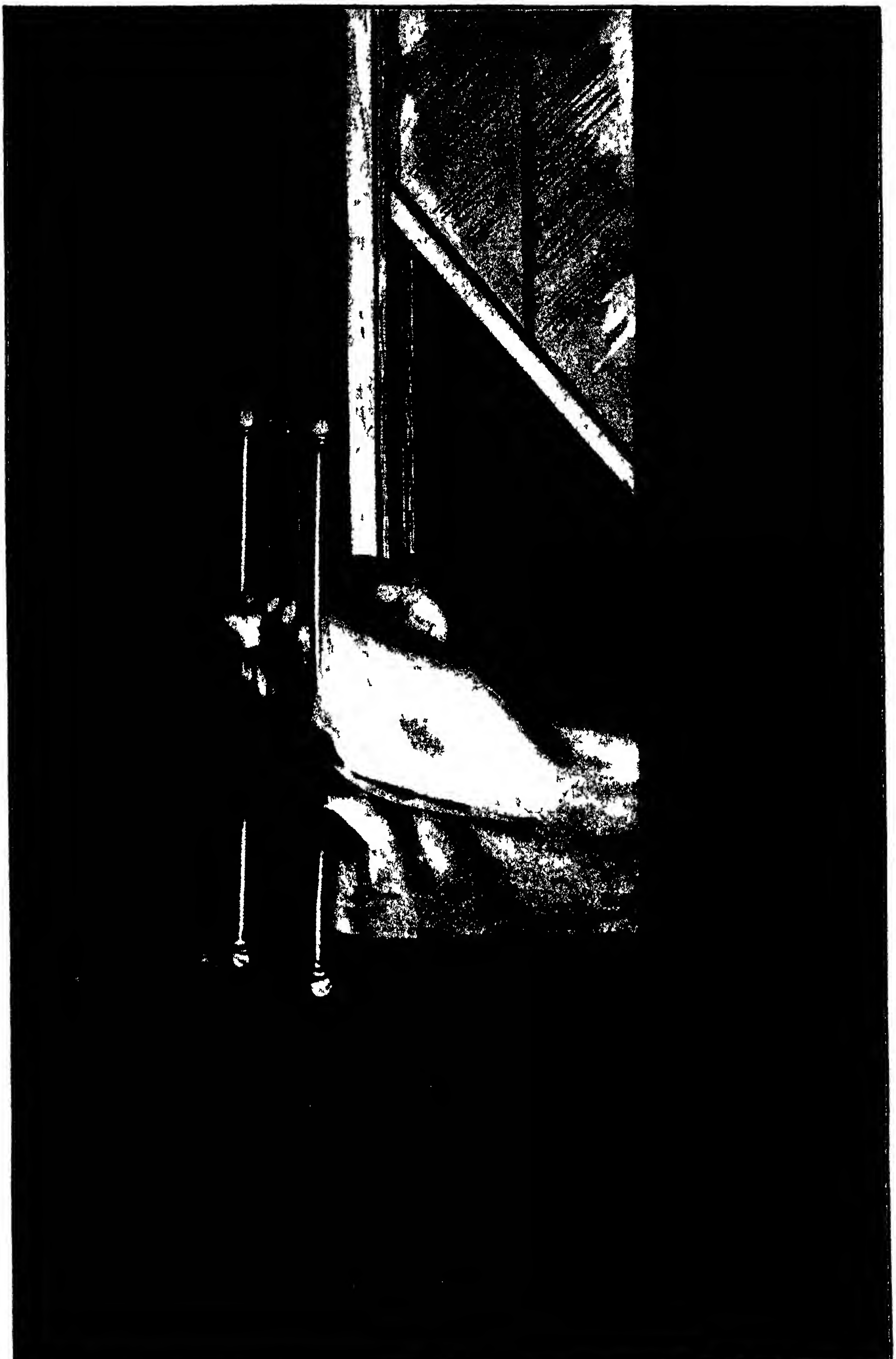
There are those who claim that oxygen is more than a food. One writer affirms that the chemical action of the oxygen as it is absorbed by the blood, furnishes the actual power that circulates the blood, and that the universally accepted theory, to the effect that the heart furnishes the power to circulate the blood, is erroneous. This theory may be correct, or it may not, but it shows the wonderful importance this author attaches to oxygen and its abundant presence in the blood.

In spite of the fact that fresh air is one of the most valuable privileges of humanity, there are hundreds of thousands of people who have no conception of its importance. Walk through the streets, both of residence and business, in any of our large cities, except during the summer months, and you will invariably find the larger part of the windows closed as if the inmates of the houses, stores, shops and offices regarded fresh air as an enemy to be avoided. When we consider that it is a part of the plan of Nature to compel the human body to breathe in oxygen and exhale waste, without a single moment's cessation, from the time of birth until the time of death, that fact alone ought to stamp the act of breathing as one of tremendous significance and overwhelming importance. What makes us inhale and what exhale? While we have a large control over our breathing apparatus, the principal operation is absolutely beyond our control or volition and goes on day and night, asleep or awake, conscious or unconscious, in the new-born babe as well as in the healthy adult.

The scientists tell us that the average adult inhales 480 cubic inches of air per minute while at rest. If he walks four miles an hour, he draws in five times as much, or 2,400 cubic inches per minute; if he walks six miles an hour, he draws in seven times as much, or 3,360 cubic inches per minute.

We have but to look at the functions of breathing to realize its supreme importance. There are three chief things that breathing accomplishes: 1. The elimination of impurities from the blood and at the same time its revivification. 2. The warming of the body. 3. It performs the last very needful act in the processes of converting the food that has been digested by the stomach into blood for use throughout the body.

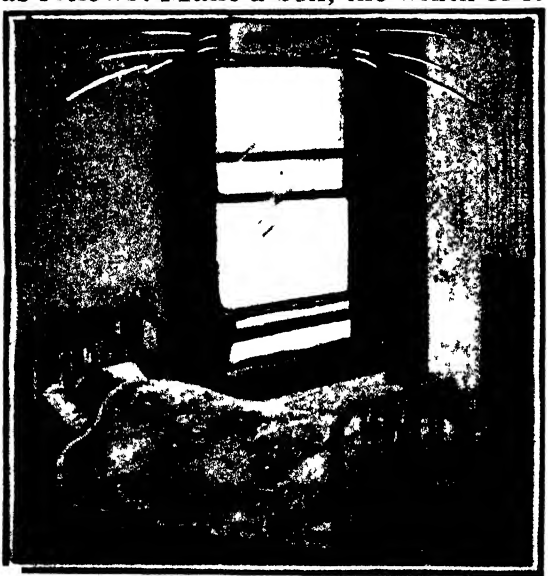
At no period of life does the human being so much require fresh air as in the periods of babyhood, childhood and growing youth. During these epochs the processes of upbuilding the body are going on continuously. We all know



Method of outdoor sleeping, possible where window opens on porch or other outdoor extension on level with floor of bedroom.

how babies and children grow. The most healthful of children are those who are taken out-of-doors and kept out-of-doors as much as possible, winter and summer, from the very hour of their birth. There is no danger whatever in this course of procedure, even if the child is sickly, provided you make every provision for the warmth of its body. See that it breathes through its nostrils, wrap its body up well and let Nature to do the rest.

It is equally important that the growing child and the adult have the same abundance of fresh, pure air day and night throughout the year. A simple home-made ventilating device, particularly effective in inclement weather, may be provided as follows: Make a box, the width of it to fit the window frame and six or eight inches high. The box is made long enough so as to extend a few inches outside of the window. Both the top and the end outside of the window are closed over, but the bottom of the box is left open. This insures a supply of fresh air without permitting wind, rain or snow to cause damage within the room. There are now on the market many patented window ventilators that may be purchased at moderate prices and which admirably meet the requirements of any home. These appliances are made in different sizes to fit the many styles and kinds of windows employed in house construction.



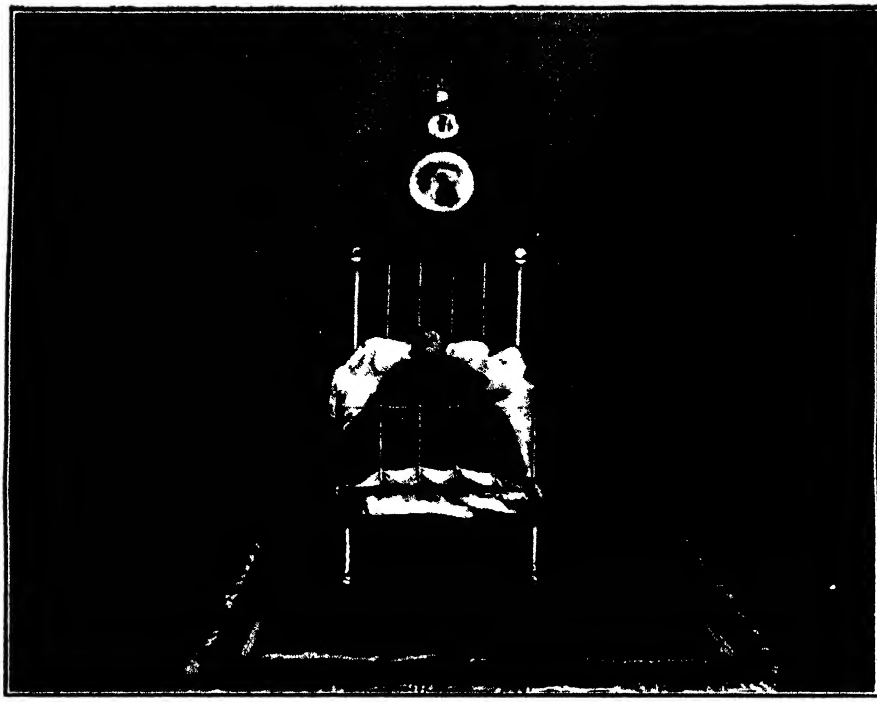
A modern window ventilator. The heated air escapes through the top openings, indicated by the arrows. At the bottom, the window is slightly raised, admitting fresh outside air into the room. Openings at top and bottom are protected against rain and snow.

No sleeping room can be healthful that does not allow the fullest supply of fresh air to enter. One of the great obstacles to this in America is that, as a people, we overheat our houses, and the difference between the temperature of our sitting-rooms and of the air from the outside, freely allowed to circulate in our sleeping rooms, is too great and consequently we do not open our windows as much as we should. The overheating of our homes is a great mistake and physically the cause of much discomfort and disease. The temperature, instead of being from 70° to 80° Fahr., as it too often is, should be from 50° to 60° Fahr. The results of breathing air at this temperature would be to produce a great diminution of our catarrhal troubles, and also to render us more willing to allow the colder air of winter to enter our sleeping rooms.

While upon this subject, however, I should like to add one word on the mental attitude. While I believe absolutely that pure air should be sought and demanded, I further believe that it is in the power of rational man to say to himself at such a time: "As I cannot secure the fresh air I require I do not propose to lose my equanimity and peace of mind by worrying about it. I have done the best I could to secure fresh air and do not propose to make a bad matter worse by fretting and worrying." In such a state of mind one will speedily find that he can rest and sleep with far less discomfort and injury than if he retires full of worry and fret.

The writer would impress upon readers the important fact that the heating apparatus of the body is operated through the lungs and the stomach—mainly the former—and that the larger the amount of pure air we consume by proper breathing the more we are able to withstand cold. Every child should have this lesson thoroughly instilled into his mind.

It is of the utmost importance that parents and others should see to it that the ventilation of every schoolhouse is as perfect as it can be. But it matters not how perfect the system installed, unless it is properly operated. Too often teachers are just as ignorant or as indifferent to the needs of pure air as are the children they are teaching. Especially in winter time is this caution imperatively necessary, for most



Suggestions for manner of placing a bed to obtain an ample supply of fresh air. In the top picture the windows are on opposite sides of the room. The sleeper's head is out of direct line of air movement. In the bottom picture the windows are at the side and end of the room but the bed is so placed as to avoid the air blowing directly against the head of the sleeper.

children suffer from colds, catarrh, and other distressing ailments at this time of the year, most of which might be avoided if a little common sense were exercised in providing fresh air for the children.

Here is the plan that is in operation with many intelligent teachers, and *always with the best of effects,* both upon the studies and the health of the pupils. Two or three times during each session of school, morning and afternoon, every door and window of the building is opened, even in the coldest weather and though a storm may be blowing. The moment the doors and windows are opened, or perhaps even before, the students are called to their feet, lined up ready for a march. At the same time a song is started, to which certain simple exercises have been arranged. The march, the exercise, the song, even though they continue for but two or three minutes, clarify the brain of both teacher and pupils, reoxygenate the blood, remove the heavy dull feeling, and at the same time the motion assists in removing the impure air and making place for the pure, fresh air from the outside.

A few facts will at once show the absolute necessity for the most perfect ventilation in the schoolroom. Suppose fifty children are confined in a schoolroom, 20 by 30 ft., and 10 ft. high. That room holds 6,000 cubic feet of air. Fifty children will spoil about 150 ft. of air in one minute, or 9,000 ft. per hour. Now, suppose the session lasts three hours, with an intermission of fifteen or twenty minutes' playtime. If the teacher and some of the pupils remain, as they so often do, and all of the windows and doors are not opened wide during recess time, except for the pure air that, as it were, inadvertently gets into the room, those children would be breathing for two hours air which was absolutely poisoned by the exhaled impurities of their own bodies.

Another thing that must not be forgotten is that wherever there is a light (any light but electricity) or a fire in a room, the supply of oxygen in the air is constantly being diminished. A stove, an open gas fire, a Welsbach light, a coal oil lamp, all alike burn up the very qualities in the air that are needed for human beings; hence, in providing for an abundant supply of fresh air, this must always be taken into consideration.

One authority states that, "For every cubic foot of illuminating gas that an ordinary gas burner consumes in an hour we should provide at least 800 cubic feet of fresh air inflow. Hence every five-foot gas burner (as well as each lamp that gives nearly as much light) ought to have supplied for it while it is being used for lighting no less than 4,000 cubic feet of fresh air per hour. Some observers consider that this allowance is not large enough. The more fresh air a room receives and the more completely all contaminated air is drawn off by suitable means, the more healthful the room is."

In the fighting of disease fresh, pure, vitalized, sunladen air is one of the greatest and most potent influences for good. There is no disease for which fresh air and sunlight are not the best kind of medicines. Nothing has delighted us more in recent years than the tremendous and growing interest manifested in the cure of consumption by open-air methods. Nearly 30 years ago when *Physical Culture* Magazine was first issued, we were as emphatic then in our statements of the benefits to be derived from the open-air treatment as we are today, and we find considerable satisfaction in congratulating ourselves upon the great help that we have been in this laudable movement. The influence of what we have said on this subject during these years has been widespread and has undoubtedly influenced thousands of people—physicians, magazine and newspaper editors, and laymen generally—to look upon this movement with greater favor than they would otherwise have done.

This open-air treatment of consumptives is largely followed in Switzerland. A lady visiting a fresh-air sanitarium in the Alps, feeling a draft on her, turned, as so many people instinctively do, to close the window, when, to her surprise, she found the windows were fastened so that they could never be completely closed, winter or summer.

In this country great and influential medical associations have joined this movement, and a few years ago, even the

New York Medical Society, one of the most conservative and reserved of bodies, came out with the most generous endorsement and advocacy of the open-air treatment in case of consumption, freely confessing that drugging methods were practically of no benefit.

I can assure my readers and the medical profession that the assertions of this distinguished medical body apply not only to consumption, but practically to every disease known to man.

The pure oxygen of the air is of even greater importance to all people who are sick than those who are well and strong. Not long ago we picked up a medical journal and read where a physician gave his experience in the treatment of whooping cough in compressed air. He had a cabinet into which the sufferer was placed and so arranged that the impure air was carried away to the outside, and the only air he was allowed to breathe was the compressed air forced into the cabinet. This compressed air contained a largely increased amount of oxygen, and as the patient remained in the cabinet from two to four hours each day, he found the disease quickly subjugated and the normal health recovered. While this was a far better treatment than the drugging method, we venture the assertion that if the patient had been treated by the out-of-door method, the recovery would have been just as rapid and far less expensive.

I cannot too strongly emphasize my assurance that in every disease the more one gets into the open air, the better it will be.

One may ask where all the fresh air comes from, and what becomes of the poison-laden air that is discharged from dwelling-houses and public buildings where large numbers of human beings congregate. This earth of ours, eight thousand miles in diameter, is completely surrounded by an envelope of fresh air to the depth of some forty-five miles. This we call the atmosphere. This is the ocean through which the ship, our earth, is constantly sailing, yet even this vast sea of fresh air would, in the course of the centuries, become vitiated, impure and injurious to human life had no provision been made for removing the impurities and revivifying it. This is a somewhat complex subject, but briefly and simply the processes may be thus stated: The leaves of the trees and all verdure is fed by the carbonic acid gas which is the chief poison exhaled from the human lungs. By those wonderful chemical processes designed by Nature, that which is poison to man and must be removed from the earth's surface, has been made the food of trees and all vegetable life. Furthermore, under the operation of this wonderful chemistry, vegetation so changes the poison that it again becomes fit for human food so that man eats it in this changed condition to the pleasure of his palate and an increase of his bodily strength.

The vast oceans, inland seas, lakes, deserts and mountains of the earth also play an important part in this purification of the atmosphere. The winds scatter the poisonous gases, the dust, and other injurious substances held in suspension in the atmosphere, where population is congested, and carries them out to sea or into the vast spaces of the desert. There the dust settles and by the free and undisturbed action of the sun the poisons are eliminated. At the same time the chemical action of the sun, and the scrubbing of the winds one upon another, combine to produce from the chemical elements of the ocean, the desert, the forest and the mountain, elements of strength, purity and life which again purify and vivify the air. Hence the winds that so often distress people are Nature's scavengers helping to remove the impurities in the atmosphere, produced by man, and substituting in their stead the pure air, which is essential for his well being.

There are five superstitions in relation to fresh air that have no excuse for existence.

1. The first of these is that night air is injurious. While there is possibly not as much oxygen during the night time, owing to the absence of sunlight, there is still nothing harmful in night air, but it is full of life and health giving properties.

2. The second superstition is that damp air is injurious.

Many people have had it instilled into them that damp air is harmful. This is a serious and foolish mistake. Damp air is no different from any other air except that there is a certain amount of moisture held suspended in it.

3. The third superstition is that drafts are injurious. Most people are afraid of drafts. The popular idea as to what is a draft is simply that it is a current of cold air coming into a warm room. There is no more need to be afraid of such a change than there is of going from a warm room into cold atmosphere.

4. The fourth superstition is that cold air is more injurious than warm air. Instead of this being true, the reverse is the fact. Warm air does not have anything like the tonic effect of cold air.

5. Again it is believed that it is injurious to sleep in a draft. The only way to sleep healthfully is to sleep in a draft. Instead of shunning a draft, the sensible, wise person, who wishes to be restored to health, or to maintain the health he has already secured, will so arrange his bed that the air, winter

An appliance for supplying fresh air which may be purchased or easily manufactured and summer, will have the freest possible opportunity to blow directly over him.

VENTILATION.—No form of ventilation is worth while unless it accomplishes a continual and rapid change of the air in the room; in fact, sufficiently so that the atmosphere is nearly or practically as fresh and pure as that to be had outdoors. This means open windows.

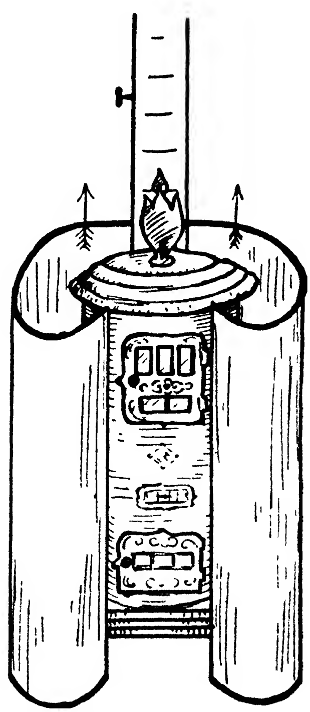
Man originally lived out-of-doors, and in a climate in which it was comfortable to be outdoors and unsheltered. In more rigorous climates the necessity for shelter arose, and since caves were not always available houses or huts were invented and used. This provision for warmth occasioned the need of ventilation, a need which unfortunately always has been, and still is, much neglected. There is no difficulty to be found in the problem of ventilation in summer, but in winter it is inevitably involved in the problem of heating or, as we should rather say, warming the house. Economy in heat and fuel makes the ordinary housewife loath to open the windows wide when she has just succeeded in getting the confined air of the room warm enough to be comfortable. With the open windows her expensive warmth will largely be dissipated into the open air. And so most people live in rooms suffering so-called colds and other complaints, as well as a chronic lack of normal energy, and do not realize that it is caused by the foul, vitiated air they breathe.

A window tent which insures an ample supply of fresh air

The first thing to be said is, that most people heat their rooms too much, and seem to demand too much heat. In most cases they would be better off and far more vigorous if the temperature were reduced some ten to twenty degrees. But the real solution of the problem, in most cases, or at any rate the most perfect solution, is that of combining the methods of heating and ventilating.

This is accomplished by some modern systems of furnace heat in which fresh cold air from out-of-doors is introduced through a very large pipe, exposed to the heating area of the furnace, and then distributed through other large pipes to the various rooms. This warm air is none the less pure or rich in oxygen because it is warm, and it keeps the atmosphere pure, the impure, dead air being allowed to escape through a so-called ventilator near the floor as fast as the fresh air pours in. The old-fashioned fireplace was a healthy proposition, though it was very wasteful, for most of the heat went up the chimney along with the smoke and bad air. The ordinary iron stove is fairly good because it creates a slight draft, but is nevertheless very faulty if the windows are kept closed. Steam heat and hot water pipes are the most unsatisfactory of all, for they simply warm the impure air of the room over and over again.

On account of the expense, and sometimes because one only rents the rooms in which he lives, it is not always possible to devise an effective method of ventilation. Nor does it always prove practicable or feasible to establish an elaborate furnace system for combining the problem of ventilating and warming. But in many cases it is possible to devise a simple method of



Cylindrical envelope for round, upright stove. Sheet of zinc or tin of required size is bent to surround stove. Flaps turned in front, to permit access to doors. Fresh air pipe at back, near floor.

accomplishing the same thing. I am offering one illustration showing how a current of fresh air from outdoors may be introduced under a stove or steam radiator so that it will be warmed as it passes up into the room. There should be an envelope or box of sheet iron around the radiator or stove, from the floor up, and open at the top, so that only this fresh air will be warmed, instead of warming the stagnant, vitiated air. And as this fresh air pours up into the room, a moderate opening of a window at the top will allow the impure and foul air to escape.

BATHING.—Of so much importance is the subject of external and internal cleanliness that a considerable portion of the *third volume* of this work has been devoted to the subject. The practical application of various forms of bathing is further detailed in the *second,* as well as in the *fourth* and *fifth* volumes.

BREATHING.—In the discussion of pure air as an essential to health, the subject is touched upon in the *present* chapter.

CARRIAGE OF THE BODY.—A vital matter in keeping health, this subject is touched upon at length in the subsequent volumes of this work, notably on *page 798* and following pages of *volume two* as well as *page 1142* of the same volume.

DIET.—A large portion of this volume has been devoted to this all important topic, and the present brief mention has its place in this chapter chiefly through recognition of its essential relation to hygienic living.

CLIMATE.—While this has doubtless some importance, it is far less important than the average medical man would have us believe. Cold, damp air is certainly not so healthful nor conducive to good spirits as a high, crisp, dry atmosphere. High altitudes are also to be preferred, as a rule, to low altitudes. Up to a certain point, the more stimulating the air the better. There are certain places, particularly along the south coast of England, noted for their enervating climate, and these should, of course, be avoided. Still, if the body be kept in proper physical condition, there need be nothing to fear from "the weather." Climatic changes and conditions alter or influence us, but *only to the extent that we are susceptible to such influence.*

CLOTHING AND THE CIRCULATION.—Reference has been made in the chapter on *Causes of Disease* to the bad effect upon the circulation produced by wearing heavy clothing. The practice that was universal in former generations and is still continued by many people, the wearing of woolen underwear, is especially to be deplored. Wool is an animal product that tends to retard the elimination of the waste products of the body through the skin. It is much more cleanly, and hence also more healthful to wear linen or cotton fabrics near the skin—in winter as well as in summer. Besides, the warmth of body that is produced by weight and imperviousness of clothing is not beneficial. It is by the active circulation of the blood that the body should primarily be kept warm.

Indeed, a degree of coldness is always desirable for physical well-being. The air should always be permitted to get at the skin. Write this down as a golden rule of health: *In winter wear no more than enough clothing to maintain the ordinary degree of animal heat; in summer wear no more clothing than convention requires.*

Proper posture—In holding head and neck.

Improper posture—In holding head and neck.

See that there is ventilation for the skin of every part of the body. Wear thin cotton or lisle foot-gear—never wool or silk. Your hat should have some provision for ventilation, for the air should reach your scalp freely if your hair is to be healthy. Go barefooted in summer when you can. When you must use foot covering in summer, acquire the sandal habit.

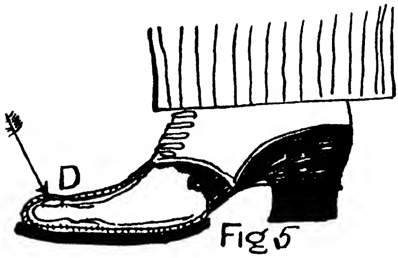
Be cautious about the wearing of an overcoat. A top-coat is preferable to a heavy ulster. There are many bright and comparatively warm days in winter when neither top-coat nor overcoat is needed. And when such a garment is not wanted, it is always better to do without it.

Make sure that there is always plenty of looseness and freedom at the neck. Men who wear high, tight collars, and women who permit themselves to fasten stocks about the throat, are denying themselves a certain amount of health that might easily be theirs if they would permit more air to get in at the tops of their upper garments. And the habit of covering the neck heavily and closely is the cause of most of the scrawny necks that are such frequent and uncomely spectacles. The well-rounded, graceful neck belongs to the man or woman who does not exclude the air from it.

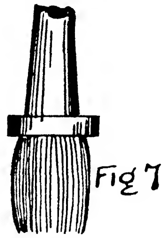
Nothing retards circulation so much as tight clothing. Avoid undergarments that bind the torso. The circular elastic garter worn by many women, and even the rolled-down stocking, bind the leg too tightly. Corsets and brassieres, if still worn, are apt to draw the body too tight and so interfere with free circulation. Men's linen collars, belts, garters—all bind the body and sometimes produce a deterring, stagnating effect equivalent almost to a tourniquet's. Avoid them. Buoyant health is impossible without free circulation.

Clothing in Winter.—It is scarcely necessary to make any comment upon the subject of clothing for the summer except to say that one should as nearly approach a state of nature—or of nudity, in other words—as the conventions of human society will permit. Wear just as little clothing as possible, and preferably fabrics which are light in color as well as in texture. Reasons for this are given in the discussion on Sun Baths under *Hydrotherapy,* in Volume III.

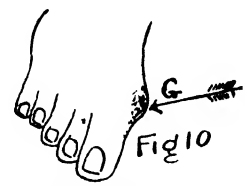
The rigors of winter, however, may require some modification of this advice, though I must emphasize that it is always best to wear no more clothing than is absolutely necessary for bodily warmth and comfort. Elsewhere the use of linen underwear, in preference to woolen, has been recommended, and even cotton rather than woolen, where it is essential to



Avoid shoes which constrict the toes.



A brush of this sort is useful for cleaning out shoes.



Badly fitting shoes cause bunions and corns.

wear underwear at all. In many cases it is best to go without underwear, provided the external clothing, which then would come next the skin, can be washed and cleaned. The clothing usually worn in winter, however, makes it desirable to use some form of washable underwear for the sake of cleanliness, though this should be as light and porous as possible, in order that it may not exclude the air any more than can be helped. Furthermore, the absorbent qualities of both linen and cotton, the former especially, make them infinitely better for use next the skin than woolen weaves.

In really cold weather a certain amount of clothing or covering is necessary for protection and warmth, but in that case it is better to put on warm garments over the light underwear when going out, rather than to wear heavy woolen underwear. Wool may be recommended for external garments where real warmth is needed, for its heat-retaining qualities cannot be questioned.

The amount of clothing needed will depend largely upon

A handy type of mitten.

Pulse warmer.

the individual and his capacity of resistance to cold. This will also depend very largely upon the activity of the individual in the open air. While playing some athletic game one may need little or no clothing even in a freezing atmosphere, whereas the inaction of standing still as a spectator at the same game would require a certain amount of bundling up. One surely does not want an overcoat on when engaged in the vigorous and delightful activity of shoveling snow off the walk, but the man who is sitting still all day upon a snow plow, driving a team of horses, would suffer in zero weather if he were not protected. And so it goes. The amount of clothing one should use always will depend upon the demands of the occasion, though one should make it a strict rule not to have any more clothing on than one needs. Just because one needs to be bundled up when driving a motor car against a North Pole breeze, one should not go about in street cars and on active walks with the same heavy apparel.

Perhaps the most important suggestions that I have to make here is that in protecting oneself against the bitter cold of the open air, it is always best to use warm external wraps rather than heavy clothes which are worn both indoors and out. While sitting in the house or the office one is really in a summer temperature, and it is only folly to have heavy

Ear-laps are sometimes useful in winter weather.

A cap of this sort may be used when the temperature is extreme.

woolen underwear and other excessive clothing on just because it is cold outside. You should really be dressed as you would be in the summer for this warm indoor temperature, and then, when you go out, you can put on a sweater or overcoat or whatever you may need on the occasion. Remember always that cold air is good for the body and for the nerves, so long as you can be comfortable in it.

This type of headgear is favored by skaters and followers of winter sport.

One thing to be kept in mind is the necessity for a good circulation in the extremities, for if the hands and feet are warm you are all right everywhere else. A chilling of the hands and feet sometimes means congestion elsewhere, and a chronic condition of cold extremities means a certain loss of vitality. When the feet are warm the blood is circulating satisfactorily, and you can observe the temperature of the entire body by merely watching the feet. On this account I would suggest that in many cases it is better to protect the extremities well instead of resorting to an excess of heavy covering for the entire body. The arteries which supply the feet and hands are not very far from the surface, particularly so in the case of the wrist, at which point we usually test the pulse, and by covering these well we will go far toward solving the problem of warmth and comfort out-of-doors. A form of knittted woolen cuff which fits close to the wrist, and which is much used in some foreign countries for keeping the wrists and hands warm, is illustrated on page 21. These will sometimes really do more for the warmth of

Proper footgear is essential to secure pleasure and benefit through walking. Illustrations Nos. 1, 2 and 3 show how feet are distorted by high heels and improperly shaped shoes. Illustrations 4, 5 and 6 show types of sandals which may be recommended for comfort and ventilation. The sandal shown in illustration 6 is particularly adapted to walking on sandy or stony roads.

the hands than the covering of the hands themselves. On some of the rivers and lakes of the West a favorite winter sport is horse-racing on the ice, for there is no better racecourse to be found than a stretch of smooth, elastic ice, for sharp-shod horses. Driving these horses, with arms stretched forward and the icy wind blowing up the sleeves, is a severe hardship if one is not prepared for it. The drivers in these races have found through experience that it is better to cover their wrists and arms, even when driving with bare hands, than to rely only upon heavy gloves.

The fashionable fingered gloves are most unsatisfactory for real protection or warmth. The proper covering for the hands, when they are cold enough to require any such protection, is the old-fashioned mitten. This keeps the fingers together and they keep each other warm. In the fingered glove the fingers are separated so that they may be chilled or frozen that much more easily. It is usually better and warmer to keep the hand bare and closed in a fist, than to put on a glove. In very severe climates it is necessary to protect the ears. The hair would do so if allowed to have its own way, but the modern hair cut has robbed us of this natural protection. For this purpose a hat is an absurdity. A cap, with a covering for the ears, is the only feasible headgear.

Do not be too much afraid of the cold air. It is bracing, invigorating, energizing. Sometimes you may find yourself shaking with a chill in a superheated room, but if you will go out-of-doors and walk around the block in the frosty, biting wind, you will find yourself warm and comfortable. It will wake you up and warm you, so that when you return you will open up the windows to stay warm.

Cold, Constant Feeling of.—This condition is largely due to anæmia of the skin, and it should be toughened by means of hot and cold baths, air baths, salt-rubs, plenty of exercise, etc. Be sure not to overeat, and masticate thoroughly every morsel of food you eat. Drink plenty of water, and breathe only pure air. Vigorous exercise is needed more than all else. Do not wear too many clothes—just as few as you possibly can, and as your skin becomes more active, it will become warmer, and will soon glow with exhilarating health. Stimulate and accelerate a flow of blood as has been suggested and you will be far more comfortable.

Cold Drinks.—Americans are very apt to indulge in too many cold drinks, and doubtless too much ice water is extremely harmful in its action upon the coating of the stomach. At the same time, *cool* water probably never harmed anybody, no matter how hot they were. It would be advisable, however, *to rinse out the mouth and bathe the face and hands in cool water before drinking when one is overheated. If you do this first there need never be any danger in drinking a supply of* cool water. *See also Water, page 50.*

Digestion is fully described in Chapter VIII of this volume. Further information on digestive disorders will be found in Volume IV.

Dissipation.—Vitality may be *dissipated* in a number of different ways—by overeating, alcohol drinking, too little sleep, excessive venery, late hours, exciting pleasures, strenuous emotions, etc. In fine, "the game is not worth the candle," and many years of a life abounding with love and health are certainly worth more than a few hours of riotous, sensual enjoyment, every now and then—followed by depressing and debasing after-effects.

Any discussion of the requirements of health would be incomplete without some reference to various forms of dissipation which are not commonly regarded as such. The term has come to have a rather narrow meaning, for at its mention one is most likely to think of drunkenness and all-night orgies in public places. Literally, however, the word has reference to all means of dissipating or wasting human energy, and in this sense it should be considered here. For instance, a man who thinks himself a model of righteousness and good conduct because he frowns upon alcoholic indulgence and the use of tobacco, may yet be guilty of even greater dissipation through the abuse of his stomach, in persistent over-eating and in the use of unwholesome foods which consume or waste vitality.

The force of this has been made more clear in the discussion of diet in a subsequent volume.

Late Hours. Probably one of the most disastrous and at the same time one of the most common forms of dissipation is the American habit of late hours. In the cities there are only a few of the old-fashioned kind of people who get to bed before ten o'clock in the evening, whereas the more usual hour for retiring is somewhere between eleven and twelve. Indeed, *there are probably more people who go to bed after midnight in the cities than who go to bed before ten. And in recent years the same tendencies are to be noted in the villages and* small towns.

Vitality is impossible without sleep. Without this nightly opportunity of rebuilding the broken down cells, charging them with oxygen and storing up energy for the following day, one must inevitably deteriorate in vigor and strength. It seems hardly necessary to say that all else that one may attempt in the way of health culture and body-building will be of no avail whatever if day after day one sits up late in the evening, not only depriving one's body of the opportunity for recuperation, but still further wasting and destroying its tissues and powers. Truly, it is a policy of slow suicide, and one could scarcely conceive of a more certain method of bringing on complete physical and nervous collapse. This habit alone would be quite sufficient to explain the large preponderance of nervous disorders among city dwellers, including large numbers of those who are as yet scarcely more than children.

Further on in this chapter I have discussed the necessity for sleep and have offered some suggestions that will be of value in many cases, but the question of the time for going to sleep, and the length of time for sleeping, are so important that they need special emphasis. For reasons which no one really understands, the body is able to recuperate much more perfectly before midnight, the sleep is more profound, the respiration deeper, the oxygenation of the blood more perfect. It has been said that burglars prefer to do their work early in the night for the reason that the occupants of the house are less *likely to awake at that time than in the hours* of approaching dawn. At any rate, the vast experience of the whole human race has so thoroughly demonstrated the greater value of early evening slumber that it has become proverbial to say that two hours of sleep before midnight are worth four hours after.

A man may sleep the same number of hours, be it eight or nine, but if he goes to bed at twelve or one o'clock and gets up at eight or nine, then he does not feel rested or refreshed as he would if he went to bed at nine and arose at five or six in the morning. That tired, languid feeling, that weakening sense of lassitude, should show only too clearly that his body has not properly recuperated from the drains made upon it the day and the night before.

And besides, it is just as easy to shift the waking and sleeping hours ahead two or three hours, to go to bed somewhere near the end of the day and to get up at the real beginning of the day.

Overwork is another fairly common form of dissipation, innocent though it may seem to devote oneself faithfully to "good, honest work." Overwork, however, much as those who are guilty of it may endeavor to excuse it, is as futile as it is disastrous in its consequences. One may plead the pressure of necessity, but at the same time he fails to see that in exceeding the normal limitations of his expenditure of physical energy he is only defeating his own purpose. Instead of recognizing that he cannot do good work if he labors in a condition of fag, instead of realizing that it is best to accomplish just so much effective work each day and keeping it up day after day without any failing of his strength, he consumes himself in a short time trying to double his productive power and then finds himself in such a condition of collapse that he cannot do half of a normal day's work, perhaps cannot even accomplish anything.

DRAINAGE AND SANITATION.—Special attention should be paid to the question of *drainage* and *sanitation*—too often neglected by hygienists, who should know better. The newest and best styles of plumbing are the cheapest in the long run, and insure good health. If there is the slightest trace of odor anywhere around the toilet-room, have it examined at once. Keep a bottle of suitable preparation on hand for purposes of disinfection. One great advantage of living in a house upon the top of a hill is that the drainage is always safer there than at a low level. The water supply, especially if you live in the country, is also less likely to become contaminated.

Choose, as the site for your house, the top of a hill, if possible, with a dry, somewhat rarefied atmosphere. This is not only more healthful in itself, but the air would be freer from *dust*—a great saving to the lungs, and especially beneficial to one having weak lungs. By all means avoid dust—either in the house or out of it. You should never brush carpets or rugs without first sprinkling them with wet tea leaves or sawdust. (See also *Sanitation.*)

ELIMINATION is discussed in detail in Volume III, page 1220 and elsewhere.

THE EAR and its functions are completely described in Chapter XI of the present volume.

THE EYE, its construction and its work, are treated in the present volume, Chapter XI.

FASTING as a curative measure and otherwise is treated in Volume III, pages 1203 to 1396.

FOOD and its uses are treated at length in the present volume, beginning page 316.

HOUSEHOLD REMEDIES are treated in the third and fourth volumes of this work in detail. Specific advice is given for the cure of various disorders.

MIND AND BODY.—No one can afford to overlook the influence of mental conditions upon the state of the body. This is important. One aspect of the subject is commonly ignored or unnoticed by most of those who appreciate the effect of the mind over the body, and that is the influence of the body over mental conditions. This is a matter that is of paramount importance to thousands whose lives are made miserable by "the blues" and tendencies to worry. These tendencies may be corrected within certain limits by the attitude of the mind itself, but in a vast number of cases they can be overcome by purely physical means.

In the writer's experience he has known of innumerable cases of pessimistic and misanthropic individuals who have become happy and congenial through the simple improvement of their physical health. While it is true that an emotion of grief will interfere with the functions of the body, it is also true on the other hand that in many, many cases a condition of mental depression is caused entirely by physical depression.

Briefly, the value of any form of recreation, mental or physical, may be judged by its after-effects. If the ultimate effect is to refresh, and one is able to look back at it only with sensations of pleasure, then he may be sure that it has been beneficial. If, on the other hand, it is followed by a sense of lassitude or a period of nervousness; if the excitement interferes with the usual appetite or the capacity for perfect relaxation in sleep; if, in short, one does not feel more ready and eager to take up his daily work, and able to accomplish it with greater dispatch and energy, then the supposed recreation has been a mistake. Many so-called pleasures may seem to afford diversion at the time, but if one can look back at them in the clear light of the morning following with disapprobation for the money spent, disapproval for the time wasted, and a generally disgusted feeling of "Oh, what's the use?" then they are not pleasures at all. At least they do not mean happiness. It is not the false joy of the moment that counts, but the sum total of contentment and happiness day after day and week after week that counts, and that helps to maintain normal health and the vigor of the body. If in doubt about any form of recreation always apply this test of the aftermath, for any pleasure that is good for you will not leave a bad taste in the mouth, either literally or figuratively.

In these remarks upon the subject of dissipation it may be well to merely mention another thoughtless form of dissipation which is commonly overlooked, probably because it is so nearly universal and more or less taken for granted. Impure sex association in bawdy houses are commonly recognized as dissipation of the worst kind, but *excesses within the bonds of matrimony* are disregarded because of their presumed propriety and the general approval of marriage. Marriage in many cases serves only as a cloak with which to cover dissipation of the most habitual and exhaustive kind, or as Bernard Shaw once expressed it, "a hot-bed of unbridled license." However, this is a matter that is taken up thoroughly in a later part of this work. No man can hope to make much improvement even with the most effective physical culture methods, if he continually exhausts his vitality in this way. Indeed, temperance and cleanliness in every form are among the absolute essentials of physical culture, in the true sense.

The mind has a powerful effect upon the whole body, and upon its functions. Depressing emotions will rapidly enervate the whole organic framework, and we know that worry and sorrow have caused the flesh to drop off men's bones at a rate which a continued Turkish bath could hardly equal! On the other hand, the man who "laughs and grows fat" also demonstrates the beneficial effects of a hearty, cheery mind. The emotions and the thoughts certainly play a most important part in the health of the body—as everyone who has had much practical experience with sick people knows.

Worry never helped anyone. On the contrary, it injures everyone who indulges in it, and prevents the return of normal, natural health. It has been proved that worry retards digestion, lowers respiration and circulation, and in fact all the functions of the body. On account of this, poisons begin to accumulate; these mix with the blood and are carried to the brain, where they poison the cells, and cause irritation, depression, and a host of kindred mental afflictions. Thus the circle is completed, and one's health and spirits are lowered more and more as time passes. In one who determined to assume the optimistic attitude from the start, all this would have been avoided. The symptoms would readily have yielded to a few simple measures; and all the rest would have been spared the patient.

Heredity is a great "bugaboo" to many minds. Such persons are afraid that they have inherited some disease, from which they must necessarily die. If their parents died from tuberculosis, and they develop a cough, they are naturally fearful that they have consumption likewise, and give themselves up for lost. But this is a great mistake. With the exception of syphilis and of one or two blood diseases of the same character, practically no diseases are hereditary. The tendency to disease may be inherited, not the disease itself. But even if it were inherited, what then? Most diseases may be cured quickly and rationally by the simple methods of cure outlined in these volumes. If an original infection can be cured, simply and effectually, why not a hereditary disease? As a matter of fact, it can be more easily cured. For it has been proved beyond all question that every disease tends to become less virulent with every generation removed from the original infection. Remembering this, why worry?

The safest rule to follow is to forget the body as much as possible, when you are not actually exercising or improving it. It can take care of itself well enough. If anything goes radically wrong, you may depend upon it that the body will let you know forcibly enough. Until this is the case, assume that your body is in good health; and you will be all the better for that belief.

All cramping, depressing mental and emotional states tend to cramp and contract the muscles of the body, while exalted and altruistic ones tend to give it a feeling of expansion; this may readily be felt by anyone who experiences the two sets of emotions one after the other in himself. With the one his whole being expands, with the other it contracts. The latter condition wastes precious nervous energy, exhausts and enervates; the former conserves and preserves it.

Mental and emotional states often cause actual chemical changes. Dr. Hack Tuke, for instance, quotes the famous case of the mother's milk which became poisoned as the result of a fit of anger. The spittle (teste) of mad dogs is poisonous for the same reason. All the symptoms of hydrophobia have frequently been known to occur when the patient has not been bitten at all; and the same thing is true of lockjaw as well. There is a species of epilepsy, known as psychic epilepsy, which so closely resembles the original that only the expert diagnostician can tell them apart. Yet it submits readily to *purely mental treatment.*

Professor Pavlow some years ago performed a number of very interesting experiments upon dogs. He proved that when hungry dogs were allowed to smell food, the glands in the stomach began to secrete gastric juice with great activity. On the other hand, if the dogs were not hungry, the smell of the food did not cause any flow of gastric juice, and even the introduction of food into the stomach itself failed to induce the flow to any extent. Here, then, we see the importance of the mental factor in digestion; and further the importance of waiting for hunger before food is ever eaten.

If mind has this great influence over the body, and can cause disease or the symptoms of diseases, it can assuredly cure them also. A *right mental attitude* can affect the functions and organs of the body throughout, and cause them to assume a very different condition.

OCCUPATION.—There can be no doubt that most outdoor occupations are by far more healthful than indoor work, since it provides opportunity for an abundance of exercise and fresh air.

Farm life would be better than it is were it not for the fact that various drawbacks are nearly always associated with it—fatigue, bad air at nights, lack of hygiene and sanitation, unwholesome food, etc. There is, as a matter of fact, no reason for this, and farm life could be made an ideal life if it were properly managed. Indoor occupations are not so bad if the windows are left wide open and a certain amount of exercise is taken every day; in fact, statistics prove that the average life of the city man is longer than the man who lives in the country. There is no just reason for this, and it must be due to the causes mentioned—overeating, lack of sanitation, lack of fresh air at night, etc. Drainage is often a serious problem in the country.

Various occupations are notoriously injurious—mining, stone-cutting, deep-sea diving, work in a steel mill, a paint factory, a feather bed factory, etc. Small particles of some of these materials fill the air, and are inhaled into the lungs, where they set up serious inflammation, and often cause death. Men who work in paint shops often suffer from lead poisoning. Men who work under great air pressure are liable to suffer from "caisson disease," ending in a frightfully painful death. On the other hand, aviators may die from lack of air. But they are usually able to get back to air levels, and deaths, therefore, do not occur very often in this way.

On the whole, it may be said that any occupation may be made more or less healthful by the manner of life which is lived after working hours, and the condition in which the blood and general health is maintained, during the period of labor.

Occupation and Health.—There can be no doubt of the influence of occupation on health, and unquestionably many who are trying to improve their physical condition are laboring under a great handicap because of the confinement of their work, the ill-ventilation of their working quarters, and perhaps compulsory overwork. Despondent and discouraged, they may ask what is the use of striving for health so long as they are thus held back in their endeavors? To all such I would say that the physical culture life offers the only hope, that if they had always lived right and had been strong enough in the beginning, they would have been able to endure the hardships of their work without breaking down under them. If your occupation seems against you, then it is all the more important that you should strive through every means in your power to counteract its evil influence, and to build up the health that will help you to overcome your situation. Do the best you can, for that is all that is expected of you, and the chances are that you will rise above the difficulties that surround you. The history of the world is full of instances of strong-willed men and women who have achieved the greatest successes only because of the strength which they have gathered in overcoming handicaps and difficulties. It may be so with you; it should be. Do not recognize your handicaps, or, if you do, regard them merely as incentives to greater effort. You can do what others have done, but even if you fail in accomplishing all that you desire, at least you will gain much by striving. You will gain infinitely more than if you did not try.

Wherever possible, one should select some occupation in the open air, or one which will permit him to be in the open air as much as possible. In these days many young men chose to do clerical work which compels them to spend their entire time indoors. Perhaps they prefer such work to anything involving any real physical exertion. Perhaps they ultimately earn twenty dollars a week where some skilled mechanic, working with his hands, gets over sixty. But most of all, young men seem to be afraid of the farm. Here, it seems to me, is the occupation ideal. It combines utility and health, while there is no line of work which offers a better opportunity for the use of genuine brains. Intensive agriculture is the thing of the future, and instead of the past migration of the young brains of the country to the city, we may some day see the best brains of the city turning to the country. Surely the wisdom of such a movement is unquestionable.

Posture of the Body is discussed in subsequent volumes, notably in Volume II, pages 798 and 1142.

Parenthood is discussed in Volume V.

Recreation.—It is naturally understood that recreation in most cases will include a very large proportion of active, physical recreations chiefly in the open air, and the reader is referred to the chapters dealing with exercise and open-air sports. But other forms of recreation of a purely mental character must also be considered, inasmuch as they have a great influence upon the condition of the body. In this connection I would refer to the paragraphs on recreation in my discussion of the subject of *Dissipation* in this chapter. Many so-called recreations are not recreations at all.

Whatever brings happiness and wholesome mental activity of a diverting kind may be generally recommended. *Music* probably offers the most satisfying and helpful recreation, and there are few who will not be better off for a certain amount of music in their lives. Its effect is exalting, refreshing. According to the character of the music and the *tempo,* it may be either soothing and resting or stimulating and energizing. It must be said that ragtime and the more trashy forms of music are of little influence one way or another, but the better kinds of music, well rendered, have a tendency to restore or maintain the functional harmony of the body in the same way that other forms of happiness accomplish this result. Those who are specially inclined towards nervousness and excitability would probably do well to select music not too rapid in *tempo;* something soft and sweet, or some rather majestic movement, would be better suited to their needs, tending to rest and quiet the nerves.

Singing is particularly to be recommended, and I would suggest that every one try to do a little singing on his own account, unless the results are disagreeable to oneself. Even if you are not able to entertain others in this way, it will be physically and mentally beneficial to yourself to do some singing either by yourself or in a chorus. If you are sensitive about your artistic failings as a vocalist, you may feel that they will never be noticed in a chorus. Singing is the most refreshing form of music, and entails no expense. Besides, it is really a physical exercise in itself, and is superb as an exercise for the lungs, and as a means of gaining control of the respiratory muscles.

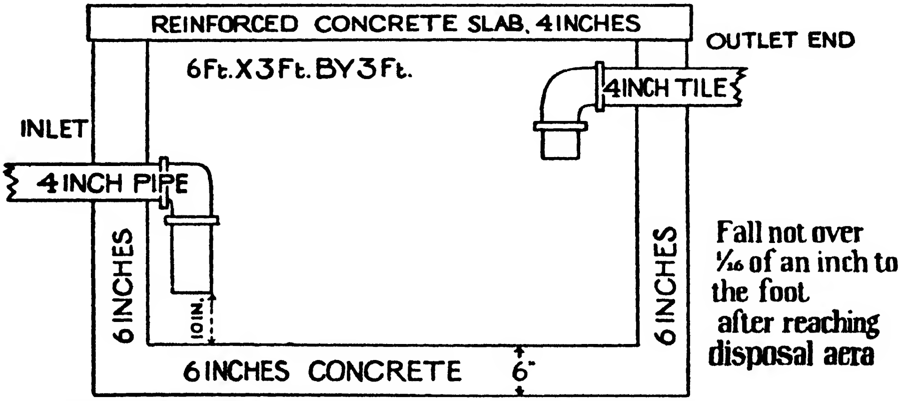
Good reading is a most excellent form of recreation, provided the type is large enough to avoid eye strain and that one does not stay up late nights to accomplish it. To read too late in the evening is only another form of dissipation. Good wholesome literature, whether in the form of history, essays or high-class novels, is to be recommended, though the cheaper class of sensational novels, which aim not to educate or inspire, but merely to stir one up and set his nerves on edge, are to be condemned. The pleasure in them is ephemeral, at the best, whereas the reading of philosophy or of practical, helpful matter that will be of aid in one's daily life will often be equally fascinating and the pleasure more lasting. Good reading helps to make life worth while and contributes greatly to the sum of happiness enjoyed by the individual, in this way being favorable to health and the welfare of the body.

I would advise every one to cultivate some wholesome *hobby* or *fad* in which he can take a keen interest. It nearly always makes a man take a greater interest in his business or profession if he has something outside to which he can turn for relief and which makes him thoroughly happy. It is all the better if one can take up physical culture as his special fad, and this is the case with the great majority of those who have given any thought or attention to the care of their bodies, but in addition to this one or two other hobbies are helpful for diverting the mind. Cabinet making or some metal hand-craft would be excellent for men to interest themselves in, particularly if their occupation is one calling entirely for mental work. Amateur photography is a splendid hobby. Botany, natural history, bee-farming, raising chickens, doves or rabbits and innumerable other diversions are interesting and helpful. Gardening is an ideal hobby, that is discussed in detail elsewhere in this work, and is really a physical culture pastime.

Lungs, Diseases of, are discussed at great length in Volume IV.

Sanitation.—By *sanitation* is meant the employment of measures designed to promote health and prevent disease. By *hygiene* is meant the use of means to make growth more perfect, life more vigorous, decay less rapid, and death more remote. It will be seen, then, that to a considerable extent the two terms may be used interchangeably. But in late years the term sanitation has come to mean more the remedying of faults of environment which are operative for disease by lowering the vitality of the inhabitants. On the other hand, hygiene has come to mean more a personal care of the body, as to food and drink, cleanliness, clothing, work and rest, moral self-control, et cetera.

Septic Tank for Sewage Disposal.—Where community disposal of sewage is not available the septic tank works very satisfactorily. This is an underground tank, into which the house sewage is carried through a sewer pipe, of the same manufacture as used in city houses where regular water systems are installed. Instead, however, of the sewage waste being carried off in sewers, this waste is emptied into the septic tank, where it is liquefied by bacteria and the water from the tank distributed into the surrounding soil by means of drain tile such as are commonly used by farmers in draining the land.



A septic tank showing size and construction, and of proper size for a family of six people.

The septic tank is a concrete box set underground. Its construction is simple. The hole is dug in the ground seven feet long, four feet wide, and five feet deep. After the hole is ready concrete to the depth of six inches is spread over the bottom to form the base of the tank. Forms of lumber are now built at the sides and ends into which is poured other concrete, the sides and ends when finished being six inches thick. In the illustration is shown the construction of the tank with placement of the inlet and outlet of the tank. When the tank is made complete, and is ready for use a concrete lid or slab, four inches thick, properly reinforced with iron rods, is placed over the tank and the earth filled in to a level with the surface soil.

The sewage from the house is admitted into the tank at the inlet end by means of a four-inch pipe, as shown. This opening is 10 inches above the bottom of the tank. At the opposite end is provided the outlet. This is placed 4 inches from the top, through which flows the liquid emptying into the 4-inch soil drain pipe. The disposal tile are laid as for ordinary drain pipe. Eight feet of disposal tile are provided for each member of the family. Thus for a family of five, 40 feet or more of drain tile would be required. If one finds the soil does not take up the liquid rapidly enough, additional tile may be laid. The amount of water used in the house and the nature of the soil govern the length of the disposal area.

The tile should be laid to give a fall of 1/16 of an inch to the foot, after reaching the disposal area. The tile are placed deep enough so as not to be interfered with by freezing weather in winter. The disposal area may be under grass, or if the tank is placed in the garden, it may be the area under garden crops.

When in operation, the solids of the sewage drop to the bottom of the tank. The solids, or fecal matter, are converted into liquids and gases by the growth of bacteria that all fecal matter contains. These decomposing bacteria develop only in places where the air is kept out—that is why the septic tank is built down in the ground and entirely covered with soil.

To keep the septic tank in perfect working order do not use disinfectants in the washing water. When such are used they tend to destroy the bacteria, thus retarding the change of solids into liquids for transfer out of the tank into the disposal area.

Sex Hygiene and Problems. See Volume V, page 2443.

Sleep.—In one sense, sleep is really a food. It feeds or rather gives the body an opportunity to feed upon itself. It induces that thorough mental and physical relaxation which is really the means of renewing life, energy and power. You may go to bed with the pangs of hunger ever so acute, but during sleep they will nearly always disappear. In some mysterious manner the body finds food within itself.

Always choose a hard bed. A soft bed is enervating, not restful. The body sinks into the debilitating bedding and the tissues and muscles become flabby and weak and the circulation is interfered with, the skin being unable to throw off its impurities in a natural way.

When given to sleeping on the back no pillow should be used, or else a very low one.

To assist Nature in her work of repairing the body during the night hours there is nothing so good as a moderately hard bed with no pillows, or very small ones. Many, women especially, suffer from constant headaches which are due to high pillows. In some of these cases where pillows have been forbidden by the physician, or very low ones made of corn-straw substituted for those of feathers or down, the headaches have totally disappeared.

It is a question what to do with the arms in sleep, as everyone has found out perhaps. If one lies upon one's arm it is apt to stop the circulation, and to cause that sometimes painful sensation known as "pins and needles." When the arms are

Complete Relaxation is essential for restful sleep. Don't grip the bed clothes, or occupy mind or body in any other way. Relax absolutely.

placed downward in front of the body, it throws the body into a very peculiar angle. It has been advised that the most restful position during sleep, that is, the one in which one will be less disturbed by dreams and from which one will awake most refreshed in the morning, is the opposite of that which has been maintained by the body for the greater part of the day. If a person while awake has been reaching upward a great deal, and so keeping the body extended to the full, it will be found that greater restfulness will be secured by taking a reverse position while in bed. There is then some excuse for doubling up the body a part of the time during sleep. Or, on the other hand, if one has been cramped up over a table or desk all the day, the greatest good will be obtained by extending the body to the full length and lying as prone as possible. There are any number of niceties of posture to be taken, and each person must find out that which best suits his individual needs.

Theoretically, one of the best positions for sleeping is lying on the right side, the arm under and back of you, or bending the arm at elbow with the wrist crossing the body under the waist.

Sleeping on the back is generally recognized as unhygienic. I recommend that some hard substance be fastened at the small of the back—for instance, say a towel with a large knot tied

A good position to assume during sleep. Lie on the right side, right arm behind, bent, and wrist under waist.

so as to be in the middle of the back when one turns over, or some similar device that will have a tendency to prevent sleeping on the back. There is a story of a young man who fastened his good mother's biscuit cutter to his back by means of a towel placed around his waist, and no further reports were received from him concerning nocturnal disturbances caused by the habit of back-sleeping.

If inclined to suffer from heart trouble, be careful not to sleep on the left side too much, as this position sometimes has a tendency to aggravate this malady. Sleeping on the right side also assists the digestion of foods, as it places the pyloric opening of the stomach on the lower side of the body, and hence facilitates the passage of undigested food from the stomach to the intestines.

There is a tendency to right-sideness in most individuals. It is true that during sleep assimilation is most active. Circulation is equalized, the work of the vital organs is lessened, and it may be that this right side position is, considering everything, the best.

On retiring at night it is well to arrange the windows so that proper ventilation may be secured. You must be plentifully supplied with fresh, pure air. If you are afraid of draughts, you must try to annihilate that superstition and cultivate the fresh air habit. If not accustomed to sleeping with wide-open windows, do not adopt extreme measures at once. Gradually accustom yourself to breathing the pure outside air that at all times should be allowed the freest access to your sleeping room. Remember that the more nearly you breathe what is practically the outside atmosphere, the faster you will be able to build physical health.

Do not cover too heavily while in bed. Use only sufficient covering to maintain warmth and no more. You can cover lightly on first retiring if you so desire, keeping other spreads near at hand, and if during the night you feel cold, add more.

Do not breathe through your mouth. Mouth breathers usually snore and if you wish to break yourself of this disagreeable habit begin to cultivate breathing through the nose. By keeping in mind the necessity for so doing, you will acquire the habit of breathing properly while asleep. If you have extreme difficulty in breaking the mouth-breathing habit, a device can be worn that will prevent you from opening your mouth during sleep, or a towel can be used. Narrow strips of adhesive tape or court plaster tipped over the lips will keep the mouth closed. For details regarding the causes of mouth breathing and constitutional treatment therefor, see page 2199, Volume IV.

A method of preventing mouth-breathing during sleep.

Breathing through the mouth is ordinarily induced by catarrhal trouble, which must first be cured. Though catarrh is an exceedingly difficult disease to eradicate, an observance of the rules of health will usually accomplish a cure.

Many experience a feeling of fatigue and exhaustion after a night of sound sleep. They cannot "understand" it; they imagine themselves "born tired," and resign themselves to their fate. It is nothing of the kind. The moment of awakening *should* be the most glorious of the whole day. Close air, overheated rooms, an over-abundance of heavy bedclothes, late suppers, overeating, drinking too little water, insufficient breathing, constipation—all have to play their part in producing this condition. The body throws off poisons more rapidly at night than during the day time, and needs a greater supply of oxygen—hence the importance of fresh air at night. But it has been proved that sleeping for too long will also give one this feeling of *ennui,* of exhaustion—the reason being, apparently, that carbon dioxide accumulates in the system after a certain period has been reached, and this acts as a poison. All of which seems to prove to us that, if we wake from natural causes we should get up whenever we wake; and if we continue to lie in bed and sleep, on and off, for two or three hours longer, we pay the penalty in added fatigue and *ennui.*

Some natures certainly demand more sleep than others. It is foolish to lay down a law, and say that seven hours are enough—or eight, or whatever it may be. Each person is a law unto himself, in this respect. Those persons who live excitable, tense lives naturally need more sleep than those phlegmatic individuals who "take life as it comes," and "do not worry about anything." As a rule, brain-workers, and those who use their heads continuously, need more sleep than those who do not. Muscular work necessitates deep but not prolonged sleep. However, no absolute rule can be given. *Sleep until you feel refreshed,* and if you feel "chronically tired," and can afford the time, go to bed and stay there until you wake up refreshed. I have known of one or two cases where a woman deliberately stayed in bed for several days and nights continuously—so determined was she to "rest out" for once. But she got rid of a feeling of "chronic tiredness," which she had experienced for years.

One of the greatest problems which confronts the student of sleep is the question of insomnia. So many people suffer from it; and its causes are so varied and so complex that it is most difficult to say, very often, what its chief cause may be, and what measures would be best to effect its removal. Worry and excitement are well-known causes, constipation is a frequent cause (the irritation of retained ingesta frequently causes wakefulness), hearty suppers may cause insomnia—though I believe they generally have the opposite effect; an inactive skin is certainly a contributory factor; close, stuffy air is frequently to blame; congestion of blood in the head, together with cold feet, is found in hundreds of cases. The treatment must be largely determined by the cause; and if one plan fails, another must be tried. Insomnia can certainly be cured by a persistent course of body-building, and vanishes before the restoration of vitality; but it frequently supervenes only once ever so often; and then there is no time to undertake a long course of training. Immediate, palliative measures must be adopted in order to occasion sleep that very night. Of the various devices and methods which have been resorted to in the past, the following will probably be found effective in nearly all cases.

(1.) A *prolonged* neutral bath is a good method of reducing nervousness—when this is the cause—and inducing sleep. The patient should be placed, full length, in a bath about blood heat (95° to 98°). Hot water should be added, every now and then, to keep the water at a constant temperature. The nerve-ends all over the body are in a state of tension, and need to be thoroughly relaxed by some artificial method before sleep is possible. This the warm water does. Do not be afraid to keep the patient in this bath—soaking, for half an hour or longer, if necessary. It may be found necessary, on occasion, to keep the patient in the water for several hours before relief is obtained. In order to prevent irritation or chapping of the skin, it should be rubbed all over with vaseline or some similar form of oil before the patient is placed in the water.

(2.) Placing the *feet in hot water* for a few minutes will induce sleep in many cases—where the head is slightly congested, and the feet are cold.

(3.) *Hot water bottles* will have the same effect very often.

(4.) A glass of *warm milk,* just before retiring, will draw the blood down from the head, to the stomach, and induce sleep, in many instances. I do not think this is a very hygienic method of inducing sleep, but I believe that, in a case like this, we often have to choose the lesser of two evils; and the ill effects of the milk are certainly less than a night's sleeplessness.

(5.) *Monotonous stimulation* will often have the effect of sending one to sleep. A metronome set going in the room will have this effect; but the "beats" must be comparatively slow. Or the tick of a watch may be listened to. Counting is usually inefficacious.

(6.) The practice of *making the mind a blank*—thinking of a high black wall—is very useful in many cases. I have used this method successfully on many occasions, and it induces sleep very frequently.

(7.) *Muscular relaxation* is very helpful; indeed, this method is too little known, apparently, for its advantages are certainly very great. The method of procedure is as follows:

Lie flat on your back on the bed; assume a restful attitude. Now think of the back of your neck. You will probably find that it is tense and rigid; you are unconsciously holding your head on your shoulders, while the pillow should be supporting it. Relax these muscles; let your head sink back into the pillow; let the bed retain the whole weight of your head. Now pass, in thought, to the right arm and relax this in turn. Then the left arm; then the right leg; then the left leg. Finally relax the trunk, sink back on the bed, make the body as "heavy" as possible. By the time you have gone all round your body in this way you will probably find that your neck is again tense, and this must be again relaxed. Go round your body three or

Children should be taught to avoid sleeping with the mouth open in this manner

The use of too many and too soft pillows frequently prevents proper breathing.

About the best position for sleeping The weight of the body here rests mostly on the right side and forward part of the body.

A fairly commendable position, recommended when there is slight tendency toward sleeplessness, provided the position of the hand with the arm far above head is found comfortable.

A good position that can be assumed for a short time when one is inclined toward sleeplessness. The arms, when held high above the head in this manner, will to a certain extent draw the blood from the head.

A poor position, frequently assumed on cold nights when there is not a proper supply of bedclothing.

four times in this fashion, always ending up with your neck and head. You will be surprised at the "relief" you obtain; and I do not doubt that, after a few trials, you will be enabled to woo slumber almost at will by this method.

(8.) *Deep breathing* is very helpful as a method of inducing sleep. Fresh air in the room is, of course, essential in this method. Yawning is a sign that the lungs are cramped and filled with carbon dioxide; and the stretch and accompanying yawn are but attempts on the part of Nature to induce greater activity of the lungs and thorax generally. Deep breathing will relieve this condition, and frequently succeeds in inducing sleep.

A position frequently assumed by sleepers when cold. Neck, chest and abdomen are cramped, restricting the breathing and circulation. A sufficient supply of bed-clothing in cold weather will usually enable the sleeper to avoid this position.

In this position the raised knees cause the heart a great amount of extra work, producing restlessness.

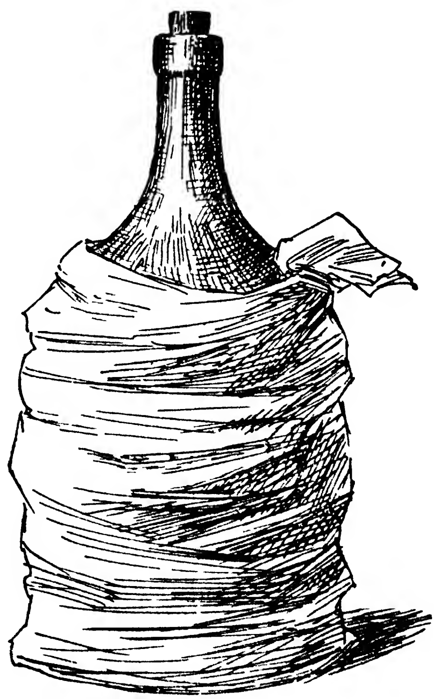
(9.) A quick *sponge bath* in tepid water will soothe the nerves in many cases, and help to bring about the desired state.

(10.) A *salt rub* is a good method—which should be taken just before retiring for the night. Sponge off afterward in cool water.

(11.) *Cold wet cloths to the head* and back of the neck will be found very efficacious.

(12.) A few muscular *exercises* in a well-ventilated room will often cure the most obstinate cases of insomnia. Bending exercises of all kinds are good; but they must be brisk and vigorous. Lack of muscular exercise is a frequent cause of insomnia.

(13.) An *air bath,* taken just before retiring, is one of the best methods possible of inducing sleep. It is said that Ben Johnson, whenever he could not sleep, jumped out of bed, walked about the room in his night-clothes for several minutes, until he was thoroughly cool, and the perspiration, if any, had evaporated. He then got back to bed again and slept like an infant.



To keep water cool, wrap a wet linen or cotton cloth around jar or bottle in which it is contained. Place this vessel in a shallow dish containing a small quantity of water. The evaporation of the water from cloth will keep the contents of vessel ten degrees lower than that of the air, and, by absorption, the water in shallow dish will keep the cloth continuously wet.

The Skin and Its Functions are described in detail in the present volume, page 290. Care of the skin is touched upon in Volume II, pages 1181 to 1193 inclusive, and elsewhere.

The Teeth and Their Care is discussed in Volume II, page 1193, and elsewhere.

Water.—Scientists tell us that every part of the body, except the bones, is virtually a fluid composed of millions of tiny cells which do their work and die. These dead cells, or the effete matter of which they are composed, are removed and eliminated and new cells are brought to replace them by means of a still thinner liquid that we call blood. Blood is thin or thick and flows through the body freely, or phlegmatically, according to its fluidity and the vigor possessed by the particles of which it is composed. This life, or vigor, is supplied by the food, the oxygen of the air, and sunlight, but the supply of water depends upon the food we eat and the water we drink. Hence it is important that we give to the body a sufficient quantity of pure water in order that the blood may be kept in its normal fluid condition, and the disease-producing effete matter eliminated.

There is no cleansing agent as important as water, not only for the exterior of the body, but for the interior from the crown of the head to the soles of the feet. It is a simple matter to drink a glass of water, yet the results of the act are marvelous. A very small portion of it enters the intestines, but by far the larger quantity is absorbed into the blood and enters immediately into the circulation of this life-giving fluid.

Sources of Water Supply.—There are five sources of water supply, as follows:

1. *Rain water* always contains more or less impurities, both suspended and dissolved. Unless unusually careful about its cleanliness an analysis shows that it contains organic and inorganic substances.

2. *Spring Water,* which, as a rule, is purer than any other. It is an easy matter to have spring water analyzed or tested, and once tested its purity can generally be relied upon.

3. *River Waters.*—Directly rain water comes in contact with the land it acquires fresh impurities. Most river water usually is dangerously impure, and offers great menace to health unless properly purified by filtration. If such water be taken and passed through an adequate filtering plant, carefully and conscientiously conducted, the water becomes practically safe for drinking purposes.

4. *Surface Well Water* is practically the same as river water, except that it is likely to be even more polluted.

5. *Deep Well Waters* are generally palatable and wholesome.

Detection of Impurities.—Water for drinking must fulfill certain conditions. There must be no smell to it, either when fresh or boiled. Its taste must be pleasant and fresh. When a large reservoir full of it is looked at, it must not be cloudy or yellowish, but of a pure blue or bluish-green color. Live drinking water always contains the three gases of air, namely, nitrogen, oxygen and carbonic acid. The reason that boiled water is always insipid and flat is because it has lost these gases. There should never be less than two to five cubic inches of gas in solution in one hundred cubic inches of water.

Some chemists contend that water should always contain a few grains of mineral matter dissolved in it, such as carbonate of lime, sulphate of chloride and nitrates of sodium, magnesia, etc. These mineral matters, however, should never exceed thirty grains in an imperial gallon of water, which weighs ten pounds, or seventy thousand grains. Other chemists declare that all such mineral matters are impurities, and that the less of them our drinking water contains the better. This seems the right view.

Filtration of Water.—Household filters, where not properly cleansed, are a source of danger instead of a preventive. The right type adopted, it must have proper care.

Distilled Water.—There has been much discussion as to whether water should be used in its "raw" state boiled, or distilled. The dangers of water in its "raw" state have already been presented. Where, therefore, there is any doubt as to its purity it should be avoided.

Many people think that boiling water is the best way to rid it of impurities. This is a grave mistake. Not only does boiling water deprive it of its life by forcing out the gases of the air, but the purest portion of it is carried away in steam. The result is that what impurities there were in the water remain practically unchanged, *but condensed,* and, therefore, made more obnoxious by the evaporation of that liquid which was most nearly pure. If, however, one prefers to use boiled water it should always be aerated before drinking. This is done by pouring the water from one vessel to another several times so as to thoroughly mingle the air with it. This will take away the flat, insipid taste and restore some of the gases of which the boiling has robbed it.

One is almost driven, if he be particular as to his water supply, to the use of distilled water. This he can purchase, relying upon the known integrity of the firm producing and disposing of it for its purity, or he can have it distilled in his own kitchen.

Ice-Water.—The drinking of ice-water is not a natural habit. It has to be acquired, and its baneful and injurious effects upon the body cannot be questioned.

There is no doubt whatever that many of the deaths that occur in the heat of summer, and which are commonly attributed to heart disease, are often caused by the shock of flooding the stomach with ice-water.

Hot Water.—There is no doubt whatever that in many cases of disease the use of hot water is beneficial in washing the accumulation of slime, mucus, yeast-germs and undigested food from the stomach and increasing the peristaltic action of the intestines. But it does not necessarily follow that what is good to change an abnormal condition of disease is either necessary or good for a body that is in a state of normal health. The natural drink for man in his normal condition is cold water, though if it is a matter of choosing between tea or coffee and hot water, preference should certainly be given to the latter.

WOMEN'S EXERCISES are treated in complete detail in Volume II, page 1042, and elsewhere.

CHAPTER III.

THE CAUSES OF DISEASE.

APPARENTLY this is one of the easiest of questions to answer. Almost any man would say that he could tell you what disease was in comparatively few words, and yet, when one considers it in the light of the theories propounded by the various schools of science and medicine, it seems to become one of the most difficult of questions. For no sooner is an answer given than new questions spring forward, each one apparently more difficult to answer than the preceding one.

The fact is, it is not necessary for us to know all the various theories and ideas that men of science hold in regard to disease. It is wiser and better that we devote our attention to a study of the conditions of perfect health and seek to attain these, with their consequent happy results. At the same time, it is well briefly to survey the field of scientific thought as to this question, and then endeavor to eliminate the mystery and consequent dread that make disease such a terror to the afflicted.

One authority states that "any departure from the normal performance of the natural functions is defined as disease." Webster says: "Any state of a living body in which the natural functions of the organs are interrupted or disturbed, either by defective or preternatural action, without a disruption of parts by violence which is called a wound."

These definitions imply that one understands what is the normal performance of the natural functions. Without any attempt at detailed accuracy, it may generally be stated that that exercise of the functions of the body that is accomplished perfectly without discomfort, distress or pain is a normal performance. For instance, the person, be he young or old, who sees perfectly with both eyes, and without strain or distress, objects that are close by, and objects that are at a distance, and recognizes all colors and forms readily, may be said to have normal eyesight. The man who breathes naturally and easily, whether at rest or during any reasonably violent exertion, and continues to do so year after year, may be said to have lungs and breathing apparatus that normally perform their natural functions. That person who continuously and regularly finds the excretory canal in perfect working order, without constipation or looseness, or any irritation in either stomach, bowels or anus, is undoubtedly enjoying the normal performance of the natural functions of excrementation.

Everything that deviates from these normal functions is what is meant by disease.

You go to a man suffering with a severe cough, great expectoration of phlegm, and with pain in his lungs. Ask him the question: "What is disease?" He answers: "I am diseased, for I suffer." You go to a physician and he tells you that that man is suffering from the disease called tuberculosis.

You see the child walking down the street, his hand to his ear, crying bitterly. You ask his mother what is the matter. She says he has the earache. That is an acute disease, giving intense pain for the time being, but which quickly disappears if intelligently treated.

You see a highly strung woman suffering from hysteria. She will tell you that that is a disease that afflicts her constantly, and that makes life unbearable.

Each of these persons thinks he has answered the question: What is disease? But immediately the mind asks: Are these not merely the statements of *manifestations* of disease? These are merely symptoms. What is the disease itself? How is it caused? Why is it caused?

If one could tell, as a result of microscopic examination, the peculiar condition of the organ and of its component parts that are the seat of the pain, even that knowledge would not satisfactorily answer the question.

Yet what a real thing disease is, and what awful power it manifests in human life.

Every one of the hundreds of thousands of physicians in the land—physicians of every school, allopathic, homeopathic, osteopathic, hydropathic, electric, eclectic, and the so-called new thought, Christian Science, mind cure and faith cure—is a proof of the terrible hold disease has on mankind.

As New Thought, Mind Cure, Faith Cure and Christian Science deal with the body only through the mind, and steadfastly abstain from the use of drugs, we have nothing to say against them. We believe it possible to carry some of their principles to extremes, but no matter how extreme their adherents may be they cannot suffer more from their trust than have the victims of the older systems of medicine. We deem this subject of such great importance, that in this chapter readers will find a discussion devoted to our ideas as to the power of the mind over the body and its diseases.

Before presenting our own thought and methods we desire to call attention to a few practical considerations that should not be overlooked.

At the outset we believe it will be generally conceded that there are few indeed who enjoy that perfect and abounding health described in the preceding chapter, and that there are but few who are not familiar with disease and its consequent pain in one form or another. Is it stating the matter too strongly to affirm that to the generality of mankind disease is the thing dreaded most of all, and to the suffering, the most insistent thing in life? Few people can rise above the immediate ravages of disease and pain and continue their daily vocations as if they were in perfect health.

Yet, in spite of the apparent dominant power of disease, it is our mission to come to the afflicted sons and daughters of man with the most perfect encouragement and hope. We wish, in all earnestness, sympathy and conscientiousness, to help remove this fearful dread of disease on the part of humanity, and implant in its stead an assurance that disease is unnecessary and abnormal and therefore preventable and curable.

Whatever may be the extent of our lack of knowledge as to the exact nature of disease, there are many things of which we are sure. We know that certain courses of action will positively produce some form of disease. For instance, a man may be in perfect health. Let him, however, shut himself up in a badly ventilated room, refuse to go out of doors, refuse to exercise, and at the same time persist in eating three heavy meat meals per day, mixing up the meat with every other kind of food given in the ordinary first-class hotel dinner. Does it need any great medical knowledge to know what the result will be? Let a man refuse to sleep for a month; what will ensue? Or let him drink whiskey and smoke strong tobacco from morning to night! Or shut himself in an absolutely dark dungeon for a few months! Or indulge to excess in running, or, as the Sacred Writer puts it, "squander his strength on women." Every man knows that these things are bound to produce distress, discomfort, disease, and that if the evils are persisted in the disease cannot eliminate the poisons that have accumulated in the blood and body, and death ensues.

Seeing, therefore, that certain courses of action are injurious to health, it is natural and rational to assume that there are other courses which are beneficial to health. We study the lives, the daily actions and habits of those men and women who live in perfect, or almost perfect, health and what do we find? Almost invariably that, in one way or another, they follow, consciously or unconsciously, the pathway that we have marked out and set forth as the pathway of Physcultopathy—the method of cultivation of the body. Thus, therefore, we come naturally to a consideration of the Physcultopathic standpoint in relation to health and disease.

At the very outset we wish to call attention to the marked difference that exists between the principles that govern the various schools and theories of medicine and the school of healing we call Physcultopathy. The former deal with disease; they fight, combat, struggle against the evil. Theirs is a warfare to overcome an evil. On the other hand, our philosophy and methods are positive. We seek to establish health. We make health the habit of the body and mind, and where health is there is no room for disease. We cannot emphasize this point too strongly upon our readers. Get HEALTH, abounding, vital, exhilarating Health, and disease will flee away from you as the darkness of night flees from the powerful rays of the morning sun. Health, Life, is opposed to Disease, Death. The average individual merely exists. He does not *live* in the true sense of the word, and when the question is propounded, "Is life worth living?" he has good reason for hesitating before making a reply. If you are *living* in every sense of the word; if you know the meaning of health and strength of the highest degree; if you have been fully, completely developed, you are thrilled always with the pleasure of mere living. Living to you is beautiful; you are full of strength; you have a surplus supply of vim and energy. You are in complete possession of manhood or womanhood. When you possess such a power, an irresistible force presses you onward. Your pleasures come from activity. You are active because you love it. You work because you find pleasure in it, and disease has no dread for you, for, knowing its impotency to harm, you are filled with self-confidence. You know there is no need to worry, no matter what disease may threaten you. You can be self-composed; you can say to yourself, "I fear no disease, for I am so strong that I cannot be attacked by disease."

In approaching the consideration of disease from the Physcultopathic standpoint, there are two most important ideas that we wish to advance. These are, first, that, in the main, *there is but one disease,* and, second, that *disease is a beneficent process of nature instead of the enemy it seems to be.* Let us endeavor fully to elucidate these two propositions, which to many will be positively startling.

1. There is, in the main, but one disease. We do not claim infallibility for our opinions, and this is merely a strong opinion, as the result of a careful study of thousands of cases brought under our immediate notice, and of all the theories of diseases and medicine propounded by the many and various "schools." Notice, also, that we say "in the main." Naturally, all diseases caused by accidents, such as fire, falling from high buildings, partial drowning, wounds made by knives, gun shots or some other method outside of the body, the taking of poisons, the presence of animal parasites, etc., do not come under the general category.

Hippocrates, often called the father of medicine, held to this idea, that disease exists merely in the fluids of the body; in other words, it is *impurity of the blood.* This disease may manifest itself in hundreds of different ways. There may appear thousands of symptoms. Medical men have named these various symptoms and they have been classed by them as different diseases (we have already named many of them), but they are all the result of one disease. Practically every advocate of natural curative methods believes there is but one disease and that disease is impurity of the blood.

Blood may be made impure in a thousand different ways, and these ways will be fully discussed and presented in the fourth volume of this work, and elsewhere; but, in brief, it may be stated that the various organs that have to do with the making of this vital fluid have certain functions to perform. If these are interfered with, or disturbed, the work is improperly, imperfectly accomplished. This results in the retention in the blood of certain poisonous or deleterious elements or substances which should not be there. If the eliminating organs are unable to do their important work, and the impurities remain and pass into the circulation, disease—discomfort, distress, pain—sooner or later ensues.

2. This latter fact now leads us naturally to our next proposition, viz., that disease is a beneficent process of Nature, instead of the enemy it seems to be. If there were no discomfort, distress, pain, there would be no warning given to the poisoned man that his body was diseased, and in a shorter or longer period death would ensue as the result. But the pain gives forceful warning. It calls his attention. It says, Halt! There's something wrong here! Remedy these wrong conditions or there will be greater trouble! And the speedier the warning is heeded, and the cause of the trouble removed, the sooner is the disease cured. Hence, is not our second proposition apparent, that "Disease is a beneficent process of Nature, instead of the enemy it seems to be"? In other words, disease is the endeavor of the body to get rid of that within itself which, if retained, will cause worse disease, or more or less speedy death. It is the sign-board at the railway crossing, the ringing of the bell, the beacon of the lighthouse that warns from the

destroying locomotive, the sunken reef, the rocky shore, that would otherwise dash you into constant suffering or a speedy death.

That I am not advocating a mere notion of my own in thus emphasizing what I believe disease really to be, let me quote verbatim from an address delivered by Sir Frederick Treves at the Inaugural meeting of the Edinburgh Philosophical Institution. Sir Frederick's eminence in the medical world is well known. He was Surgeon-in-Ordinary to King Edward of England from 1901 to the time of his death. I quote his exact words as cabled from England to the New York *Herald:*

"In the popular view," he said, "it is held that disease is a calamity, that its end is destruction and that it is purposeless, except in one direction—that of doing harm.

"Popular terms bear testimony to the prevalence of that belief. A man is said to be 'struck down' by disease as by the avenging angel. It seizes upon him as does a roaring lion. It consumes him as does a fire. The attitude of the medical man towards disease is that of an opponent to deadly influences.

"He has to combat an enemy to mankind whose every movement is dark and malicious. There is no symptom of disease that is not believed to be noxious and, as such, must be stamped out with relentless determination.

"If the patient be ill, the illness must be stayed. If he coughs, the cough must cease. If he fails to take food, he must be made to eat. And why? Because these are manifestations of disease and, therefore, of ill intent and to be banished.

"I hold that there is nothing preternatural in disease; that its phenomena or symptoms are marked by purpose and that that purpose is beneficent.

"Disease is one of the good gifts, for its motive is benevolent and protective. I cannot express that more precisely than by saying that, if it were not for disease, the human race would soon be extinct."

Sir Frederick Treves then demonstrated his proposition by instances. His first was that of a wound and the supervening inflammation which was a process of cure to be imitated rather than hindered.

Peritonitis, which had always been spoken of as the operating surgeon's deadliest enemy, was in reality his best friend.

The general mortality of the common disease known as appendicitis was low. This fortunate circumstance was due to peritonitis, for without that much abused ally every case of this disorder would be fatal.

Another instance given was that of a common cold which was, no doubt, a so-called bacterial disease.

"Catarrh and persistent sneezing are practical means of dislodging bacteria from the nasal passages, while the cough removes them from the windpipe."

"According to popular medicine," he said, " the phenomena constituting disease are purposeless, profitless and wantonly distressful, so that the victim demands from the physician means for stamping out the trouble. These symptoms, however, are in the main manifestations of a process of cure and are so far benevolent that without them a common cold might be a fatal malady."

These ideas so forcefully presented by Sir Frederick cannot be too strongly impressed upon the mind, or too widely disseminated. They would do much to awaken in the thoughtful, at least, a horror of all systems of drugging which seek to stifle these notes of warning given by disease. The physician who gives morphine to the sufferer from appendicitis is simply inviting death. The pain is Nature's call for help, for relief—and this call should be intelligently obeyed and not stilled by the deadening influences of potent drugs.

As I wrote many years ago: "Disease is a process of cure. It is the result of efforts on the part of the functional system to bring about a normal condition of health.

"It is the route back to health.

"It is the means adopted to throw off the various accumulations of foreign or impure matter which has interfered with the normal condition of health.

"A disease becomes chronic when the conditions producing it become chronic.

"If a boil appears on the body one does not usually adopt means to drive its virulent contents back into the system, but allows it to run its course, or else tries to hasten the process of expelling the impurities it contains.

"Nearly all diseases can literally be compared to a boil. A boil rids the system of impurities—it is a means adopted to reach normal health.

"Nearly all diseases are similar. When they appear they are like a boil in its first stages. They are preparing the way for the expulsion of impurities with which the system is overloaded.

"Even if it were possible with the use of a drug to cure or drive into some other channel a disease immediately upon its appearance, it would be like driving the contents of a boil back into the system. The disease must run its course—*It is the process of cure.*

"If this great truth can once be thoroughly understood, one need never have fear of any disease.

"There are rare occasions where the accumulations of impurities are so copious that the symptoms of the disease assume such virulence as to cause death, but such cases are extremely exceptional, and only occur when the patient's habits have been most uncommonly perverted."

In further illustration of this position, let us consider one or two other diseases and endeavor to show that the pain accompanying the disease—which to most people is all they care to know about disease—is their best friend *under the evil conditions that exist.*

For instance, let us take the dread disease called pneumonia. This disease is nothing more than what might be termed a cold on the lungs. To be sure, you must be vitally depleted in order to be attacked by this complaint, though remember you may appear vigorous, you may look healthy, your cheeks may be red, you may be a picture of vital vigor, and yet may not be immune from this disease. Very fleshy men or women, especially meat-eaters, or alcohol drinkers, are liable to be attacked by pneumonia, and it is really more difficult to effect a cure in such persons than when there are less of the ordinary signs that indicate vigorous health. Let us say, however, that fat is not health. Too red cheeks are a sign of disease rather than of health. It is more difficult to cure a fleshy person of a dangerous disease than it is one of medium weight or even those termed thin. When one is attacked by pneumonia, there are frequently knife-like pains in the chest and excruciating soreness all about this region of the body, and when the disease begins to abate, you eliminate a vast amount of mucus or phlegm from the lungs. Now this vile poison had accumulated in the body, because it could not be thrown out by the ordinary organs, and you have therefore had pneumonia. The disease has appeared simply to throw out these poisons, these foreign elements, which, if they had remained in the body, would undoubtedly have caused death. Pneumonia may be said to have intervened and saved your life. This idea may seem strange to the uninitiated, but not to those who have a clear conception of the nature of disease and its purpose.

Pneumonia is not necessarily a dangerous disease, if treated in the proper manner. Where natural methods are used, pneumonia is rarely followed by death. The percentage of deaths is so small that it is hardly worth considering, although the mortality record from this disease ranges from twenty to thirty per cent. when medical methods are used. A larger part of these deaths are caused solely through improper treatment, through a want of understanding of the nature and cause of disease. The patients die because it is declared that they have to be fed, because a certain amount of nourishment is supposed to be necessary to keep up the strength of the patient. The digestive organs of one who is attacked by pneumonia are not in a condition to assimilate food, and if food is forced into an unwilling stomach, a large amount of poison is certain to be absorbed and circulated through the blood from the undigested matter the patient consumes. When you are suffering from a complaint of this character, your entire bodily strength is needed for the one purpose of cleansing the body. You have not an iota of energy left to digest food, and every mouthful of food given adds to the poison that must be eliminated.

Many other diseases might be taken up and dwelt upon in a similar manner. There are the various signs that appear as the result of skin diseases. These diseases are known by many names, and yet they are simply an outward manifestation of an internal condition. They are brought there by the blood. The disease is not simply superficial, it is actually in the blood. It is a part of the blood. Of course, there are skin diseases that are supposed to be contagious. They are passed from one to another, but as a rule such diseases are brought about by a minute insect, and a better way to cure complaints of this kind is to use some method of destroying the insect. In such cases I believe in the use of a poison that will kill these insects, just as I believe in the use of poison to kill rats and mice. Medicines and poisons are useful under such circumstances, but I know of few other occasions where they are required.

Health and strength and poison cannot possibly harmonize —they are not related. When you put poison into the body every organ which comes in contact with that poison is excited to the greatest possible degree of activity for the purpose of eliminating it. Take a small quantity of alcohol, or use one of the patent medicines that contain a liberal quantity of this poison. Take a spoonful, and it may cause you to feel temporarily benefited, refreshed. This result, however, is produced simply by a momentary excitement of the internal organs. There is no permanent benefit from a remedy of this kind. One simply makes the various organs work a little harder to throw out the poison that you have used, and the result of this waste of vital vigor must be an injury instead of a benefit. The alcohol, it must be remembered, makes absolutely no change in its transit through the body, and every organ with which it comes in contact is compelled to make an extra effort in order to be rid of the poison.

The body is at all times doing the best it can to maintain health and strength. When you consider the abuse that the average human body endures in this day and age, one might reasonably come to the conclusion that man is the toughest animal upon the face of the earth. We hear much talk about a cat having nine lives, but the ordinary man or woman of to-day surely has ninety-nine. There is no living creature upon the face of the earth that could exist under the conditions that the average human being of to-day endures. Take any wild animal of the forest—even the fiercest, strongest lion, and make him live as a civilized man, eating three meals a day whether he needs them or not, and I would venture the assertion that his great strength would lessen in a short time and he would soon die of one of the various diseases from which we have to suffer.

You will therefore see that disease is a physical house-cleaning. This refers largely to acute diseases, as I have already shown, though chronic diseases to a large extent perform a similar office. This is illustrated very accurately in a chronic running sore which refuses to heal. The pus poisons that are eliminated in this sore cannot be thrown out by the ordinary organs that are supposed to perform this duty, and they therefore seek this particular sore for outlet. As long as the body is encumbered with these poisons, this running sore will remain, but, as has been proven in hundreds of cases, by simply changing the habits of life, by purifying the body with a view of eliminating these poisons from the blood, the pus that appears at this point of the body gradually decreases and finally the sore heals entirely.

You have a fever, for instance. There again is an accelerated pulse, a very high temperature, every organ of the body is accelerated to its greatest degree of activity for the purpose of throwing out poisons which if allowed to remain in the body would in many cases cause death. The fever, therefore, comes as a means of saving your life, and death would undoubtedly ensue because of the accumulation of poisons if it were not for the appearance of these fever symptoms. Some outlet must be found for the poisons, and disease is the outlet. When attacked by a fever, even a layman should realize that his body is harboring a vast amount of impurities or poisons. They must be eliminated in some way, and the disease is Nature's endeavor to thoroughly effect this purpose.

By all means get rid of the idea that disease is a mystery, a something to be deadly afraid of, a power that, like the lightning, may strike anywhere, everywhere, in the most unlikely place, without warning or reason. It is nothing of the kind. It comes as a friend, it gives timely warning to help you escape from destruction or death, hence its warnings should be understood, heeded and obeyed.

The sooner we comprehend the fact that disease is brought upon us by our own actions the better it will be for us. Disease is the result of our own misunderstanding of the great health laws. Disease is impure blood. You may ask how we are to trace the various diseases to impure blood. Let us take apoplexy, for instance. How would impure blood cause the symptoms connected with this complaint? Some say it is produced by unusual pressure of blood on the brain. How will impure blood produce such a manifestation? Unquestionably the pressure is first of all brought about through the existence of impure blood, and the really serious symptom of the disease, the breaking of a bloodvessel, has been made possible because of the weakened tissue which naturally results from defective elements furnished by the blood. The tissues are too weak to hold the blood pressure. You therefore cannot have apoplexy even unless your blood is impure, unless it fails to contain those elements needed to build the proper tissue.

The blood is the life. It makes your body, it makes every part of your body. There is nothing within the body but what has been placed there by the blood. For instance, you have a manifestation of some disease. One or more of your organs are sore, inflamed. What is the cause? This inflammation must have been brought there by the blood, except in such cases as already mentioned. It could not be brought there in any other manner, and yet when such symptoms appear you often consult a surgeon. He may find the organ slightly misplaced and diseased, and he will frequently advise you to cut it out. Now, how are you going to eliminate disease by simply cutting out the organ in which the disease has manifested itself? Disease is really not in the organ itself, it is simply a sign of disease. The disease, I repeat, is in the blood; therefore, the proper way of treating a diseased organ is not to cut it out. The proper way is to remove the impurities from the blood, to make this vital fluid so virile, so full of health and strength that the poisons will be carried away and recovery will then be complete and definite. In the majority of operative cases, the disease for which the knife has been used can be cured quickly simply by purification of the blood. The poison, the inflammation and soreness are caused by impurities in the blood. There may have been local conditions that would help to produce the inflammation, but if the blood contains proper healing elements, the disease could not possibly become chronic, for the blood would then slowly but surely heal the affected part.

The reader should now be fully persuaded to accept the statement of our assurance that *most disease is preventable.* There is no physician of any school who will not agree to the proposition that if the body be healthy it has the power to resist the aggressions of any kind of disease. Even though one accept the germ theory to its fullest extent, we have shown that disease germs cannot grow and thrive in a healthy organism. No matter what *contagion* is, or *how* it works, it has no power over a healthy body. In other words, disease either comes and is totally ignored by the healthy person, or if it succeeds in making an entrance it is so quickly and so unceremoniously kicked out that its presence has had scarcely any opportunity to make itself felt. So we believe in fostering two distinct attitudes of mind towards disease: first, that you have no need to fear it, and second, that if it takes hold of you, it only requires courage, and a quick, sharp fight to eradicate it. The first proposition, fearlessness, we have already briefly discussed. Let us give a few moments to the second. The fighting spirit is good, when properly understood and controlled. It is the power of initiative set in motion. It is the fighting spirit against things as they are which makes progress possible, stimulates improvement, encourages invention and causes enlightenment and civilization. It is the fighting spirit that prevents tyranny, compels graft to loose its hold, and that drives greed, lust, and all other evils to get under cover. The fighting spirit means strength in training, watchfulness, caution, courage and confidence. Let every man and woman be imbued with this spirit, and with knowledge to accompany it, the world would see disease almost banished in two or three generations. For every fighter knows he must be kept in training. In that one idea, we have proof that disease can be prevented. It has no power if one is willing to keep *himself in training*. And what does training mean—even what some might term the lower kind of training that the prize fighter demands? Simply that they live naturally, bathe properly, breathe pure air, live in the open as much as possible, exercise the muscles thoroughly and keep all the functions to their healthy performance by doing nothing to render them abnormal in exercise.

Now let a man or woman of intelligence determine to get into training to fight disease. How long is it going to be before such a one becomes absolutely sure of that method that keeps out disease? Experience has demonstrated that in a comparatively short space of time reasonably perfect health is established and may be maintained from that hour to the time when the body, slowly dissolving itself, allows death to come easily, painlessly and without fear or terror.

There is a vast difference, however, between our theory of the preventability of disease, owing to perfect health and the theory—guesswork—of the physiological chemists who claim to have discovered how to render us immune from disease by means of antitoxins. While this matter will be discussed elsewhere, I wish to make reference to it here, for I believe that *no person can be regarded as truly and perfectly healthy who is not absolutely immune from any and all disease,* except, of course, those caused by accident. These chemists assert that they have discovered an antitoxin or serum which absolutely destroys diphtheria.

Pasteur claimed to have discovered a serum for the cure and prevention of hydrophobia; Koch for consumption, and so on.

In fact, for a time the medical press was flooded with assertions that now, at last, by means of these antitoxins all infectious diseases could be overcome and immunity secured. And there loomed before the American and other civilized peoples a menace more terrible than that of vaccination, viz., that we should have to submit to compulsory injection of a serum for diphtheria, one for scarlet fever, another for yellow fever, typhus, typhoid, hydrophobia, glanders and a dozen other dread diseases which human flesh is subject to. What a frightful thing to contemplate! Yet, if the theory of compulsory vaccination be a correct one, how much more ought it to apply to the antitoxins which we should be assured would give us absolute immunity from these dread diseases.

In the middle of the year 1909 I wrote an editorial in *Physical Culture* which, in the main, is herewith reproduced, as suggestively covering this ground of immunity, and the difference between our methods and those of the chemical physiologists.

What would it be worth to the average individual to feel, at all times, immune from disease of every character? The value of this assurance could not be adequately measured, and yet this immunity could be secured and retained on to the very end of life. The fear of disease is universal. To most people it is a grim spectre. It assumes fearful aspects.

I am satisfied that almost any broad-minded individual can be freed entirely from the fear of these gruesome possibilities. Not only can one be freed mentally from the fear, but one can develop and maintain such a high degree of vital strength that disease can never secure a hold upon the body. I realize that to many this may seem to be a greatly exaggerated statement, but to those who have lived in accordance with the methods of Physcultopathy, and have indulged in a degree of reasoning on the subject in their own behalf, the conclusions advanced are facts, and are truthful in every respect.

Disease cannot attack a perfectly healthy body. Disease germs can never secure a foothold in healthy tissue. The entire medical world is continually searching for some means of rendering the body immune to disease. They are delving deeply into apparently impenetrable mysteries in their endeavors to solve this important problem. Their investigations, however, have been more or less confined to the study of disease itself and the symptoms and detailed characteristics associated with it. For instance, medical scientists have discovered what are commonly termed germs or microbes in the pus or other matter discharged from the inflamed surfaces of the diseased tissues, that are the results of various complaints. Great importance has been attached to the discovery of these germs, and the conclusion has been reached that in all cases these particular minute organisms are the cause of the disease with which they have been associated.

These deductions have been accepted as the result of experimentation. One experiment, for instance, has been to inject the germs of a definite disease into the circulation of a healthy animal. These germs usually cause the disease with which they have been associated. Even this experimentation, however, does not necessarily prove that the germ is in all cases the cause of the disease, for if these same germs were placed in contact with the mucous membrane which is said to be the seat of infection, they will produce the disease for which they are considered responsible only in those cases where the vital resistance has been lowered, or where the mucous membrane provides fertile soil for them—in fact, in those cases where poisons or impurities have accumulated to such an extent in the body that they are actively seeking a means of outlet. Then such germs may be able to produce the disease with which they have been identified.

Practically every advanced student of medicine is now prepared to admit that disease germs are innocuous or harmless to those who possess what might be termed a high degree of vital resistance. Such persons are classed as immune, and it has always been an unsolvable riddle to me why the germ-seeking scientists do not turn their attention to the study of the how and why of this immunity. They are seeking a method of insuring immunity against disease. Why do they devote so much time to the study of the minute details of disease itself, instead of learning something of the nature of the forces within the body which can render it practically immune from all disease?

Almost every physician will tell you that the severity of the attack of any acute disease will depend upon your vital resistance; in other words, upon how much functional strength or general bodily vigor you may possess. For instance, in a circular distributed by the Indiana State Board of Health we find the following:

"Diphtheria may be so mild as to pass as a 'simple cold.' We know this to be true because microscopical examination of children's throats have again and again discovered the germs to be present when the diagnosis was 'a little cold,' or 'a mild tonsilitis.'

"Diphtheria germs are frequently found in the throats and noses of children when no complaint is made, when there is no fever, and when no sign of illness can be discovered. Why all the symptoms of diphtheria do not appear under such circumstances may be due to the child's resistance (good health), or because the germs themselves are weak. It is found that diphtheria germs from the throat of apparently well persons, when cultivated, produce a poison which will kill guinea pigs and rabbits. It is further found that if 'weak germs' are transferred from one child to another they frequently grow strong and produce unmistakable diphtheria. Before this discovery was made the doctors thought it was necessary for spots or a membrane to appear on the tonsils and the walls of the throat before the case could be diphtheria. Only not-up-to-date physicians think so now. Very frequently the mistake is made of diagnosing a case as tonsilitis when it is diphtheria. The fact is, hundreds of cases of diphtheria are called sore throat, tonsilitis, or something else, and all such wrongly diagnosed cases may, and frequently do, spread diphtheria. This is how it happens that people frequently say, 'I can't see where my child caught diphtheria, for there have not been any cases around here,' while many undiscovered cases were on the streets or in school all the time."

Remember these statements are made by a specialist, who emphatically believes in the germ theory of disease. "Diphtheria may be so mild as to pass as a simple cold." There must be some definite reason for the mildness of such an attack, and would it not be easy for an advanced student of the healing art to discover this "reason why"? And, "It is found that diphtheria germs from the throat of an apparently well person, when cultivated, produce a poison which will kill guinea pigs and rabbits." Now, if germs are in all cases the cause of disease, how could one remain well with diphtheria germs in his throat? In fact, do not the statements of this authority prove absolutely beyond all possible controversy that disease, even in accordance with his own theories, is made possible, not by the so-called germ, but by the condition of the body itself? In other words, when the vitality of the body is lowered, which usually means that it is overloaded with poisons or impurities, which frequently assume the form of mucus or pus seeking an outlet from the inflamed membrane, then disease is easily acquired, for under such circumstances the body actually needs disease or some means of cleansing it of accumulated poisons. Such a disease may assume the form of diphtheria, scarlet or typhoid fever, or any one of a thousand other symptoms for which the medical profession have high-sounding, and often unpronounceable names. Let us quote further from the same authority:

"Diphtheria germs have been frequently found in the throats of persons who were quite well and who were not afterward brought down with the disease. Some people seem not to be susceptible to diphtheria, and the germs, although present, do not grow and cause the disease. A high authority tells of a nurse who carried diphtheria germs in her throat for a long time and introduced the disease into five families. This fact explains in a degree how it is possible for diphtheria to appear when there seems to have been no exposure, and it also teaches us to be very sure that recently recovered patients are free from diphtheria germs before they are allowed to go out."

You will note the statement: "Some people seem not to be susceptible to diphtheria." If the germs are found in the throats of persons who are not afterward brought down with the disease, and if it be true that the germs are in all cases the cause of the disease, how can anyone come in contact with them without suffering from the complaint? The advocates of the germ theory themselves thus prove in a very forcible manner that the proper way to make oneself immune from disease is to maintain the vitality at high-water mark. In other words, the dangers on which advocates of the germ theory of disease lay stress offer not the slightest menace to an individual who will so guide his habits of life as to maintain a superior degree of health at all times. Our contention, therefore, that disease is, after all, not a thing to fear, but that it is actually bodily "house cleaning," and cannot come to you unless there is need for eliminating impurities that have accumulated in your system, is to a certain extent upheld by the medical men themselves.

The medical scientists should turn their investigations to another channel. They should learn something of the powers of resistance possessed by the body, they should learn why health itself practically makes one immune from all diseases, and instead of going deeper and deeper into the unfathomable depths of the germ mysteries, they should begin to learn how to teach rational methods of building the vitality needed to insure freedom from all disease.

Disease is not an enemy! It is a friend! It comes as a means of bringing relief. It is an effort on the part of the body to right a wrong. It shows that the body is struggling for life and health, and on many occasions, if it were not for the diseases that come as a means of ridding the body of the vile accumulations of poisons, death would unquestionably ensue. Therefore, disease in many cases actually saves life. To be sure, if there is but a small amount of foreign material in the circulation and tissues of the body, the attack of the disease will be slight in character, though the authorities we have quoted refer to this physical characteristic as "resistance or good health."

All this reasoning brings us back to the question: "What is the cause of disease?" The medical scientist takes the disease itself, with all its minute symptoms, and attempts to solve the problem then and there, but it is far back of this. The cause of an acute disease, for instance, may have begun years before the body is finally attacked.

Medical men are slowly returning to Nature. They are beginning to abandon the use of drugs; they are realizing that the body itself must be depended upon to right physical wrongs, that drugs and poisons are useless. And the day is not far distant when they will all have to fall in line and commend in every detail the conclusions advanced by that famous physician, Professor William Osler, now of Oxford University, England, who has endorsed practically every rule of living inculcated by Physcultopathy.

Professor Osler, in a lecture before the Pathological Society in Philadelphia, stated that "he is the best physician who knows the worthlessness of the most medicine." He stated there were four drugs of inestimable value in the practice of medicine, and when he said he would decline to name them a roar of laughter went up from more than two hundred physicians, who were his auditors.

Dr. Osler said that the prevention of disease has now become quite as important as a cure. "Who would have thought only ten years ago," he asked, "that malaria and yellow fever could be prevented and their cure made unnecessary? The discovery of the germ of tuberculosis had brought no cure for that dread disease, by drugs, but it had brought an amelioration, and sometimes cure, by fresh air and diet."

Years ago I came to the conclusions of Professor Osler and with all the fervor and power at my command have been presenting them to the people. I again affirm that the best way to render people immune from disease is, not to drug them, not to dose them with antitoxins, but to teach and induce them to live normal and healthful lives, lives of simplicity and naturalness.

Thus believing, we come to our next proposition, viz., that *most manifestations of disease are curable.* To me, with my experience of over a quarter of a century, this has become almost an axiom. There are cases where the vital forces are so depleted, and the courage and fighting spirit of the patient so lowered, that death ensues. But, taken early enough and with intelligence, there is literally no disease under the sun that ought not to succumb to man's power. It may require "eternal vigilance," but surely if that is the price we are willing to pay for liberty, we should be willing to pay the same price for health. And it does not require drugs, special nostrums, great learning or superior intelligence. All it requires is common sense, persistence, energy, belief in the body that it is doing the best it can for itself, and that if helped, not hindered, in its efforts, *it will bring itself into a healthful condition.* I have thousands of letters from all parts of the world from persons who have suffered from nearly every disease known to man and who have said in effect:

"I have suffered from this and that disease, and I have tried every method know to medical science and have failed to secure results, and after trying your simple suggestions I have been able to secure that health and strength that has been denied me for many years."

How then can we be any other than filled with confidence that our position is a secure one and our methods unassailable? They have been tried over and over again, thousands of times; they have brought results where every known means advocated by the medical fraternity had failed; they are simple; they bring certain results in practically every instance, so that it becomes a mere matter of believing what you see with your own eyes.

In a lecture delivered in 1909 in one of our Sanatoriums I made the following personal statements, which are worth reproducing here:

"Nearly twenty years have elapsed since I first had occasion to try out these fundamental principles. At the time to which I am about to refer I was considerable of an athlete; I was indulging in all sorts of athletic contests, and about this time I contracted a cold. I tried to cure it by increasing my exercise. I ran a number of miles and worked in the gymnasium to induce profuse perspiration. I thought I could eliminate the cold in this manner, but it was apparently too deep seated. I gradually grew worse, and I soon noted various symptoms of pneumonia, the knife-like pain in chest, etc., etc. The problem as to the means of cure finally became acute. Though I had never tried fasting before, I concluded to stop eating. I decided that the impurities were being fed by the food that I put into my stomach. In two days I noticed a difference, a slight change for the better, and I was practically cured in four or five days.

"Now suppose I had gone to a medical practitioner and described my symptoms, what would have been the result? He would have said, 'You go to bed at once! Why, you are seriously sick!' I would have followed his advice, I would have been housed up in a room with closed windows for fear of a draft, I might have been fed on milk and whiskey and a lot of other 'stuff,' and if I had followed methods of that kind, I would not be here. I am positive of this conclusion because many years ago I had all the symptoms of incipient consumption, and after building the vigorous health that I now enjoy, I became an enthusiast, a crank, as many might call me. When I first began to search for a cure, I tried everything, all kinds of drugs and medicines. I grew worse, slowly but surely, and as a last resort became interested in exercise, nothing but exercise, and as I was simply dying for the need of some activity of this kind, I recovered. I built myself into a strong man, and the more strength I acquired, the more enthusiastic I grew, the more thoroughly I became convinced that drugs were needless, that the pretension as to their being able to cure disease was a serious error and of great danger and injury to humanity. You may say that I am prejudiced, and perhaps I am; but if you had been compelled, as I have been, day after day for many years, to read letters from thousands of victims of drugs, you might be prejudiced against the drugging methods. I believe every man and every woman is entitled to superb health. If you have enough vitality to live, you have enough strength to be healthy. Life, if it is worth living at all, is worth living in its highest, noblest sense. If you cannot be a man or a woman in every way, you might just as well get 'off the earth.' Take advantage of every opportunity to develop your body, make yourself strong and capable. Do not let those around you dictate to you.

"Do your own thinking! Come to your own conclusions! Use your own reason, and I am assured that you will forever abandon the old, complex and harmful methods of the past, and follow the simple and helpful methods we advocate. For in the one there lie misery, wretchedness, disease and death, in the other joy, happiness, health and life."

If, then, what we have advanced be true, ought we not to lose our great dread of disease? And it is one of the missions of this cyclopedia to help bring about this desired end. As was once stated in one of my public lectures to invalids:

"I would like to transmit to you the supreme confidence that comes to me when I happen to be attacked by a disease of any kind. I would like everyone to be able to help himself under such circumstances. I would like to see each one avoid that feeling of fear that often ensues when there is a slight pain or any other symptom that indicates disease. One special reason for the pressing need of this mental confidence is the destructive power possessed by fear itself. When you become possessed of a fear of disease, it has the best of you in the beginning. In fact, fear, the product of ignorance, is a disease in itself. Therefore, if you can eliminate fear when you are attacked by a complaint of any kind, if you can simply say to yourself: 'Well, I know the nature of this complaint, it cannot scare me, I know that it is simply a symptom, which is the result of natural causes and it will finally disappear.' If you can make such a statement to yourself when attacked by a complaint; in other words, if you can eliminate fear, then you will do a great deal in the beginning towards curing your disease.

"Disease is functional disturbance. In some cases you might say it is lowered vitality or lessened vital resistance. There is something wrong with the functional organism. Disease has not come upon you because you have been attacked by a germ of some kind, it has not come because you have breathed some extraordinary microbe, it has appeared because you are ready for it, in most cases because you have deserved it as a penalty for violating Nature's health laws. It has nevertheless come upon you as a friend. It is not an enemy. I would like especially to emphasize that disease is not an enemy. It does not come upon you like a thief in the night; it does not come to injure you. It comes to benefit you. Disease is, therefore, not a bad thing; it is a good thing. This may seem an unusual statement, and yet it is truth. I do not believe that disease is sent upon us for the purpose of making us suffer. Disease is useful. It serves a beneficent purpose. It really comes in most cases to clean our bodily house."

After reading these ideas for the first time in the *Physical Culture* Magazine, one of our good English friends wrote a letter of criticism in which he said: "I think disease should rightly be considered an enemy. I quite agree with you that disease only attacks those that are weak and of depleted vitality, but does that make disease a blessing? This world is a world of eternal fighting—only the fittest survive—but that surely does not make the destroyer of the weak their friend. There are diseases, as you admit, which are contagious. Perhaps all diseases are contagious, but they only develop where they find favorable soil. Disease does not exist in the blood, but the food for it does. There are two factors that determine the contraction of disease—the state of development and vigor of the attacking microbes and the degree of resistance of the organism they attack. The issue is this: That although we must try and develop resistance of our bodies and minds against attacking microbes by building up vitality, bodily and mental vigor, we must none the less directly combat these microbes by sanitation and cleanliness. We must not present to them a passive but an active resistance."

In response to this I made, in part, the following reply:

"Under no circumstances do we believe that disease is a condition to be desired. Circumstances sometimes compel one to choose between what might be termed two evils. For instance, if one had opportunity to choose between death and disease, the probabilities are one would take disease, and that really gives you a clear impression of what we meant when we stated disease was not an enemy, but a friend; not a curse, but a blessing. We meant to convey the idea that disease is friendly, beneficent, when it was actually needed by the system to cleanse the organism of impurities—to eliminate the poisonous or fetid matter that might be clogging functional activity. It is not difficult to realize that under such circumstances disease is friendly, and one might further state that disease never attacks one under any other circumstances. You cannot be attacked by disease if the body is in perfect health. Disease cannot enter your organism unless there is need for it. Therefore, when disease comes, you have deserved it; you are requiring the particular symptoms manifested by the disease at that particular time for very important reasons.

"Our friend says that disease does not exist in the blood, but food for it does. If food for disease exists in the blood then why can we not reasonably state that disease itself exists in the blood? If foreign or poisonous matter which is the cause of various symptoms of disease exists in the blood, then it is the blood which is out of order and it might be termed the direct cause of disease. If these impurities or poisons can be thrown out of the blood there would be no reason or cause for disease, and naturally disease would not appear.

"He also says there are two factors to determine the contraction of disease—the vigor of the attacking microbes and the vital resistance of the organism. Here is where he makes a very serious blunder, for the vigor of the attacking microbes is determined entirely by the fertility of the soil with which they come in contact. In other words, if the microbes, no matter how inactive or undeveloped they might be, should come in contact with tissues that are loaded with impurities and poisons, which are food for microbes, they would quickly become vigorous and multiply by the millions. It should be remembered that microbes are nothing more or less than minute scavengers and their purpose is beneficent. If the particular conditions which are essential for their existence are found they will thrive and multiply. If the particular poisons with which they are associated are present they will grow strong, but if the body is healthy and vigorous, if the organism is free from disease, the blood free from poisons, the microbes, regardless of their character, are powerless. They are not needed and they waste away and die when they come in contact with healthy tissue.

"We should, of course, try to develop the resistance of our bodies to the highest degree and by every means within our power, through sanitation and cleanliness, and the various vital building methods should be adopted with that particular purpose in view, but we should at the same time understand clearly and definitely the nature and cause of disease. We should understand that the body under any and all circumstances is working for its own good; that disease, if it does come, is the best means that the body can adopt at that particular time, and under the existing circumstances, to combat the unfavorable conditions that must then and there be resisted. There may be diseases that are contagious, but we think the most experienced bacteriologists will admit that no disease is contagious to perfectly healthy tissues; that a man enjoying perfect health can eat disease germs by the millions and they will not have the slightest effect upon him—but if the circumstances are otherwise, if there are poisons in the tissues and the body is not properly cleansed of impurities, disease can of course secure a foothold, and the germs under such circumstances might be capable of creating the disease with which they are allied.

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"We want to entirely eliminate the idea of mystery with which disease is almost universally regarded. We want to make our friends understand that the functional processes of the body are at all times striving with might and main to bring about the very best results. When you build strength, when you add to your vital power, you are diminishing the possibility of disease. But if you neglect the body, if the blood is charged with foul poisons of all kinds, these poisons continue to accumulate, and there comes a time when they taint the blood stream, and the tissues throughout the body are everywhere clogging the functional activity, and then the resisting powers of the body call a halt. They call for some relief; they send out a message for help and help comes in the form of disease. This disease as a rule takes away the appetite; it is preceded by various symptoms containing inflammation, soreness, and is accompanied or followed in nearly all instances with the elimination of a vast quantity of vile poisonous material, which is really and truly the actual cause of the disease, and the elimination of these poisons represents its true object.

"Let us not make any mistake. Disease is not an enemy; it is not unfriendly; it only comes when it is pitifully needed. Sometimes it actually saves life and it is a choice between that and the grave. There is no need of seeking disease; one should avoid disease, but it should be avoided by maintaining that degree of health which does not allow of the accumulation in the body of those poisons which are the actual causes of the various symptoms associated with disease."

Most people totally ignore the relative questions of health and disease, until some form of disease takes possession of them. I use this term "takes possession" advisedly, not that disease comes in that way, but because nearly every sufferer from disease feels he is "taken possession of." Usually he calls in the services of a reputed expert in whose mastery of medical lore he feels compelled to repose confidence and whose orders he generally follows with a blind faith that is as pathetic as it would be laughable were its consequences not so fraught with danger, and, oftentimes, death.

Most of us depend entirely too much upon the judgment of others, in matters of disease, and if we could only impress all those who read with the terrible necessity of doing some of their own thinking on important subjects, the effort expended will not be unrewarded. I earnestly desire to encourage the habit of investigation in every one. In the study of healing, as well as every phase of human life, use your own judgment. When doctors disagree, it is time for you to do some thinking on your own account. He who depends entirely upon what can be accomplished through drugging, when his health is in need of urgent attention is walking blindly towards impending disaster. He is apt to fall over the edge of a precipice, and into the great beyond at any moment. One might say he is blindly feeling his way through life. He is unable to look ahead, and he knows not what is before him. He is groping in the darkness of a hidden mystery, though in many cases his fears are alleviated to an astonishing extent by sometimes absurd and ridiculous advice that guides his physical welfare.

I have no set and immovable theories to defend, upon which I invariably depend. I have had a large personal experience in healing disease, and in teaching others to heal their own diseases. I have carefully and thoroughly studied the theories and principles of the various schools of physicians and common sense has urged me to reject them. I have openly and frankly said so, and have also openly explained why, and then, with equal candor, frankness and sincerity, gone on to explain why we should revert to simpler methods of obtaining health, driving out disease, and maintaining health.

Though I have studied the subjects for over a quarter of a century I am still studying and expect to continue to do so as long as I have the capacity for reasoning. As long as you maintain an open mind, you will progress and will be able to deduce clear, rational and really valuable conclusions. My advice is: Take no conclusions for granted. Learn all you can from the knowledge and conclusions that are presented to you by books and by those looked upon as authorities; all knowledge is of value. Test the ideas thus acquired.

Do not accept them as indisputable facts. For instance, if you read a book that appeals to you, do not accept the statements made in it until, through your own individual efforts, you have been able to prove the truth of its conclusions. The questioning habit is a splendid one to cultivate. Take nothing for granted until you have proven it to your own satisfaction.

It is from this open standpoint of mind that we shall discuss the question and seek to show, in this chapter and succeeding ones, the causes of disease and how easily preventable many of them are and how that simple and natural methods will generally, in the other cases, restore the sufferer to health, or at least mitigate his sufferings.

All disease may be summed up as caused by a deviation from the natural and normal course of life. What is the natural and normal course of life? To this question there are almost as many answers as there are inquirers. There can be no denying that in many of its aspects civilization is a series of deviations from nature. For instance, in a state of nature we should be born, live, work and die out of doors; we should wear practically no clothes except when cold compelled; we should eat food just as it was found prepared for us by nature; we should use neither artificial light nor heat; we should walk, ride perhaps on the back of animals or on vessels capable of sustaining our weight in the water; we might even attempt, like Sinbad the Sailor, to take flight on the back of the roc; but electric cars, automobiling, railroads or flying machines and all other paraphernalia of our advanced civilization would repel us as being unnatural and therefore injurious.

Yet we cannot ignore the facts of civilization. We do live in houses, and wear clothes, and use fire to cook our food and a thousand and one other things that separate us from a state of nature. Are we then to imply that civilization is a foe to health; that it is the creator and breeder of disease, and that the men and women who seek to live healthily must abandon civilization and revert to a natural condition?

While there is much of truth implied in these questionings, it is both foolish and impossible to expect men and women of today to abandon civilization and revert to what would generally be deemed a condition of primitive savagery. Hence the problem is to weigh carefully the advantages and disadvantages of civilization; to use the advantages as much as possible; to avoid the disadvantages with rigorous care, and at the same time to take advantage of all natural methods which will aid us in building up strong and healthy bodies, capable of repelling disease, or, where disease exists, find out the best methods for its elimination.

The following will be found to embrace all the known causes of disease: 1. Heredity; 2. Mental Influence; 3. Contagion; 4. Improper Diet; 5. Overstrain, Underexercise; 6. Physical Causes; 7. Mechanical Causes; 8. Chemical Causes.

Before proceeding to a detailed explanation of these causes I would call particular attention to the fact that they are divisible into two great classes, viz., those that happen to us without our knowledge or volition, and those that we bring upon ourselves. We might therefore term these two great divisions, the *unavoidable causes* and the *avoidable causes.* In discussing the following lists, therefore, it will be observed that we have devoted but little time to the unavoidable causes—for reasons which will be self-apparent—and have enlarged considerably and with all the emphasis at our command upon those causes and diseases that are avoidable or preventable.

1. HEREDITY.—Heredity has always been regarded as a predisposing cause to certain diseases. But the more advanced scientists are inclined to view with disfavor many of the ideas that have been so strenuously held in years gone by. Luther Burbank claims that heredity is but "the sum of our past environments." Tyson, one of the most eminent professors in America on "the practice of medicine," however, asserts that "There is reason to believe that the children of alcoholics are not only more susceptible to the degenerative effects of alcohol, but also to other disease such as gout, rheumatism, syphilis, and diseases of the nervous system. Among the latter may be men-

tioned especially epilepsy and melancholia, dementia and insanity."

It is well known that infants are born suffering from syphilitic and scrofulous diseases. "At the present time the most common cause of blindness among civilized peoples, is the purulent, or gonorrheal, conjunctivitis of the newborn." —*Reissig and Jelliffe.* Congenital dislocation of the hip-joint is a hereditary defect, and many other ailments, of greater or lesser seriousness, are known to exist in the newborn.

2. Mental Influences.—No intelligent person can question the wonderful influence the mind has over the body in the cause of disease. Many people are perpetually sick because they perpetually worry. Violent frights have caused convulsions, paralysis, insanity and even death. Mental distress is often said to cause insanity in predisposed individuals. In a later chapter we shall discuss the power of the mind in the healing of disease.

Especially upon the young would I impress the importance of preserving the right mental influences. *Fear* is a constant predisposer to disease. There is an epidemic—smallpox, measles, spinal meningitis—and because we reproduce in our bodies the conditions that the mind constantly pictures and dwells upon, otherwise healthy persons develop the disease. Parents and physicians too often have taught children fear—fear of this, fear of that, and of the other. We are afraid of wet feet, of draughts, of taking cold, of germs, of night air, of running up stairs, of childbirth and of a thousand and one things that there ought to be no fear of whatever.

There is but one thing we should fear, and that is fear that we may be wrong, and even that a really healthy mind will never contemplate—for no really healthy person ever wishes to do wrong. Fear is a despot as cruel as it is cowardly, as mean as it is powerful. It takes every mean advantage and strikes one unawares and in the back. It never comes out in the open and in the light like a courageous opponent, but fights in the dark. It "suggests" certain evils, urges you to "think over" things, and is sure "you ought to be more careful." It hints, whispers, nods, lurks, sneaks, skulks, slinks, prowls, mystifies, disguises. It lures its victims on by lulling their fears for a while and then suddenly reawakens and strengthens them by shouting "Boo!" at them unexpectedly. It sometimes appears to grow like the genie out of the Oriental bottle, until its immense form reaches to the sky and shuts out the light of the sun; and again it hovers around like a black cloud assuming all kinds of horrible shapes and fearsome forms. It has power to make you dream and thus with cowardly ruffianism strikes you while you are asleep, whispering in your ear of this danger and that, of this possible evil and that, until crazed with its direful suggestions, the victim's brain reels and topples over into semi-insanity. Fear fills the body with poisons.

Quit being afraid. Strangle this monster fear. Become men and women, fearless and unafraid. Face all there is, bravely, knowing that a foe well faced is half conquered. God and Nature mean well by you in every way. Trust that basic fact. Rely upon that. Strengthen your heart and courage with that, and then as you walk through the years of life you will come fully to realize that difficulties and dangers disappear before the brave of heart.

Anger is a cause of disease. Anger poisons the secretions. Who has not felt the mouth become dry, and then bitter, under the effect of anger? Nursing mothers have killed their babes under its influence, their milk becoming charged with anger-generated poisons. Long-continued anger produces a breaking down of muscular and nervous systems, often causes acute and, finally, chronic dyspepsia, insanity and death.

Jealousy is a cause of disease. It unsettles the nervous and digestive systems, disturbs the circulation of the blood, irritates the brain and is an associate cause of insanity.

Prudery is one of the most serious causes of disease. According to the Standard Dictionary, prudery is the "exhibition of extreme propriety in conduct and mental attitude; an undue and sometimes insincere display of modesty and delicacy; primness; overparticularity." This does not entirely express it. It is important that you distinguish between true modesty and prudery. One may be ever so modest, and yet consider and discuss the subject of sex in every detail, in a pure-minded, wholesome manner. The term prudery, however, refers to excessive and affected modesty, and implies a degree of insincerity. Prudery involves hypocrisy, which is only another name for dishonesty and deceit. In fact, hypocrisy is a most contemptible form of lying. Prudery is distinguished by its indisposition to accept and face the truth, or to tell the truth. Its representatives would have us believe that ignorance in regard to sex means innocence and virtue. Prudery simulates this innocence and virtue by a conspicuous silence, and it would if it could stifle the entire subject of sex by crying out "shame, shame" every time it was approached. In this way, not only boys and girls, but even men and women are left in ignorance of the sexual quicksands and pitfalls which they are bound to come across at some time of their lives when, as is manifest, they should be possessed of that knowledge by which they would have thorough understanding of the dangers in question. Ignorance is always dangerous. Philosophers have said that "ignorance is the only sin." The more vitally important any subject is, the more dangerous it is to be kept in ignorance in regard to it. The great facts of life and sex are of the very first importance and those who would encourage ignorance about them are public enemies of the most dangerous type. The prude is invariably inclined to pruriency; indeed, it is difficult to conceive how one can be prudish who is not prurient. Moreover, the prude fails to realize that morality is a matter of behavior, and not an attribute of any special material thing or organ of the body. Because of the very common misconduct and perversion in sex matters, even on the part of the prudes themselves, all being due to ignorance, they have placed upon the reproductive function the stigma of impurity. They fail to understand that there can be no indecency attached to sex except by reason of the misuse they have made of it, and that the reproductive function in itself is as natural and as pure a function in human beings as it is in flowers. Still and in view of his abnormal vileness, it is conceivable that the prurient prude would find something vulgar and degrading in the reproduction of plants.

My experience is that all attempts to hide the facts of natural function, or to keep knowledge of it from the young, foster the very mental activity we are supposed to deaden by our silence. No young person, boy or girl, who is intelligent and observant, or who reads and studies, is going through life ignorant of sex function nowadays, and frank and open discussion and explanation is the only moral, right and sensible procedure.

We have received thousands upon thousands of letters from young men and women who have gone down to perdition, wallowing in the wreck of sickness and ruin, simply because of this accursed prudery—because they did not have parents, guardians, or teachers who were clean, intelligent, and noble enough to tell them the truth in regard to matters of sex.

Worry is another mental cause of disease. To be in a perpetual state of fret, of mental unrest, of undue solicitude, of disquiet, of anxious dread, of fearful anticipation, and of terrifying expectation—how can one not become diseased when given up to such mental condition? Mothers worry about their children when they are absent. How absolutely absurd! How foolish! How insane! Can the worry protect the child? If there is any truth in the idea that our mental conditions are transferable then the worry injures and jeopardizes him instead of protecting him. And certainly when the child has returned to the presence of his mother the expression of the worry would disturb him if he were as healthy as a Hercules, and as serene as the Sphinx. So that both "worrier" and "worried" are injured by worry.

Husbands worry about their wives, and wives about their husbands, business men about their business, society women about their social functions, financiers about their investments, chemists about their experiments, students about their examinations—all futile, all wrong, all unnecessary, all provocative of disease.

Another prolific cause of disease is unhappy marriage. This may be a mental or a physical difficulty, or a combined one, but there can be no question but that disease is often the result of improper or unhappy marital conditions. No man, no woman, can live continually in a state of irritation, discontent, unhappiness, regret, or anger without suffering, and this soon begets disease of mind or body. Nervous disorders, brain diseases, dyspepsia, sexual diseases all may spring from an unhappy marriage.

Besides the suffering to the ill-mated couple, if there are children they are made subject to disease. Children born in unhappiness are almost sure to be prone to disease, and others are subject to the irritating influences that come from the quarrelings, the irritations, the sulkings or the heart-breakings that arise from these unhappy marital relationships.

It may not seem scientific to those who regard "life" as subject merely to the laws of the scalpel and miscroscope, to make the statement, but we wish to assert that another great cause of disease, too often ignored by the scientist, is what the churches call "sin." Sin is wrongdoing. It may be merely in thought and thus come under the head of mental influences, or it may be converted into act and then come under some other head. We do not intend to enter into any discussion as to the nature of sin, or its origin. The human mind is so organized and trained that it generally recognizes the law of the "ten commandments," and knows that violation of those is sin. Violation of law often produces remorse. Concealment is also necessary and remorse and concealment, anxiety lest one be discovered, and fear of consequences if discovered, are some of the strongest *mental* causes of disease associated with what is called sin.

3. Contagion.—As I have shown elsewhere, the medical world believes thoroughly in the idea that many diseases are caused solely by contagion. We largely combat this idea, but at the same time we recognize that there are certain parasitic contagions which are the result of transferring living organ-

isms from one body to another, as ring-worm, the itch, the trichina from eating diseased pork, the tape-worm, etc. But the most important phase of the theory of contagion as held by the later schools of advanced scientists is that generally known as the "Germ Theory." The microscopists tell us that there are three forms of disease germs in the blood. These are *rods, spheres* and *spirals* and they are divided into *bacteria* or *bacilli, cocci* and *spirilla,* as they assume one or the other of these three forms. They are all generally known as *bacteria* or *germs.* And we are told that the germs of anthrax, of diphtheria, of tuberculosis, or influenza, leprosy and the plague are rod-shaped or *bacilli,* while those of erysipelas, of gonorrhea, of pneumonia and of trachoma are sphere-shaped or *cocci*, and the Asiatic cholera and relapsing fever are spirals or *spirilla.* This list, however, the scientists tell us, is merely suggestive and incomplete, as the work in this field is as yet in its early stages.

While I have written strongly on the absurd fears implanted into the hearts of people by the scientists in regard to "germs," I would not have it thought that I do not recognize any danger from contagion. In such cases as itch, ringworm, trichina and the like it is perfectly possible that the insects may be transferred from one body to another and this "transplanting" we call contagion.

In regard to the "germs" of disease, there may be a similar transplanting, but experience demonstrates that to a healthy body there need be no fear, as the germs have no condition for growth.

And the vaccine and antitoxin therapy methods which the scientists adduce from the "germ theory" are entirely repugnant to our sense of right and health; hence we oppose them with unextinguishable vigor and earnestness.

4. Improper Diet.—Disease may be caused by deficiency or by excess. Foods may be improperly balanced, too much of one kind, too little of another. Upon the right solution of this question of diet largely depends the health of the race.

Improper dietetic habits are the cause of many serious diseases. The average individual knows little or nothing of diet, and when you discuss the value of knowledge of this character, you will often hear remarks like the following: "My father lived to be eighty or ninety and he did not bother about these new-fangled ideas of health. He was rugged and healthy." He may have been, but as a rule he had a great deal more vitality than his sons or his daughters. He may have been one of those pioneers who grew up on farms, who had to chop wood and grub up stumps the larger part of their early years. These vigorous exercises, long continued, connected with the simple diet that he was necessarily compelled to subsist on, were the means of building great vitality, and consequently, after he attained maturity, any ordinary deviations from a healthful diet would have little or no effect upon him. The digestive organisms of many individuals possess such an extraordinary degree of strength that they seem to be capable of getting nourishment from any kind of food, no matter how difficult it may be for the ordinary stomach to digest.

In these days we are not called upon to live the vigorous and simple lives of our forefathers and naturally we do not have the vitality that many of them possessed. Then, too, we have been feeding on their vitality for generations. This conclusion is very easily proven by the experience of the average country bred man who moves into the city to found a home. He brings with him all the vitality and strength that he has gained from outdoor country life; but notwithstanding the great vigor that he brings to the city, his family tree, as a rule, exhausts itself in from three to five generations.

If the great cities were not fed by the life blood of the country districts, they would cease to exist. They would begin almost immediately to decrease in population and would soon be wiped out of existence entirely unless they learned the lesson of preserving the vitality of their people. The American people have been wasting their vitality generation after generation. We have been feeding largely for the last generation upon the vitality of the people who have come to us from foreign shores, and now we are beginning to realize that we must learn something of the laws of health if we are to fight disease, sickness and early death. We must learn how to feed ourselves. We know how to feed our horses. Scientific dietetics, so far as they are concerned with the feeding of hogs, chickens, dogs and various other live domestic property, have been thoroughly studied, but scientific dietetics for the human race are still in their infancy.

While I freely confess there is such a thing as being too anxious about diet, there is also an ignorance, a carelessness, a disregard of natural principles that is dangerous to health. We have seen that disease is a departure from the normal. To eat properly we must understand what is normal in regard to appetite; we must know what to eat, what to avoid, when to eat, when to fast, how to eat. These branches of the subject have been thoroughly discussed in the first volume of this work on Diet, but here we wish to call attention to some common and well known errors in diet which produce disease.

That *insufficient food* causes disease, is known to all who have seen or read of the famines of India, Asia, and elsewhere, or of the potato famine in Ireland and similar shortages of staple articles of diet among the poor of many lands. While what Jesus said is undoubtedly true, viz., that "man shall not live by bread [food] alone," it is a fact of universal observation that all animals subsist upon food. A diminution of this supply of food below a normal ration means malnutrition—incomplete nutrition—and this is disease.

But not only may the total quantity of food be below normal. One may be fed upon food which seems to be quite sufficient in bulk for one's needs, and yet be insufficiently or improperly fed. This we believe to be the case with white and bleached flour. Babies fed on a mixture made of white flour, water and sugar are poor, weak, anemic creatures and thousands of them die annually. Adults fed on white flour do not have the strength that do those fed on whole wheat flour, and constipation with its attendant evils is often the result of its use.

If we were to enumerate all the dietetic errors of which the American people are guilty, we are afraid our list would be as startling as it would be long. The majority of Americans eat too much and they eat too great a variety of food at one meal. One has but to look at the menus of an ordinary hotel, especially those of the high class hotel, where course dinners are still the rule, or the American plan of service is still in vogue, to find adequate proof of this statement. From five to eight and even ten courses are served, often with a variety in each course. Take a full course dinner for example—I quote from a menu of August, 1919:—Cantaloupe; clams or oysters; soup; fish; (with relishes, olives, radishes, onions and pickles—sweet, sour and Dill); entrée of minced chicken; roast beef, salad, squab, (with a full assortment of vegetables); ice cream, cake, pie and other desserts; crackers, cheese; and coffee. This is an ordinary standard menu of a first class hotel, and no account has been taken of ice water, tea, milk, lemonade or other drinks, or the tidbits and relishes that some people habitually use while partaking of a meal of this character. Does it need much wisdom to know that to eat heartily of such a meal is a crime against any stomach and that disease is an almost inevitable result?

For a moment recall the important fact that the stomach is a muscular pouch which receives all these various articles of diet and drink *together*, and then proceeds to *mix them thoroughly*. Contemplate this stomach mixture. Or better still, suppose you take all these various articles of food enumerated and mix them together in a large punch bowl. Now stir them altogether and carefully examine the mixture. Do you not think the result would be a frightful warning?

The experiences of all races in all ages have taught that too many varieties of food at a meal are always provocative of disease. It is the habit of most people today to eat too many different foods at the same meal. They also eat entirely too much.

If we would eat less in quantity, masticate more thoroughly and avoid such a great variety, confining the meal to, say, two or three articles, the digestion would be carried on to a far greater advantage. It is unwise, to say the least, to eat a combination of various articles of food at one meal. We eat all we really require of one or two articles of food and then we proceed to tickle the appetite with half a dozen other foods, while if the meal had been confined to two or three articles, we should not have eaten half as much.

Another serious dietetic error is found in connection with most foods where we eat too much and of too great variety. They are nearly all very highly seasoned; Salt, pepper, vinegar, with other spices and condiments are used to great extent, and when so used they are undoubtedly harmful and provocative of disease.

But it is not only the diet of the well-to-do that is disease-producing. The poor and the artisan are too often both ignorant and careless in their dietetic habits. Food is improperly cooked, and oftentimes depraved tastes are followed in the way of greasy pastries, meats fried in lard, sausages which are either too highly seasoned or preserved with injurious chemicals, and the whole meal washed down with ice water, hot coffee or beer instead of its obnoxious features being ameliorated by proper mastication.

This brings us to the consideration of another bad dietetic habit, namely, eating too fast. One has but to watch the people of a great city at its noonday meal to fully realize the evils of this habit. And in this consideration, we will leave out the people who are financially able to eat the elaborate course meals we have described, and who compel themselves to take more time. We refer to the class who visit the cheap restaurants, *cafeterias*, lunch rooms, etc. These, as a rule, are the men and women who do the actual work of a community and who, therefore, should always be in the highest state of mental and physical efficiency. Watch them from the time they leave their store, factory, workshop or office. They *hurry* to put on their hats, *hurry* to the eating place, *hurry* inside, give their order in a *hurry* (or if in a *cafeteria, hurry* to have themselves served), are impatient until their food arrives, often commanding the waiter to *"hurry it up"*; and when fairly seated before their food, fairly attack it with a fury of *hurry* that would be ludicrous were it not both disagreeable and painful to contemplate. Instead of properly masticating hard food, it is bolted or washed down with water, coffee, tea or beer. And in hundreds of cases one may see the victims of these bad dietetic habits taking a pill or powder before or after the meal to counteract the ill effects of their own ignorance or indifference. Then, instead of taking a little rest after the meal, they hurry back to their work, taxing brain, hand or eyes unduly, and thereby adding an additional burden to their already overworked body.

This hurried mastication—or rather this insult to the real idea of mastication—results in putting an extra burden upon the stomach, and at the same time works a direct injury to the teeth.

Your stomach is not supplied with teeth; your teeth are in your mouth. They were put there for a purpose. No wonder we have need for so many dentists. If you feed a cow on slop food, her teeth will fall out. If you feed yourself on mushy food, if you use mostly those foods which require no chewing, your teeth will gradually lose their strength and vitality and will require fillings and may finally be destroyed through decay. Horace Fletcher, the mastication expert, proved that you can live on half or at least three-quarters the amount of food you are eating at present if you will simply masticate your food thoroughly. Thorough mastication does not mean thirty-two times as has been advocated by Gladstone, the renowned English statesman. It means that you should masticate and continue masticating every mouthful until it disappears without swallowing. It frequently takes a great deal of practice to cultivate the mastication habit—to actually make it a habit. In some cases it takes determination. We have to be persistent for a long period. If you were to masticate to the extreme advocated by Mr. Fletcher, you would have to chew an ordinary mouthful of food from seventy-five to one hundred times in order to thoroughly masticate and liquefy it until it would pass down your throat without any effort being made to swallow. As a rule, if you will simply retain the idea that food should be swallowed at all times without effort, that is, that you should never make an effort to swallow your food, and never, by any means, *wash it down* with water, milk, tea or any other liquid, that you should masticate it until it seems to disappear without swallowing, you can rest assured that you are masticating sufficiently. This might not require you to masticate to the extent advocated by Mr. Fletcher, but you would be following the laws of mastication as nearly as can be expected. If it were not for the liquids that are used at mealtimes, very many human beings would nearly choke to death in endeavoring to swallow their food. The average individual takes a mouthful of food, and washes it down with a swallow of coffee, without mastication.

Another gross dietetic error is that eating keeps up the strength. We eat three meals a day because it is our rule, not because the body calls for it. Few people are able to eat three hearty meals each day without injury. It is not what we *eat* but what we *digest* that nourishes us, and when food is not digested every additional particle taken into the stomach is a direct injury and a sure inciter to disease. Few people know what real normal hunger is because they never give the body a chance to find out. The craving for food that we all have at the usual meal hours—that gnawing, empty sensation—is not hunger, as all can testify who have taken a fast for a few days, and have then felt the generous flow of healthful saliva, the keen delight of feeling the teeth biting a hard, dry biscuit, or the pleasure of masticating a dry morsel that ordinarily he would never have looked at, without any appetizers, condiments, extras or "fixin's."

Unless the normal, healthful appetite calls for food, let the stomach rest, by taking a fast for a day, a week, or even longer. As a rule there will be no danger. It is not often that a fast can possibly do the slightest harm, and with all but one out of a million it will do much good.

Here is another important consideration. The less you eat to maintain health and strength and the vitality that is essential, the longer the human machinery will wear; the longer you will live; the fewer diseases you will have, and the stronger you will be in every conceivable way.

I have also demonstrated in my own and thousands of other cases that the more one adheres to a wholesome diet, the more you can rely upon your appetite and stomach to tell you what is good for you and the reverse. It becomes like a tender conscience—more sensitive to good and evil, and therefore, in time, can be absolutely relied upon. For instance: Many persons, when they have been accustomed to three meals a day and change to a more reasonable diet, find that their stomach causes them more trouble than it did when they were eating three meals daily. Then they become aware that they have a stomach. In other words, the stomach develops a capacity to discriminate between right and wrong; and some, when they notice this particular inclination, have the impression that they are beginning to acquire stomach trouble. Never were they further mistaken. They are, in reality, just beginning to get ready to really enjoy the pleasures of a healthy stomach, for this slight distress is proof that the delicate nerves of the stomach are coming to life. They are not being "doped" with food, and they begin to understand the difference between wholesome food and that which is pernicious, and the more closely you adhere to what is normal and right, the more delicately acute will become the nerves of the stomach. Then when you fail to obey the rules of dietetic wholesomeness it will very plainly indicate its displeasure in pain and discomfort.

Another important fact has been brought out by our large and long continued experience, viz., the danger of giving food to those who are suffering from acute diseases. This is no longer a theory. It has been proven so often, without a single failure, as to have all the positiveness of mathematical demonstration.

In all acute diseases, regardless of what they may be, the functional system is taxed to its utmost in eliminating impurities. It has no time to digest food—no need for food. Proof positive that food, either liquid or solid, eaten under these circumstances, does not nourish the body in the slightest degree, is seen clearly in all fever patients. No matter how much food they eat, their bodies continue to waste just the same. In fact, it will nearly always waste still more when food is given, because the process of recovery is prolonged under these unnatural circumstances. The process of curing the body of its disease is compelled to cease in order to rid itself of the material that is forced into an unwilling and unprepared stomach. Thus a body already overloaded with an excess of food must be subjected to the outrage of being compelled to free itself from the additional impurities created by incomplete and imperfect digestion always produced when food is eaten under these abnormal conditions.

The muscles of the arms, legs and every part of the body are frequently so weak in illness of this character as to be almost incapable of action, and still patients and physicians have the incomprehensible ignorance to suppose that the stomach is still capable of digesting food that would nourish a day laborer.

The stomach is a muscular organ; digestion is carried on mostly by muscles, and these muscles are as proportionately weak in your stomach as they are in your arms, legs or elsewhere—even the digestive fluids are furnished almost entirely by elements of the blood which build muscular tissue, and when the muscles are weak this element is, of course, not plentifully supplied by the blood. Therefore, under these conditions, food is not needed and is not craved. But foolish doctors tell you that you must feed—that food is necessary to give the patient sufficient strength to bring about recovery. The instinct of the patient, which generally testifies to the absolute necessity for fasting, is of no importance. "No matter if there is no appetite for food you must be fed nevertheless," says the wise (?) doctor.

Thousands of years before the existence of medical science with its vagaries, its powders, its pills and its potions, there was in the possession of every human being an instinct which guided correctly his every action.

Even dogs, horses, cows and other domestic animals possess this instinct, though slightly marred by contact with civilization. All wild animals possess it in a perfect state. Though human beings of today are not blessed with the great protecting power of this instinct in all its completeness, they are, nevertheless, able to determine when they are hungry, and this instinct, no matter how much it may have been subverted, is a thousand times more capable of accurately dictating as to the time when food is needed than is any physician, regardless of how great his intelligence may be.

It will be remembered that when President McKinley was shot, I emphasized these facts in *Physical Culture* Magazine. I then believed, as I believe now, that the unhappy man was killed more by the food taken than by the assassin's bullets. Indeed, the bulletins of the medical men clearly showed that this feeding while the President's body was enfeebled and enfevered was the cause of death. For the first six days after the bullets entered his body, he practically ate nothing, and his condition was so satisfactory that the physicians who attended him said that he would soon be able to sit up. The President was a fleshy, well nourished man and could have been well fed from his own body for from thirty to sixty days without injury, thus giving every opportunity for the elimination of all poison generated by the bullet wounds, and allowing them to heal. The effect of a gunshot wound is to produce in the body what is practically an acute diseased condition. It is a made sore, which in the process of healing is accompanied with fever and inflammation. Had this sore in the President's case been treated by the simple, natural method, no food would have been given to him until all fever and inflammation had subsided. Unfortunately, the physicians were cursed with the erroneous, and proven to be false, notion that to maintain the strength capable of eliminating the fever and healing the wounds he must eat. The result was they urged the President to eat a meal of coffee, toast and chicken broth.

The following day they themselves explained that "the accumulation of undigested food in the stomach had at that time become as rank as ptomaine and that a bolus of calomel and oil had to be given. It was exceedingly drastic. When relief came, exhaustion followed."

Here are cause and effect so clear that a child might read. The food was unnecessary and uncalled for. In the fevered condition of the President's body, it could not be digested. Undigested, it becomes a mass of poison, breeding ptomaine poisons enough to kill a dozen healthy men, let alone one in his condition. The result was death and the weeping of a nation.

I have quoted this case at some length in order that its lesson might be forcibly impressed upon the minds of readers. Let it be clearly understood: In all acute diseases, whether caused by accident, or otherwise, do not force the patient to eat until he positively craves food, and even if he calls for food, do not give it until all fever and inflammation have subsided. Exactly the same conditions apply in nearly every case to patients after undergoing surgical operations.

From what has been stated it will be seen that we believe the following dietetic habits to be serious causes of disease: The eating of white flour foods, eating too much, eating too large a variety at one meal, eating too fast, drinking at meals to wash down food improperly masticated, eating too highly seasoned food, eating improper and improperly cooked food, improper mastication of food, eating too often, and eating when suffering from the fever and inflammation of a wound, surgical operation or acute disease.

No wonder that with these conditions constantly violated the drug shop with its vast array of drugs and its worse array of patent nostrums flaunts itself on every street corner; that there are at least as many physicians as there are public school teachers, and more sanitariums and hospitals than universities. To a healthful, hygienic, self-respecting nation, every patent medicine advertisement and drug shop should be an insult, and every physician, whose duties were not confined to surgical cases, accidents, births and deaths, should be a reproach.

While we have here treated the subject of diet at some length, it has been mainly to show how improper diet contributes to disease. We wish especially to have our readers carefully and studiously peruse what we say on the health side of this diet question. Here we show what to avoid; there what and how to eat to gain and maintain that perfect and abounding health which is a perennial joy to its happy possessor.

5. Overstrain or Underexercise.—In this category may be included overstrain of the eyes by excessive reading or under improper conditions; bicyclists and other athletes often suffer severe heart and nervous strain by too long continued performances; many business and professional men, and even society women, break down as a result of nervous overstrain caused by the rapid pace at which we live. On the other hand, much disease is the result of want of exercise. If the eyes were closed for months at a time and then suddenly exposed to the light it will be found that they are permanently injured. So with the muscles. Sometimes the fracture of a bone will compel muscles to lie inert for some time. They then become "atrophied," which simply means wasted away, with a consequent loss of strength. Thousands of people, however, suffer daily from underexercise. To put it plainly, they are lazy. They eat too much and thus become "logy," and that is an excuse for their laziness. They thus become subject to disease and its suffering. We are equally opposed to overstrain as to underexercise, but where one person suffers disease from the former cause, we are assured there are ten thousand who suffer from the latter.

As we shall emphatically show, the science of Physcultopathy has for a fundamental basis the proper exercise of every organ and muscle of the body. We contend with greater emphasis than any other health teachers or healers of disease that all the muscles of the body should constantly be exercised if health would be secured and maintained.

6. Mechanical Causes.—Among these may be stated what we term the mechanical accidents, such as cuts, stabs, falls, bruises, and the like, but even here the problems are not simple. For instance, a man falls from a horse and fractures his skull, causing direct injury to the brain. This may induce paralysis, and general derangement of the nervous system and ultimately a complete wrecking of the entire organism. Other mechanical causes of disease are those connected with bad habits of clothing, as tight and high-heeled shoes, the use of the corset, the wearing of a tight, unventilated hat, etc.

While the accidents above mentioned are often unavoidable, bad habits of clothing are deliberate, or at least wilful, and, therefore, the diseases caused by them are preventable. The use of tight shoes prevents absorption of the insensible perspiration that is continually being given off by the pores of the skin, and this inevitably results in disease of the feet. Who is there that believes the foul odor that emanates from the feet of some persons is a sign of health? Such fetor is frequently a sign of disease. It is the protest of the much abused feet, and is a warning calling for a change in the habits of the foot-abuser lest worse suffering come. The soles of the feet, as well as the armpits, and the palms of the hands are all especially qualified for throwing off waste matter, hence should equally be kept clean and aided in their important work. But this is only a small part of the trouble. Tight shoes prevent the proper circulation of the blood of the feet, and this, and the extra undue pressure on certain joints and other places, produce unsightly, disfiguring and painful enlargements of the joints, together with corns, bunions and other feet injuries. We speak of the brutality of the Chinese in cramping the feet of their women so that they are rendered incapable of walking, but our civilized habit is of exactly the same criminal nature, limited only in degree. There is no doubt but that one great cause of the diminution of the healthful and invigorating exercise of walking arises from this use of improper footgear.

In addition to the badly ventilated and too tight footgear, let us add the high-heeled shoe which distorts the foot in another way. Dr. Francis D. Donoghue, one of Boston's eminent surgeons, asserts that "only the small fraction of one per cent. (practically none) have normal feet or walk properly."

He says that thousands of shop girls, domestics, factory workers, working men, mechanics, artisans, machinists, and also people of the wealthy class are unwittingly but constantly laying up a store of trouble by ignorantly abusing the delicate joints and tendons of their feet and legs. Many a shop girl suffers pain about the hips and of the spine which she attributes to some internal trouble, aggravated by being on her feet ten of twelve hours a day, when the whole trouble is entirely owing to ill-fitting shoes with their idiotical and injurious high heels. When the foot is encased in one of these destroying implements, the bones, muscles, nerves and tendons not only of the foot, but all the way up the legs and back of the body suffer as a result. Hence every person seeking to be free from disease and live in perfect health should avoid this class of footgear and find one that allows the foot proper ventilation, right pose for the heel and the proper and natural freedom of the foot in exercise.

The same strictures that we have used in reference to tight shoes applies with equal force to tight, unventilated hats. It should need no argument to demonstrate that the natural, normal condition of man's head is not bald. Nature has kindly designed a hirsute covering for all her human children. Few suffer from baldness until it is created by the wearing of unhygienic and tight hats. The tight derby, or any tight unventilated hat, is little better than the much-abused stove-pipe. The effect on the scalp is much the same. Poor ventilation, and the constricting band around the forehead which prevents the free circulation of the blood that nourishes the scalp and hair roots, unite to accomplish the mischief. And the result is, we find young men who are bald. Experience has demonstrated that baldness is almost entirely preventable. It is unnatural and abnormal.

Another mechanical cause of disease is the corset or constricted waist.

Corsets and Constricting Clothing.—There are tangible reasons for believing that we have passed the day of tight lacing and clothing constricting the abdomen to the point of injury. Yet it is unfortunately true that no one knows what infliction the vagaries of fashion may next saddle upon womanhood. It should be remembered that constriction at the waist line is certain to prevent effective return of the venous blood from the parts below the waist line, hence producing imperfect circulation and consequent retention of impurities of the blood, thus laying the foundation for tumors, cancers and other abnormal and inflamed conditions which force so many women to turn to expensive and dangerous operations for relief. It is the greatest cause of the functional disorders peculiar to women, and by weakening the nervous and muscular systems is the invariable cause of displacement of the important internal organs. It thus perverts and often destroys the instinct of sex.

Perfect health demands perfect freedom for exercise of all parts of the body. A boy in the free restlessness of his boyishness and refusal to be trammelled by the fears of impropriety, and also because society allows him a much larger freedom than it does his sister, enjoys this freedom of body to a very great degree. Up to the time of puberty, at which time they are supposed to begin to wear long dresses, many girls have a large amount of freedom allowed them. But at this time, acting under a mistaken idea of kindness in supposing that her child needs the support of the corset, or controlled by the insane dictates of fashion, the mother encases the flexible, yielding, expanding and growing body of her daughter, budding into young womanhood, in this monstrous and cursed device of civilization. What is the result? From the very first the constraining and constricting influences produce nervousness and general physical irritability. This may be borne with complacency by the young miss, for a short time, while she is under the impression that her new article of apparel makes her more womanly. But, in time, this complacency wears off, especially as the injurious effects of the corset begin to be felt. The vital organs which, viewed from the standpoint of motherhood and of the welfare of the race, are far more important in the woman than in the man, are constricted, thrust out of place, diseased, and thus rendered incapable of properly performing their God-appointed functions. The corset ultimately injures and makes shapeless, flaccid, and nerveless the flesh at the waist line; it destroys the beauty lines of the body, of the limbs, arms and bust by restricting nourishment, interfering with normal circulation and thus lessening vital power.

Another mechanical cause of disease is unthinking rashness of action. Often a woman's clothing in cold weather is inadequate to maintain bodily heat, due to the dictates of fashion; colds and disease result. Men's rash chasing of trolley cars, "taking a chance" to dodge traffic in large cities, et cetera, lead to injury and sometimes permanent disability.

7. Physical Causes.—Disease is induced by exposure to undue cold or heat, impure air, lightning or electricity. People are affected by high altitudes and aeronauts suffer when they ascend above a certain elevation.

A great cause of disease is the custom of overheating the body by too warm rooms, and too heavy clothing. This seems to be an American proclivity. In England, where the inhabitants exercise more freely and lead more vigorous lives, one will find drawing-rooms from ten to fifteen degrees cooler than those of their American cousins. The waxy color seen in so many American faces comes from lack of exposure to fresh air and sunshine, dearth of exercise, and living in hot rooms.

Build up warmth in the body by accelerating the circulation; by using the right sort of food; by refusing to coddle yourself in warm places under the delusion that you are making yourself comfortable. Live out of doors as much as possible, and thrive upon the oxygen that is essential to keep the fire burning within your body. Fight the tendency to wear more clothing than is needed, lest you become so cold-blooded you will encumber yourself with so many clothes that circulation and general health will be interfered with. Excessive clothing is inclined to stop the pores and partially paralyze their activity and thus one becomes far more liable to colds and other complaints.

The barefooted boys and girls that one sees in Scotland on a winter day know nothing of colds or the many other ailments that our pampered children, living in hothouse parlors, have to fight all the time. It is a fact that the more the body is hardened, the less susceptible one is to disease and the more vitality he will generate. Linen makes better underwear than wool, because it more quickly absorbs the impurities, and therefore allows the pores to retain their activity. Next to linen, cotton makes the best underwear; and these materials can be worn with comfort during the coldest weather.

Endeavor to get hold of the great principle here involved, viz., that he who pampers himself in the assurance that he is thus taking care of himself is doing the very opposite of what he desires. The *greatest care* of the body is that which secures the most perfect health. And as we shall fully show in later portions of this series of books, that person only is wise who fortifies the body against cold by naturally warming the blood. By exercise, sharp walking, deep and nasal breathing out of doors, and proper food "put your overcoat into your blood," and thus you will be able to resist disease, as well as enjoy health.

A serious cause of disease is the breathing of impure air. Neglect to supply the proper quantity of oxygen is the cause of many very serious ailments. It produces disease frequently in the first instance and is the cause of its continuance in others. Early in the history of the *Physical Culture* Magazine we called attention to the value of outdoor treatment for consumption. We emphasized the importance of this method of treatment, and the result of our efforts and those of others is seen in the marvelous change that has come about everywhere in the treatment of this complaint. The medical profession is now advocating the outdoor treatment, and, strange as it may seem, many professors of various medical schools have admitted that medicine is ineffective in the treatment of consumption. Now, within the simple theories that are being definitely advocated largely by nearly all members of the healing art who have eliminated the drugging idea, you will find the real science of bodily rejuvenation by natural diet, natural breathing in the open air, and natural exercise.

Consumptives and all kinds of invalids are now being made to sleep out of doors, even in winter, with the most beneficial effects.

The need for a proper supply of oxygen cannot be too strongly emphasized. It is necessary to ward off disease. It is still more necessary to cure disease. It is therefore the duty of every one to cultivate the fresh air habit until the average person may regard you as a fresh air crank. Fresh air cranks are a great source of annoyance to those who insist on closed windows. Yet it is well to secure fresh air at all reasonable hazards in the way of annoying or offending others. Health is a matter of primary importance, and in no way is health more surely gained and regained than by the continuous breathing of pure, sun-laden, vivifying, moving, fresh, out-of-door air, and in no way more quickly lost than by breathing shut in, poison-laden, dead, fetid, heavy, indoor air.

EXCESSES.—While it is only a general term, we believe that a note of warning should be sounded to the effect that *excess is a great cause of disease.*

With prosperity come all sorts of evil influences. By far the worst of these may be termed our excesses. The science of life, to the average individual, is a closed book. He knows little, cares less, of himself and of the science of his natural requirements. Civilization has largely destroyed the instincts which, when followed, save us from excesses, and having provided for us no other guide, we are left without safeguard, a prey to the unnatural and abnormal desires that civilization has fostered in us. Everywhere, in every department of life, we find excesses. We eat too much, we drink too much, we ride too fast, we work too hard, we sit up too late, we overheat our rooms, we dance too much, we make too much money, or strive too hard to make it. Temperance is taught everywhere *in words*, but *in fact* few of the teachers themselves demonstrate in their own lives that they know the meaning of the word. With all our advance in science and knowledge, with all our increased wealth, with all our increased opportunities, it is doubtful if we get one-fourth as much real happiness out of life as our forefathers did who lived without our advantages, but equally without our excesses. The average human being today wears out half of his life by his excessive striving for enjoyment the other half. The human machine is worn out before it has lived half its life and in the excessive race for pleasure a large part of the power to enjoy life is destroyed.

As a nation, we are rolling in wealth, we are revelling in luxury. Even those families that consider themselves poor often have many times more than they really need. They have more food than is good for them, they usually wear more clothing than is healthful, and they are superabundantly supplied with what are supposed to be the necessities of life.

Nothing is known of the value of abstinence in this age. Fasting and prayer as a combination have not been handed down to us by our forefathers. Dissipations of every kind stare us in the face at every turn. The victim of excesses knows nothing of life from its most magnificent viewpoint. He is usually jaded, worked out; and there are very few moments in his existence that he really feels that exhilaration, that buoyancy, that comes with superb health.

Intemperance is a terrible sin. Alcohol has ruined millions of lives and has shortened the lives of millions more. But it is not by any means the only evil. Overeating is a sin that exists in practically every home. It is not here and there—it is everywhere. How many years of your life are you spending for the privilege of stuffing your stomach? Some give twenty or twenty-five years, others from forty to sixty years. Have you figured out, dear reader, how many years of your life you are expending in this manner? There are excesses everywhere in life, but there is no evil or no combination of evils that has such a terrible effect upon bodily vigor, upon nervous energies, as a continuous habit of eating beyond the needs of the body. You simply wear out the human machine years and years before there is really any need of its showing the slightest sign of weakness.

Eating three or more meals daily that are not intensely enjoyed, as a habit, is criminal. It is worse than criminal, because as a rule you sit down to a meal before the previous meal has been fully digested. The crazy idea that food is needed merely to keep up your strength has filled thousands of graves.

Learn to eat what you need. Learn to scientifically feed the human machine. Don't dissipate in work. Don't be excessive in anything. Take care of your body. It is the only one you have and you are liable to need it next year and the year after, and in fact, for many years to come. Don't wear out the vital organs by compelling them to handle from two to four times as much food as is needed to fully nourish your body.

Any attention that is given to these important subjects will be repaid over and over again, hundreds, yes, thousands of times, not only in increased physical health, but your earning power, financially, will be vastly increased. You will be a better man, a stronger woman, and life will open up opportunities under these changed conditions that will amaze you.

There is a healthy expenditure of energy that is beneficial to all concerned, but the great trouble with the American race is that it shirks this healthy expenditure and then goes to excess in those things where excess ultimately produces disease, unhappiness, misery and death.

8. CHEMICAL CAUSES.—A child drinks carbolic acid, men and women are partially suffocated by the escape of illuminating or sewer gas, painters and paper hangers are poisoned by chemicals used in their profession, whole communities are poisoned by impure water. In this category belongs the use of tobacco, drugs and alcoholic liquors. I might also add highly seasoned foods, etc.

There are many professions whose followers have our heartiest sympathies. In their struggles to gain a livelihood they seem compelled to engage in industries which are direct producers of disease. Glass blowers, hat makers, rag sorters, coal miners, coal weighers, cement makers, and all those employed where dust and other small particles are being inhaled either through the mouth or nostrils, are oftentimes in danger of disease. Such workers are to be pitied. They deserve our deepest sympathy, and we should gladly urge the adoption of all methods that would ameliorate their lot. We hail all legislation that seeks to benefit or improve the hard conditions under which they labor.

But what shall be said of those men who wilfully, deliberately and habitually take into their bodies, for a mere temporary pleasure, those substances that the experiences of the ages have taught are great and awful producers of disease? I refer to the use of alcohol, tobacco and drugs.

Alcohol. That alcohol in its various forms is one of the greatest causes of disease, we think no physician can deny and no careful observer will dispute. We regard it as one of the greatest curses of our civilization. We believe it would have been infinitely better had its use never been discovered.

To quote eminent scientific authority: "Until very recently, the drinking habit was looked upon as an incurable evil. Efforts were confined to exhortations which usually went unheeded. A great advance was made when it came to be realized that complete abstinence could alone free the individual from his desire for alcoholic beverages. The damage done to the various organs cannot be rectified, but the drinker can be warned of further inroads on his health which are liable to occur."

But, immeasurably better than the cure of diseases induced by alcohol is the healthful life that abstains from them. We urge absolute and life-long abstinence upon all who seek to be free from disease and to live in perfect health.

Do not touch, taste or handle the dangerous stuff, for then, and then only, is one safe.

The tobacco habit manifests itself in five different ways, all harmful, all disgusting, and all equally deserving the strenuous opposition of every advocate of perfect health. These five forms are cigarette smoking, cigar smoking, pipe smoking, chewing and taking of snuff.

Cigarette Smoking. Independent of the moral aspect of this question, we will discuss cigarette smoking purely from the physical standpoint. The testimony of chemists, physicians, criminal experts and athletes is absolutely unanimous in regard to the physical injuries that follow the formation of this habit. It generally begins with an effort to be smart. It soon becomes a pleasure and a means to tide over a moment of nervousness or embarrassment. Next it becomes a necessity of life. When it has attained this stage, its victim loses physical, mental and moral control. As Dr. Orison Swett Marden, formerly editor of *Success,* forcefully said:

"I denounce it simply because of its blighting, blasting effect upon one's success in life; because it draws off the energy, saps the vitality and force which ought to be made to tell in one's career; because it blunts the sensibilities and deadens the thinking faculties; because it kills the ambition and the finer instincts, and the more delicate aspirations and perceptions; because it destroys the ability to concentrate the mind, which is the secret of all achievement.

"The whole tendency of the cigarette nicotine poison in the youth is to arrest development. It is fatal to all normal functions. It blights and blasts both health and morals. It not only ruins the faculties, but it unbalances the mind, as well. Many of the most pitiable cases of insanity in our asylums are cigarette fiends. It creates abnormal appetites, strange, undefined longings, discontent, uneasiness, nervousness, irritability, and in many, an almost irresistible inclination to crime. In fact, the moral depravity which follows the cigarette habit is something frightful. Lying, cheating, impurity, loss of moral courage and manhood, a complete dropping of life's standards all along the line, are its general results.

"Magistrate Crane, of New York City, says: 'Ninety-nine out of a hundred boys between the ages of ten and seventeen years who come before me charged with crime have their fingers disfigured by yellow cigarette stains. I am not a crank on this subject, I do not care to pose as a reformer, but it is my opinion that cigarettes will do more than liquor to ruin boys. When you have arraigned before you boys hopelessly deaf through the excessive use of cigarettes, boys who have stolen their sisters' earnings, boys who absolutely refuse to work, who do nothing but gamble and steal, you cannot help seeing that there is some direct cause, and a great deal of this boyhood crime is, to my mind, easy to trace to the deadly cigarette. There is something in the poison of the cigarette that seems to get into the system of the boy and to destroy all moral fiber.'

"E. H. Harriman, late head of the Union Pacific Railroad system, said that they 'might as well go to a lunatic asylum for their employees as to hire cigarettes smokers.'

"Cigarette smoking early impairs the digestive organs. It causes a gradual loss of appetite, and the wretched victim substitutes more cigarettes for food. In fact, he finally gets to a point where he becomes a slave to the cigarette and cannot do without it.

"Herein lies one of the greatest dangers of the cigarette. It creates a longing which it cannot satisfy."

Cigar and Pipe Smoking. It is hard to tell which is the more dangerous and more disgusting habit of the two. The time has gone by when the cigar can be said to be the rich man's refined method of taking nicotine. It is the nicotine poisoning that both kinds of smokers wish to enjoy. This nicotine is a volatile oil distributed through the tobacco plant. In its pure state, it is as deadly a poison as prussic acid. The great surgeon, Sir Benjamin Brodie, once administered a single drop hypodermically to a cat and the animal fell dead almost as quickly as if it had been struck by lightning. In the case of the smoker, the nicotine enters the system either through the tissues of the mouth, or if he "inhales," through those of the lungs. While the testimony of smokers cannot be ignored that the sensations produced by this process are sedative and agreeable, the constant and accumulative effects are injurious to a high degree. The immediate effects vary considerably according to the temperament of the smoker. In some cases it acts as a sedative or soothing influence. In others it acts as a stimulant and nerves up the smoker to renewed activity, but in all cases the injury to the body and mind is sure, and sooner or later the victim will feel its deadly influence. These statements are verified by the scientific assertions of scores of leading authorities.

Chewing. Everything that has been said on the smoking habit can practically be said on the chewing habit, and in some respects, perhaps, with greater force. In chewing, the tobacco user absorbs more direct nicotine, although he generally falls into the disgusting habit of spitting out, every now and then, a large mouthful of tobacco juice. But while this seems to be ridding himself of the poisonous nicotine, he does not empty his mouth until the effect he desires has been produced by the absorption of a sufficient quantity through the tissues into the system. Another great injury induced by the chewer of tobacco is the undue increase of the flow of saliva. Any unnatural, habitual excitation of this flow is sure to produce serious derangement of the salivary glands, and to chemically injure the saliva produced. Consequently, in addition to the nicotine poisoning induced by this habit, the tobacco chewer has to overcome in some way the inadequacy of the digestive processes brought about by the injury to the saliva.

Snuff Taking. This form of tobacco is perhaps more injurious than any other. The tobacco is ground into a very fine powder and undergoes a special treatment. Formerly this powder was snuffed into the nostrils, but this method is rarely employed at present. The substance is now placed between the gums and the lips, and allowed to rest there until its ability to excite the salivary flow is expended. Lying in direct contact with the mucous membrane, its nicotine is absorbed by the blood stream, and it produces its harmful effect upon the nervous system. Though for a time it was considered a most elegant habit, even the dainty dames of the courts of England and France indulging in it, it is now justly considered equally as disgusting and filthy as chewing and all medical testimony is to the effect that it is just as harmful.

Drug Taking. A cause of disease equally as perilous as that of alcohol or tobacco, and as prolific in its ultimate manifestations of suffering, is the drug habit. Thousands of persons annually form this habit innocently and ignorantly. They find themselves suffering from temporary inconvenience of the stomach, a headache, or something of the kind, and seeing the advertisements of *a sure cure* flaunting from billboards and placards in the most respectable drug stores of their home city, they innocently imagine that all they have to do is to take a few doses of this much advertised and lauded medicine to make themselves feel all right. The "cure all" probably contains alcohol, cocaine, chloral, morphine, opium, antikammia, acetanilid, or some other drug equally obnoxious and injurious. The first few doses soothe the suffering by drugging the nerves into insensibility, and the innocent drug-taker is so pleased with his experiment that he renews it, when, a few weeks later, he again suffers from overeating, late hours, overindulgence in a "glass with a friend," or finds himself "let down" with overwork or the constant strain of his nerve-wearing occupation.

Another great danger lurks here. The fact that he can so soon "cure" himself has the tendency to render him reckless to the cause of his trouble. Why shouldn't he *enjoy himself,* he asks, if he can so easily remove the effects. It only needs a glass of this, or a dose of that, or a few pills or powders and he will be all right. Thus the drug has lured its victim the more quickly to his destruction.

A few months of this course of procedure and the end is certain. The drug habit is formed. Everything else gives way to the gratification of this new appetite, and the victim now enters upon the open pathway to disgrace and death—ruined, slain by drugs. This is no fanciful picture. Thousands have gone this road to destruction in America alone, and there is not a city in our land today that does not have its army of men, women—aye, and youths and maidens, whose lives are wrecked and who are dragging out a living death owing to

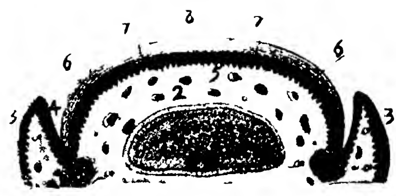
PLATE A

THE HUMAN SKIN
Section Through the Skin.
(Very highly magnified)
(Detailed reproduction)

1 Epidermis
2 Granular layer with pigment
3 Papillæ with blood vessels
4 Papilla with touch organs
5 Nerve fibers
6 Sweat glands
7 Openings of sweat glands
8 Sebaceous glands
9 Openings of sebaceous glands
10 Hair muscles
11 Connective tissue fibers
12 Cross section of same
13 Hair follicle
14 Outer sheath layer

15 Inner sheath layer
16 Outside of hair
17 Core
18 Bulb
19 Papilla
20 Shaft
1 Adipose
Art[illegible]
V[illegible]ns

End Bulbs Organs of Touch
(Very highly magnified)
1 Outer skin with pigment cells
2 Connective tissue fibers
3 Papillæ
4 End bulbs
5 Nerve fibers



Cross Section of a Finger Showing Nail
1 Bone
2 Connective tissue
3 Nail wall
4 Nail furrows
Corrugated bed of the nail
6 Layer of young horny cells
7 Boundary layer
8 Horny layer

Longitudinal Section of a Finger.
1 Bone of the last joint
2 Matrix of nail
3 Finger nail
4 Epidermis

Section of a Hair
(Very highly magnified)
(Detailed reproduction)
1 Outer sheath layer
2 Inner sheath layer
3 Shaft
4 Pigment layer

CHAPTER IV.

THE WONDERS OF THE HUMAN BODY.

MEN and women usually deem it necessary to go traveling in order to behold the wonders of the earth, making far pilgrimages to the Alps, the Pyramids, or the Canals of Venice, while all the time they can find nothing in the world so wonderful as their own bodies. In point of external beauty and grace of outline, there is nothing in the world of flowers or in the animal kingdom that can favorably compare with the human body at its best, when it is normally developed, filled with vitality and radiating the charms of health. And in regard to the internal mechanism, surely, nothing so marvellously delicate and yet powerful, so complex and yet efficient, was ever known. All animal life is wonderful enough, even vegetable life, when we study and observe it closely, but no other creature has anything like the powers and faculties of man, the infinite possibilities of his two perfect hands, for instance, and the brain equipment with which to manipulate not only those hands, but everything else that is on earth or in the air. Truly, what an amazing thing is human life!

How frail a thing seems life, sometimes, snuffed out perhaps by a swift little ball of lead, a mere speck of some deadly chemical, or the sting of a venomous bug! And yet, how continuously enduring is human life, surviving every hostile condition, the tropical heat, the Arctic cold, and dominating all the earth. How brief is the span of life, and yet how it has persisted all down through the ages, the chain of life passing unbroken from one generation to another, with vitality undiminished, and with never an interruption of the constant, endless beating of the human heart through these hundreds of thousands of years.

Think how our own lives are linked with the past, back, back, back, and yet still farther back, far away into the unfathomable. And yet, we know that of all the life that has been on this earth, generation after generation, *ad infinitum,* we represent the best. Just fancy, reader, by what a narrow chance it comes that you are here on earth; for if any single one of the eternal chain of your ancestors had failed to live out his destiny, there would have been no *you*. The same with each one of us. Let our hearts swell with pride as we think just who we are. Not the offspring, we, of the fittest to survive of a single generation, but the descendants of the fittest for survival of every generation that ever was. If our progenitors at any single time, any year, any day, any minute, of all those eons and ages had met with some catastrophe, or had proven to be among the degenerate and unfit of the time, our chain of existence would have ended then and we would never have known, would never be here to know.

But yet here we are, having arrived through channels of growth as wonderful as the fact of our being here. The individual man, proud lord of creation, comes into being as a single cell, the very next thing to nothing in size, but a cell filled with the infinite potentialities and possibilities which he may later realize and develop. How wondrously, through that single little cell, there survive the innate faculties, qualities and characteristics of both the father and the mother, the gifts of the countless generations farther back, together with the original tendencies resulting from the combinations of all these forces. From his almost incredible existence in this wee bit of protoplasmic matter not so big as a grain of sand, how the child grows and takes form, with the subdivision and multiplication of cells and the organization of these cells into the various members, organs and tissues of a human being, meanwhile depending for life upon the unfailing sustenance brought through the blood stream of the mother. How mysteriously there, beneath the heart of the mother, the tiny heart of the new life commences to beat, while every tissue and organ of the embryonic human assumes its ultimate perfect form and gradually comes into readiness for the life-long service which it is to do. Finally, with what amazing and unerring judgment the subconscious forces of life seem to know just when this part of the mother's work is done, just when the time is ripe and the little one ready to take up the struggles of existence in the external world.

Arrived in our midst, how strangely and yet how faultlessly those tiny, inexperienced little organs take up their respective functions, how the delicate lungs begin to breathe, ministering to the incessant and imperative demand for that oxygen which but a few moments before had been supplied direct from the blood that visited the lungs of the mother, and with what energetic goodwill the muscles of that diminutive tongue contract to produce a suction that will bring forth a dinner out of anything that offers it. (The new-born infant does not suck with its lips.)

If we say that the baby doesn't know anything, we are mistaken, although it does not know them in the conscious way in which we know them in later years. It possesses the limited supply of instincts retained in the human race, and in this way knows just enough for its needs of the moment, knows how to get along with the mother's help, knows how to make trouble when it has trouble, how to move its bodily members sufficiently to develop its muscles and learn their better control, and, in the learning of this, to educate the cells of the brain.

The exceptional length of the period of infancy and growth of the human being is a peculiar and significant fact, and one which to the casual observer may seem to be at variance with the superiority of humankind in other respects. Among all forms of animal life the human baby is the most helpless at the time that it comes into the world. It is more perfect than any other, even then, along the lines of its own human organization, but it is not as capable in any respect as the newly born of any of the lower animals; it is more dependent upon the mother for incessant and tender care. We all know that the puppy of six months is a very active and vigorous creature —indeed, not far from being physically as capable as he ever will be. Some of the lower animals are able to walk about, or at least crawl, the very day they are born. With ourselves, however, it is different. At six months of age we can still do very little; certainly we cannot emulate the agility of the puppy. At six months we are still learning the use of our muscles and our sense of balance, but are not even able to walk as yet. At two years of age the dog is at his best, but at two years the child is still only in the beginning of its development, when compared with the long period of growth, both mental and physical, which lies ahead of it. Maturity will not arrive for a score of years.

But why this exceptionally long period of growth and dependence upon the parents in the case of the human offspring? Might we have not supposed, with the superiority of our kind, that we should be able to outstrip any of our lower animal kindred right from birth?

It is, in truth, this extended period of dependence and growth that makes possible the high attainments of mankind, whereas the rapid growth of our furred fellow creatures only marks their limitations when they have reached maturity. The nerve organization of man is of a finer nature, for one thing, and this requires a longer time to develop. Furthermore, because of the extended period of the necessity of the supervision and care of the parent, not only is the child provided with greater possibilities for education and training, but from the standpoint of the parents there is formed the basis of that form of established family life which is one of the great factors of human progress. But the real reason is that which follows.

In the development of the human race, the more primitive instincts, or "race habits," of the lower forms of life have largely given way to the power of reason. Instead of these instincts being retained by us alongside of our intellectual developments, they have chiefly been displaced by the latter. Naturally, choosing between instinct and intellect, the latter is the higher gift. Some of our original instincts we still retain, and they serve us and protect us in many matters, but for the most part we depend upon the power of thought. The dog will sometimes turn around two or three times before lying down upon a smooth, soft rug, just as his wild and wolfish progenitor once did in order to make himself a comfortable bed when lying down to sleep in tall grass or deep snow; but we do not do such unintelligent things. We learn to use our minds in these matters and just here is the secret of our protracted infancy—*we have to learn* to use our minds and to reason. The animal finds himself in full possession of his instincts at his birth. But having largely lost our instincts, each individual human being is compelled to build up his own mental machinery, or rather to train it as he does his muscles, and this takes time. If, like many animals, we grew to maturity in a very few years, we should be incapable of the high development of nerve tissue and mind that makes us what we are.

Our slow physical growth, corresponding with the development of the mind, is quite in line with the refinement of our tissue structures, their vitality and enduring quality. A creature of cruder structure might mature in a fraction of the time required for us. However, our prolonged period of growth is in accord with the usual rule among other animals that the period of physical growth varies with the varying life-spans of the different species, and according to which an animal that matures in twenty years is likely to live five times longer than that which reaches full size and strength in four years.

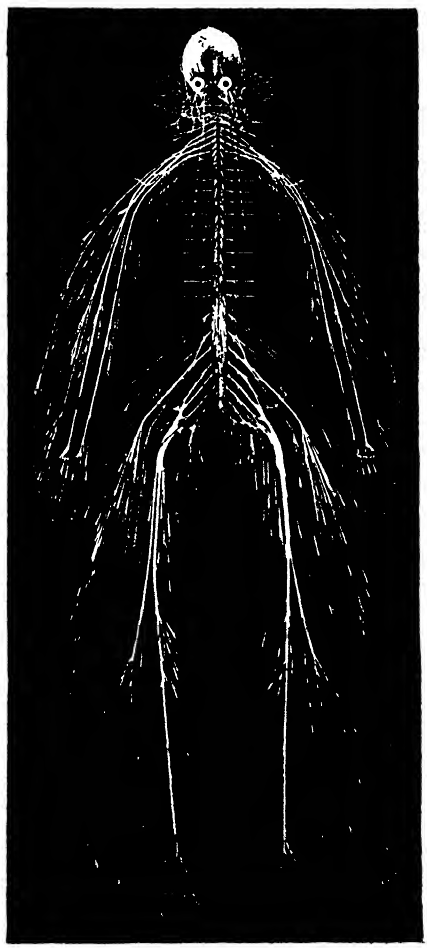
The deepest minds and the highest mental gifts are not always likely to manifest themselves very early in life, and may not assert their full strength and power until some time after physical maturity has been reached. The parent, therefore, should not feel concerned if his child is not so precocious as that of his neighbor, for precocity does not mean anything, one way or the other. We sometimes read of incredible precocity in the eulogistic biographies of some great men (more frequently musicians and "geniuses"), but probably in the greater number of cases they do not startle their folks with their exceptional qualities in their more tender years. We do know that many of our most successful men have seemed to be almost stupid during their school days, though even this may mean nothing more than a reflection upon or criticism of our unsatisfactory school methods.

When one considers the requirements of slow growth upon the part of the human brain, the common attempt to force the education of children is little short of criminal. *The development of the mind should be a growth, and not a cramming in from the outside.* It should be the natural unfolding of that which is in each individual, and not the attempt to "store away" innumerable silly and useless facts. The brain of the child does not reach its full growth until about the age of seven years, after which it grows very little, if any, in size. Every one has noted the large size of the head of a boy, for his size, compared with that of a full grown man. After the age of seven years this brain is ready for a certain amount of study, if necessary, or training, but before that time any such attempts, or, at least, any forcing, is almost sure to be detrimental. Later on we shall learn something of the structure of this brain.

In the succeeding chapters we shall consider specially and in detail the various wonders of the body, the remarkable and ingenious framework which gives support to the whole and protection to the vital parts, the elaborate, beautiful and infinitely capable muscular system and the remarkable delicacy and efficiency of the important internal organs. We shall see how all of these separate parts work together harmoniously to produce a complete and perfect whole. We shall observe the splendid mechanism of the heart and entire circulatory system, how the blood is made and how it is purified, and caused to penetrate and circulate through the most remote tissues of the body, even the bones themselves, noting also how shrewdly Nature for the most part has placed the arteries deeply within the various members so that they may be less susceptible to injury, allowing only the veins to run along the surface where necessary, and, in the very few parts where the arteries are not deeply located, having them so placed that they are the least liable to be torn or opened by accident.

We shall study the structure and operations of the organs of assimilation, by the aid of which all manner of food and liquid substances are actually converted into the materials and tissues of which the body is composed. Surely, this, when we stop to consider it, is far more mystifying and miraculous than any feat of magic or witchery that was ever told of in story.

We shall see how we depend upon the action of the lungs in supplying the life-sustaining oxygen and in freeing the body from carbonic acid; we shall see how the other wastes of our various tissues are depurgated through the effective service of the kidneys and the pores of the skin; and we shall observe what we can of the marvellous mechanism of those important organs by means of which we sense our position and relation with the outer world, by which we are able to see all external objects, to hear the noises they make, if any, to feel them, to smell their odors, and to taste of those which are suitable for food, these faculties of smelling and tasting, indeed, enabling us to determine just what is desirable for food.



Photograph of the nervous system made by articulating every nerv of human body in approximately the same position as in life.

And fundamentally more important than all the rest, we shall consider the wonders of the nervous system, the dominating and most vital factor of the whole, the part that thinks, the part that feels, the part that determines what every other part of the body shall do. Surely, if the human "soul" is localized in any part, its special habitation is the nervous system. It shall be our privilege to contemplate from a physical or physiological standpoint, the mysterious organization and functions of the brain, the organ of the mind, the seat of intellect, the home of conscious thought. We shall take note of the incredible powers of the spinal cord, the center of the elaborate and complex organization of nerves which penetrate every minutest particle of every tissue of the entire body, instantly telegraphing, as it were, to the central governing body, the news of the condition, welfare and experiences of each part, on the one hand, and, on the other, carrying to each and every part instructions as to just what to do. Never was there another so perfect a system of intelligence transmission, for these nerves never make a mistake.

But with all the incomparable delicacy and refinement of organization of these various organs, systems and tissues of the body, they possess a strength and a power of resistance that would be utterly astonishing were it not such a commonplace fact of everyday life. Indeed, the very strength and enduring power of the body is the result of this minuteness and refinement of structure.

Not the least wonderful thing about this unique body-machine of ours is its almost unlimited power of self-regulation, of recuperating its own wasted forces and of mending itself when it is injured. Like any complex machine, the body may suffer some disorder or injury as the result of exceptional strain or violence, but, unlike any ordinary machine, it repairs itself. If any part be broken, or torn, or cut (any part with the exception of the nerves), the body sets about in a most remarkable and systematic way to mend it, sending an exceptional supply of blood and new building material to the affected part. With the activities of each day we use up a good part of the available energy of the body and consume a greater or less amount of the bodily tissues (largely muscular); but even as this is done the organs and fluids of the body are at work rebuilding new tissue and energy. And at night, when the deficit of energy, the breaking down or consumption of cell tissue, and the accumulation of the waste matter so produced becomes sufficiently great to cause decided fatigue and inconvenience, then the work of repair is carried on in a far more rapid and effective manner through the revitalizing processes of sleep, "Nature's sweet restorer."

Similarly, when, through mistaken habits of life, and the failure, through ignorance or otherwise, to observe the conditions of health which Nature has laid down for us, some of the organs and functions of the body become deranged and the condition of the blood impaired, or, in other words, we contract "disease," then, even then, in the same way, the self-mending and recuperating powers of the body assert themselves and endeavor in the most wonderful way to restore a normal condition. Unless impeded or handicapped too much, the body will usually accomplish this result without outside help. But in cases where the condition of ill-health is serious it is important to understand the construction and requirements of the body, and also the conditions of health which Nature imposes (frequently called "laws" of health), in order that the body may be able the more effectively to accomplish its purpose. As we have seen, the Science of Physcultopathy is devoted to this end.

For though we are fearfully and wonderfully made, yet in many respects the functions of the body are not so mysterious as they may seem. We may know and understand much of them—indeed, should know these things in order the better to work for our own welfare. The fundamental mysteries and secrets of life we may not understand; just what life is we never will know; but that it is, we know, and many of the conditions of its best development and progress we may know, and these we wish to teach in these volumes. It is possible for us to know in a limited way the anatomy and functions of all parts of the body, the location, nature and actions of all important organs, and knowing these things, we may avoid their abuse and neglect, so modifying and arranging our habits and conditions of life as to maintain them in health and vigor. People do not voluntarily choose to be sick, and for the most part illness is the ultimate result of ignorance along these lines, an ignorance which is as nearly universal among so-called civilized people as it is dangerous and unnecessary.

What would we think of a man who owned and operated a complex and intricate machine of such value that he could not even compute its worth, but who placidly went about his way satisfied not to know anything of the construction and workings of his machine, so that he could keep it in good order? The thing is inconceivable, because men always take painstaking care of all machinery, and yet this is the situation of nearly every one with reference to his own body machine. If our systems of public education are to be worth anything, we should demand that our children be given the most complete and thorough instruction along these lines, including not only the intimate study of the anatomy and physiology of the body, but also of all conditions and habits of life favorable and unfavorable to its welfare. Surely, the knowledge of the height of the tallest mountain in Asia, or of the date of the birth of Confucius, is of little importance compared with the necessity for a knowledge of one's own self. It is true that physiology is taught in the schools after a fashion, but considering the vital character of the subject it should be taken up in a manner infinitely more thorough, and with it should go the most absolute insistence upon those habits which are conducive to the very highest degree of health and energy.

The man who is physically self-conscious, who "knows himself," as it were, and understands the character and functions of every part of himself, will see the very first danger-signs of the approach of disease. Not only will he know how to cope with trouble of any kind, but he will be so alert to his condition that he will be able to prevent its ever reaching him. If he has inherited special weaknesses and is threatened with any disease, he will not wait until he is caught in its throes, but will take the matter in hand so early that he will never develop the condition of body which makes it possible. He will increase his constitutional strength and powers of resistance, build up vitality, purify his blood, improve his circulation and in every possible way make perfection of health inevitable.

Before the forms or uses of the various portions of the body are studied, it is necessary to understand that the body as a whole is a compact mass of chemical compounds arranged according to a definite and unvarying scheme of Nature. These compounds are very numerous, indeed, but all are made up of differing combinations of the chemical elements that are found in the human body. These elements are thirteen in number, and are: Oxygen, hydrogen, nitrogen, carbon, chlorine, fluorine, phosphorus, calcium, potassium, sodium, sulphur, magnesium, and iron. Some other elements, such as silicon and iodine, are found in the body, though in very small quantities. Still, they must be supplied.

The combinations of these elements, as found in the body, are divided into two chemical groups—the organic and the inorganic compounds. The organic compounds are those that contain carbon as one of the elements. The inorganic compounds are those that do not contain carbon. Thus albumen, which is composed of nitrogen, hydrogen, carbon, oxygen, sulphur and phosphorus, is an organic substance. Calcium phosphate, which makes up nearly sixty per cent. of the human bone, is composed of calcium, oxygen and phosphorus; having no carbon it is an inorganic compound. Broadly speaking, all of the substances that we are accustomed to regard as foods are made up of organic compounds. The carbon in them is burned in the body for the purpose of giving out bodily heat. These organic foods are divided into three classes, as follows:

(1) Nitrogenous foods, commonly called proteids—Albumen, fibrin, casein, gluten and gelatine. Albumen is found in its purest state in the white of egg; fibrin is the substance in blood that causes its coagulation when exposed to the air; casein is the valuable principle of cheese, and gluten of the grains; gelatine is obtained from the bones and the fibrous tissues of animals.

(2) Fats—Animal and vegetable oils. The fats of meat. butter, olive oil, etc., are good samples.

(3) The Carbohydrates—The starches, dextrin and sugars.

Fats and carbohydrates contain no nitrogen and are therefore called non-nitrogenous foods. For convenience sake, alcohol, tea, coffee and cocoa are classed as non-nitrogenous foods. but are appropriately set in a class by themselves as stimulants. With the exception of cocoa, there is no real food value in the stimulants.

Proper clothing keeps as much of this heat in the body as is needed. Too much clothing keeps too much heat in the body. Exercise not only facilitates the removal of the waste that it causes in the body, but it brings about the rebuilding of the cells destroyed with newer, fresher, better material. This style of repair not only produces a finer quality of tissue, but gives to it also greater strength and size. If exercise merely resulted in replacing matter in the body with equivalent matter there would be little or no benefit in exercise. It is through the improved quality and increased quantity of cell matter supplied that exercise works its wonders. Even the bones of an adult may grow, though slowly, through exercise.

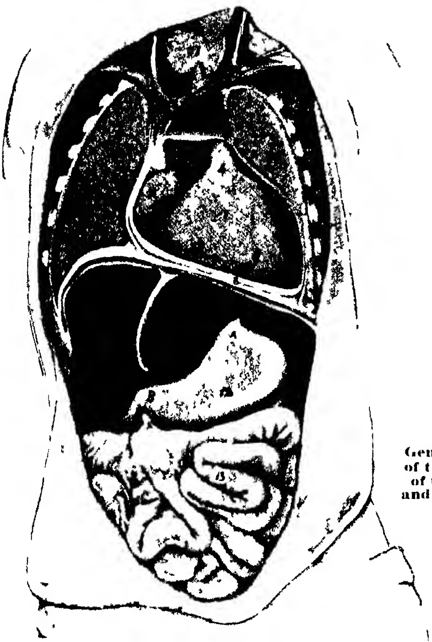
If it were not that Nature has ordained that a time must come when decay will take place in the body more rapidly than repair can offset the destruction, it would be possible, generally speaking, for man to make himself immortal in this world through the right amount and kinds of exercise, proper breathing of pure air, sensible diet, the proper use of water inside and out and the right amounts and kinds of rest and clothing. As it is, by these aids man is so well able to prolong his life to a healthy and advanced old age that it may well be said in most cases that health is optional.

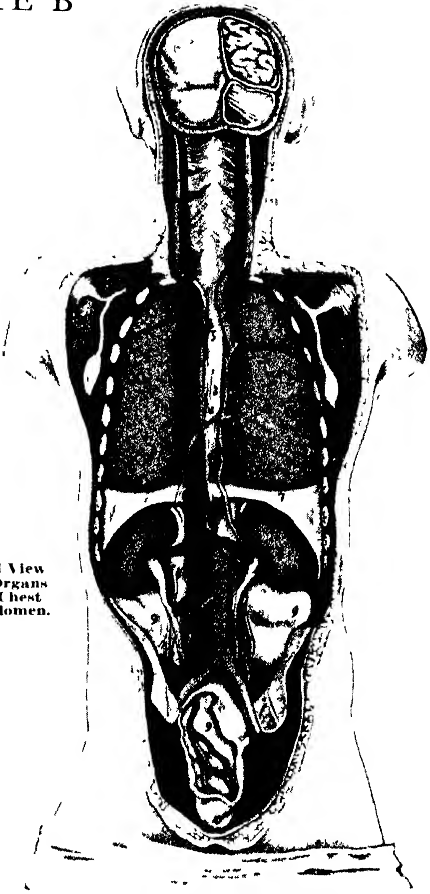
As we have seen, the cell is the elementary structure, but a collection of these cells, united in such a way as to form a whole, is spoken of as a tissue. In using the word "tissue," we often think of materials more or less interwoven, but in the human body it may mean simply a collection of cells placed side by side and cohering together in whatsoever manner.

The tissues of the human body may be classified into five different kinds, namely: (1) Epithelial tissue; (2) Connective tissue; (3) Muscle tissue; (4) Nerve tissue; and (5) Blood and Lymph. All of these different kinds of tissue involve a different character and arrangement of cells.

1. *Epithelial tissue* consists of cells placed very closely in contact, with very little cement substance interposed, and is found chiefly in three forms, (a) pavement epithelium, in which the cells form a plate-like substance, either thick or thin; (b)

PLATE B





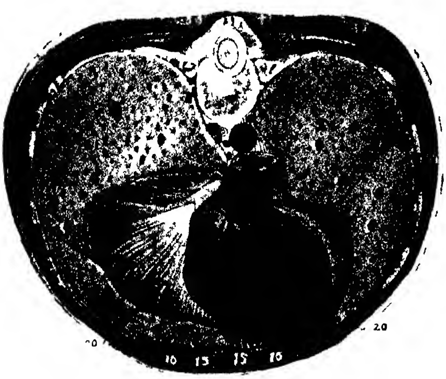
General View of the Organs of the Chest and Abdomen.

Front View

1 The heart
a Visible portion of the left ventricle
b Right ventricle
c Right auricle
2 Left lung
3 Right lung
4 Pulmonary artery
5 Aortic arch
6 Superior vena cava
7 Thyroid gland
8 Diaphragm sending a broad ligament through the liver
9 Liver
10 Gall bladder
11 Spleen
12 Stomach
A Cardiac opening
B Pyloric opening
13 Small intestine
14 Descending colon

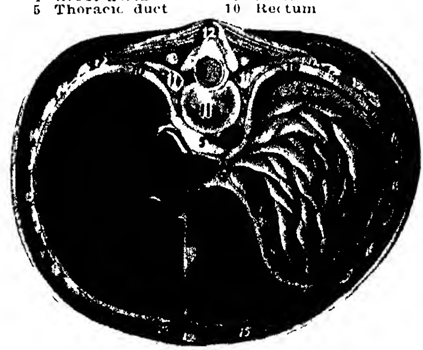
View from the Rear.

1 Left lung
2 Right lung
3 Esophagus
4 Great aorta
5 Thoracic duct
6 Interior vena cava.
7 Diaphragm
8 Kidneys
9 Peritoneum
10 Rectum



Cross Section of the Chest.
(Just above diaphragm)

1 Right lung
2 Left lung.
3 Diaphragm
4 Apex of the heart
5 Pericardium
6 Inferior vena cava
7 Aorta
8. Esophagus
9 Pneumo-gastric nerve
10 Thoracic duct
11 Lung
12 Ninth vertebra and ribs
13 Eighth rib
14-16 Seventh to fifth ribs
17-20 Muscles



Cross Section of the Abdomen.
(Beneath diaphragm)

1 Liver
2 Portal vein
3 Inferior vena cava
4 Aorta
5 Thoracic duct
6 Stomach
7 Spleen
8 Supra-renal gland
9 Nervus sympathicus
10 Diaphragm
11 Eleventh thoracic vertebra and its ribs
12 Tenth rib (a) and the spinous process (b) of the tenth rib
13-16 Ninth to the sixth rib
17 19 Muscles

cylindrical epithelium, the form being indicated by its name; and (c) ciliated epithelium, upright cells provided with the most minute hairs for certain purposes.

Pavement epithelium may be found in several layers, a splendid example of its structure being found on the surface of the human body. Cylindrical epithelium lines the interior of the stomach, intestines and many other of the cavities of the body, while ciliated epithelium lines the inner surface of the greater part of the respiratory tract. In every case the epithelial layer serves as a protection for the tissues lying underneath, the latter being subject to injury whenever there is a break in the former. We are all familiar with the wonderfully protective character of the skin, for instance. The epithelial cells are also to be found in the true glands of the body, lining all ducts and tubes.

Indeed, the most primitive or simple type of gland is a mere tube, lined with epithelial cells. The secretion formed by the gland empties upon the epithelial surface, whereupon it finds its exit from the tube. *A gland,* we may say here, is an organ which secretes, that is to say, produces certain substances necessary for the proper functions and activities of the body. According to the nature of these secretions the glands are called salivary glands, gastric glands, mucous glands, sweat glands, sebaceous glands, the liver, pancreas, etc. Other important glands giving internal secretions are pituitary, pineal, thymus, thyroid, adrenals, spleen, etc. These glands yield internal secretions of great importance. It happens in many cases that a number of these little tubes unite to form a larger gland, the openings from these various tubes discharging their excretions into a common duct or outlet channel. This would be called a compound gland; the interior space, both of the tubes and the main duct, if filled in, would perhaps take the form of a microscopic tree. A gland of material size, like the larger ones that we shall speak of later, consists of many of these ducts, uniting to form a large common duct into which all the secretions are emptied, like the tributaries of a stream. All these ducts of the glands, and their tiny tributaries, are lined with the epithelial cells. The lymph glands, which we will refer to later, do not secrete in the true sense, are not supplied with excretory ducts, and are not to be confused with the true glands.

(2) The term *connective tissue* includes several tissues of the human body, whether to support parts of the body or to embed various organs. There are four chief classifications: (a) Connective tissue proper; (b) Fatty tissue; (c) Cartilage; and (d) Bone.

(a) Connective tissue proper consists of cells embedded in a comparatively large amount of ground-substance, which has a remarkably fibrous structure. These fibers are generally arranged in bundles or bands, in two varieties—loose and firm connective tissue.

Loose connective tissue is more elastic and more easily displaced, its separate fibers or bundles being arranged in wider meshes, like a mass of loose woolen thread. It is to be found where certain organs are close to each other but yet are movable. A certain amount is placed between the different muscles so that they may contract and move without friction. Loose connective tissue is found underneath the skin, and in greater quantities in those parts where the skin can be picked up in folds. If we could maintain this connective tissue in more perfect condition with advancing years we might avoid much of the appearance of age, as in the face, for instance. Vigorous health and an active circulation, therefore, are very efficacious in this direction. Loose connective tissue forms a light gray mass, and may be seen in the meat of animals, separating or lying between the red masses of muscle.

Firm connective tissue consists of similar fibers or bundles placed very closely together or interwoven. We will remember this later when we speak of the tendons which attach the muscles to the bones, for these tendons are good examples of firm connective tissue, as are also the ligaments which reinforce the bony framework and hold it together. The important membranes of the body, chiefly protective agencies, are also composed of connective tissue, more or less firm, in which the fibers usually run in all directions.

The fibrous matter of connective tissue consists of gelatine. When boiled in water it dissolves finally to a jelly-like mass, which, on cooling, forms a thick, firm jelly. Those who cook and eat meat are familiar with it. Much of the glue of commerce is manufactured from the hoofs and horns of cattle, and other parts rich in connective tissue.

(b) Fatty tissue is a form of connective tissue in the cells of which large amounts of fat have been distributed, so that the cells are round like balls. Normally, a certain amount of it is valuable as a reserve deposit of nourishment. Among wild animals who hibernate or for other reasons are sometimes deprived of food for a time, the storing up of fat is a wise provision. Not only is fat useful to produce heat in the body in winter, but it is a poor conductor, and prevents the internal organs from having their heat too rapidly dissipated when the body is exposed to chilling air. In cold water, it is the man with a fair supply of fat who is able to swim the longest without inconvenience or injury. At the same time, the fat man will suffer most in summer, since the heat of his own body can less easily find an outlet.

Fatty tissue, furthermore, acts as a cushion and support for delicate organs, which without this protection might be frequently injured. The eye proper lies in a soft cushion of fatty tissue, and the kidneys are likewise embedded in layers of it. So we see that this form of tissue is really indispensable, although we all dread an excess of it.

(c) Cartilage also consists of a certain proportion of cells, but embedded in a firm, translucent ground-substance, which, while giving firmness, also possesses a certain degree of flexibility and ductility. It has a bluish-transparent shimmer, looking something like porcelain. If you want to feel a good example of cartilage, feel the end of your nose. The bone of the nose comes about half way down the bridge, and the tip, somewhat flexible, is given its character by a formation of cartilage. You can feel how firm it is, and yet how ductile. It will not break readily, as will bone, under strain or violence. It is found throughout the body wherever a certain amount of support is required, without loss of this ductility. The front ends of the ribs are of cartilage, to permit of the movements of the ribs in breathing. There is usually much cartilage, also, about the joints, to reinforce them and to provide against friction. We shall later observe the indispensable character and use of cartilage in the wonderful structure of the spine, in which nothing else could provide the same cushion-like quality combined with strength and support. In some cases many elastic fibers are embedded in the ground-substance, as in the cartilage of the ear, making it unusually elastic.

(d) Bone, in spite of its hardness, is only a form of connective tissue, consisting of cells which lie in a ground-substance composed very largely of phosphate and carbonate of lime. We shall consider its character in more detail in the next chapter.

The other tissues of the body, (3) Muscle tissue, (4) Nerve tissue, and (5) Blood and Lymph, will be considered in other chapters dealing especially with them. If it should seem strange that we classify blood and lymph as among the tissues of the body, in spite of their fluid character, then it may be said that they consist of cells suspended in a fluid ground-substance and may properly be included in this classification.

In the succeeding chapters we shall not attempt to consider exhaustively every minute detail of every nook and corner of the body, for that would take years to accomplish, and a library greater than any man could read through in a lifetime. We propose, however, to give a clear, general understanding of the make-up of the body and a practical working knowledge of its functions. Aside from hair-splitting details, the careful student will secure from these pages almost as good a knowledge of the important facts of his make-up as those whose profession it is to know these things. I have simply offered this information in a terse and practical form, so that the student of Physcultopathy will be able to go ahead intelligently with the study of the succeeding volumes.

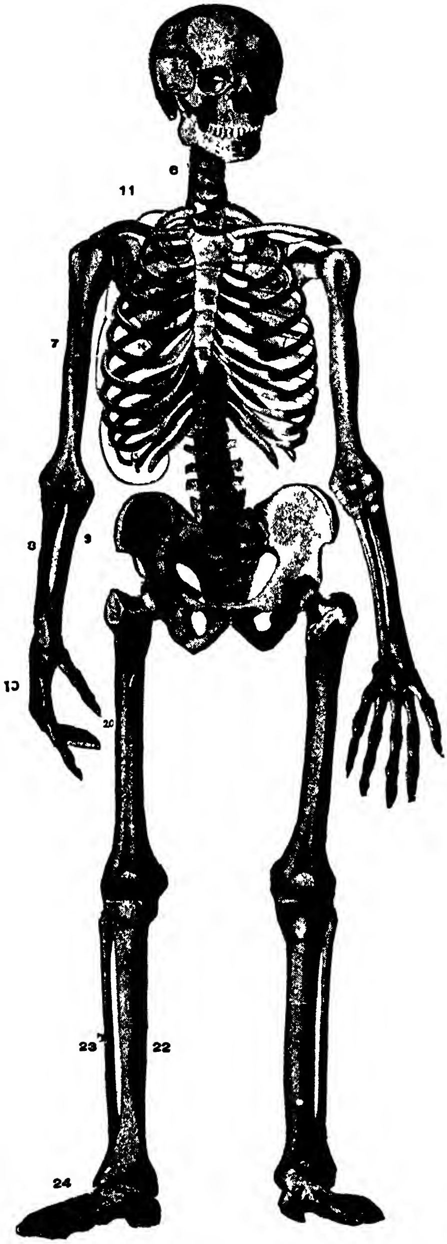
CHAPTER V.

THE BODY'S WONDERFUL FRAMEWORK.

WHAT the steel framework is to the modern "sky-scraper" building, the skeleton is to the human body, only much more. The steel structure of a thirty-story building is rigid and immovable, designed only to support the weight of the whole, but the skeleton, while giving stability and support to every part of the human body, and protection to the most vital parts, is at the same time so wonderfully devised as to permit of every possible movement.

Most of us perhaps do not realize what a truly remarkable piece of work is this skeleton of the human body from a structural standpoint. Some may consider it ugly in itself, but it is so designed that when normally and perfectly filled out with flesh and blood, with the various organs, muscles and tissues of the body, the entire completed structure is the most exquisitely beautiful creation in the world. It is impossible to conceive or imagine how it could be better or more perfectly arranged to fulfill the purposes of life and strength and movement. Just think of the resisting power of the bones of the body, a strength like that cf steel. The bones of a single man have been known to uphold the weight of several horses, or of a giant automobile filled with people. Such are the extreme possibilities of the human skeleton. At the same time think of its wondrous mobility, the ease and freedom of movement of every part being such that ordinarily we forget that there are bones or rigid members within ourselves. We can move every part almost any way we choose, the articulation of the joints and hinges of the body being so smooth and perfect that they seem absolutely without friction, except perhaps in extreme age or in disease.

This framework of all the bones of the body, taken together, is known as *the skeleton.* In this simple yet wonderful structure there is not a false touch. The tiniest bone has its place, and the human body cannot be perfect without it. In the normal body each bone is just as strong as it needs to be—



Front View of the Skeleton.

1. Frontal.
2. Parietal.
3. Temporal.
4. Superior maxillary.
5. Inferior maxillary.
6. Cervical vertebræ.
7. Humerus.
8. Radius.
9. Ulna.
10. Hand bones.
11. Clavicle.
12. Sternum.
13. Xiphoid process.
14. True ribs.
15. False ribs.
16. Thoracic vertebræ.
17. Lumbar vertebræ.
18. Sacrum.
19. Ilium.

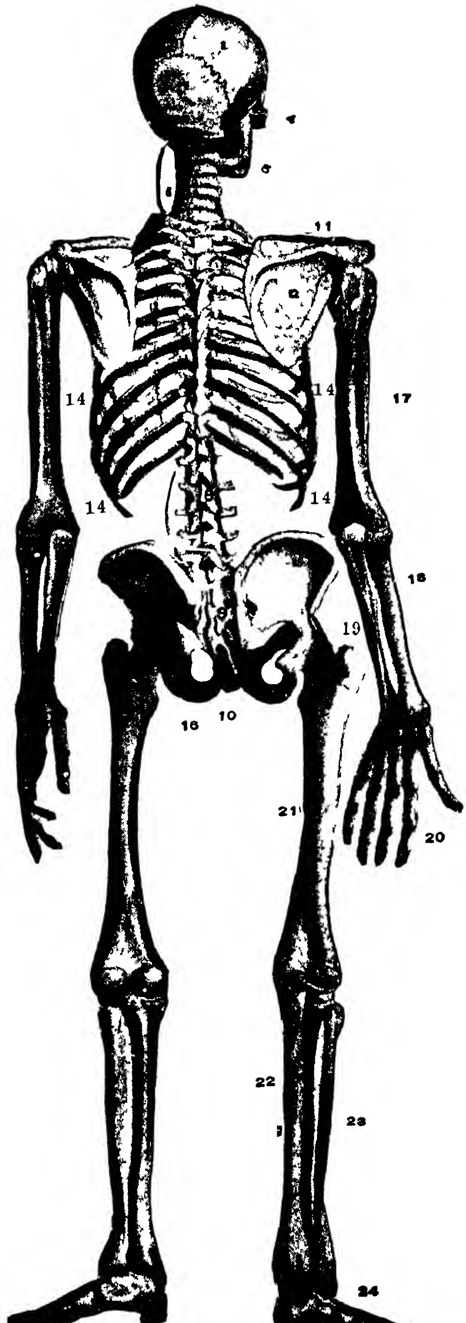
19a. Ischium of pelvis.

19b. Pubis of pelvis.

20. Femur.
21. Patella.
22. Tibia.
23. Fibula.
24. Foot bones.

Rear View of the Skeleton.

1. Occipital.
2. Parietal.
3. Temporal.
4. Malar.
5. Inferior maxilla
6. Cervical vertebræ.
7. Thoracic vertebræ
8. Lumbar vertebræ
9. Sacrum.
10. Coccyx.
11. Clavicle.
12. Scapula.
13. True Ribs.
14. False Ribs.
15. Ilium.
16. Ischium.
17. Humerus.
18. Radius.
19. Ulna.
20. Hand bones.
21. Femur.
22. Tibia
23. Fibula
24. Foot bones.



neither more nor less. It is in its exact place, and works in perfect harmony with the other bones.

We all of us know, or will realize, that the bones grow in the earlier years of life. It is apparent at once that the child's bones must increase in size. The bones of the body undergo just as incessant change, at all times in life, as do the fleshy or muscular tissues or the nerves. Bones are made up of cells, just as flesh is, and these cells are constantly going through the same processes of birth, growth, decay and death as do the fleshy cells. Cells of the bones may be increased in size, number and in health just as are the other cells of the body. The only difference is that the cells that make up the bony structure go through their processes more slowly than do the cells in the fleshy parts.

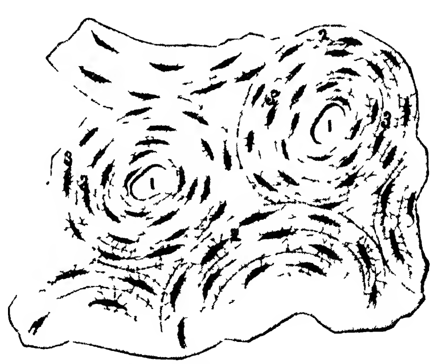
As we have already seen, bone tissue is a form of connective tissue, its cells being embedded in a ground-substance of extreme hardness because of the large percentage of phosphate of lime and carbonate of lime. The cells themselves are star-shaped, with many little projections not unlike the legs of a many-legged bug, these projections serving to connect each cell with its neighbors.

In the adult, the bones are made up two-thirds of this mineral matter, and perhaps one-third of animal matter, chiefly the gelatine, which is characteristic of all the fibrous matter in the various connective tissues. The bones of babies are nearly all of gelatine, or, in other words, they are largely cartilaginous, being therefore so pliable that they do not break easily. As they grow older the percentage of mineral matter is increased, but throughout all childhood the bones continue to be sufficiently pliable to avoid breaking easily. As age approaches the gelatine gives way almost entirely to the mineral matter, causing the bones to become extremely brittle. The more active one's habits, the better his health and circulation, the more perfect will be the condition of his bones to the very last. Stagnant habits and poor health will hasten these characteristics of age.

The disease known as *rickets,* among poorly nourished children, and most common in the slumming districts of our great cities, is largely the result of a deficiency of the deposit of these salts of lime in the bones. If the truth be known, however, it is not so much the result of insufficient feeding, even among the poor, as of ignorance as to just what kind of food to give the children. The remedy for rickets is to be found in more perfect nutrition and plenty of opportunity for active outdoor play, especially an abundance of sunlight.

The living bone is covered with a delicate yet extremely tough membrane known as the periosteum. This membrane is intricately equipped with blood vessels that nourish the bone. Another function of the periosteum is to protect the bone as much as possible from shocks and jars. Let a portion of the periosteum be injured, and the bone contiguous to the injury will suffer disease and decay. So wonderfully vital to the processes of the bone is the periosteum that where pieces of the bone have been removed without injury to the periosteum the bony tissue has been known to grow again to full health—a secret of Nature's of which surgeons have taken advantage in the performance of some seemingly wonderful operations on bones.

Yet not by any means all of the nourishment of the bone comes through the periosteum. Any long bone, if cut so that the cross section may be examined, reveals the fact that the hard, ivory-like substance with which we are all familiar does not extend throughout the thickness of the bone. Inside of the hard outer shell is a softer substance called the cancellous tissue. This is sponge-like, somewhat hard near the shell, and becoming by gradual transition softer and softer as we go toward the center of the bone. This inner, softer part of the bone



Cross Section of Bone.
(Highly magnified.)
1 Haversian canal.
2 Lamellæ
3 Canaliculi

forms what is known as the medullary canal, the canal being employed to carry nourishment to every portion of the bone in conjunction with the work of the periosteum. This canal is filled with a yellow, fat-like pulp to which we give the name of marrow, and which is thickly supplied with blood vessels. The whole interior of the bone is a complicated system of canals; in many of the bones is found an especially large canal known as the nutrient foramen, and this protects the main artery that carries nourishment throughout the structure, branching off into more and more minute arteries.

In the flat bones, on the other hand, we find two thin plates of the harder material, with the spongy or cancellous tissue between them. The short and irregular bones have the cancellous tissue, but there is no medullary canal. When a thin section of bone is seen under the microscope a great many openings are detected in the cancellous tissue. These are the openings of channels that are called the Haversian canals, after their discoverer. These run the length of the bone, and contain myriads of the minutest blood vessels. All around these canals is a thick network of tiny cavities known as the lacunæ, which contain bone-cells, while wonderfully small canals—infinitely smaller than hairs—connect the Haversian canals with the lacunæ.

There is no medullary canal at the end of a long bone; it ends in cancellous (spongy) tissue with a very thin shell.

It is a curious fact that there are more bones in the infant's body than in that of the adult. Thus, there are twenty-two bones in the skull of a man of thirty; in the infant there are more, in order to permit of the growth of the skull and of the brain that it encloses. As adult age is neared some of the separate bones knit together. By the time old age is reached this process has gone even further, and there are less than twenty-two bones in the skull. The same peculiarity is noted in the sacrum and the coccyx at the base of the spine, and at some other points in the body. There are, in all, two hundred distinct bones proper in the frame of the adult.

Besides the various large and small openings in the bones by which the blood vessels and nerves penetrate and leave them, there are numerous projections and irregularities on the surface by means of which the various muscles are more securely attached.

The skull is the name of the group of bones contained in the head, these serving not merely for support, but, what is even more important in the case of the brain, as a means of protection. The skull may be divided into two sections, the *cranium* and the *face*. The cranium is a truly wonderful structure, considering the protection which it affords and its moderate size. With all the strength and hardness of the bones of the cranium they yet have a certain elastic quality which makes them far more effective as a means of protection, as in the case of a blow on the head.

The arched or upper part of the skull is known as the *vault*, whereas the lower portion is called the *base* of the skull, being very irregular, and provided with many projections and openings.

The front of the vault is made up by the frontal bone; back of this, side by side, and forming the large middle of the vault are the two parietal bones; and behind, forming also the posterior portion of the base, is the occipital bone. Here, in the base of the skull, is found a large round opening (the foramen magnum) through which the spinal cord passes into the brain. On each side of the skull are the temporal bones, forming chiefly the lateral walls, and on the lower sides of which are the openings leading to the mechanism of the ears. Behind these, and pointing downward, is an important projection known as the *mastoid process*, to which is attached the strongest muscle of the neck, the *sternocleidomastoid*. This mastoid process also contains a number of cavities which communicate with the middle ear. There is serious trouble when inflammation of the ear spreads to these cavities.

The *malar bones*, usually known as the cheek bones, are found below and at the side of the orbits. They are connected with the temporal bones by means of a narrow arch of bone, the *zygomatic arch*, the horizontal ridge of bone which can be felt with the fingers just under the temples. The two nasal bones give shape to the upper part of the nose, that of the lower part being determined by cartilage. Beneath the malar and nasal bones is the large upper jaw, constituting the greater part of the framework of the face, and containing the upper teeth. This upper jaw really consists of two bones known as the *superior maxillæ,* entering into the formation of the walls of the cavities of the nose, mouth and orbit. They, of course, have small foramina for the transmission of the nerves of the teeth and nutritive arteries.

The lower jaw, or *inferior maxilla,* the only movable bone in the head, consists of two bones at birth, which unite at the chin into a single bone during the first year of life. It forms the lower part of the face, and consists of a horseshoe-shaped body from the ends of which two branches extend upward, these latter branches possessing articular processes which connect with the temporal bones by means of the *temporo-maxillary joint.* This is the "hinge" upon which the jaw works when we open and close the mouth.

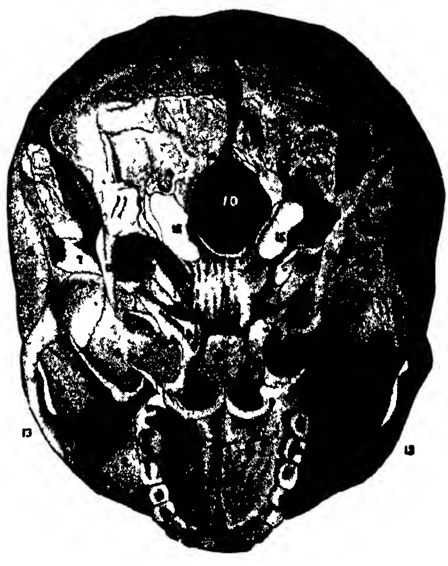
Front View of Skull.

1. Frontal
2. Parietal
3. Sphenoid.
4. Temporal.
5. Malar.
6. Nasal.
7. Nasal septum.
8. Superior maxilla.
9. Inferior maxilla.

The orbital cavities for the eyes are very pronounced, but for general purposes it is not necessary to know in detail all of the small accessory bones. Between the orbital cavities is the nasal cavity, divided by a partition into two sections, known as the left and right nasal fossa. From the lateral walls of these project three shell-like processes, the so-called turbinate bones of the nose. The floor of the nasal cavity is formed by the hard palate, this also forming the fore part of the roof of the mouth.

Beginning with the trunk, we take up, first of all, the bones of the *spine,* or "back-bone." It is impossible to conceive of a more wonderful bit of machinery, since, in one way and another, it dominates all the functions of the body, and all other portions of the skeleton are made subservient to it. This spinal column is made of separate bones; there are seven that belong to the neck, and are known as cervical vertebræ; below are twelve vertebræ that belong to the back and support the ribs, and these are known as dorsal vertebræ; the five lowest vertebræ, belonging to the loins, are known as the lumbar vertebræ.

It is most important that the student should thoroughly learn and remember the names and locations of these various groups of vertebræ, with their numbers, because of the importance of locating thereby the various spinal nerve centers later, in the study of the nervous system. It is more important to have a knowledge of the bones of the spine than of any other part of the human skeleton.



Base of Skull.

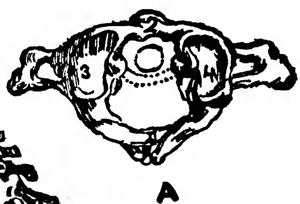
1 Palatal portion of the superior maxilla
2 Facial portion of the superior maxilla.
3 Palate bones.
4 Sphenoid.
5 Vomer.
6 Temporal.
7 Petrous portion of the Temporal.
8-9 Occipital.
10. Foramen magnum.
11. Posterior nares
12. Styloid process of temporal.
13. Malar.
14. Parietal.
15. Condyles

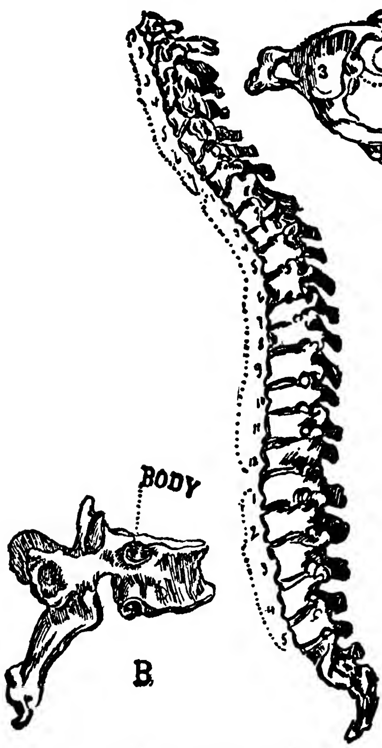
While the bones of the spinal column differ slightly in shape, according to location, the general structure of one vertebra is like that of another. On page 154 may be noted the atlas, or uppermost of the cervical vertebræ. It is upon this atlas that the head rests. A central cavity, a *foramen,* is shown, and this foramen is repeated in each of the vertebræ, thus forming a canal through which the spinal cord passes. This spinal cord is the master nerve of the body, controlling the entire nervous system. Between each two adjoining bones are openings through which branch nerves pass out to all portions of the body.

Between each pair of vertebræ is a cushion of cartilage. These hold the spine together, soften jars, prevent friction of the bones, and give the needed elasticity to the spine. Cartilage thus performs here the same service that it does in other portions of the body. In meat we are familiar with the appearance, and somewhat familiar with the structure of cartilage under the common name of "gristle."

At the base of the spinal column is a most important but little-heard-of bone, known as the sacrum, or sacred bone. It is a three-sided, wedge-shaped affair that gives some support to the spinal column. It is wedged between the hip-bones in such manner that it will be seen to form the keystone of the pelvis. The sacrum terminates in a series of little bones, known under the name of coccyx.

When the head moves for-





The Spine with the Vertebrae Numbered.

(At the lower end are shown the sacrum and coccyx)

There are 7 cervical, 12 dorsal and 5 lumbar vertebræ.

A. Flat view of a vertebra, showing the foramen, or canal through which the spinal cord passes.

1. Posterior arch.
2. Anterior arch.

3-4. Articulating surfaces.

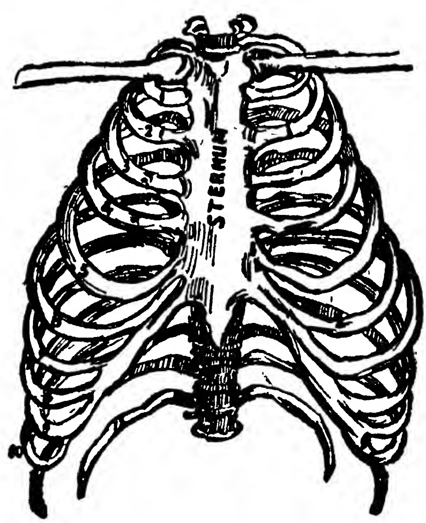
B. A side view of a vertebra.

ward or backward, it moves on the axis, and the ligaments prevent it from moving too far. When the head is turned from side to side the skull and atlas pivot on a bony peg on the top of the axis or second cervical vertebra, and here again ligaments prevent the head from making a complete turn around.

The spinal column is the base of many of the important muscles of the trunk; and especially of those that aid in keeping the body erect. On the whole, the spinal column possesses almost incredible strength, considering its divided character and the amount of cartilage making up a part of its structure.

Beginning at the base of the neck in front, the sternum or breast-bone runs downward. This bone has a most important function supporting the ribs, as it does, in the front of the body. From the necessities of its office the sternum is tough and elastic at the same time. It is rarely fractured by a blow in the breast, having as it does great resistant power and great power to bend before a blow. When a fracture of the sternum does occur it is a very serious matter for the victim.

The seven uppermost ribs are known as the "true ribs," since they all connect directly, on both sides of the body, with the sternum. The next three ribs, on either side, are known as "false ribs"; they do not touch the sternum, but are connected with it through other ribs, and by connection of cartilage. The lower two ribs on either side are called "floating ribs," for the reason that their forward ends are not in any way associated with the sternum. All of the ribs proceed from the dorsal vertebræ.



Sternum and ribs, the latter numbered, branching sidewise from head of sternum, the clavicle, or collar bone.

Considering the importance

of the hip-bones in the skeleton structure of the body, it may seem odd that anatomists have given to them the name "ossa innominata," which means "unnamed bones." Much more expressive was the old Anglo-Saxon name, "haunch bones." The shape of these bones is oddly irregular; at first glance their appearance conveys an idea of awkwardness. But the bones are ideally shaped for the work that they have to perform. On the inside edges these two bones are joined firmly together, but the sacrum is wedged into place between them. The hip-bones, sacrum and coccyx form the framework of the pelvis, or pelvic basin, of the trunk. It will be noted that there are no bones in the front or anterior portion of the lower trunk, the abdomen being without a framework protection, since it needs none. This arrangement allows of a natural expanding and contraction of the abdomen by deep breathing, and provides a flexible portion of the trunk for body bending and rotation. This portion is covered with heavy muscles, whose fibers run in various directions, forming a natural corset. It expands by food excess; hence this corset may become weak.

There is a notable distinction between the male and female pelvis, suited to the bodily requirements of each. The female pelvis, suited to the requirements of maternity, is considerably broader and not so high, whereas that of the male, perhaps designed for the greatest possibilities in the way of strength, is higher and more narrow.

On the outer edge of each os innominatum is a cup-like socket, into which fits the rounded head of the femur, or thigh-bone, the long and solitary bone of the upper half of the leg. The articulations of the joints of the arms and legs, and the part played by the shoulder-blade and the clavicle, or collar-bone, will be explained later.

Breaks or fractures are common accidents to bones, and require prompt surgical attention if the bone is to be restored to something like its former strength. We have a simple fracture when a bone is broken in a single place; it is a comminuted fracture when the bone is broken in two or more places. Occasionally a bone is broken in such fashion that a splintered end punctures the periosteum, the soft flesh and the skin. This is known as a compound fracture; it is always a serious bit of business, and calls for surgical skill out of the ordinary, since, if the periosteum be not restored to perfect health and wholeness, the bone near the fracture is certain to deteriorate and decay.

In the appearance of the structure of the shoulder-blade there is much of similarity with the hip-bone; and, indeed, the shoulder-blade performs a very similar office in providing a hinge from which a limb may hang and act.

This shoulder-blade, or scapula, as anatomists term it, is triangular in form. It forms the back portion of the shoulder girdle, which is composed of the scapula and of the clavicle, or collar-bone.

The scapula begins at about the level of the first dorsal or thoracic vertebra, and extends down about to the level of the seventh dorsal vertebra. In some skeletons the scapula is found to extend as low as the eighth dorsal vertebra. The inner edge of the scapula is close to the spinal column, and runs nearly parallel to it, being at a greater distance from the column at the lower end than at the upper. To a great extent the scapula is held in place by the muscles, ligaments and cartilages that bind it in its place. The clavicle, or collar-bone, has also much to do with keeping the scapula in place.

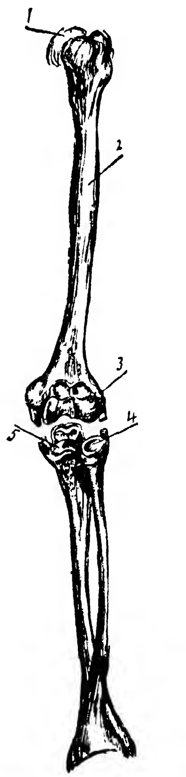
Along the back or posterior surface of the upper portion of the scapula runs a ridge of bone that is known as the scapular spine. This spine terminates in a winding, irregular bone that projects out beyond the scapula proper, and this projecting bone is known as the acromion process. It forms the posterior guard to the glenoid cavity. Running from the anterior side of the upper scapula, and somewhat in line with the acromion process, is the coracoid process, a projection of bone which forms the anterior or front guard of the glenoid cavity.

The glenoid cavity itself is a shallow, cup-like hollow at the upper, outer end of the scapular triangle. Into this hollow fits with great nicety the smoothly-rounded head of the humerus, or bone of the upper arm. This gives us a fair ball-and-socket joint, which renders possible the great freedom of movement of the arm from the shoulder.

But there is yet one more essential in this shoulder movement, and it is to meet this necessity that the clavicle exists. The clavicle articulates with the manubrium, or head of the sternum (breast-bone), being attached to a depression at the side of the manubrium. The clavicle, long, slender and bending, extends out past the scapula, attaching to the upper edge of the acromion process. Thus the clavicle helps to hold the scapula, and incidentally the arm, in place. The clavicle prevents the scapula from moving too far backward, and, at the same time, keeps the shoulders from coming too close together, thus forcing the arms well out and giving them greater liberty of movement and execution.

Study the peculiar formation of the humerus, or upper arm-bone at the joint of the elbow, as it is illustrated on pages 146, 147 and 158. In the shoulder we have found the ball-and-socket joint, but here at the elbow we have still another kind, known as the hinge joint, so called from the fact that it allows forward and backward movements.

It will be seen that the heads of the ulna and of the radius furnish sockets into which projections from the base of the humerus fit, form-



Bones, Left Arm.
1. Ball head of humerus that fits into glenoid cavity.
2. Shaft of humerus.
3. Base of humerus.
4. Cup in head of radius.
5. Cup at head of ulna.

Note.—The wrist is turned, which accounts for relative positions of ulna and radius at their bases.

Bones of Left Leg.
1. Head of femur.
2. Shaft of femur.
3. Outer condyle.
4. Shaft of tibia.
5. Shaft of fibula.
6. Base of tibia.
7. Base of fibula.

ing the perfect hinge that Nature designed. The ulna is the larger bone of the forearm. It is aided by the radius, which is the shorter bone on the same side of the arm as the thumb. The radius is so called because it is articulated with the wrist-bones and permits the radiation, or turning, of the wrist.

When we come to the skeleton of the hand we find it to be divided into three groups of bones. These are: (1) The carpus, or wrist; (2) the metacarpus, or bones of the palm; (3) the phalanges or fingers. There are twenty-seven separate bones in the hand; of these eight are carpal, five are metacarpal; and there are fourteen phalanges—three in each of the fingers and two in the thumb.

It will be noted that the eight carpal bones, all of them very irregular, form in two rows, which fact gives greater flexibility to the wrist. These bones are bound by closely interwoven ligaments, but still there is greater flexibility, and the division of the wrist-bones into two rows renders the wrist less liable to fracture.

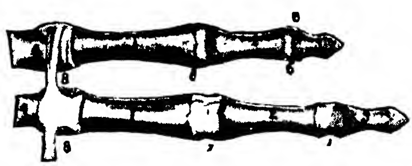
The metacarpal bones—those of the back of the hand—are attached at one end to the carpal bones, and at the other end to the fingers or thumbs. It will be observed, by experiment, that the metacarpal bones connecting with the fingers have but little freedom of movement, but that the metacarpal bone between the carpus and the thumb is capable of several distinct move-

Photograph Showing Bony Structure of the Back of Right Hand.

1 First row of phalanges
2 Second row of phalanges.
3. Third row of phalanges
4 Metacarpals
5-8 Second row of carpals.
9-12 First row of carpals.
13 Radius
14. Ulna

ments. Observation of a little varied work with the hand will show why this must be so. The greatest freedom of the phalanges is directed to various forms of grasping, although other movements of the fingers are employed in the use of the hand.

Reference has already been made to the ball-and-socket joint of the head of the femur, or thigh-bone, and the cavity in the hip-bone. The joints at shoulder and hip are very similar; here at the knee we have a hinge joint that is rather like that of the elbow. At the base of the femur are two well-polished protuberances, known as condyles, separated by a groove, that form a hinge joint with the knee cap and with the two bones of the lower leg, these two bones being known as the tibia and fibula. The tibia is known to everyone under the name of "shin-bone." It is a long three-sided shaft, and much larger than the fibula, which latter bone is firmly attached to the tibia at both ends. The lower extremity of the tibia forms the inside projection of the ankle-bone; the lower extremity of the fibula forms the outer projection of the ankle-bone.



Ligaments and Joints of the Fourth and Fifth Fingers of the Right Hand, Viewed From the Palmar Surface.

1. First row of phalanges.
2. Second row of phalanges.
3. Third row of phalanges.
4. Metacarpals.
5. Outer ligaments of the joint.
6. Inner ligaments of the joint.
7. Capsular ligaments of the joint.
8. Ligaments of the metacarpals.

The tarsal bones make up the ankle. These bones are seven in number. The rearmost of these bones, the os calcis, forms the heel. The powerful tendon of Achilles, the strongest tendon in the body, which may be felt just below the calf, runs down to this heel bone, and is greatly used in keeping the foot in exact position.

Next to the os calcis is found the astragalus, the bone that articulates with the tibia, forming a hinge joint. This astragalus bears the weight of the body on the foot.

Of the metatarsal bones it need only be said that they are five in number, and very similar in structure and functions to the metacarpal bones of the hand. The phalanges of the foot correspond rather closely to those of the hand, and are the same in number. The phalanges of the great toe are two in number, as in the case of the thumb.

At the knee the purpose of the patella, or knee cap, which is a small irregular disk of bone, is to protect the joint and to give greater leverage to the more important muscles there.

At the joint ends of bones are found thin layers of cartilage, which make the joints fast. Sockets have a deep ring of cartilage at the outer edge for the purpose of making the socket deeper. To hold the bone in place, and to give them greater security, ligaments pass over the joints, connecting the two bones with tough, elastic fibers that give the bones sufficient freedom and yet hold them strictly to their places and tasks. Ligaments do not break, as bones do, but they may be torn—lacerated—and it is, of course, possible to carry the laceration of a ligament so far that the last remaining fibers will snap if strain is put upon them. Lacerated ligaments of the knee may result from wrestling, and, in general, any

Bony Structure of the Right Foot From Below.

1 First row of phalanges
2 Second row of phalanges
3 Third row of phalanges
4 Metatarsals
5-6-7 Cuneiform bones
8 Cuboid
9 Scaphoid
10 Astragalus
11 Os calcis
12 Sesamoids

severe wrench may result in the painful laceration of ligaments. A very thin tissue, known as synovial membrane, is found covering the concave surfaces of the sockets of joints. This membrane secretes and gives out at need a joint-oil known as synovia. It resembles white of egg in appearance. By oiling the joints the synovia defeats the friction that otherwise would wear out the joints. Bursæ or synovial sacks, are also found at the joints.

The question may arise in the mind of the reader as to whether or not the bones may be enlarged and developed as the muscles may be. We may say briefly that this is possible, but in most cases not likely. Naturally, the size and strength of the bones may be influenced chiefly by the habits and exercises of the individual during the years of growth, but after reaching maturity little increase in size can be expected. If one's physical development has been neglected during the years of growth, then a proper course of training taken up after maturity will tend to bring about a normal condition of every part, the bones included, and the latter may be increased somewhat in size even if they cannot develop the greatest strength which might have been possible had the boyhood and youth been more favorable.

Ligaments and Joints of the Fourth and Fifth Toes of Right Foot, Viewed From Below.

1. First row of phalanges.
2. Second row of phalanges.
3. Third row of phalanges.
4. Metatarsals.
5. Outer ligaments.
6. Inner ligaments.
7. Ligaments of the metatarsals.

The more perfect and pure the condition of the blood, the greater the vitality, and the more active the circulation, the more satisfactorily will the bones be nourished, and under such conditions of good health they will improve if they have been below par in size and strength before the inception of the good habits which have brought about this good health. If they were already fully developed, then no change in size will be apparent, although they may be improved in quality and strength. A vigorous muscular condition is invariably accompanied with the active circulation that helps to keep all other tissues at their best. Laying aside all comparisons of muscular development, the bones of the athlete are far stronger than those of the sedentary worker; his nerves are less susceptible to shock; his tendons are tougher and his ligaments less easily torn. Men who play football develop such hardihood that they can not only endure with impunity what might almost kill the average man of business, but when they are injured they do not require so much time in which to mend. Their bones knit more rapidly, wrenched tendons and lacerated ligaments recover in surprisingly short time, while bumps and bruises which others might feel for a week seem to disappear over night. Such are the advantages of a vigorous physical condition, whether acquired by football or by the more rational and more effective methods which we are teaching. The bones, like all other tissues of the body, may be influenced in this way.

If one really desires to enlarge a particular bone, he can do so by subjecting it to repeated and long continued strain. If he has a slight wrist and wishes to strengthen and enlarge it, he could do so by working as a bricklayer for two or three years, or by persistent practice of exercises which place a decided strain upon the wrist without injuring it. Bricklayers and blacksmiths all have good wrists. Mountaineers all have stout knees and sturdy limbs, and a continuous life on the mountains, climbing, hunting and struggling over rocky passes, would strengthen anybody's legs, both with reference to muscles and bones. As for the bones, however, the greatest effect could be accomplished only by beginning before maturity. In most cases it is not advisable to attempt to enlarge or alter the bones, except where there is some deformity, in which case corrective exercise, persisted in, will usually accomplish marked results in one or two years, sometimes in much less time.

CHAPTER VI.

THE MUSCULAR SYSTEM.

IN the effort to bring about improved health and increased vitality, we depend upon nothing so much as the voluntary use of the muscular system. In this we find the only part of the body that is directly under our complete and willful control, and in order that we may employ it successfully and intelligently, not only for strengthening and perfecting the muscles themselves, but for increasing the energy and improving the quality of all other organs, tissues and systems of the body, it is important that we know and understand the nature of this important part of our make-up.

In colloquial speech we commonly differentiate between the muscular system and the various internal organs of the body, such as the stomach, heart and lungs. However, a muscle is really an organ and an important one—an organ of motion. Without our muscular tissues, could we imagine ourselves as being ourselves? And lacking in this nearly half portion of our total make-up, we could not only not move a single member of the body, but the functions of our various internal organs and the vital processes of life could not proceed for an instant.

This power of voluntary movement is perhaps the first thing that distinguishes animal life from the vegetable world. The tree is an example of organic life, as distinct from what we term inorganic matter. The tree has the power of absorbing and utilizing moisture, sunshine and air, of breathing through its leaves, of growing, and of giving off its life-perpetuating fruit or seed; but it has no power of movement, being utterly at the mercy of external forces.

All forms of animal life, however, have the power of moving themselves of their own volition. The more highly developed the form of life, the more varied and complex are the movements of which it is capable, men and women being possessed of the most extraordinary and wonderful accomplishments because of this. The marvellous manual dexterity and piano technique of Paderewski are simply a matter of muscular proficiency and training. The divine touch of the great artist, as he expresses his very soul in his masterpiece, is placed upon the canvas by means of the muscles that guide his gifted hand. Not alone the important things of life, however, but also the trifling and commonplace actions, usually more important than the seemingly big things, depend, all of them, upon this elaborate system of organs of motion which we call muscles.

As we have already shown, we cannot move nor exist without muscular action. It is the essence of natural locomotion. In the more primitive conditions of life, we could not build fires or houses, or clothe ourselves, or even seek refuge in the remote warm corners of a cave, as a protection against cold, without muscle. We could not put our food into our mouths, we could not chew it or swallow it, and we could not digest it without muscular action. We could not lift our lids to open our eyes, we could not turn our eyes to see, nor focus the sight upon objects far and near, without the use of muscles. We could not speak, in tones either gentle or harsh, we could not sing, we could not even breathe, except through the help of muscles. Even the heart, universally regarded as the most vital of all organs, is a muscular structure, working tirelessly and with greater persistence and fidelity than any clock for perhaps a hundred years, a piece of muscular machinery without which the blood could not circulate, and to which any injury usually means the instant death of the individual.

It is true that the impulses which actuate the muscles come from the brain, and that their actions depend upon the electrical or nervous energy thus imparted. They are still just as important for their purposes, even if regarded as only the instruments of the mind. It is also true that some of the muscular tissues concerned in these various operations casually mentioned are of the involuntary kind, but they only serve to show the importance and dignity of these tissues as an important factor in the making of a human. Muscle is not a low-grade tissue, as some have fancied, and it should be self-evident that the more perfectly the muscles and tissues of the body are trained and cultivated, the more efficient will they become in themselves, and the more capable the individual whose will they obey.

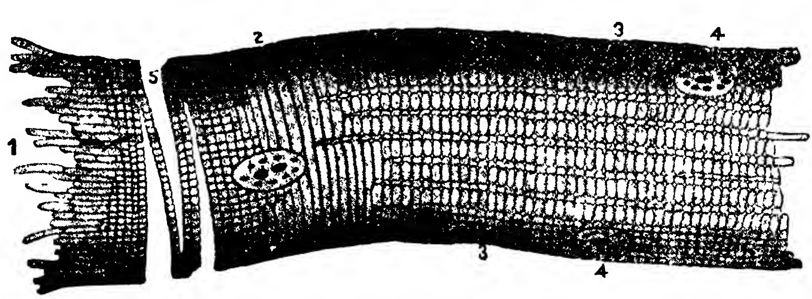
Seeing things in this light, how absurd becomes the pitiful attitude of those pretended worshippers of the high brow who sneer at muscle and its exercise. Unfortunately, there are still many, the number happily becoming less and less, who tell us with a tedious reiteration that what we need is brain and not brawn, mental and not muscular strength. But this is like saying to the builder of a magnificent building that he should go ahead first to build the dome; that he is wasting time on the foundation, but that he should go ahead and erect the upper part of the building without it. We know, however, that in erecting great buildings more time is usually spent upon building the foundation right than in putting up and completing all the rest of the structure. And this is even more important in the case of the body.

Perhaps the importance of a perfect and normal condition of the muscular system lies not so much in its value for the purpose of maintaining external strength and manual efficiency as in the more vital considerations having to do with the chemical and functional processes of life. These will be apparent at once when we observe that the muscular system of a normal and healthy human body comprises something between forty and fifty per cent. of the total bulk or nearly three times more than any other system or tissue of the body. When we realize that perhaps two-thirds of our vital heat is produced by the muscles, and that the greater part of our food is consumed in them, we can begin to appreciate their tremendous physiological importance. We will see how imperative is the requirement that we should be and continue to be muscularly perfect, or as nearly so as possible. With this aspect of the subject in mind, we will see, as we may never have seen before, that in neglecting to take at least a fair and healthful amount of active exercise daily, we are simply following a policy of slow self-destruction. It is impossible to be muscularly wrong, and to be right in other respects. When we say muscularly perfect we do not mean an extreme or abnormal development, but a normal condition of every part of the body, a natural, vigorous degree of strength, and, in short, a physical condition in which we may compare favorably with the common perfection of life among the lower animals.

Voluntary motion by animals, as we shall see later, comes through the exercise of some degree of mental power, but the finest of nervous organizations would be incapable of inspiring any motion if it were not for the co-ordination of muscles.

The more muscles there are trained the greater will be the varieties of motion that are possible. The firmer and larger the muscles are the greater the strain that they will endure. If the muscles are trained in toughness alone the possessor may have great strength that will be equal, for instance, to carrying great loads, or lifting great weights. But if the muscles are so trained that they do not become merely tough but elastic as well, he who has such muscles will display great agility in the different methods of exercising his strength. Finally, he who is intelligent, and who has a nervous system that is perfectly balanced, so that the brain may direct, and the nerves may carry the orders to the muscles, will be strong, agile and skillful in anything that involves muscular motion.

If a human cadaver be examined upon the dissecting table, it will be found that the muscles that perform the work of the



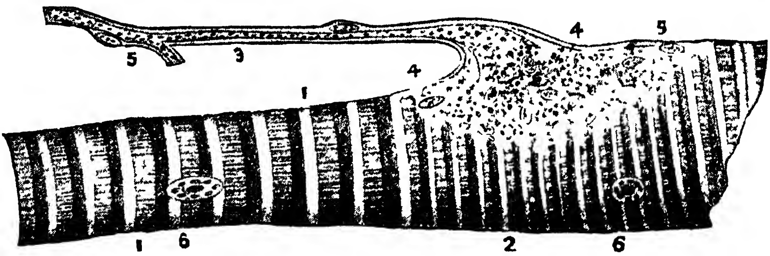
Striated Muscle (Greatly magnified.)

1. Fibrillæ.
2. Cross striations.
3. Longitudinal striations.
4. Nuclei.
5. Separation into disks.

arms and legs, of the chest, back, etc., are long and red. These are known as the voluntary muscles, for the reason that they move only when their living possessor wills that they should do so. All of the voluntary muscles present this same color, although in differing shades of redness, so that the voluntary muscles may always be known when seen. There is another characteristic of the voluntary muscles that is apparent to the eye in the larger muscles, but which must be found with the aid of a microscope in many of the smaller muscles. This is the fact that voluntary muscles have one characteristic of structure in common: They are *striated*—that is, striped. These striated muscles may be likened somewhat to the spiral spring, and it is this characteristic of structure that makes the contraction of the muscles possible.

The essential principle of all muscle, whether voluntary or involuntary, is this power of contracting. Raise your fist so that it touches the shoulder, and several sets of muscles have been contracted to make the movement possible. Straighten the arm again, and other sets of muscles have been contracted in order to bring the first out straight from the shoulder.

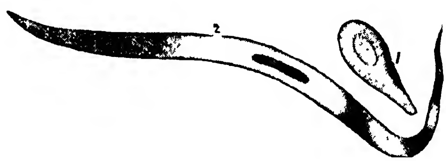
Merely for the sake of convenience, we speak of a muscle as if it were one single and complete affair by itself. Yet, if we place a cross-section of even a very small muscle under the lens of the microscope, we find that it is made up of a bundle of a great many fibers. Each fiber is enclosed in and protected by a very thin, transparent sheath known as the sar-



Striated Muscle Showing Ending of a Nerve.
(Detailed reproduction—greatly magnified.)
1. Striæ in relaxed muscle.
2. Striæ—contracted.
3. Motor nerve.
4. End of nerve.
5. Nuclei of the nerve sheath.
6. Nuclei of the muscle cells.

colemma. And each fiber is made up of many much smaller threads of tissue which are designated as fibrillæ. The striated appearance is found even in the fibrillæ. Now we find that fibrillæ, bound up in the sarcolemma, form the fibers, which are bound together in bunches known as fasciculi, and that these latter are in turn bound together and enclosed in sheaths. A muscle, therefore, is a number of fasciculi bound together, and often very intricately.

Upon further examination we find that each muscle, however small, has its own complete and even intricate set of nerves, lymphatics, and blood vessels. It is the presence of these blood vessels that gives to the voluntary muscles their red color. Of the lymphatics more will be said in a later chapter; they are an important part of the nutritive mechanism of the body. Blood vessels, lymphatics and nerves that are on missions to other parts of the body do not pass through the voluntary muscles, but between them.



Smooth Muscle Fibrillae.
(Highly magnified.)
1. Not fully developed.
2. Fully developed.

These voluntary muscles cover the bones, but are not directly attached to them. At either end of a muscle may be found a white connective tissue, the tendons. These tendons are familiar to all who have cut up raw meat. When examined closely it will be seen that there is a gradual merging of the fasciæ, or connective tissue forming the sheaths around muscles, into the tendons.

Very different in appearance are the involuntary muscles. They are smooth and regular in appearance; they are band-shaped, with somewhat of the appearance of gutta-percha. They are not striated (striped). A powerful microscope reveals the fact that these involuntary muscles are not made up of fibers, but are composed of long, needle-shaped cells that form flat textures like sheets of paper. Another peculiarity of the involuntary muscles is that they have no tendon attachments; from the fact that involuntary muscles are not attached to bones they have no need of tendons. Involuntary muscles have the same characteristic of contraction that is possessed by the voluntary muscles; they also respond to irritation, although to a less marked degree than do the voluntary muscles.

Of all the involuntary muscles the finest samples are those found in the heart, that organ which never ceases work for an instant while life lasts. Other involuntary muscles are those of the lungs, which carry on the work of respiration even when we are asleep. So, too, do the stomach, the liver and kidneys, the intestines and all of the other vital organs perform their various tasks through the constant contractions of their involuntary muscles. Thus the churning of the stomach brings about the performance of digestion. The involuntary muscles of the intestines force the contents along. The blood vessels and the lymphatics perform their offices by the aid of involuntary muscles.

Whether or not the involuntary muscles can be made, by a direct effort of the will, to take on some of the voluntary characteristics is a question that cannot be decided with finality. It is not to be thought that the involuntary muscles can act wholly independent of the control of the nervous system; in fact, it is well known that the possessor of a finely organized nervous system will have healthier involuntary muscles, and this would seem to indicate complete nervous control of the involuntary muscles. We know that one can increase his heart beat by breathing much more rapidly; he can stimulate the churning of the stomach by an effort of the will; but here the involuntary muscles are forced into action by the voluntary muscles. In this way the involuntary muscles would seem to represent a finely adjusted automatism. Fundamentally, however, they really depend absolutely upon the control of the nervous system. When influenced by the voluntary muscles in this seemingly automatic action, it is really the nerves which are first affected, they acting in turn upon the involuntary muscles. Let anything happen to the nerves and the involuntary muscles are motionless. A blow in the solar plexus, for instance, a sympathetic nerve center, will temporarily paralyze the action of the involuntary muscles of the heart and of respiration. In short, these involuntary muscles, like all others, depend primarily upon the brain and nervous system, but in a sub-conscious manner instead of being subject to conscious volition.

The most pronounced characteristic of either voluntary or involuntary muscles is their apparent "irritability." Any form of irritation that is applied to a muscle causes it to contract. This is seen, readily enough, by touching a muscle sharply. There are other forms of irritation than mere contact. Excessive heat will cause quick and sharp muscular contraction. When one is insensible his muscles will contract—twitch—if a strong current of electricity be passed through his body. Active respiration, forcing the blood through the body, will cause the muscles to twitch on account of the irritation caused by the passage of blood against the muscles, and also on account of the other irritation produced by the involuntary muscles in motion in the blood vessels.

Perhaps we should make a distinction here, for the reason that in some cases what may seem to be the irritability of the muscle is only the result of the action of the nerves contained in it. The nerves in such a case are affected by the irritation or external influence, in turn causing the muscle to contract by reflex action. In the case of an electrical current, however, this will act directly upon the muscular tissue, causing it to contract in much the same manner as by the stimulus of "nerve-force," though without the control and direction that come through the nerves from the brain. The best proof of this is that electricity will cause contraction of the muscles of a dead person. As we shall see later, this similarity of the influence upon the muscles of both the nerve impulses and electrical currents is one of the facts which tend to show that the mysterious force of what we call "life" is either a form of electrical power or something akin to it.

Muscles are said to have an "origin" and an "insertion"—terms that are much used. The origin of a muscle is its source, or the place where it begins. The insertion is the spot where the farther end of the muscle is attached. For instance, in an arm muscle, the origin is the point on the bone from which the muscle proceeds; the insertion is the point which, by muscular contraction, is brought nearer to the origin. The voluntary muscles always end in tendons at the points of origin and insertion.

In the limbs the "tendon of origin" is usually that attached to the trunk of the body, or nearest it, while the other tendon, to be called the "tendon of insertion," is the one at the farther end of the muscle farthest away from the body.

Muscles are divided into several groups, according to their position, structure and functions. The commonest of the voluntary muscles are the recti, or straight. Then we have the deltoid, or triangular shaped, the brachial or arm muscles, and the intercostal muscles between the ribs. The biceps are two-headed muscles and the triceps three-headed.

The muscles of the face are by no means unimportant in relation to the work for which they are designed, but they scarcely require any special attention from the student of Physcultopathy and for that reason we need not enter into any detailed study of them here. They will be made clear by a study of the anatomical charts, in the light of our understanding of the action of the other muscles of the body.

Superficial Muscles of the Head.

1 Tendons of the Occipito-frontalis
2 Occipito-frontalis
3 Temporal
4 Sphincter of eyelids
5 Zygomatic major
6 Zygomatic minor
7 Levator of lip and nose
8 Compressor of the nose
9 Risorius
10 Sphincter of the mouth
11 Masseter
12 Sterno-mastoid
13 Trapezius
14 Splenius
15 Levator of the upper lip
16 Levator of the angle of mouth
17 Platysma myoides
18 Depressor of the nose
19 Depressor of the corner of mouth
20 Depressor of the lower lip
21 Levator of the chin
22 Pyramidal of the nose
23 Upper eyelid
24 Lower eyelid
25-26-27 Muscles used in moving ears.
28 Occipito-frontalis

Many physical culturists are guilty of the fault of letting the neck muscles take care of themselves. Special exercises should always be provided for the purpose. Twisting and bending the head and neck in all possible positions will provide the work needed for the neck muscles, which are highly important in the general anatomy.

Yet it is not necessary to study carefully all of the nine groups of muscles that are found in the neck. Most of these muscles are of interest only to the dissector and the surgeon. The platysma myoides is a superficial muscle covering all others in the front of the neck. It has no great importance, and outside of physical culturists people do not usually know of its existence. Yet is is very conspicuous when developed and vigorously contracted. The two important pairs of muscles to be studied and watched in the bodily development of the pupil who is to have a strong neck are the splenius and the sterno-cleido-mastoid. If these muscles be strong, as may be ascertained easily by feeling them in motion under the skin, then one may be satisfied that the other muscles are also in good condition and that the neck of the pupil will have all of the muscular power that should be developed.

It will be remembered that the twenty-four vertebræ of the spinal cord are divided into three groups, as follows: Seven cervical or neck vertebræ, beginning directly at the base of the head; below these, twelve dorsal vertebræ, belonging to the back proper, and five lumbar vertebræ in the small of the back. It is well to study the exact positions of these vertebræ and to keep them in mind at all times in connection with the muscles and nerves, particularly the latter, that have their starting point from the spinal column.

The splenius muscle has its origin in a single tendon, very narrow and pointed in form. It arises from the large ligament (ligament nuchæ) that passes down the back of the neck over the spine, proceeds upward from the last cervical and the upper six dorsal vertebræ, and broadens on the way upward. As it broadens the splenius divides into two broad bands of associated muscle, the splenius capitis and the splenius colli.

The capitis has its insertion at the temporal bone over the ear. The colli's insertion is at the two or sometimes at the three upper cervical vertebræ.

The splenii, both the capitis and colli, are the muscles felt at the back of the neck between the mastoid muscle and the spine. Its motions are readily felt when the head is turned to one side, or when the head is nodded. Anatomically the splenius is designated as one of the trunk muscles, but its action is felt most readily in the neck.

On the other hand, the sterno-cleido-mastoid muscle, found on either side of the neck, is a true neck muscle. It is readily found by placing the hand just back of the ear. Any pronounced movement of the head will bring the mastoid into prominence under the fingers. This muscle runs obliquely downward to the front. At the center it is thick and narrow, and feels like a stout rope beneath the fingers. At each extremity it is broader and thinner. One portion of the lower mastoid has its origin at the head (manubrium) of the sternum (breast-bone). Another portion of the mastoid has its origin at the upper surface of the collar-bone. The two portions have their common insertion back of the ear.

A glance at the color plate will make clear what is to be said of the more important of the muscles of the back. These are the trapezius, the latissimus dorsi and the rhomboids.

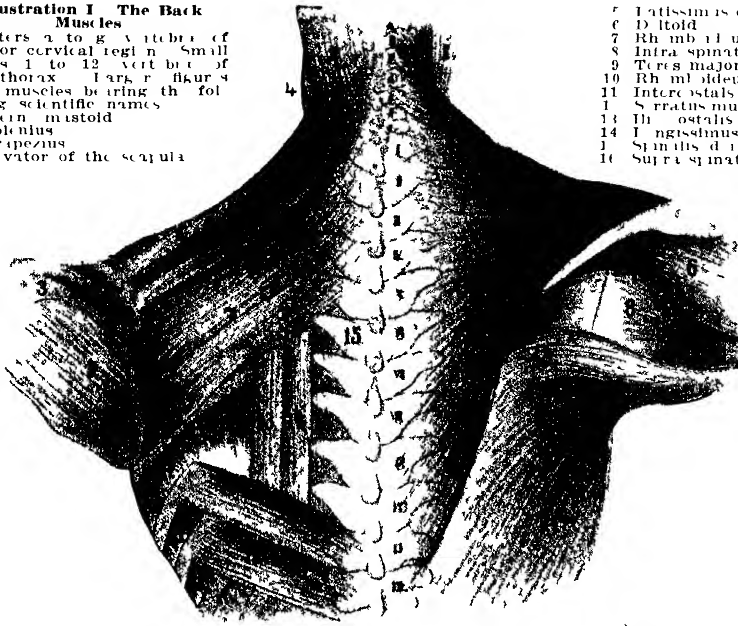
Let us first glance at the location of the trapezius. It will be seen that this is a very large muscle of triangular shape, and reaching all the way from the base of the skull to the lower portion of the dorsal region. It is a flat muscle just underneath the skin, and is composed of a great network of smaller muscles. The origin of the trapezius is a broad one, this muscle arising from the base of the skull, from the great neck ligament already mentioned, and from the seventh cervical and all of the dorsal vertebræ. The insertion is on the clavicle and on the acromion process of the shoulder-blade. In most of its extent the trapezius is fleshy, but at the points of origin and insertion the ends of the muscle are found in tough tendons. The function of the trapezius is to control the backward movements of the head and

PLATE C

Illustration I The Back Muscles

Letters a to g vertebrae of neck or cervical region Small figures 1 to 12 vertebrae of the thorax Larger figures show muscles bearing the following scientific names

1 Sterno mastoid
2 Splenius
3 Trapezius
4 Levator of the scapula
5 Latissimus dorsi
6 Deltoid
7 Rhomboideus (greater)
8 Infra spinatus
9 Teres major
10 Rhomboideus (lesser)
11 Intercostals
12 Serratus muscles
13 Ilio costalis
14 Longissimus dorsi
15 Spinalis dorsi
16 Supra spinatus



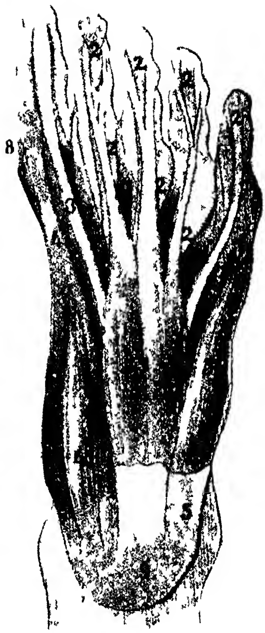


Illustration II Inner Side of the Hand Showing Muscles and Tendons

1 2 3 Flexing tendons
4 The annular ligament
5 Small flexor of little finger
6 Tendons of flexor muscles
7 Lumbricales
8 Palmaris brevis
9 Adductor of the thumb
10 Small flexor of the thumb
11 Abductor of the thumb
12 Opponents of the thumb
13 Flexors
14 Pisiform bone

Illustration III Back of the Hand

1 2 Extensors of the fingers
3 Capsular tendons
4 Interosseous muscles
5 Extensor of the little finger
6 7 Extensors of the thumb
8 Adductor of the thumb
9 Annular ligament
10 Radius
11 Ulna

Illustration IV View of Under-Surface of Foot

1 Short flexor of the toes
2 Long flexor of the toes
3 Flexor of the great toe
4 Abductor of the great toe
5 Abductor of the little toe
6 Interosseous muscle
7 Lumbricales
8 Annular ligament
9 Os calcis (heel bone)

shoulders. In lifting or in pulling the trapezius plays its important part; hence exercise for the trapezius should involve lifting, as of weights and pulling, as in tugs of war.

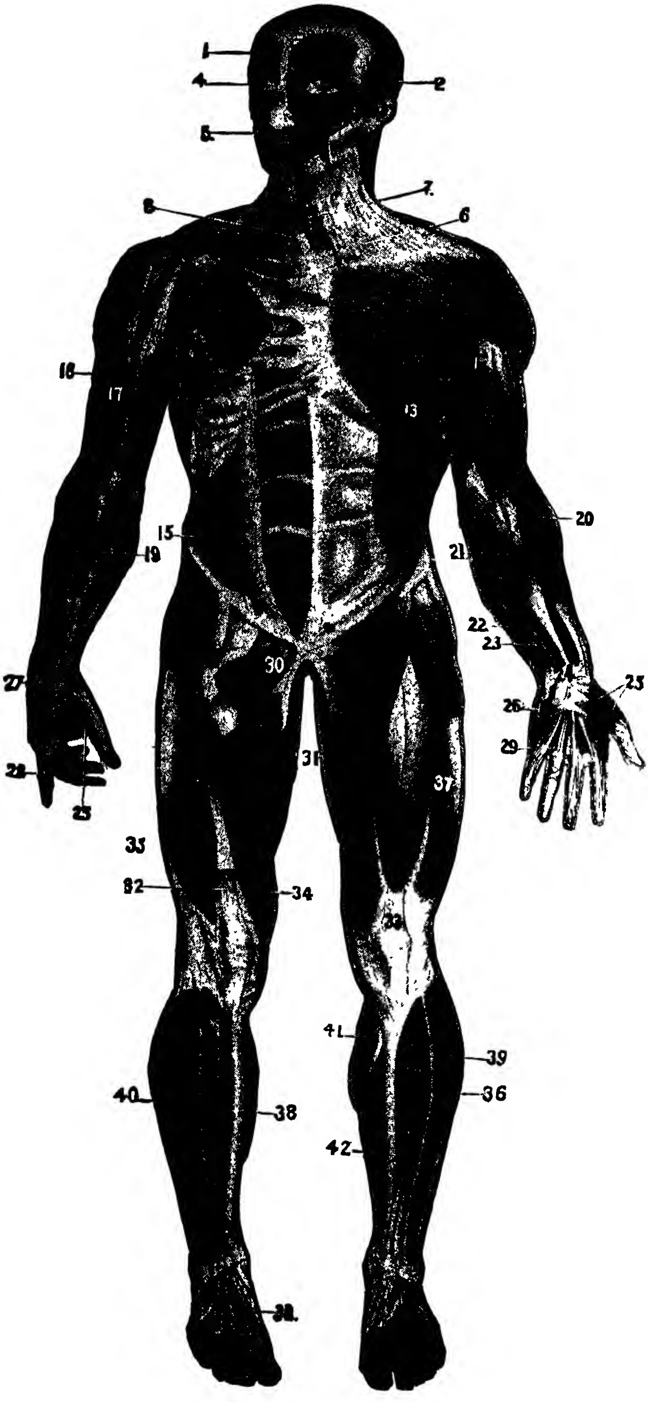
On either side of the lower half of the back we find a muscle that corresponds somewhat to the trapezius in shape and extent, at least, and this is the latissimus dorsi, which is also just beneath the skin, except where, at its upper end, it passes under the trapezius. The origin of this lower back muscle is at the six lower dorsal vertebræ, the lumbar vertebræ, the sacrum and at the upper edge of the hip-bone.

The latissimus dorsi, like its mate, the trapezius, is a complicated network of muscles, whose windings it is unnecessary for the gymnast to follow. The muscle converges in a short, very thick tendon that finds its insertion near the upper end of the humerus, the large bone of the upper arm.

The function of the latissimus dorsi is to draw the arm downward and backward. From this statement it will realized what a great variety of exercises can be utilized in strengthening this muscle. Any form of systematic exertion that pulls the arms downward or backward is indicated. The schoolboy usually thinks that he "chins" himself entirely with the biceps, but it is not true. Work on the bars, "chinning" for instance, or climbing ladders or ropes, bending, swaying or twisting the trunk, dumb-bell work that throws the elbows and shoulders back—these and countless other forms of exercise employ this muscle and are valuable for strengthening a "weak back."

The rhomboid muscles are found readily in any well-developed back. Let the subject stand with elbows at his sides, forearms horizontal and fists clenched. With the arms tense let the subject move his elbows and shoulders back. The rhomboids will show plainly to the eye in little ridges of muscles, showing outwardly in an almost perpendicular position, between the two shoulder-blades.

The rhomboids occur just underneath the trapezius, and assist the latter in its work. Hence the same kinds of exercises are called-for as in the case of the trapezius. The minor rhomboids originate in the ligament umnuchæ, already referred



Muscles of the Human Body Viewed From the Front.

1. Frontal muscle, opens eyelids.
2-3. Temporal, moves the ears.
4. Sphincter of the eyelids.
5. Sphincter of the mouth.
6. Platysma myoides (neck muscle).
7. Laryngeal and hyoid.
8. Sternomastoid (bowing muscle).
9. Pectoralis major (great breast muscle).
10. Pectoralis minor (smaller breast muscle).
11. Subclavius (collar bone muscle).
12. Intercostals.
13. External oblique.
14. Rectus abdominalis.
15. Transverse.
16. Deltoid.
17. Biceps.
18. Triceps.
19. Pronator radii teres.
20. Supinator longus
21. Flexor of the wrist (radial).
22. Flexor of the wrist (ulnar).
23. Flexor of the fingers.
24. The annular ligament.
25. Flexor of the thumb
26. Palmar muscle.
27. Extensor of the wrist.
28-29. Extensors of the fingers.
30. Adductor of the thigh.
31. Sartorius.
32. Rectus femoris.
33. Tendon of the knee cap.
34. Vastus internus.
35. Vastus externus.
36. Tibialis anticus.
37. Semi-tendinosis.
38, 39. Extensors of the toes.
40. Soleus.
41. Gastrocnemius (calf).
42. Peroneus longus (foot extensor).

to, and in the seventh cervical and first dorsal vertebræ, and their insertion at the root of the spine or ridge of the scapula. The major rhomboids have their origin in the first four or five of the upper dorsal vertebræ, and their insertion in a thin arch of tendon that is attached to the spine of the scapula.

Now, let us take a brief glance at the muscles found at the front of the trunk. First of all are the pectorals, or chest muscles, which cover the chest. The upper and more important of the pair on either side is the major pectoral, or pectoralis major. Its origin is from the clavicle near the sternum and from the sternum itself as far down as the cartilage attachments of the sixth or seventh ribs. This major pectoral is fan-shaped and terminates in a thick and powerful tendon, some two inches broad, inserted at the outer edge of the upper end of the humerus.

The origin of the minor pectoral is at the third, fourth and fifth ribs, near their cartilages, and the insertion in a tendon that connects with the coracoid process of the shoulder-blade. The coracoid process, you will remember, is the bony projection from the front of the scapula which helps to protect the glenoid cavity in which the head of the humerus rests.

It is the work of the major pectoral to draw the arm across the front of the chest, while to the minor pectoral is assigned the work of depressing the shoulder-point. A somewhat mild but effective exercise for the pectorals, in which, also, the intercostal (rib) muscles are benefited, is found in deep and long-continued breathing of outdoor air, in which the chest is repeatedly raised and lowered and forced outward.

The intercostal muscles are set rather deeply between the ribs and assist in the expansion of the chest during such free breathing as may call for this expansion of the chest.

The serratus magnus arises from the upper eight ribs a little forward from the sides of the body, and is inserted in the shoulder-blades.

Of great importance are the oblique external muscles of the abdomen. These pass down from the sides obliquely across the abdomen toward the front. They are broad, flat muscles that are used in the various bending movements of the trunk. Behind them are the internal oblique muscles of the abdomen, which aid the external muscles in their tasks. The character and location of these muscles should be carefully studied both on the charts and on one's own person.

The rectus abdominis, or straight abdominal muscle, is to be found on either side of the central perpendicular line of the abdomen. It is a long, flat muscle which extends the whole length of the abdomen, and the work of the pair is to press the intestines inward, as in abdominal breathing, to depress or pull the shoulders and chest downward, or, when lying on the back, to raise the upper body to a sitting position. This is the muscle that gives the great ridge-like appearance to the stomach, when well developed and contracted, and of which athletes are sometimes so very proud.

The study of the muscles of the arm will probably be found very interesting inasmuch as they indicate so clearly both the general structure and the character of muscular action. Their actions can be felt and seen very clearly from the outside and the swelling of the biceps in the bending of the arm is one of the most familiar facts of childhood.

It should be remembered, however, that in many of the movements in which the upper arm is concerned, we do not depend so much upon the muscles of the arm itself (with the exception of the deltoid and its action) as upon those of the upper trunk, of the chest, back and shoulders. For instance, in striking a blow forward, we depend largely upon the pectoral muscles for bringing the arm forward, the extensor of the upper arm only straightening the member as it is brought forward to strike the blow. The heavy hitting boxer, therefore, does not depend upon his arm muscles merely. The similar participation of the latissimus dorsi, and other trunk muscles in the movements of the arm, has already been noted. It will be seen that, with the exception of the deltoid, the muscles of the upper arm are concerned with the movements of the lower arm or forearm, and the muscles of the latter with the movements of the wrist, hand and fingers.

Stand with the arm hanging limply at the side, the open palm of the hand resting against the side of the leg. Clench the fist, raise it quickly to the shoulder, and strike out hard at some imaginary foe. The performance of this simple action has called into play a great, complicated and magnificent system of muscles which control every act that makes for the sustenance and protection of human life, muscles that are brought into constant use in every one of the thousands of tasks that make up the sum total of civilization.

The main causes of the difference between man and the lower animals are that man has a better brain with which to decree the acts of his life, and that he has *hands* with which to execute the orders received from his brain. And the hands are directly controlled by the muscular movements of the arms.

Biologists declare that the use of the muscles of the body, but especially the manipulation of the hands and other external objects through the hands, has been one of the most important of all factors in the education of the human brain. This is true not only with reference to the race, but in the case of each individual human during his period of infancy. The man who can "do things" with his hands usually has a pretty good level head. But this would lead us into another line of study.

In the very act of raising the arm from the side the use of one of the arm muscles was necessary. This is the deltoid muscle, which we referred to a moment ago, a flat, strong, triangular mass of fibers that is found on the outside of the upper shoulder. The play of this muscle may be felt plainly by placing the hand of the other arm in place over the muscle, then raising and lowering the arm rapidly.

Covering nearly all of the front side of the upper arm lies the muscle that is best known and most interesting of all to the novice in physical culture. This is the biceps—so called because it is two-headed. By "two-headed" is meant that the muscle has a dual beginning or head. These beginnings are tendons; there are two, a long and a short one. The short tendon has its origin in the coracoid process of the shoulder-blade. The long tendon has its origin in the glenoid cavity, and passes over the head of the humerus or upper bone of the arm. Each tendon merges into a long, muscular "belly," as the fleshy part of a muscle is termed. These two "bellies" lie close together, although they can be distinguished easily from each other until they are within some three inches of the hinge joint of the elbow.

In general contour the biceps is a long spindle. The insertion of the biceps is in a single tendon that is attached to the upper end of the radius, the smaller and outer of the two bones of the forearm. You will remember, of course, how the upper ends of the ulna and radius are so joined together as to effect a hinge joint with the lower end of the humerus and it will be understood from this how the biceps operates to bring up the forearm.

Now, there is another very important muscle of the arm of which not so much is heard in the boastings of the schoolboy as of the biceps. This is the triceps. It is on the under side of the upper arm, and, as its name implies, is three-headed. The middle tendon of the triceps has its origin on the scapula, just below the glenoid cavity; the external head rises from the upper shaft of the humerus, on the under side, and the internal, or short head, has its origin also from the shaft of the humerus. The main insertion of the triceps is in an attachment with the head of the ulna, although a set of fibers from the tendon attach lower down in the back of the forearm.

It is the task of the biceps to bend, or "flex," the forearm upon the upper arm. This is the familiar movement when "feeling muscle." The function of the triceps is to straighten the arm out again; hence it is called an extensor. The biceps and triceps, as we see, are exactly opposed to each other.

Besides the biceps there is another important muscle in the front portion of the upper arm, the one known to anatomists as the brachialis anticus. Its main position may be detected readily by the examination of one's own arm while steadily flexing and extending it. It is a broad muscle that covers the elbow and the lower half of the front of the humerus. The origin of this muscle begins at the insertion of the deltoid, and extends to within an inch of the elbow joint. The insertion is in the ulna. The function of the brachialis anticus is to flex the elbow. No especial form of exercise is indicated for this muscle, the general work employed for the development of the arm accomplishing all that is needed.

In the forearm the muscles that need to be considered principally may be divided into four groups, and all of these have the function in common of controlling the wrist and hand. The movements of all these sets of muscles may be followed with ease through the covering of skin.

Rest the elbow and the back of the hand on the table. Still letting the wrist lie on the table, bring the palm of the hand up toward the elbow. The muscles that move during this exercise will be found on the front and the inside of the forearm. These muscles are known as the flexors, since it is their function to bring the palm of the hand up toward the forearm.

Now, extend the hand again, until it is in line with the forearm and the back of the hand rests once more on the table. The muscles that move now will be found on the front of the forearm, near the outer edge and along the outer edge of the forearm. It is the work of these muscles to extend the hand, and these are known as the extensors.

Both the flexors and the extensors can be felt to still better advantage if you extend your arm horizontally forward. Holding the arm somewhat rigid, with the hand straight out at first, flex the palm up toward the elbow; then extend it. If the arm be held tense, it will be noted that there is slight fatigue on the inner edge of the forearm when the hand is flexed, with the same perception of fatigue on the outer edge of the forearm when the hand is slowly extended.

Next rest the forearm and open palm of the hand on the table. Without raising the forearm, turn the hand over so that the back of the hand rests upon the table. This way of turning the hand is called supination. The supinator muscles that make this turning of the wrist possible will be found in the front side of the forearm.

After you have thus located the supinator muscles, and have felt their movements, turn the hand back again so that it rests upon the palm with the back of the hand up. This movement is known as pronation, and the muscles that accomplish it are called the pronators.

Both the supinator and pronator muscles are attached to the front of the radius, the smaller and shorter bone of the forearm. It will be remembered that the base of the radius articulates with the carpal bones of the wrist, and it is through the contraction of the muscles just discussed that the movements of the wrist and hand are compelled.

When these four sets of muscles are well-developed and healthy it is said that one has a strong wrist. Lack of development in these muscles is responsible for weakness of the wrist.

Since these muscles have so much to do with the movements of the hand, it is highly important that they should be trained to a high degree of excellence. An arm that is strong at every other point is weak, indeed, if it be lacking at the wrist.

Gripping and lifting work will be effective. Any form of exercise that forces the wrists to turn freely, rapidly, and under tension, is indicated. Work on the bars, and tugging, are to be commended for this purpose, as well as climbing, especially on ladders and on ropes. The muscles that make for "strong wrists" do not yield readily to treatment. A gymnasium pupil with weak wrists must work some time before he can hope to note a great improvement.

Rowing and ball-pitching do much for the weak wrist, but fencing is *par excellence* the exercise of them all that is needed to insure the building up of a wrist that shall be at once strong, flexible and supple. It is to be regretted that fencing exercises only the right wrist. The left wrist, therefore, must receive its full share of benefit by being more employed than the right in other forms of wrist training.

If one takes up fencing or broad-sword work for the sake of exercise, then he should learn the game with either hand, practicing with both, so that he may be symmetrically developed and equally strong on both sides.

When we come to consider the anatomy of the muscles of the hand we find it impossible to learn much unless we consider these muscles in connection with those of the forearm, some of which we have just considered.

A careful study of and frequent reference to the illustrations will be necessary, in order to understand the muscles which control the hand.

Let us examine, first of all, the muscular control of the thumb. On the front or palm side of the thumb we find a short muscle at the outer edge known as the abductor of the thumb. Its purpose is to draw the thumb inward and toward the palm. On the inside edge of the thumb, nearest the fingers, is a muscle known as the thumb's flexor—the flexor longus pollicis. While it is the task of an abductor muscle to draw the member away from the center, the flexor is always the muscle that causes a member to fold over on itself. Thus the thumb flexor is used when the thumb is bent inward, as in the ordinary clenching of the fist. And thus the other muscle described, the abductor, draws the thumb away from its center, and necessarily toward the palm. On the extreme outer edge of the thumb is a short muscle (the opponens) that acts in opposition to the abductor, thus bringing the thumb straight again when employed.

Now we go up into the forearm in search of a muscle that is most important to the successful work of the palm of the hand. This muscle is known as the palmaris longus. It will be seen that it is a long and narrow muscle. It rises in the condyle of the humerus, the condyle being the extremity of that bone which fits into the socket-like heads of the ulna and radius to form the hinge joint of the elbow. The course of the palmaris longus will be seen to be at first along the ulnar side of the forearm, but it obliques gradually inward, and is found crossing into the hand at about the center of the wrist. The tendon of this muscle ends partly in the palmar fascia. It will be remembered that fascia is the name given to sheaths that cover muscles. This palmar fascia is a common sheath covering the muscles of the palm of the hand. It will be seen that this fascia branches off into four slips, each connecting with one of the four fingers. Each slip gives off numerous muscular fibers that extend to the skin of the palm and of the fingers.

There are two lateral sections of the palmar fascia. One, on the thumb side, covers the muscles of the ball of the thumb; on the little finger side the lateral portion of the palmar fascia covers the muscles of the little finger.

Now it will be understood how much of the movements of the hand is controlled by that slender muscle, the palmaris longus. And the exact location of this muscle, and the work that it performs, may be studied in the living arm and hand. Stand with the arm held horizontally forward, but with none of the muscles of the arm or hand tensed. Ascertain the exact course of the palmaris longus, as shown in the illustrations. Now, rapidly open and close the hand. While doing so let the fingers of the other hand move rapidly up and down along the indicated line of the palmaris longus. The location of that muscle will be verified as its action is felt through the skin.

For the next examination rest the finger tips of the right hand in the center of the palm of the left hand. Now close the fingers of the left hand over the backs of the fingers of the right hand, and the movements of the muscles enclosed in the palmar fascia will be felt. This may be extended by placing the right finger tips over the inside of the first phalanges of each of the fingers of the left hand and again working these left fingers shut and open. The play of the finger muscles will thus be illustrated.

On the inner sides of the fingers the most important muscles are naturally the flexors which have to do with folding the fingers over when closing the hand. The first and fourth fingers are also supplied with active abductor muscles, which are used in drawing these fingers away from their fellows.

In the palm of the hand is an extensive system of muscles of an inferior class that are known as the lumbricales. They perform an important part in aiding the flexors of the fingers.

At the base of the hand, where it joins the wrist, is a strong ligament known as the annular. It forms a strong band, or ring, around the wrist, and is divided into two portions, the anterior (front) and the posterior (rear) ligament.

At the forward or finger end of the palm is another ligament known as the superficial transverse ligament. This is a fibrous band that stretches across the roots of the four fingers, and is closely attached to the skin in the clefts.

Both the annular and the superficial transverse ligaments aid in keeping in place the bones that they cover. They furnish protection, also, to the muscles, tendons, blood vessels and nerves that pass under them.

Of course, the most important muscles that we look for in the back of the hand are the extensors that serve to straighten the wrist, hand and fingers in line with the forearm, thus doing work exactly opposite to that performed by the flexor muscles.

As a matter of course, then, we look to the forearm for a muscle that shall control these extensors of the fingers, or of the back of the hand, or of the back of the wrist. The extensors of the fingers we find to be controlled by a muscle known as the extensor communis digitorum. This rises in the back of the condyle of the humerus, or on the opposite side of the condyle from the palmaris longus already described.

This extensor communis digitorum, just below the middle of the back of the forearm, divides into three muscles that pass on to the first, second and third fingers, forming the extensor system there. There is a separate extensor muscle for the little finger, but it is connected with the common extensor of the other fingers.

For the thumb there are three extensors, one of these rising from the back of the shaft of the radius, and two from the back of the shaft of the ulna. One of the muscles rising from the shaft of the ulna controls the extension of the metacarpal portion of the thumb; the extensor rising from the radius connects with the first phalange of the thumb, while the other muscle that rises from the ulna is the long extensor muscle of the thumb, and controls the second or end phalange of the thumb.

We have left to examine only the extensor muscles of the wrist or carpus. The carpal extensors, as indicated on the plate, are the long and the short wrist extensors, both of them lying close to the thumb or radial side of the back of the forearm.

We find that the most remote muscular control of the wrist and hand comes from the lower extremity of the upper portion of the arm. In other words, the principal muscles controlling the wrist and hand rise from the condyles of the humerus. It may be added, by way of review, that the biceps and triceps muscles of the upper arm, by means of their insertion respectively in the radius and ulna, assist in two forms of motion of the wrist. Thus the biceps helps to control the supination of the wrist and hand, while the triceps helps direct the pronation of the wrist and hand. These two movements of the wrist are of importance in a great variety of manual activities.

An observer, watching the countless movements of any normally active person's hand through a day, might conclude that the muscles of the hand had so much to do that no especial muscular training is needed for the hand. But it would be a huge mistake to make such a conclusion. Exercises that provide for the severe flexing and extension of the hand and fingers are of importance in every scheme of physical training. Consider, for instance, how much is implied by the use of the common expression, "a strong grip." And this grip of the pupil can be strengthened greatly by exercises that provide vigorous and continued activity to the flexor muscles, the extensors receiving their share of exercise from movements as much opposed as is possible.

Outside of well-trained gymnasts weak wrists are so common as almost to be the rule. Exercises that provide for the supination and pronation of the wrist—such as movements that twist the wrist rapidly and vigorously—are indicated. Nor can the importance of the various forms of "tug" be overlooked when the muscular upbuilding of the wrist is attempted. It must be borne in mind that weakness at the wrist travesties swelling biceps. Of course, the reader must not forget, in considering the question of the strength of any set of muscles, that the muscles are only the instruments or agents through which power is expressed. The real power is in the nervous system, as we shall show later. Of course, it cannot be manifested through the muscles if they are undeveloped or otherwise incompetent. A strong grip, accordingly, while of course requiring a perfect muscular equipment, really depends upon one's nervous energy, or what people sometimes call constitutional vigor, because it is a matter that depends upon the strength of the body as a whole. We know that it depends upon the mental effort and the intensity of "mind-strength" exerted when gripping tightly with the hand. We usually find that persons capable of great mental concentration, men of exceptional nervous organization, have very good grips, at least when in a fair condition of health and even moderate muscular vigor.

Stand on one leg and raise the other until the thigh, or upper part of the leg stands out horizontally forward. Over this horizontal thigh run one of the hands along over the front —now the upper portion, moving the thigh part slowly up and down while continuing the examination with the hand. Carry this examination along the center of the front of the upper leg from the point where it joins the trunk, at the upper end, to the knee, at the lower end of the femur.

As the leg is kept moving a little up and down the play of the muscles under the skin over which the hand is passing will be felt. And it will be seen that a compact mass of muscles covers the front of the upper leg over its whole length. Indeed, this mass of muscle will be found to extend over the sides of the femur. Near the knee it will be found that this aggregation of muscle unites in a single and very strong tendon.

For purposes of convenience this great mass of muscle is treated as one muscle and is called the quadriceps (four-headed) extensor. It is the great extensor muscle of the leg, and is therefore used for straightening the leg. It is the greatest factor in the muscular work of walking or running, of cycling, of going up or down stairs, or in any movement where the leg is alternately bent and straightened.

While the quadriceps muscle is treated as one, it is divided into four muscles, each of which has its appropriate name. The four muscles composing the quadriceps are the rectus femoris, the vastus externus, the vastus internus and the crureus. Each of these muscles has its own head, or point of origin.

But all of these four branches of the quadriceps unite near the knee in a single tendon that is attached to the patella, or knee-cap. Thus, through contracting, is the quadriceps able to "pull" the leg straight. And it will be understood what mischief to locomotion is caused by a fracture of the patella.

The rectus femoris has its origin in the ilium, or upper ridge of the os innominatum, or hip-bone. It passes in a straight course downward over the front of the femur. It arises from the point of origin in two tendons, which unite, then spread into a mass of tendinous fibers. Farther down the muscle becomes a broad, thick mass of tendinous fibers and then unites in the common tendon of the quadriceps.

On the side of the femur is the vastus externus, which forms the largest part of the quadriceps. Its movements may be felt plainly, and it may be distinguished easily from the rectus femoris. On the inner side of the leg the vastus internus will be found. The crureus, the fourth and remaining muscle of the quadriceps, appears to be a part of the vastus internus, but in dissection it will readily separate.

A muscle of which much is heard is the sartorius, or "tailor's muscle." It has received this latter name because it is much used by tailors when they sit cross-legged. This muscle has its origin in the upper part of the hip-bone; it crosses obliquely over the upper portion of the femur to the inside of the leg. Now it descends vertically, and passes behind the inner condyle of the femur, and passing into the form of a tendon is attached to the upper part of the inner shaft of the tibia. It is the longest muscle in the body.

Well on the inside of the leg, and toward the back, are the adductor muscles, which are used to draw the legs together or to draw either leg inward in line with the spine. Whenever, from a position of standing with one leg well out at the side, you draw it in closer to the other leg, the adductor muscles are used, and their motions can be felt through the skin. There are three of these adductor muscles, the adductor magnus, brevis and longus. All have their origin at the crotch, and they extend obliquely to the femur. The magnus is the uppermost muscle; just below it is the adductor brevis, and below that the adductor longus. The three lie together with the triangular appearance of an open fan.

At the back of the leg we must begin with the gluteal muscles. There are four on each side; it is not necessary here to name them separately. These gluteal muscles are all found over the buttocks. They perform a variety of muscular work, such as adducting and extending the thigh, and also causing it to rotate outwards. The gluteals have another important function; in conjunction with certain of the back muscles they help materially in holding the body erect.

Behind the thigh-bone are the muscles that act in opposition to the quadriceps extensor. The most important of these, which serve to flex the knee, are the biceps (two-headed) femoris, the semi-tendinous and semi-membranous muscles. Of the two latter it is enough to say that they aid the biceps femoris in flexing the knee—that is, causing it to bend. These three muscles are known as the "hamstrings," and their powerful tendons may be felt very plainly just above the knee at the back of the leg.

The biceps femoris is a muscle of considerable size. It is found at the back and outer edge of the thigh. The main attachment of this muscle at its insertion is to the fibula near the head, but a slip from the tendon is attached to the shaft of the tibia.

Note, particularly, that the biceps extends obliquely downward to the side of the leg. Thus, when the biceps is slightly contracted, and the knee but half flexed, the knee will point outward—or, in other words, be rotated—and this is on account of the oblique direction that the biceps takes.

Passing on to the muscles of the leg below the knee we will consider first the tibialis anticus. This is the somewhat fleshy muscle that will be felt when running the finger tips down over the outer side of the tibia or shin-bone. The work of this muscle is to raise the inner edge of the foot. The origin of the muscle is at the head of the tibia; it passes vertically down over the shin-bone and passes under the annular ligament of the ankle. The muscle ends in a tendon, and its ultimate attachment of insertion is with the metatarsal bone of the great toe.

On the back of the lower leg we find, principally, the two muscles that form the calf. These muscles are known as the gastrocnemius and the soleus. The gastrocnemius is broad and forms the largest part of the calf. The soleus is a broad, flattened muscle lying directly beneath the gastrocnemius. The lower tendons—that is, the tendons of insertion—of these two muscles unite near the heel to form the strongest tendon in the body. This is known as the tendon of Achilles. The size and strength of this tendon may be felt through the skin at the back of the heel. The tendon is so hard, in fact, that it might be mistaken easily for a small bone.

There is an exact reason for this tendon being the strongest in the body. If it were not so it would be difficult to stand, and all but impossible to take even the most faltering steps. The tendon of Achilles is placed where it is for the purpose of keeping the body in an erect position as the weight of the body is thrown on the foot.

It is time, now, to mention, briefly, the details of the general muscular scheme employed in holding the body upright.

In the leg the muscles employed for this purpose are those found at the front and back. At the upper part of the femur the work is carried on upward by the gluteal muscles over the hip. These, in turn, combine in action with certain muscles of the back, and thus the muscular connection is kept intact until the base of the skull is reached.

On the front of the body there is a slight break in the muscular connection at the head of the thigh, but just past this brief interval the work is taken up once more by the vertical abdominal muscles, and there is another break in the direct muscular connection when the sternum is reached. Beyond, however, strong muscles at the front of the neck carry the work upward to the head. It requires the co-operation of all these muscles in the front and at the back in order to make man different from the lower animals in that he is able to stand and to walk in an upright position.

At a casual glance the foot does not seem to be the seat of a very extensive muscular system. We are liable to look upon the foot only as a flat-bottomed sort of affair on which to stand. Certainly the foot is not capable of as great a variety of movements as is the hand. Hence, why should there be as many muscles? Why should they be of the same importance as the muscles of the hand?

It must be admitted that a knowledge of the muscles of the foot is not as essential as is a knowledge of the muscles of the hand. It is equally true that, when a physical trainer gives proper attention to the training of the muscles of all other parts of the body, the muscles of the foot will be taken good care of without especial effort directed to them.

But a knowledge of the muscles of the foot is of interest nevertheless. We depend upon the feet for locomotion, and surely that is reason enough for knowing something of the muscles of the lowest member of the body.

In general, it may be said that there is a close relation between the foot muscles and the hand muscles. In the ape, which makes more nearly a similar use of hand and of foot, the similarity of muscular structure is even more pronounced.

The study of the muscles of the human foot must begin with the ankle. We found that at the wrist of the hand there is an annular ligament that completely binds the wrist and covers and protects the tendons of muscles as they pass into the hand. At the ankle there is a similar annular ligament, with this difference: That, while the annular ligament of the wrist consists of two portions—the anterior and posterior—the annular ligament of the ankle is divided into three portions. The anterior annular ligament of the ankle passes transversely over the front of the ankle. (See color plate, page 176.) On the outside of the ankle is the external annular ligament, and on the inside is the internal annular ligament.

Treating the ligament as a whole, it may be said that it binds down and protects the tendons of the muscles that pass under on their way to connection with the muscular system proper of the foot. And, at the same time, the blood vessels that nourish and the nerves that serve the muscles of the foot pass inside this annular ligament.

Corresponding with the palmar fascia of the hand is the plantar fascia of the sole of the foot. This plantar fascia is the densest fibrous membrane of the body. It is of great strength. The fibers are pearly white and glistening. This fascia is divided into a central portion extending to and along either edge of the sole.

The central portion is the thickest and is attached to the os calcis, or heel bone. At the rear of the foot this fascia is narrow and thick. Farther forward it broadens and becomes much thinner. Near the forward extremity of the metatarsal bones (the bones of the flat of the foot) this fascia divides into five processes, one running to each of the five toes.

The lateral portions of this plantar fascia cover the outer and the inner edges of the foot, and do much to give shape to that member.

The external fascia partly covers the muscle known as the abductor minimi digiti (small toe). It is the function of this muscle, which extends from the heel bone to the little toe, to abduct that toe—that is, to draw it away from its nearest fellow. The action of this muscle may be felt very plainly when the little toe is made to move sideways from its neighbor.

In like manner the internal lateral portion of the plantar fascia, which is very thin, covers the muscle known as the abductor hallucis, which is the muscle that draws the great toe away from the second toe.

The important muscle of the sole of the foot is known as the flexor brevis digitorum. It takes up the whole of the sole of the foot that is not occupied by the abductor muscles of the great and little toes. Near the metatarsal bones this broad muscle, which has its origin in the os calcis, divides into four tendons, which proceed to the great toe and to the three other toes nearest it. Just where one of these tendons passes into its toe it divides into two portions, allowing between the two portions the passage of the tendon of the flexor longus digitorum to the end of each toe.

Curiously enough, as it may seem, it is the upper side of the foot that is called the dorsum or back of the foot. But when it is considered that the sole is the portion of the foot corresponding to the palm of the hand, it will be easy to understand why anatomists denote the upper side of the foot as its "back." And, as the extensor muscles of the hand are found in its back, so the extensor muscles of the foot are located on the upper side.

Corresponding to the plantar fascia of the sole is another fascia on the dorsum or upper side of the foot. This is a very thin membrane, and on the sides of the foot it blends with the lateral portions of the plantar fascia.

On the top of the foot we find the important muscle to be the extensor brevis digitorum, opposing the flexor of the sole. This extensor muscle has its origin in the forward, upper and outer portion of the os calcis. The muscle passes obliquely over the dorsum of the foot, and, like the flexor of the sole, it divides and passes into four tendons. Of these the largest tendon passes into the great toe, the other three tendons passing into the second, third and fourth toes, and proceeding on the outer sides of the long extensor tendons of those three toes.

Just how are the muscles of the foot to be exercised? By any one of the numerous forms of locomotion. Walking, running, swimming, dancing—it is all the same. In ladder climbing it will be understood how the muscles of the feet must be employed to advantage. The use of the feet in holding to the stirrup of the saddle, or in pressing against the foot-brace of the row-boat, are forms of exercise for the muscles of the feet.

Perhaps one of the most perfect exercises for the feet is tree climbing, bare-footed, especially small trees where the knees do not hug the trunk of the tree but where the feet are used to "walk-up" the side of it, as it were.

A great deal that is of practical value concerning the work that is performed by the muscles of the feet can be learned by resting one foot over the knee of the other leg. Move the foot in every possible direction, feeling for the muscles that supply the desired motion. The muscles may be felt through the skin, and their location is easily found.

The best and most satisfactory treatment that can be given to the overstrained, sore muscles of the feet is found in bathing them in water as hot as the flesh will endure. While so washing the feet, knead the overstrained muscles with great thoroughness. Then retire immediately for the night's rest.

Apart from exercise, the best method of hardening the foot muscles is to bathe the feet well in cold salt water on rising in the morning, accompanying the bath with vigorous massage of the feet while immersed.

With a good general knowledge of all the important muscles of the body, their location, structure and actions, we shall be able to devise appropriate exercises for their healthful employment, at least where they are not sufficiently used in the everyday activities of life to keep them in the best condition. We know that if our muscles are not used they will atrophy and lose their powers, and, furthermore, with such inaction all of the other functions of the body will stagnate, and, eventually, bring about all manner of abnormal and diseased conditions. Without muscular activity the circulation becomes sluggish, the functions of assimilation and nutrition are impaired and the entire human system loses tone and vigor. In another volume we shall take up the subject of exercise for detailed and thorough treatment, offering exercises of every suitable kind for every part of the body, not only to strengthen the muscles themselves, but for curative effects and for increasing the store of dynamic or nerve-energy of the body. As we have said, we can accomplish innumerable results in improving the welfare of the body by the use of the voluntary muscular system, this being perfectly within the control of the will.

The benefit of exercise to the involuntary muscles comes from the fact that the free use of the voluntary muscles forces the involuntary muscles to greater activity through greater demands upon the respiratory, circulating and digestive organs and vessels. Thus, exercise is of direct and instant value to the health, activity and strength of all of the general organs. These, in turn, through their greater and purer activity in eliminating waste and in supplying nutriment, return incalculable benefit to all of the voluntary muscles by building them up with fresher material.

CHAPTER VII.

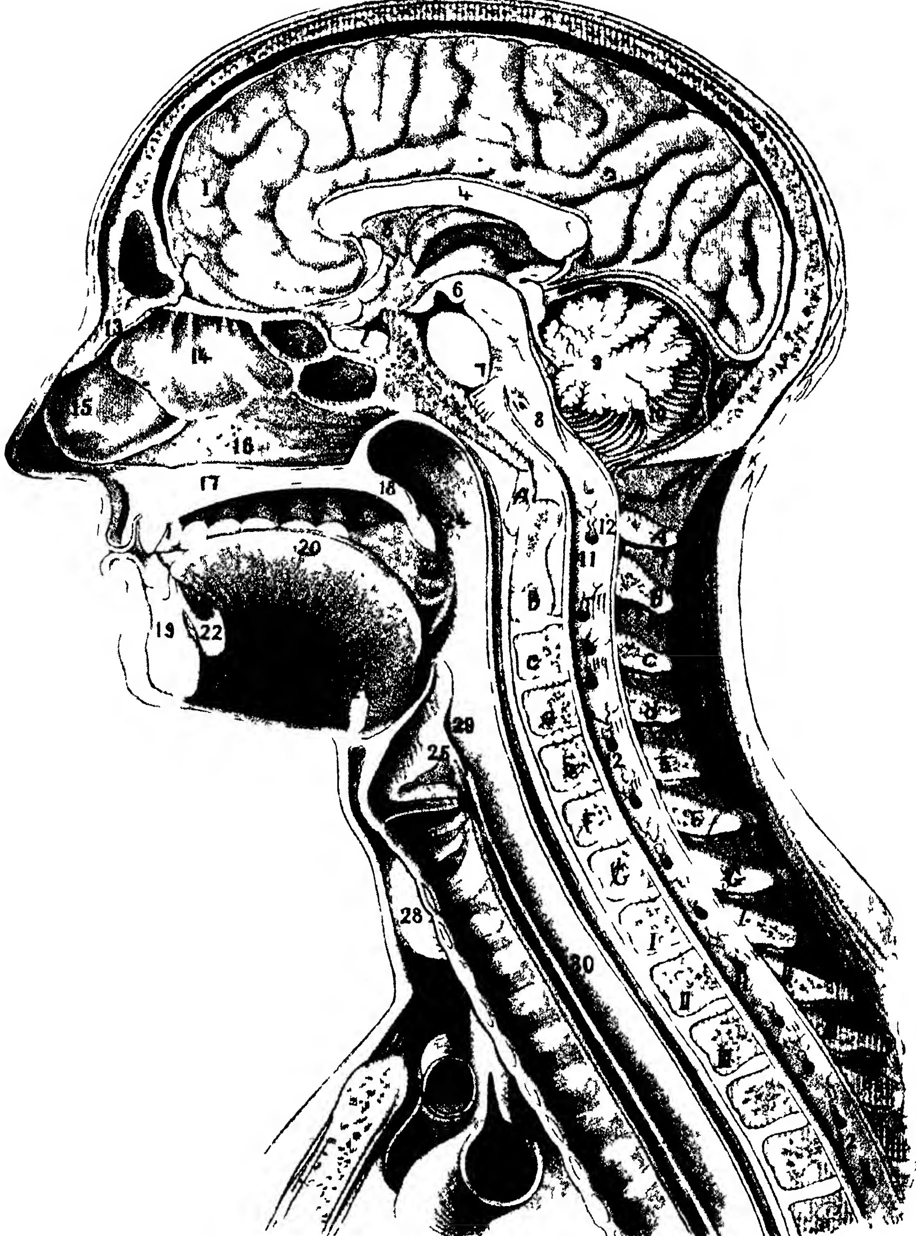
THE SPINAL CORD AND THE NERVOUS SYSTEM.

THE special and careful attention of the reader is invited to the study and consideration of this chapter because of the great importance of the spinal cord and the nervous system in the Science of Physcultopathy. If one were given the privilege of making a study of only one part of the body to the exclusion of all others, supposing that it were possible to study any one part independent of its relationships, then the student of health would do well to concentrate his attention upon the nerves and the great nerve centers. As I have already explained, and shall later show even more clearly, the secret of human power lies in the spinal cord, the brain and the nervous system generally. It is one of the great privileges as well as one of the purposes of Physcultopathy to teach how most effectually and perfectly the dynamic energy of the body, stored in the spine and brain, may be increased, and the muscles and organs be given a greater degree of power and efficiency.

An intimate and thorough knowledge of the anatomical aspects of the spine and nerve centers is the first essential to the intelligent and successful application of the principles of this modern and rational system of overcoming disease and building vigorous health. Much can be done for improving health by living a natural, outdoor life, but it is obvious that infinitely greater results can be obtained with the help of a clear understanding of the nature and requirements of every part of the body, this being particularly true with reference to those who are weak and ailing. By knowing something about the spine and nerve centers, and their relations to the various other parts of the body, not only can we increase the power and energy of the body as a whole, but by directing our treatment to the nerve centers that control certain parts of the body we can directly influence those parts for their respective benefit.

The longer and the more thoroughly we study the structure

PLATE D



VERTICAL CROSS SECTION THROUGH THE CENTER OF HEAD AND NECK

A G Neck (cervical) vertebræ
I II III Vertebræ of Thorax

Brain

1 Frontal lobe
2 Parietal lobe
3 Occipital
4 Corpus callosum
5 Septum lucidum
6 Pituitary body
7 Pons varolii
8 Medulla oblongata
9 Arbor vitæ
10 Cerebellum
11 Spinal canal
12 Opening for spinal nerves

Nasal Cavity

13 Nasal bone
14 Superior meatus
15 Median meatus
16 Inferior meatus

Cavity of the Mouth

17 Hard palate
18 Soft palate
19 Lower jaw
20 Muscle of the tongue
21 Hyoid bone
22 Tendons
23 Tonsil
24 Nasal cavity
25 Epiglottis
26 Glottis
27 Trachea
28 Thyroid gland
29 Pharynx
30 Esophagus

and functions of the human body, the more clear and absolute becomes the conviction that the secret of human strength and energy lies in the nervous system, the great central office represented by the spinal cord and brain serving as a store house, as it were, for the dynamic energy which is expressed through all of the tissues and organs of the human system.

At the very best, life is an unfathomable mystery, one which neither we nor any one else can hope to solve. We cannot presume to say just what this mysterious force of life is. As we have previously stated, it is possible to diminish this energy by unwholesome habits and conditions of life and also to increase it by Physcultopathic methods. Whether this mysterious force of life is electricity or not, or whether it be a form of electrical energy, we at least know that it is not unlike electricity in many respects. We may call it nerve-force or vitality or electricity, or whatever we choose. We do not know just what it is, but we do know that it exists and there can no longer be any reasonable doubt that it is centered in the nervous system. Although this is not clearly understood by the general public, yet one might think that it was partially recognized in colloquial terminology by the very common use of the expression, "nervous energy." When we speak of a person who seems to be tireless, possessed of a fund of working power that seems almost without limit, we make comment upon his having an unusual amount of "nervous energy." What do we mean by that? It appears to be almost an instinctive or intuitive appreciation of the fact that strength and energy are not resident in the muscles or other tissues of the body, but in the nervous system.

An interesting fact, confirming the truth of our conclusions, is found in the peculiarities of athletic success. One might otherwise expect that sheer bulk of muscle would predominate, but, on the contrary, we have continuously noted that the victor in most athletic contests is not so much a man of remarkable muscular bulk as of exceptional nervous strength. The nervous temperament, so-called, when properly balanced and supported by a normal and vigorous bodily development, makes the successful athlete. Who has not seen a man with spindling legs and apparently slight, wiry muscles outrun an entire field of more heavily muscled men, both in short dashes and in distance runs? Such a man is usually capable of an exceptional degree of speed and endurance. And who has not occasionally seen a man of a hundred and forty pounds accomplish some feat of strength that others weighing two hundred pounds could not duplicate? And among athletes of the same weight and apparent muscular development, who has not seen one so far outstrip the others in strength, endurance and general muscular efficiency that he seemed to be in a different class? What is the reason? Muscular development? No. There are differences in the muscular fiber and quality of different individuals, but not to the extent of accounting for the remarkable variations in strength. The secret of these differences lies in their respective nervous systems and in the amount of dynamic or electrical energy stored up there. This will also explain, in a way, the variations in the strength of the same individual noted on different occasions, even though his muscles are of the same bulk and apparent condition. At one time he will have a greater amount of energy or nerve-force stored away in his brain and spine than at another.

Mental concentration in muscular effort is another fact which should indicate the source of energy. Every one knows that it is the man who can get his mind into his effort who can accomplish the most in a lift or a feat of strength. Those who are accustomed to athletic endeavors will understand this very readily, from their own consciousness of the sensations of extreme muscular effort. Did you every try, reader, to exert yourself to your full strength in the effort to accomplish some difficult piece of work, and then find that you would have to do even more than that, and have you then gathered together all your forces, as it were, and made a second attempt in which you knew that you would have to do twenty-five per cent. better, and in which you actually did do that much better, in order successfully to accomplish your purpose? If you have ever done this you will recall that the effort was largely a mental effort, that you entered into the final attempt with what you would call an inflexible determination or power of will, and that by this means you succeeded. But this expression of will-power, or mental determination, should show very clearly the nature of the power that did the work. Indeed, you can almost "feel" that this is true when you exert yourself, if you are alert and conscious of your sensations at the time. You realize that it is a matter of mental application and nerve-force; that you do it *by putting your mind into your muscles.*

It has been thought that energy is generated in the muscles, but we know that the muscles are powerless to act without the impulses from the nerves. Then is not the power that moves them the electrical or motive force that comes from the brain and spine? The theory was that the union of oxygen with the tissues of the muscles, producing combustion, liberated energy just as it is liberated in the combustion of wood and coal by fire, resulting in heat. We know that heat is generated in the process of muscular action, but it would appear from our more ripe and modern study of the subject that this is probably incidental rather than the cause of the manifestation of energy known as muscular strength. We also know that waste matter is consumed by chemical union with oxygen, forming carbon dioxide, or carbonic acid, as it is more popularly known, among other things, this combustion producing heat. It would appear, also, that the breaking down of muscular tissue which gives rise to this waste matter is only incidental rather than the cause of the expression of energy. As already said, we know that the muscles do not and cannot act of themselves, but only through the nerve impulses transmitted from the brain, and we can scarcely avoid the conclusion that the actual power which operates in these tissues is the electrical force or dynamic energy which comes from the spine and brain, which serves as a storage battery, and which, when partly exhausted, is regained through the building up and revitalizing processes of sleep. The oxygen of respiration carries with it an electrical charge which, when carried through all of the tissues of the body by the blood, is absorbed by the millions of nerve branches permeating every tissue, and stored away in the spine.

The muscles and nerve fibers are the instruments through which this power is manifested. We may compare the organic and muscular system of the body to an engine, the agency through which power is expressed, while the power itself is the expanding force of steam or the explosive energy of gasoline. Better yet, we may compare the body to a collection of perfectly constructed electrical motors, these being incapable of anything in themselves, but marvellously efficient when supplied with a current of electricity. In our own body, the muscles and organs are the motors and the nerves the live wires, while the brain and spinal column are like a storage battery, except for being far more wonderful, delicate and powerful in proportion to their weight.

This storage battery of the body, unlike the electrical devices which we know, is not ordinarily completely exhausted. There is always sufficient vitality or electrical energy left in the body to keep up the action of the heart and lungs and such other vital processes as are necessary during sleep to rebuild the wastes and to store up further energy for the succeeding waking hours. Before absolute exhaustion of this store of electrical power or nerve-force comes upon us we feel the necessity for sleep, thus giving the brain a rest.

This rest of the brain and nervous system, as will be apparent at once, is a matter of vital and utter necessity, whereas we know from the constant beating of the heart and the uninterrupted action of the muscles involved in respiration, that there need be no such complete rest for the muscular tissues. It is because the actual source of energy and power is to be found in the brain and spine that we require the unconsciousness and rest of sleep. It is true that a certain degree of nerve force is expended even in sleep, in continuing the action of the heart and respiratory muscles, but this is insignificant compared with the phenomenal outlays of energy known during the waking hours.

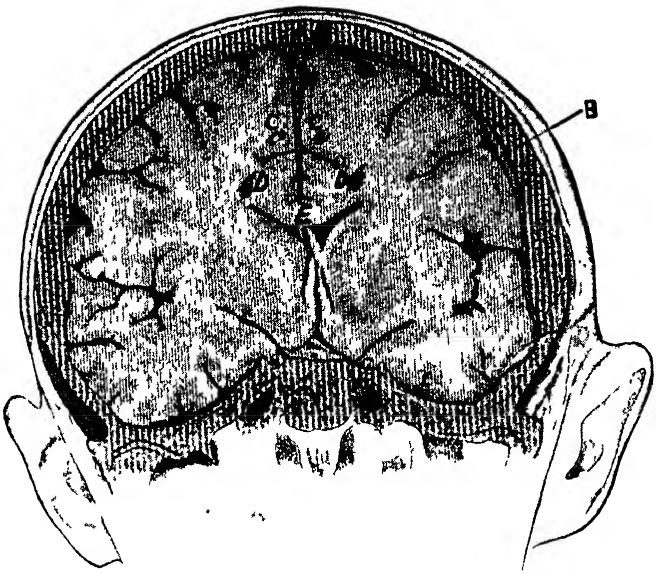
Now that we have elucidated the importance of the intricate mechanism of the brain and nervous system, the vital and dominating factor of human life, we will consider its remarkable anatomical structure.

It consists of two kinds of nerve tissue—first, gray matter or nerve cells, and second, white matter, composed of nerve fibers and end-organs. In the gray matter or nerve cells is the central source of nerve energy, the white nerve fibers are the wires over which this is sent, while the end-organs, which I shall refer to later, are specialized apparatus for the immediate transmitting or receiving of impulse for motion or sensation.

The whole nervous system of the body may be compared to a telephone system; the gray matter, the central offices; the white matter, the wires; and the end-organs, the local telephones. The gray matter or central offices, like a telephone system, has one great exchange and many smaller ones. The great central exchange is known as the brain, while the smaller ones are such as are found along the spinal cord, and many other parts of the body, in the form of small lumps of gray matter called ganglia. In the white matter—the nerve fibers or wires—we have the same simile carried out, for we find single fibers or wires going to certain end-organs or local phones, as well as large cables or bunches of wires passing along through the body, giving off here and there one or more wires; the greatest example of which is the spinal cord.

In our discussion of the nervous system, we will take up, first, the separate divisions of this great human telephone system, and when these are described it will be my endeavor to explain in what manner and to what end the whole works as a unit.

The Brain.—First and foremost in this description comes the brain, which is like a great central telephone office, and which occupies the whole interior of the same. It is easily divided for purposes of description into three parts: the cerebrum, or fore-brain, the cerebellum, or hind-brain, and the me-



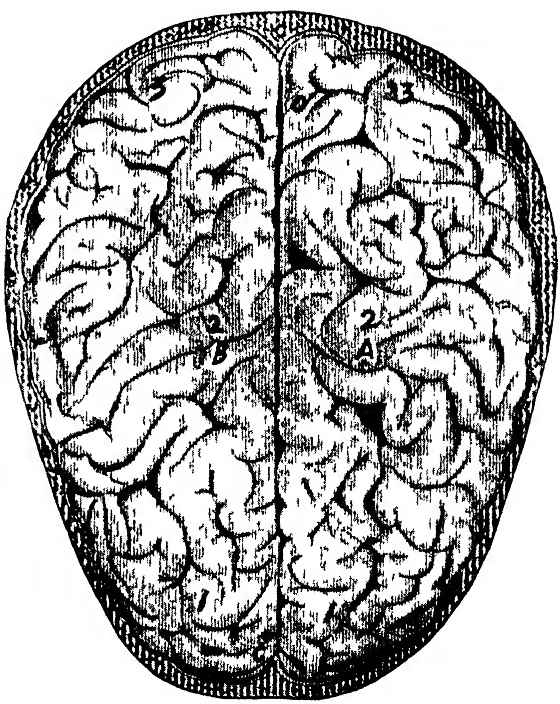
Section Through the Skull, with a View of a Cross Section of the Cerebrum.

a Skull
b Dura mater
c Cerebral hemisphere
d Parietal lobe
e Corpus callosum

dulla or connecting link between the above two parts and the spinal cord, or great cable. The cerebrum, or fore-brain, occupies all that portion of the skull situated about the level of the openings of the ear. It is held in place by a stout white fibrous membrane, which encloses it in a firm, elastic case by which it is attached to various places in the interior of the skull. It rests upon the floor of the skull from the forehead as far back as the rear of the ears, and thence to the back of the skull it is supported by a strong, fibrous membrane which is known under the name of the roof of the cerebellum. This membrane separates the fore-brain from the hind-brain. These are also sometimes called the "upper-brain" and "lower-brain."

The cerebrum or fore-brain is roughly of the shape of half a walnut kernel, its average weight being forty-nine ounces, in man, while the brain of the average woman weighs five ounces less. It is soft, easily torn, and is held together for the most part by a very fine network of elastic fiber which permeates all its parts. The gray matter or nerve cells of this part of the brain is found in a layer of about one quarter of an inch in thickness all over its surface. This surface is not smooth, but is thrown into multitudes of tiny hills and valleys, a good deal like the markings on the surface of the walnut kernel previously mentioned. This formation is for the purpose of making a larger extent of surface than if the exterior were smooth.

The rest of the fore-brain, or the inner portion of it, is composed of white nerve fibers which connect not only this brain with the hind-brain or cerebellum, but also with the spinal cord, and also each portion of the cerebrum with every other portion thereof. The cerebrum is divided by a large fissure, running from the front backward, into two equal parts, lying one on each side of the cavity of the skull; these are called hemispheres. Between these two hemispheres we have a band of white nerve fibers, running transversely, which connects the two sides of the cerebrum together. This band is known under the name of the "hard body." Then there are bands of white nerve fibers passing from one portion of each side of the cerebrum to other portions of the same side, and also running downward from each half of the cerebrum in the form of a cable which afterwards divides into two cables, one connecting with the hind-



Photograph of Brain From Above.
B-A Right and left cerebral hemispheres
C Median fissure.
1 Frontal lobe
2. Parietal lobe.
3. Occipital lobe.

brain, the other with the medulla. These cables are known as the legs of the cerebrum. In each half of the cerebrum there is a large irregular space known as a ventricle, which is more or less filled with fluid known as cerebro-spinal fluid. This cavity is a water cushion, and is for the purpose of taking up any and all shocks which may come to the brain, and of making them harmless to that tissue.

The gray or surface matter, or nerve cells of the cerebrum, are definitely localized in their working abilities or powers. In other words, there are points in various portions of the brain which are invariably the surface of the centers of the production, either of impulses, the reception of sensation, or the conceptions of special sense. To know the location of these centers in a general way should be of great interest. The region of the surface of each half of the cerebrum situated immediately above and a little behind the ear contains the centers of action for voluntary motion of muscles of the face, limbs, and trunk of the body.

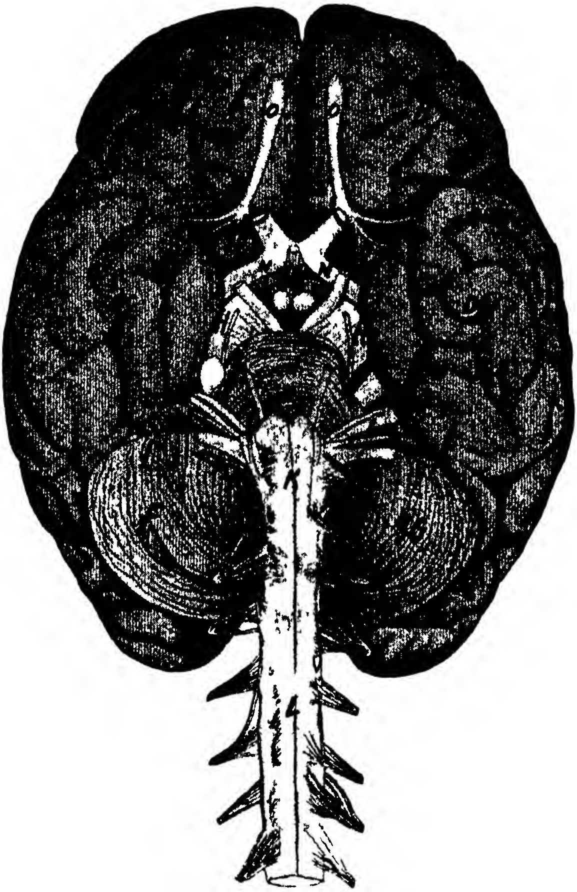
Just here a very interesting fact should be noticed, that is, that the centers of the left side in this region govern the voluntary motion of the left side of the face and that of the limbs and trunk of the right side of the body. Those on the right side of the brain in the same region control the right side of the face and the left side of the body. The gray matter covering those ends of the two halves of the fore-brain situated behind the forehead is the localized center of the intellectual faculties, while the gray matter covering the rear ends of these two halves contains the following nerve centers: First, that controlling vision or eyesight; second, the original center for speech; third, the primary nerve origin of the sense of smell, and the function of reasoning known as memory. The special nerve center for the sense of hearing is behind each ear.

When one remembers the description of the multitude of nerve fibers connecting the various portions of this brain with each other, it is easy to conceive the means by which harmony and equilibrium of the workings of both sides of the body and the mutual activity of the double organs of special sense are accomplished.

THE CEREBELLUM, OR HIND-BRAIN, is situated in the rear, lower portion of the skull, below the posterior half of the cerebrum or fore-brain. It is separated from the latter by a strong partition of fibrous material, extending from the back of the skull to the middle of its base. Lying, as the partition does, horizontally, it forms the rear part of the floor which supports the cerebrum, constituting at the same time the roof of the cerebellum.

The hind-brain, like the fore-brain, is divided into two hemispheres or lateral halves, and these are connected by transverse bundles of nerve fibers with each other. Besides this connection, each half of the cerebellum is connected in a similar manner with the hemisphere of the cerebrum on the same side above, and with the medulla below. Resembling the cerebrum, the hind-brain is formed with the gray matter or nerve cells on the outside thrown into folds or convolutions which, however, are not so numerous nor so deep as those of the fore-brain. The nerve fibers (or white material) are situated in the interior cerebellum and give the appearance, on section, of a tree trunk with leafless branches. This has been called in Latin, "The Tree of Life." This mass of nerve fibers is made up of radiating fibers from those connections between the cerebellum and other parts previously mentioned. In the cerebellum there are no ventricles or water cushions as have been described as occurring in the cerebrum.

In this hind-brain are located the centers of voluntary motion of a peculiar order. Here we find the source of that energy which causes the control of movements which are especially concerned in progression and the maintenance of equilibrium. This control is somewhat sub-voluntary in its action, as only the start in walking is consciously voluntary. The same is true of equilibrium or muscular harmony. Besides these functions, the cerebellum acts as a sort of a relay or way station for impulses going in both directions.



Under Surface of the Brain.

A-B. Frontal lobes
C-D Temporal lobes
E. Pons Varolii
F-G Cerebellum.
H. Crura cerebri.
I. Peduncles of the cerebellum
K Medulla oblongata.
L. Spinal cord
M Pituitary body.
N Optic nerves.
O Olfactory nerves.

THE MEDULLA is the connecting link between the brain and spinal cord, and is really a modified portion of the latter. This is often called the medulla oblongata, because of its form. In our study of Physcultopathy we should pay special attention to the medulla and the spinal cord, because of their more intimate relation to the condition of our physical energy, rather than to the cerebrum. We shall refer to the reason for this later. The medulla differs from the cord mainly in its shape and in the fact that it contains a set of higher class nerve centers. It is situated below and in front of the cerebellum. It is about two inches in length and commences at the juncture of the brain and the spinal cord at an orifice in the base of the skull. In it are contained the following great nerve centers: First, that which controls the muscular activity of the head; second, the energizing center for respiration; and, third, the center for articulate speech.

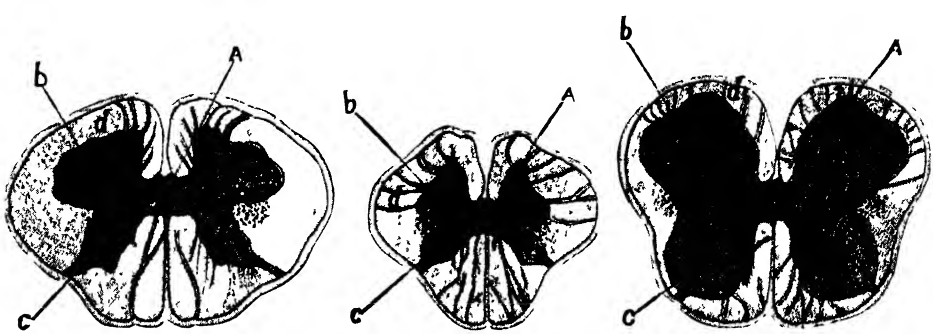
All parts of the brain, as previously described, are supported, protected and suspended in their place and divided from each other by a dense, white fibrous membrane, known as the *dura mater*. The brain tissue is so soft, that without such support it would simply fall apart. Enclosed as it is in the bony cavity of the skull, it needs to be supported in such a manner as to be protected from sudden jars and shocks. The bony skull itself is built in such a manner and of such material, that only under exceptional violence does it fail to prevent injurious jarring or direct injury to the brain tissue. Underlying the fibrous covering or *dura mater,* we find a sac-like membrane resembling in its formation the pleura (which covers the lungs) and carrying a vast net-work of blood-vessels which penetrate to all portions of the brain and nourish its tissue. This membranous sac is called the *pia mater* and invests the brain in all its parts with a double layer. The opposing surfaces of these layers are smooth, shiny and covered with a lubricating secretion, for the purpose of allowing free, frictionless movement of the brain in all directions. On the under surface of the brain may be seen the various nerves of special sense making their exit from its substance. Under the fore-part of the cerebrum, beginning in front, one sees first the two olfactory bulbs from which arise about twenty nerves of smell on each side. These latter penetrate the floor of the skull going straight downward to be distributed to the membrane which lines the upper cavity. Next in order comes the optic nerve, that of the sense of sight, arising directly behind the orbits and proceeding through holes in the skull, one to each orbit, to be distributed to the eye. The nerve last mentioned has a peculiarity not noticed in the other nerves of special sense, in that before entering the orbits, the fibers mix together so that in each optic nerve we have fibers from both sides of the brain running to each eye, thus producing harmonious action between the two eyes.

The Spinal Cord is the cylindrical, elongated part of the cerebro-spinal system, which is contained in the spinal column or back-bone. It extends from the base of the skull, where it connects with the brain, through the medulla, to the upper border of the small of the back, where it terminates in a number of nerve fibers which pass down the balance of the spinal canal, below the termination of the spinal cord. These nerves are so disposed as to resemble in appearance the tail of a horse and are called in the Latin language, "the horse's tail." The length of the spinal cord proper is usually about sixteen or seventeen inches, its weight being about one ounce and one-half. It does not nearly fill the canal in the back-bone in which it is located, but is surrounded and separated from the bony walls of this canal by a supporting and protecting membrane (similar to that surrounding the brain), loose connective tissue and a net-work of veins.

The shape of the spinal cord varies considerably, according to the part of the back-bone which it occupies. In the region of the neck, the diameter of the cord is greater from side to side than from front to back, and all its diameters are greater in this region than elsewhere. At the middle of the back of the chest all the diameters of the cord are smaller than anywhere else in its length, and are about equal to each other. Below the chest the cord again widens from side to side, but although larger in every way than in the chest region it is much smaller than in the neck.

The material of which the spinal cord is constructed is exactly the same as that which constitutes the brain. However, in this region of the spinal cord, the component parts are arranged in exactly the opposite way to that in which they are put together in the brain. In the cord, the white material or nerve fibers, instead of being in the inside as in the brain, composes the outer portion of the cord, while the gray matter is located in the center, never appearing on the surface, and only to be seen on cross sections of the cord. When a transverse cut is made of this organ, the gray matter appears in the center, disposed roughly in the shape of a butterfly, the tips of the wings barely touching the circumference of the cord. The amount of gray matter in proportion to the white varies greatly in different parts of the cord.

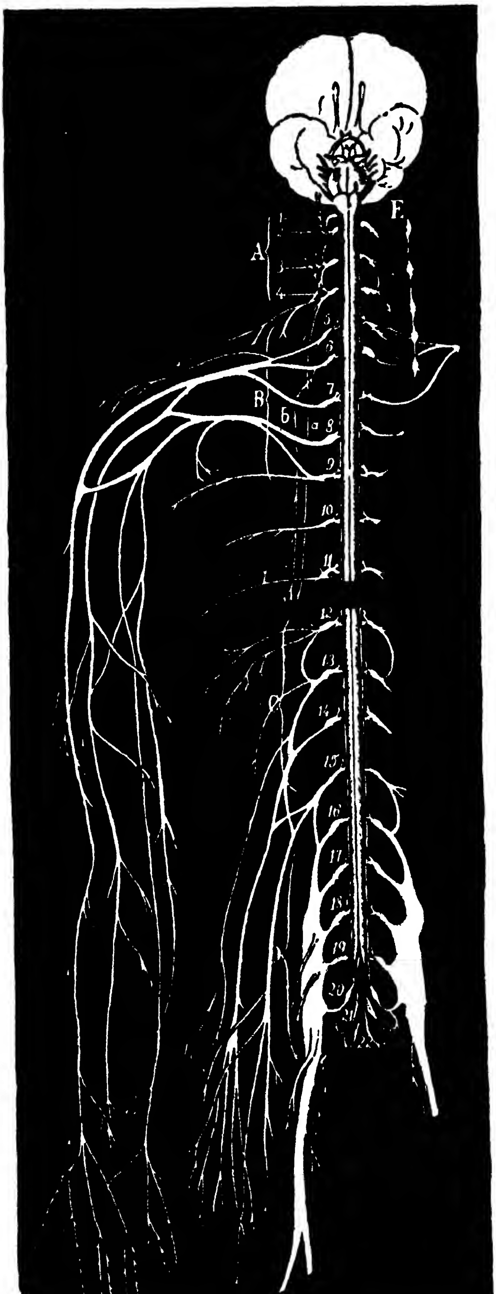
On examining the surface of the spinal cord, one finds on its anterior portion, a fissure running the whole length of the cord, up and down. This fissure is just deep enough to barely reach the gray matter of the cord. In the middle of the posterior surface, one may see another longitudinal fissure, also extending the whole length, but deeper than the anterior one. These two fissures divide the cord into two lateral halves which are connected to each other by the gray matter. The gray mat-



1. Spine at neck. 2. Spine below center of shoulders. 3. Spine at lumbar region.

Photograph Showing Spinal Cord at Different Portions of Spinal Column.

In each photograph, a represents central canal, b ventral horn of gray matter, c dorsal horn of gray matter, d white substance.



The Spine and Important Branches of the Nervous System.

A. Cervical Nerves.
1-4. First to fourth cervicals.

B. Thoracic Nerves.
5-9. Brachial plexus.
10. Second dorsal.
11. Third dorsal.
a-b. Phrenic nerve.

C. Lumbar Nerves.
12-15. First to fourth lumbar.

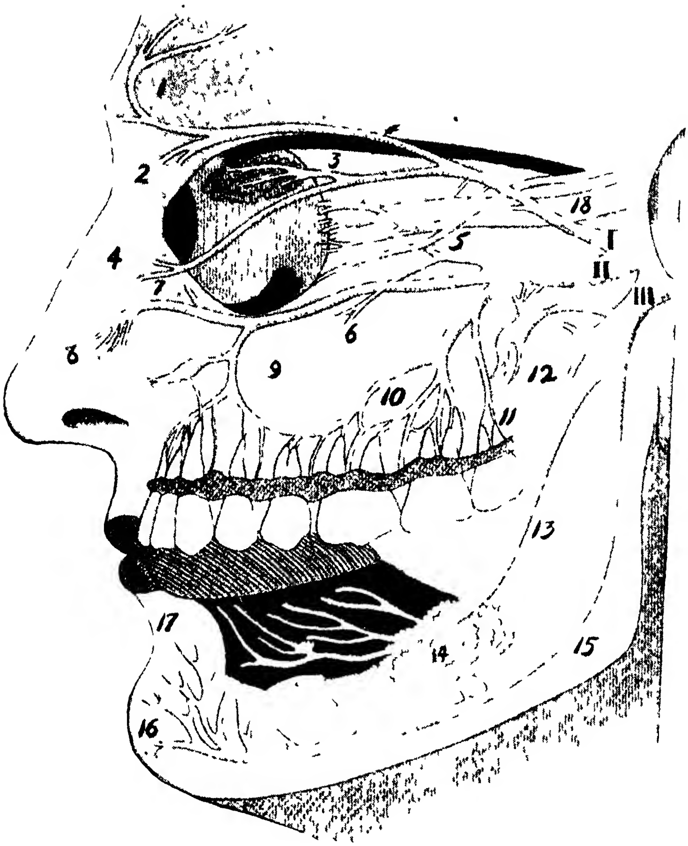
D. Sacral Nerves.
16. Fifth lumbar.
17-22. First to sixth sacral.
E. Shows form of connection with the sympathetic system.

ter of the cord, like the gray matter of the brain, is a mass of nerve centers for the origin or reception of nervous impulses. Reverting to the simile made use of in previous installments on this subject, these nerve centers in the cord may be compared to local telephone exchanges.

The white matter of the cord consists of bundles of nerve fibers running up and down this organ. These bundles may be divided into three classes, regarding the work they do, namely, those which are continuous fibers from the brain through the cord and out again to some organ of the body; those which start from some nerve center of the gray matter of the cord and run upward or downward to some other nerve center of the cord or brain; and those which, originating in some nerve center of the cord, pass downward and outward to some tissue of the body. Again, these nerve fibers of the cord may be divided into two classes in regard to the character of the nerve impulse which they carry, namely, first, motor nerves, which carry impulses for motion from the cord to the tissues of the body; second, sensory nerves, which carry impulses of sensation from the tissues of the body to the cord.

This nerve fiber material of the cord can, therefore, be compared to the largest or most central telephone cable in a country, which not only connects the central telephone exchange with all the smaller local exchanges, but connects those local exchanges with each other and sends out smaller cables into different parts of the country to connect the local phones with the local exchanges and, through them, with each other.

As the spinal cord passes down the length of the canal in the back-bone, it gives off bundles of nerve fibers which pass out from this canal through openings in the side walls of the bony cavity. These are the local telephone cables, leaving the local exchanges to spread their wires through the country. They are technically called Spinal Nerves and each one arises by two roots or bundles from the side of the spinal cord. These roots are on the same level but placed one behind the other. The one in front is called the anterior root and carries nerve fibers for the transmission of motor impulses only. The one



Fifth Cranial Nerve and Its Principal Branches.

I. First Branch (sensory).

1 Supra-orbital
2 Supra-trochlear
3 Lachrymal
4. Infra-trochlear.

II. Second Branch (sensory).

5 6. Orbital
7 Lower eyelid branch
8 Nasal and upper lip branch
9 Anterior dental
10 Posterior dental
11. Separate nerve to the wisdom tooth.

III. Third Branch

• 12 Principal group of motor branches.
13 Branch to tongue
14. Submaxillary ganglion.
15. Branch to teeth of lower jaw.
16 Branch to chin
17. Branch to lower lip
18 Optic nerve.

towards the rear is called the posterior root and carries fibers for the transmission of sensory impulses only. These two bundles of nerve fibers or roots, shortly after emerging from the cord, mingle their fibers with one bundle called a spinal nerve. All along the course of the cord, these spinal nerves arise and issue in pairs, one (by two roots) on each side of the cord. The spinal nerves, therefore, are symmetrically placed on each side of the back-bone, and, in number, correspond to the number of the vertebræ or bony sections of the back-bone from the skull to the small of the back.

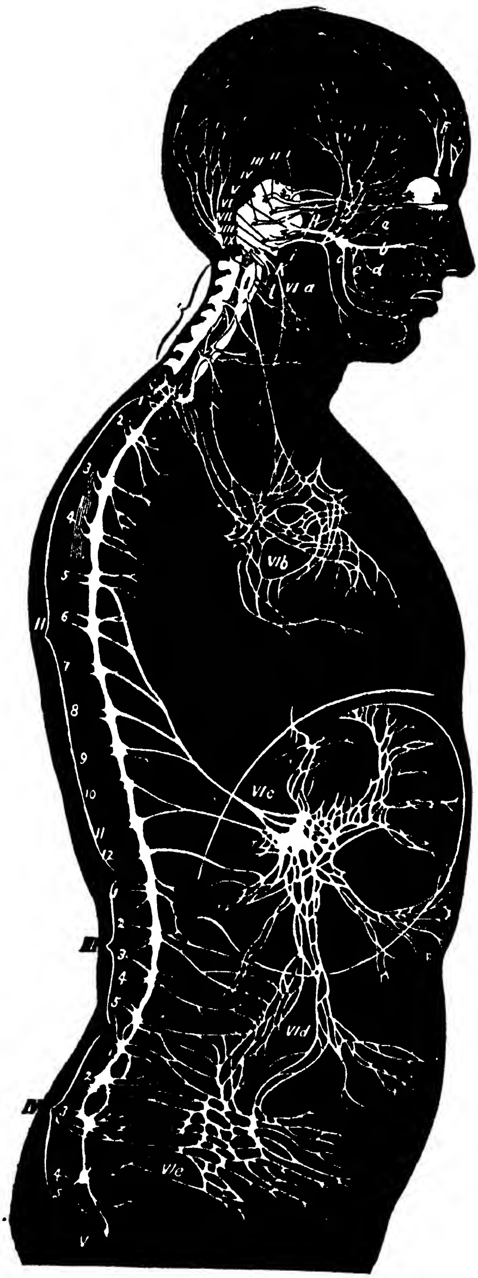
After their emergence from the back-bone, numbers of these spinal nerves on each side mingle their fibers together on the same side, and again split up into bundles of nerve fibers which are distributed to every part and tissue of the body. This commingling of the nerve fibers just described is called a nerve plexus, and these plexi are given specific names according to the region of the spinal column near which they are located.

After a nerve reaches a tissue for which it is destined, it splits up into its separate fibers and each one of these proceeds to the special piece of tissue which it is intended to serve. Here, at its final end, there is a specialization of the nerve fiber, called an "end-organ," which may be compared to the terminus of a telephone line. This end-organ is so specially constituted in each and every portion of the human anatomy as to be capable of doing one and only one of the following special pieces of work: First, it may be intended to communicate energy of motion to a muscular fiber; second, to receive sensations of feeling or pain; third, to recognize sensations of special sense, such as light, heat, sound, smell and taste.

All of the nerves proceeding from the brain and from the spinal cord exist in pairs, one nerve of each pair proceeding on either side of the body.

Of the cranial nerves, which proceed from the brain, there are twelve pairs, classified as follows:

First pair.—The olfactory nerves, ending in branches



The Nervous System.

1. The Cranial Nerves.

I. Olfactory.
II. Optic.
III. Oculomotor.
IV. Pathetic.
V. Trigeminus.
a. Ophthalmic.
b. Superior maxillary.
c. Inferior maxillary.
d-e. Dentals.
f. Frontals.
VI. Abducens.
VII. Facial.
H-VIII. Auditory.
i-IX. Glosso-pharyngeal.

2. Sympathetic Nerves.

I. Cervical ganglia (1-3).
II. Thoracic ganglia (1-12).
III. Lumbar ganglia (1-5).
IV. Sacral ganglia (1-5).
V. Coccygeal ganglion.
VI. Plexus.
VIa. Carotid.
VIb. Cardiac.
VIc-e. Solar plexus.

throughout the lining of the nerve. These nerves are sensory, and report to the brain the impressions of odor.

Second pair.—Optic nerves; sensory; inform the brain what the eyes see.

Third, fourth and sixth pairs.—Motor nerves that control the movements of the muscles of the eye.

Fifth pair.—Each nerve of this pair divides into three branches. Hence this is called the tri-facial. First branch, sensory, and gives sensibility to eyeball. Second branch imparts sensibility to nose, gums and cheeks. Third branch, partly sensory and partly motor, controls sensation on front part of tongue, on inner side of cheek, on the teeth and on the scalp in front of the ear, also the special sensation of taste.

Seventh pair.—The facial nerves, motor, spread their branches over the muscles of the face and control their movements.

Eighth pair.—Auditory nerves, sensory, are the nerves used in hearing.

The ninth, tenth and eleventh pairs of nerves all have their origin in the medulla oblongata.

Ninth pair.—Two branches; one, sensory, spreads over back part of tongue, controlling taste at that point; other branch, motor, directs the swallowing muscles.

Tenth pair.—The pneumogastric nerves, motor and sensory. Pass to the stomach, sending off branches to heart, lungs, larynx and throat. One of the most important nerves in the body.

Eleventh pair.—The spinal accessory nerves; motor. Control muscles of neck and back.

Twelfth pair.—The hypoglossal nerves. Extend to muscles of tongue and direct them in the movements of speech.

Of the spinal nerves there are thirty-one pairs. These nerves proceed through small openings between the vertebræ. Each nerve has two roots, as we have already seen, one proceeding from the front of the spinal cord and the other from its rear. The roots proceeding from the front part of the spinal cord, as you will remember, furnish the motor nerves; those from the rear the sensory nerves. If the front root be severed the power of moving the muscles that it controls is lost; if the back root be severed the faculty of sensation is lost in the portion of the body dominated by this sensory nerve. All of these nerves divide and subdivide, reaching out in an intricate branching to all parts of the body.

These thirty-one pairs of nerves are divided, according to location, as follows:

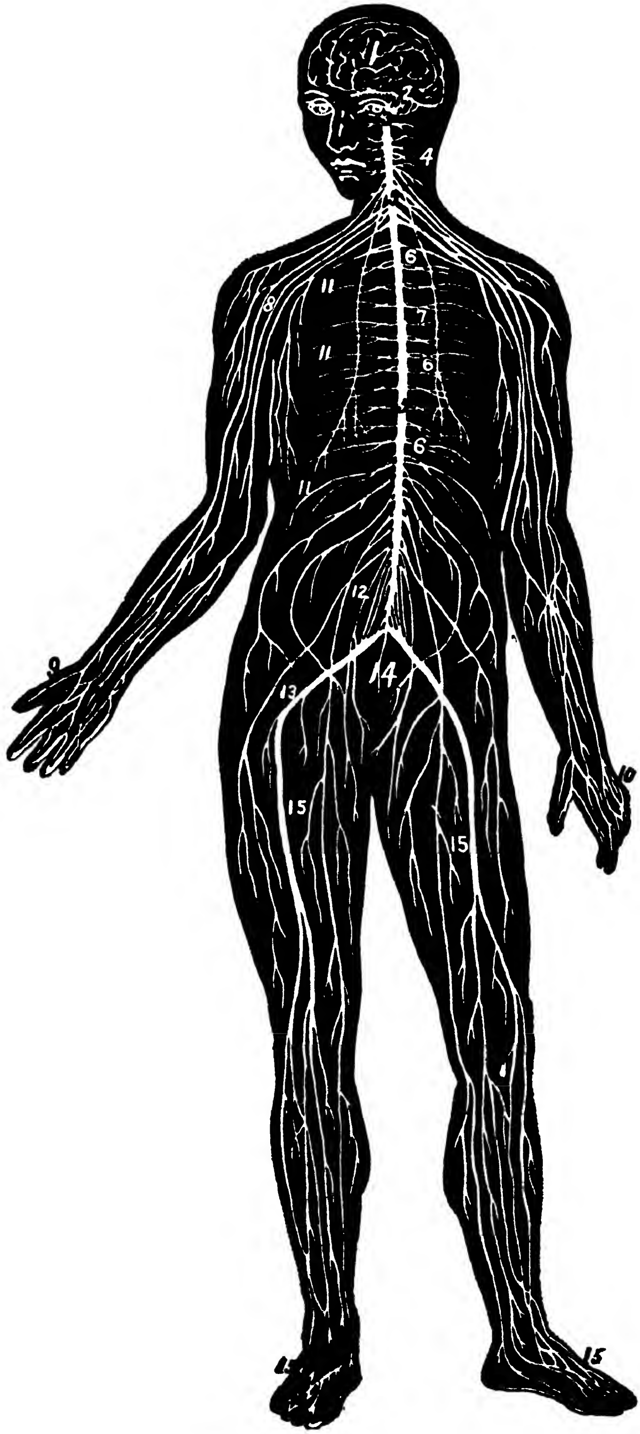
Eight upper spinal or cervical nerves, twelve dorsal, five lumbar, five sacral and one coccygeal. You will, of course, remember about the cervical, dorsal and lumbar divisions of the bony spinal column and also the nature and location of the sacrum and the coccyx.

Before proceeding further with the study of the spinal nerves it is necessary to define a "plexus." This may be a network either of nerves or of veins. In this chapter a nerve plexus is meant.

Of the cervical nerves the four upper pairs interlace to form the cervical plexus. From this plexus motor nerves are sent to the nearby muscles; sensory nerves are distributed to the skin of the back of the head, of the outer ear, neck and the top of the chest and shoulders. A branch of this plexus, the phrenic nerve, passes down to the pericardium of the heart, and sends motor nerves to the diaphragm. The four lower cervical nerves form the brachial plexus, which sends sensory branches to the shoulder, the upper part of the chest and the skin of the arm, and motor branches to the muscles of the shoulder, arm and hand. Branches of this plexus are the median nerve and the ulnar nerve, which supply the sense of touch to the fingers and hand.

The first dorsal nerve is a part of the brachial plexus, and it supplies sense and motion also to the first intercostal muscle. The eleven other dorsal nerves are also intercostal nerves, and they communicate. as well with the sympathetic system and with the muscles of the walls of the chest and those of the sides and front of the abdomen.

The four upper lumbar nerves comprise the lumbar plexus.



The Nervous System.

1. Cerebrum.
2. Cerebellum.
3. Medulla oblongata.
4. Cervical (neck nerves).
5. Spinal cord.
6. Thoracic nerves.
7. Phrenic nerve (to diaphragm).
8. Brachial plexus.
9. Palmar nerves.
10. Nerves of back of hand.
11. Intercostal nerves.
12. Sciatic plexus.
13. Sciatic nerve.
14. Terminal filament.
15. Nerves of the leg and foot.

Its branches go to the muscles and skin of the lower front of the abdomen, of the hip, outer side of thigh, hip and knee-joints and outer border of leg and foot. The last lumbar and four upper sacral nerves combine to form the sacral plexus, which sends motor nerves to the gluteal muscles, which, as you remember, are those of the hips, and to those of the back of the thigh, leg and foot. From this same plexus come sensory nerves for the skin at the back of the hip and thigh, for the front, outer side and back of the leg, and as well for the back and sole of the foot.

THE SYMPATHETIC NERVOUS SYSTEM of the body, although as widely distributed as the cerebro-spinal system, or even more so, is infinitely less generally understood even by scientific men.

It has been considered, for ages, to be the source of the sympathetic workings of the internal organs of the body, and the seat of human feelings or passions, hence its name. This statement, however, is no more true of the sympathetic system than of the cerebro-spinal.

The sympathetic system, so-called, consists of two parts: First, ganglia, which are small masses of nerve cells, gray in color; and, second, nerve fibers, also gray in color.

The main or central sets of ganglia are situated symmetrically on each side of the spinal column, within the cavities of the body. They are not as numerous as the spinal vertebræ, and are situated as follows: In the head there are four on each side, and one additional single one; in the region of the neck there are three pairs; in the dorsal or chest region, twelve on each side; in the lumbar region or loins, there are four pairs, and in the pelvis there are five on each side and one single one.

These ganglia, or masses of gray cells, are connected with each other not only up and down in the body, but across in front of the spinal column. In other words, each ganglion is not only connected by a nerve with the next one above it and the one immediately below it, but also with its fellow of the opposite side. Thus we see that all these ganglia, which are located in pairs along the sides of the spinal column, from the brain to the lower tip of the spine—from the single one at the top, which is situated directly at the under surface of the brain, to the single one on the pelvis directly in front of the tip of the spine—are all connected with each other in every conceivable way.

Besides those ganglia already mentioned there is a subsidiary series of similar ganglia situated in the cavities of the body, being generally placed near or upon some one of the greater blood vessels.

Still further, there are large numbers of still smaller ganglia, yet more secondary in character, scattered all over the body in the various tissues. They are found in the heart, in the liver, in the spleen, in the kidneys, in the lungs, in the brain, between the voluntary muscles under the skin, close to the secreting glands of the body, between the coats of the stomach and intestines, and in and about the walls of all the blood vessels. In fact there is no definite specialized tissue of the whole body which has not more or less of this ganglionic tissue situated somewhere in or about it. Thus it may be seen that the entire body is abundantly provided in every nook and corner with more or less of these gray, sympathetic nerve cells.

These ganglionic masses act in exactly the same way as does the gray matter of the brain and spinal cord. That is, they are originating or receptive centers of more or less ability. From the central or spinal column ganglia first described, nerve fibers originate and pass outward, to enter, after ramifying into a mazy network of connecting fibers, into one of the primary subsidiary ganglia. From thence, fibers again pass out, ramify, re-collect and enter the secondary subsidiary ganglia in the organs.

From this third set of ganglia, fibers finally pass to various tissues of the organs of the body, such as the involuntary muscular fibers of the heart, the muscular fibers which control the motion of the stomach and intestines, the plain muscular fibers in the skin whose contractions cause the appearance known as goose-flesh; the tiny muscles in the pupil of the eye (the activity of which changes the size of the pupil), or the tiny muscles in the walls of the blood vessels, the function of which is to increase or decrease the size of these vessels. They also pass to the cells of such organs as the liver, spleen, kidneys, salivary glands, sweat glands, etc., whose work it is to secrete certain materials used in the chemistry of the body.

Now that we have looked for a few moments at the superficial anatomy of this great part of the nervous system, let us try to obtain a good general view of its purpose: In the first place, the sympathetic system controls and energizes all the muscular power of the body which is involuntary in action. In other words, it is the source of the nerve power of all those muscular activities of the body which so rhythmically and untiringly manifest themselves without the aid of will power. It keeps the heart in action, and, with the assistance of the cranial nerve known as the pneumogastric, regulates and controls that action. It is the source of the muscular activity of the stomach, intestines and other similar organs which, at stated times and under certain forms of stimulus, carry out their duty. It is largely by the nerve force of the sympathetic system, that the closing and opening of the gates of the bladder and rectum are controlled. By its force the quantity of light allowed to enter the eye is regulated. Through its nerve energy, the tension of the blood current in the whole body or in any local part is increased or diminished. By means of this system, the salivary, gastric and other glands pour forth their digestive fluids at the proper time.

Besides these functions of muscular, nutritive and controlling power previously mentioned, the sympathetic portion of the nervous system is a means to the reception and conveyance to the brain of peculiar sensory impressions. It is by this means that sensations of temperature, such as heat and cold, are given to the mind. Through it, also, is conveyed that peculiar form of sensation which is known as muscular sense. For example, the impression of pressure, hardness, softness, etc., are obtained in this manner. Impressions of pain in the internal organs of the body are carried to the mind in this way. Through this channel, also, we probably obtain knowledge of more or less distant presence of bodies.

We attempt in this chapter to give but a general understanding of the structure of the nervous system and of its importance. The practical application of this knowledge for the purpose of invigorating the spinal cord and thereby increasing the energy of the body as a whole, will be taken up in another volume.

In the treatment of the subject it will be noticed that we are directing our attention chiefly to the spinal cord, rather than to the upper brain. This is because we have every reason to believe that in the matter of vitality and physical energy, the spinal cord and the medulla are of special importance, that, indeed, the real energy of the body, that which we call the essential force of life, is centered there. The cerebrum, on the other hand, is rather the organ of thought, the seat of intellect. In creatures of great intelligence the cerebrum is large and well developed, whereas in those of low intelligence it is small and undeveloped, and all irrespective of the strength and vitality of the animal. The life-force or vital strength does not seem to have much to do with the development of the cerebrum.

In the brain of the gorilla, essentially the same in structure as that of man, the cerebrum is very small and undeveloped, but there is no denying the nerve-force resident in that powerful spine, or the tremendous physical energy of which this brute nether-man is capable. The same will apply to all the lower animals, down to the almost brainless but much vertebrated snake. On the other hand, we may sometimes find a top-heavy college professor, with bulging forehead and almost incredible powers of memory in his exceptional cerebrum, who may possess scarcely more than enough physical energy to supply his top-most gray matter scantily. The cerebrum may be very active, and we know that it may be greatly stimulated by thoughts of various kinds, yet without adding to the energy of the body (save as this may arouse a far more active circulation of the blood through the body generally). In another volume we shall discuss the effect of the influence of thought over the welfare of the body. But for the practical purposes of Physcultopathy it will be seen that the vital energy, the life-force of the body, is rather centered in the spinal cord and medulla oblongata, perhaps also partly in the cerebellum or hind-brain, rather than in the fore-brain, and that in order to increase the strength and powers of resistance of the whole body, the most successful method is the employment of measures that will invigorate the spinal cord.

In searching for the source of all human energy we readily find it in the air we breathe, in the food we eat. All energy is electrical; human energy is no exception; the same force moves alike the human machine as well as the universe.

The body is really an electrical machine. The life and strength that it possesses are unquestionably electrical in nature. The impulse that comes to any part of the body, which is the cause of activity in that particular part, comes from the brain, through the nerves, and is transmitted by electricity or by some force very similar. This is readily proven by an experiment that has often been made. You can cut the nerve that supplies stimulus to any muscle of the body, and then apply electricity to the muscle, and the muscle will contract or shorten, in the same manner that it does when it receives its stimulus from the human brain. In fact, electricity has been applied to the muscular tissue of animals that have been dead for some time and the muscles have, to a certain extent, manifested action similar to that which they would while alive.

Now, if the body is an electrical machine, how and from whence does it secure its electricity? We have already traced the source of human energy from the sun to the food that we eat, from which it passes into the blood through digestion and assimilation. Now, this blood, when in the right condition, contains the nutriment needed to build up human energy. It contains those particular elements that replace all the worn-out cells with new, live cells. It contains those elements that are needed to supply the body with the electrical energy required. But, what is probably far more important, there is the electrical energy contained in the oxygen of respiration.

Every minute nerve throughout the entire body is a part of the complicated electrical outfit that performs such an important purpose in all human life. Even the smallest nerve assists in the work of absorbing electrical energy from the blood as it circulates throughout the entire body. Just as the materials which form new blood are absorbed from the food as it passes through the alimentary canal, so electricity is absorbed from the blood by every nerve through the entire body, as the vital fluid circulates through every minute tissue.

Nobody knows anything really definite about electricity. Nobody has ever seen it, except as manifested in the electric light or in lightning, or as it is exhibited in the force that it is capable of creating. It is the great Unseen Power. Though we know little about it we know something of the force of the energy that it can create, and in the mechanical world scientists have learned how to make electricity. We have learned how to store this mysterious power. We have "harnessed" it and are using it everywhere with vast benefit to mankind; but little, however, is known of what might be called "human electricity." We often hear the term human magnetism or personal magnetism, and there must unquestionably be a close relationship between what we term human magnetism and human electricity. They are probably one and the same thing, because in nearly all instances one who possesses a large amount of human magnetism is strong and well built, and this indicates beyond all possible doubt the possession of a large amount of energy, which cannot be acquired unless the storehouse of human force—the nerve centers—is richly supplied with electricity or a kindred force.

There may be some who say that it has yet to be proved that the energy that is transmitted to the muscles and various organs of the body is electrical in nature, or can in any sense be called electricity. We would ask, then: What is the energy that is thus transmitted? Nobody has ever analyzed electricity; no one has ever analyzed human energy. We may call it electricity or we may call it by any other name. Mere names are unimportant. We believe it can be taken for granted, however, that the actual force that is generated within the human body and which furnishes the energy to perform muscular and mental labor and to maintain the vital processes of the body comes from the nerve centers of the body. Whether or not this force is electrical in nature or is in any way similar to electricity, is of no particular importance. We speak of it as "electrical" because it seems more like electricity than any other force we know of.

If the nervous energy which impels the human machine is located in a definite part of the body, is it not quite plain that the stimulation of this particular part of the body, through various natural methods that are easily within our reach, would accelerate the activities of those particular parts and therefore very materially increase the amount of energy at the disposal of the body? Under those circumstances, we would have a stronger brain, a more powerful muscular system, and would have a very materially increased amount of energy that would be at the disposal of the vital organs themselves.

As stated a little while ago, we have now come to the very important question: How can this source of human energy be stimulated? Now there are various methods of stimulating the action of the spinal column, and each of the various means that can be used will be plainly illustrated and described in another place. However, we wish specially to dwell upon the advantages of stimulating this particular part of the body through the use of those muscles and cords that surround and bind together this very important part of the body.

Now, what is the effect of muscular action or exercise on any part of the body? It is to a certain extent necessary to give some information on this subject that our readers may be able to follow our theories. A muscle brought into action by normal use or special exercise very greatly increases the supply of blood that is brought to that particular muscle. It not only accelerates the activity of the part used from this standpoint, but it very materially hastens the elimination of dead matter or waste, which is continually being carried to the various depurating organs of the body. Exercise, therefore, not only makes the part stronger, but cleanses it of all impurities by the increased circulation.

Now the exercise of the muscles surrounding the spinal column increases the strength of the muscles themselves and also draws an additional blood supply to these parts. The spinal cord, therefore, has the advantage of the additional supply of blood and of a better supply of blood. In addition to this the movement of the spinal column in various ways tends to stimulate the nerves located therein. Furthermore, it strengthens the cords and muscular tissues which hold the spinal column so closely in its place and should there be any slight displacement of any of the cartilages which form this spinal column, the various movements back and forth and in all directions slowly but surely force the displaced cartilage into its proper position. Osteopathy attaches very great importance to the necessity of a straight spine and to a very large extent can be commended.

I have evolved a practical and complete system of exercises for the purpose of energizing the spine in the manner indicated, and I am offering it, with explanatory illustrations and careful descriptions, in another volume of this work. I will there take up the various practical phases of the subject more in detail. (See pages 790-92, 806-7, 821-27 and 1522 to 1600.)

Now such exercises straighten the spine, give it its proper form, imbue one with a desire to walk erect, and thus all the organs of the body secure the advantage of being in a normal position. The shoulders are held erect, in line with the hips, as they should be, because when the muscles are properly developed, this is the most natural position for the body to assume. And, most of all, the action and exercise of these muscles surrounding the spinal column unquestionably bring about the very result that we are desirous of obtaining, that is, the storing up of an increased amount of electrical or nervous energy. If one has stored up a large amount of energy, it is, therefore, reasonable to believe that each organ, and in fact every part of the body, will be supplied more freely with this particular energy, that makes the human machine a more perfect device. We become more capable in our work regardless of its character. One is a better business man, a better lawyer, doctor, statesman, and more efficient generally, even if his time is taken up in manual work, through the practice of these methods. The human machine is made stronger, and is capable of rendering more efficient service, whether it is necessary for you to call upon your brain or your muscles.

I do not wish it understood that the mere occasional exercise of these muscles which force the spinal column to assume a more perfect form is all that is needed. You have to make use of every muscle of the body more or less all the time if you want to develop them. The development of the muscles of the entire body will to a certain extent increase the amount of nervous energy that will be finally absorbed. Therefore, if you want to be in possession of a human machine that is as nearly perfect as it can be made, first of all give especial attention to the development and constant use of the muscles about the spinal column. See that every muscle of the body receives a certain amount of active use when in action. It is not absolutely necessary to take special exercises every day. For instance, if your occupation should be of such a nature that on two or three mornings or evenings of the week you are unable to take your scheduled exercise, this will work no special harm, though, without question, after exercising you will feel more capable and you will be better able to perform your duties than you were on the day that you failed to take any exercise, that is, if taken in the morning.

As further evidence that the development of the muscles around the spine tends to increase physical efficiency of the entire body, we direct the attention of the reader to men and women who have a large development of the muscles about the neck. You will rarely find a man with a broad, thick neck who is not vigorous, who does not possess a large amount of nervous and general physical energy. Similarly, the woman with the round, well developed neck, is usually a virile specimen of womanhood. It does not always indicate that these persons have given this particular part of the body a large amount of exercise. They may merely have inherited great vitality and the large neck has been one of the signs that indicate their general physical condition.

Among professional wrestlers are to be found some of the strongest men of the world. They are powerful, hardy specimens of human efficiency from a physical standpoint. It might be said that nearly every athlete of this type is as strong as an ox and as hardy as an oak tree. In practically every case they have been made so by their favorite exercise. Wrestlers use nearly all the muscles of the body, but they use more especially the muscles of the neck and back. A wrestler, therefore, has all the advantage of an extraordinary amount of exercise for these particular parts of the body that surround and protect the nerve centers represented by the spinal column. Their great physical strength, in my opinion, is almost entirely due to the continual stimulation of the spinal column induced by the practice of their favorite exercise.

There are many other reasons why we should emphasize the value of a strong back. The muscles of the back enable one to hold the body erect and in its proper position. All the digestive organs are thus held in their normal positions, and consequently perform their functional processes more easily and more thoroughly. When the muscles of the back are developed as they should be, it is practically impossible for one to be "round-shouldered." Strong back-muscles practically force the shoulders into a proper position. Every bone is then held in place.

Spinal curvature, for instance, is caused in nearly all cases by weakness of the back muscles. The cords and muscles are not strong enough to hold the vertebræ in their proper position. They bend from side to side or, in some cases, outward, as is seen in the case of a hunchback. These defects are usually possible solely because of weakness of the muscles of the back, and I will go further and state that every one of these deformities can be remedied (except in very rare instances, such as in the extraordinary change in the formation of the back found in the hunchback) by the proper development of the muscles of the back. Of course, manipulation of the spine will be necessary in those cases where the defects are greatly exaggerated. In the ordinary case of spinal curvature, the exercises that I will illustrate in another volume, if followed intelligently and regularly, will in nearly every instance remedy the defect. (Volume II, page 779.)

There are many other serious physical defects that can also be remedied by these methods. If any one of the spinal vertebræ is displaced in the slightest degree, it very often presses upon the spinal cord or impinges either the motor or sensory nerve which emerges from the spinal cord at that point, and as a result, some part of the body is affected by this pressure. Paralysis, for instance, can be easily caused by pressure of this kind. Even where the complaint is not of such a serious nature, a comparatively slight amount of pressure affecting one or more nerves is liable to lessen their efficiency and thus cause partial paralysis, and so prevent the particular part to which the nerves are connected from working properly. Straightening the spine will therefore, as you can readily realize, remedy serious defects of this nature. In fact, this is the theory upon which osteopaths largely proceed. They maintain that a properly formed spine is absolutely necessary to the enjoyment of the highest degree of health, and that if any of your organs is not properly performing its functions, the cause can, in practically every case, be located in the spine. When one or more of the vertebræ is misplaced or pressing upon the nerves leaving the spinal column, they are lessening the efficiency of the particular parts controlled by these nerves.

Now in moving the body in any direction, there is a certain amount of movement of the spinal column. The more of an effort this movement requires, of course, the more vigorously it uses the muscles about the spine. Whenever you move in any direction, the spinal column bends in accordance with the posture of the body. It is this bending back and forth and from side to side that gives this particular part of the body the necessary use required to keep it in a satisfactory degree of health. The spinal column is bound together with tendinous tissue. Over and surrounding this, are the muscles that help to hold it in place. The bending of the spine in various directions strengthens not only the ligaments and tendons but the muscles. The proper use of any part of the body adds to its general vigor, and if any of the vertebræ should be misplaced, the vigorous use of the muscles around the spinal column, the strengthening of the ligaments and muscles, finally forces the misplaced vertebra into its proper position. Not only is it forced into proper position, but the increased strength of the muscles and the ligaments, of course, causes it to remain in that position. In this respect Physcultopathy has an incalculable advantage over Osteopathy, Chiropractic and all other systems of spinal correction. These other methods, while commendable in many cases, do not develop that strength which makes the improvement permanent.

You will find that a strong back and a properly formed spine will give you confidence. It will mean greater physical power. You will feel more of that exhilaration that comes with a high degree of health, for then you will really enjoy this superior condition. The result could not be otherwise, provided, of course, you give an ordinary amount of attention to your dietetic needs and to the general exercises essential for keeping the body in a vigorous condition throughout all parts.

It would be impossible to emphasize too strongly the very great value of these methods for strengthening the internal organism. Internal strength is necessary to bodily vigor. The vital organs manufacture the blood, from which the elements that go to maintain and build up the entire human organism are secured. Now, as previously stated, the internal organs secure all the energy necessary for the performance of their functions from the nervous system. Each organ requires a certain amount of power to force it to continue its efforts. The entire functional system is self-operative. Its efforts are involuntary, and if there is need for energy, there is a call made upon the nervous system for the power required.

Now, in developing the muscles around the nerve centers, more healthful action and greater vigor of these parts is secured. More nervous energy is stored away, and then, as one might say, one has more life or vim, but one really has a larger supply of human electricity, that can be used as needed by the voluntary or involuntary muscles of the body. When you increase the supply of nervous energy, the internal organism is not only strengthened (that is, the tissues forming the walls thickened and increased in vigor) but it has a larger supply of nervous energy to draw upon when needed.

Let us take the stomach, for example, one of the most important of all the internal organs. The influence of the spinal invigoration, advocated here, upon the stomach is in the nature of a strong tonic that has no bad after-effects. The food eaten is thoroughly mixed and exposed to the action of the digestive juices by the muscular efforts of the stomach. As you can well realize the digestion of the food depends to a very large extent upon the strength of these muscles. The strength of the muscles is secured almost entirely from the nervous or electrical force that has been stored away for use by the functional system. In proof of this, if you should exercise so hard by running or walking such a great distance as to entirely exhaust yourself, your appetite for food would disappear entirely, or if you had a desire to eat anything, it would be an abnormal craving, for the stomach, in such circumstances, is not able to digest food. Food would simply have to lie there undigested until sufficient nervous force had accumulated to make the stomach properly perform its functional process. Of course, a moderate amount of exercise would increase your appetite, for then the system would be calling for more nourishment, and there would be enough nervous energy to digest whatever food you might eat; but when the exercise is continued beyond fatigue to exhaustion, as previously stated, then there should be no appetite, for food could not be digested under such circumstances.

The stomach, therefore, is strengthened by securing an additional supply of nervous or electrical energy. It actually thickens the muscular walls of the stomach itself and gives it more of the nervous energy essential for performing its office. The digestive juices that flow into the stomach from the various glands also depend upon nervous energy for their activity. These glands require an electrical or nervous impulse, just as does the stomach, in order to carry out their work properly, and the strength and quantity of the digestive juices, of course, very materially affects digestion and the general processes of caring for the food while in the stomach.

Functional vigor is really a part of exhilarating health. Health means a harmonious working of all the functional processes. A high degree of functional vigor naturally insures a satisfactory supply of blood. It insures proper elimination. The poison that is always present even in the healthiest body is eliminated through the various depurating organs existing for that purpose. A high degree of functional vigor insures the proper performance of this important office. The body is then properly nourished, it is kept clean and purified, and is consequently strong in all parts. This is absolutely necessary, as one can well realize in developing and maintaining exhilarating health. When one possesses health in this high degree, life is a constant delight. Work is a pleasure, no task is difficult. The hardest kind of labor, mental or physical, is easy to perform. Your strength is abundant; you are almost surfeited with power. At times, when enjoying health of this high degree you almost feel as though you were walking on air. There is a lightness, a resiliency in your bounding steps that makes every movement a veritable joy. The possession of exhilarating health means living in the highest sense of the word. Ordinary health as a rule means a mere existence. The crawling worm, I might say, enjoys health, but in a blind way. He crawls through life groping about here and there. He does not live. But the wild horse or the wild buffalo of the plains revels in his abounding strength. He lives and breathes-in to the full the joys of life. He is often surfeited with power. There is nothing in the life of a crawling worm that could be suitably compared to these virile specimens of animal power, and we would say to every reader of this volume, it lies with you whether you shall be a strong, virile animal, as far as your physical nature is concerned, or a miserable little crawling worm. You can be either one or the other. You have been invested with the faculties and the powers of the highest of all animals, and if you fail in your duty to yourselves, if you fail to take advantage of your own opportunities, then you have only yourselves to blame.

If you do not possess health of the highest degree, then you must be suffering from some disease. If you do not possess the gift of abounding health that we have tried to describe, then there is something wrong. But no matter what your complaint may be, a large amount of nervous energy is absolutely essential in order to bring about a definite and permanent cure. We must also realize that the failure of the body to properly maintain a high degree of health, is nearly always due to functional difficulties brought about through improper diet, muscular inactivity, dissipation, and various other evils that are found everywhere in this enlightened (?) age, these evils themselves largely the result of insufficient nerve-energy.

Now in curing an ailment of any kind, the functional system, must, of course, be set right. It must be made to work harmoniously, and the vastly increased amount of nervous energy that can be secured and actually stored up by the body from the following up of the methods we are advocating will cause every organ of the body to work more smoothly and harmoniously, and disease of any nature will slowly but surely begin to disappear. Vital vigor is at the highest point when through constant efforts you have been able to develop the degree of muscular and vital strength necessary to actually force the body into a proper performance of its duties. Then you will probably find that your ailment, whatever its nature may be, has entirely disappeared.

Disease, regardless of its nature, in nearly all cases indicates vital depletion. The vitality is lowered below the normal. The supply of nervous energy has been materially lessened, or else the nerve centers through some difficulty are not able to properly supply the required energy. All these results are caused in most cases by what we term vital depletion, and this lack of vitality or lack of nervous energy can be satisfactorily remedied in practically every instance by adhering to the methods we advocate in these volumes in a general way, and especially by giving attention to the methods of spinal invigoration which we are offering and the practical application of which will be taken up in detail in another volume.

It is usually quite a problem for the average manual laborer as to whether or not he can be benefited by taking additional exercise of any kind, and as those who are in the habit of using the muscles all day are frequently tired out at night and exercise of most any kind seems an irksome task, you can hardly blame manual workers for questioning the value of additional exercise. The ordinary occupations of manual workers require the use of only a part of the muscular system. These few muscles are, of course, in many instances, overworked, while other muscles of the body are used but very little. Where this is continued year after year, the result is that the body is pulled into various shapes which are far from those it should assume to maintain proper proportions. We would, therefore, say to the manual worker, learn something of your body. Learn its anatomical structure and its muscular needs, and those muscles that are not being used daily in your work should be given a certain amount of vigorous use at frequent intervals.

We would hardly advise a manual worker who goes home completely tired out, to take up additional exercises at that particular time when he cannot enjoy them, but at some other time when he is not so tired and he feels he has a certain amount of reserve energy, the active and thorough use of those muscles that are not brought into play during the day at his regular work will be of very great benefit. We have seen this demonstrated in a large number of cases.

This is especially true as to the special exercises designed for the purposes outlined here. If the muscles all around the spinal column are strengthened and thoroughly developed in every way, they will not only increase one's general vital vigor, but those in the habit of doing hard manual labor will find that their general strength will be very greatly enhanced, because they will then have more nervous energy to be used in their labors. Where the occupation requires a certain amount of lifting, of course, the muscles at the small of the back will not need to be given very much attention, but the muscles at the back of the neck and between the shoulders should be given regular exercise. Not only that, but all the various exercises that are inclined to lengthen the spinal column, and to push the vertebræ together, will be found a very great stimulant to the muscular and vital organism.

The brain worker requires nervous energy. He can hardly secure too much power of this kind. The more vim and vitality one possesses, the more life and spirit one can put into his brain work. Continuous brain work is said to be the hardest kind of labor, and the statement is undoubtedly true where the work is continued for protracted periods or where one works long hours each day. The efforts of the brain, however, depend very largely upon the physical efficiency, upon the possession of a high degree of nervous energy, and because of this, there is nothing that we know of that will so stimulate the vital energies of the brain worker as the methods that I am presenting. The exercises get right at the seat of the nervous powers. They almost directly affect the brain itself. Accelerating the circulation through the entire spinal column very materially enhances the healthfulness of this particular organ, and at the same time encourages the nerve centers in their efforts towards storing up a large amount of nervous or electrical energy. Most brain workers can take the exercises for this purpose that I will present in another place, and will note an almost immediate increase in their general mental energies. They will quiet the nervous system. They will be inclined to draw the surplus amount of blood from the brain, which often accumulates there in excessive quantities through a large amount of brain work, and they will be inclined in every instance to make one more calm and cool and resourceful from a mental standpoint.

Mental power depends upon nervous vigor. A brainy man is always a man in the possession of a high degree of nervous energy. In some instances he may be phlegmatic from a physical viewpoint; at the same time, in order to possess more than usual brain power he must have back of it a strong nervous foundation. He must be full of nervous energy. Though in a general way the truth of these statements is realized by brain workers everywhere, it has never been impressed upon them sufficiently to make them understand the necessity of trying to increase their supply of nervous energy. These methods advocated provide a powerful means of stimulating the mental energy, and anything that stimulates the mental energy, gives one an increase of general intelligence. He has more brain power to work with, and he has more nervous energy that can be converted into brain power. Those who may have occasion to doubt these statements will be literally amazed at the results of a trial of the methods herein advocated. I do not pretend for a moment that they will bring about such a change in one's mental power in a day or two as to be immediately noticed, but if they are given a few weeks' trial I do claim that the change will be startling in character, and frequently, if the exercises are taken but one, two, or three times, there will be a very noticeable change for the better. It is to be remembered, however, that usually, if the exercises are taken rather vigorously in the beginning, there is a slight soreness and stiffness, which will, to a limited degree, interfere with brain energy. If the exercises are continued, however, after the soreness has sligthly disappeared, the good results will then be noticed and you can secure the highest degree of physical vigor, and at the same time do a vast deal towards the acquirement of those mental energies essential to secure the wonderful power usually possessed by a "brainy" man.

Because life is represented by circulation, movement, it can readily be seen that the more perfect the circulation, the more life one would possess. Death always occurs where there is stagnation. For instance, if the blood were stagnant in any part of the body, and was not allowed to circulate, that part would quickly die and would actually drop off of the body. Tie a string around any of your fingers so tightly that the blood cannot circulate therein. The finger will soon turn black and will finally drop off, except, perhaps, the bone. But an increased amount of nervous energy insures more thorough circulation. It insures an acceleration of the activity of all the functions that have to do with the circulation of the blood. Therefore you have more life. The minute atoms of death that linger in the body everywhere are carried away, thrown out. The new life-giving cells are brought into the various parts of the body where they are needed. The body is therefore properly nourished. It is full of life and vitality and it is only then that you know what it is to live. It is then that you realize the meaning of exhilarating health.

CHAPTER VIII.

GLANDS AND THEIR INTERNAL SECRETIONS

IN the past few years, there has been a decided change of viewpoint in regard to certain glands of the body, such as the pituitary, pineal, thymus, thyroid, adrenals, spleen, etc. These glands, together with several others, are now known to yield secretions which enter into the blood stream not by direct means, but by absorption through intervening membranes. Many of them have direct connection with the blood stream, but several of them have no such communication and are therefore called "ductless glands."

The vast importance of the secretions of these glands, called "internal secretions," is just beginning to be realized. The subject of internal secretions is called *endocrinology,* and internal secretion treatment is called organotherapy. More and more the medical profession is depending, to a considerable extent, upon this system of treatment to normalize the chemical balance of the body—without which balance, as we have long known, there can be no health. And certainly this form of treatment for internal secretion disorders is infinitely preferable to the too free use of the drugs of former years, by which merely symptoms were treated.

The experiences of a large number of capable and conscientious investigators have shown that all the organs of internal secretion are extremely closely associated and interrelated functionally, so that whenever one is disturbed there must be a more or less profound disturbance in others. This indicates the close interrelationship between all parts of the body, and the futility of attempting to treat the body other than as a whole.

It is this very close relationship that saves us from utter physical annihilation, and that within a short time. For influences are constantly at work to unbalance some part of the body, particularly some gland producing an internal secretion. If the other glands were not called into action by the change in the one secretion, the change would be felt immediately by the body as a whole. But the change in secretion, made manifest to the other glands through the blood plasma and the sympathetic nervous system, brings about a response of these other glands and, to some extent, they with their secretions combat the change, the body being thereby apparently restored to balance. But if the alteration in the first gland continues for a considerable time or is very marked, then even the combating glands are altered in function more or less permanently. A man cannot be normal or healthy when his chemical balance is disturbed, whether this disturbance is produced by gland derangement, wrong dietetic habits, drugs, alcohol, or what not.

Briefly, I shall attempt to enumerate the glands which supply these internal secretions, according to the latest authentic information concerning them, and to outline the functions and importance of each.

The *thyroid* gland, which is located in the front part of the neck, has been called "the keystone of the endocrine system," as it is vitally important as a controller of metabolism—the tearing-down and building-up processes of the body tissues. Growth is also largely governed by it. The thyroid has, when normal, a stimulating effect upon the sexual organs, but it is likewise stimulated by these organs. In the adult we have the condition of myxedema, and in childhood cretinism, which result from *deficient* thyroid secretion. Cretinism and myxedema are similar to the condition resulting from removal of the thyroid gland by surgery. We are all familiar with exophthalmic goitre, or Graves' or Basedow's disease, which is due to an *excess* of thyroid secretion. Other common symptoms of deficient thyroid activity in comparatively normal individuals are falling of the hair, dry and wrinkled skin, lowered temperature, lessened perspiration, slow digestion and consequent loss of weight or reduced metabolism and resulting obesity, reduction of mental power and activity of the nervous system, skin disorders such as hives, itching and herpes (shingles) migraine, asthma, chilliness, enlarged breasts, etc.

The *adrenal* (also called the suprarenal) glands are small glands, one above each kidney. Their importance to the system can scarcely be over-estimated. Their secretion is supposed to help maintain the oxidation within the tissues. One of the functions of the adrenal secretion is to combat toxicity when there is infection. The fever during these infections is thought to be due to the excessive oxidation which the increased secretion produces. Other functions of the secretions are to maintain normal tone of the nerves, including the vasomotor nerves, and of the entire musculature of the body, especially of the heart and blood vessels (involuntary muscles). When it is *excessive,* we have high blood pressure, headaches with threatened apoplexy, violent or at least greatly increased force of the heart action, flushed face, mental acceleration, etc. When it is *deficient,* as frequently follows the overstimulation of the adrenals in combating infections like influenza, typhoid, pneumonia, and other prolonged fevers, following surgical anæsthesia, in alcoholism, etc., one is listless, subject to neurasthenia, with low blood pressure, lack of ability to stand either physical or mental exertion, vague aches and pains, especially lumbar pains, etc.; in fact, every function of the body is reduced. Slow convalescence is frequently the result of adrenal depression. Sudden severe injury, great loss of blood, severe psychic shock, and acute acidosis bring about acute prostration of the adrenals, as they are called upon suddenly for a greater supply of bracing secretion than they can supply. Many deaths taking place on the operating table, supposedly due to "surgical shock" or from the anæsthesia, are more than likely due to an acute reduction or suspension of adrenal function. We may see, then, that the adrenals have a most decided effect on establishing or maintaining a normal condition of every part of the body.

The *pituitary* gland, located within the skull, is divided into two sections, the anterior and posterior. The action of the anterior portion is somewhat similar to that of the thyroid, and yet it has work entirely different from that of the thyroid.

To some extent the posterior part does work similar to that done by the adrenals. It is known to have a very marked effect upon the heart and other involuntary muscles, and kidney secretion. Giantism or acromegaly results where the anterior lobe is especially involved in a manner to greatly *increase* its secretion, while growth and maturity are delayed or retarded permanently where there is a *lessened* amount of its secretion. In cretinism and myxedema the pituitary is involved, along with the thyroid. Epilepsy is frequently brought about or aggravated by disturbances of the pituitary. Neurasthenia depends in some cases, apparently, upon defective secretion of the anterior part of this gland, and where this part supplies less than a normal amount of its secretion there are apt to be menstrual disturbances, sterility, and easy exhaustion. In certain extreme abnormalities of action of this gland we have arrest of sexual development, obesity, continual desire to sleep, erratic heart action, "smothering" sensations, profuse perspiration, extreme irritability, and one form of diabetes.

The *gonads* are the ovaries in women and the testicles in men. Formerly they were thought to be strictly reproductive glands, but they are now known to have an internal secretion that is of the greatest value to the organism. They have a repressing effect upon the thymus gland, a gland of the growth period. It is these glands which, in a large measure, are responsible for the change in secondary sexual characteristics—in the youth the change to a deeper voice, the growth of hair on the body, the broader frame, heavier muscles, and the desire for association with the opposite sex; in the girl, the development of the breasts, the beginning of the menstrual phenomena, and also a desire to associate with the opposite sex.

These glands have much to do with mental activity, also with general body metabolism. This latter effect is noted in the marked ability of a woman to gain weight after the change of life, for after this time the ovaries have ceased functioning and the body is minus their secretion.

In the period of pregnancy, the breasts, not retarded by the secretion of the ovaries, undergo enlargement and begin the change necessary for their secretion of milk. Where the ovaries are undeveloped or *decreased* in function for some reason, we have infantilism, menstrual irregularities, smothering sensations, palpitation, headaches, neurasthenia, fatigueability, irritability, hysterical crises, anxiety, loss or absence of sexual desire (frigidity), low blood pressure, etc. Where there is excessive ovarian secretion we have precocious puberty, copious menstruation, increased sexual instinct, large pelvis, firm, fairly small breasts, well rounded lower limbs with proportionately smaller upper body, desire for movement and action, erotic crises, tendency to loquacity, etc. Insufficiency of testicular secretion results in absence of secondary sexual characteristics, lessened supply of hair, tendency to obesity, long lower limbs, small head, childishness, frigidity, impotence, sterility, fatigueability, etc.

The *thymus* gland is a small gland prominent in infancy and childhood. It lies in the upper chest, extending from the lower border of the thyroid to the membranous bag enclosing the heart. It was long thought to have little function after the age of two, and to disappear completely shortly after puberty. But it has been found to persist well up in life, though it does undergo a fatty change at about the time of puberty.

This gland has a vastly important role to play in the development of the child during its intra-uterine life and for the first years of extra-uterine life. Marasmic babies who have died have been found to have the thymus gland greatly atrophied. It is thought to have a restraining effect upon the sexual apparatus, preventing in some measure a precocious sexual development. Where the secretion of this gland is *deficient* there is reduced hemoglobin with lessened body heat and a tendency to rickets. *Excessive* secretion causes profuse sweating, heart palpitation, an excess of red blood corpuscles and hemoglobin, headache and weakness.

The *pineal* gland is the second small gland within the skull. Experimental work has shown that its removal or lessened activity results in sexual precocity, indicating a restraining effect upon the gonads. In cases of tumor of the gland there are metabolic and nutritional changes, such as obesity and an abnormal enlargement of the sexual organs and the breasts.

The *pancreas,* we know pours into the duodenum during digestion an "external secretion," which contains substances for the digestion of all classes of food. But this gland also supplies a most valuable internal secretion; it is a disturbance of certain small areas in the body of this gland, called islands of Langerhans, that is responsible for most cases of diabetes. The secretion of these minute islands is responsible, to a considerable extent, for the oxidation of sugar.

Among other symptoms resulting from pancreatic disturbances are skin affections, such as dry skin, boils, itching, and reduced perspiration; dry mouth, neuralgia, atrophy or diminished activity of the testicles, headache, fatigueability, susceptibility to cold, perforating ulcers of the foot, apoplectiform attacks, paralyses, dizziness, false angina, depression and coma.

The *parathyroid* glands are minute glands, from two to four in number, situated within the substance of the thyroid or thymus gland or sometimes outside of either of these glands. It is known that these glands are glands of internal secretion, and that their functions are different from those of either the thyroid or the thymus. Their secretion is thought to have in some way an important part in the development of paralysis agitans, epilepsy, chorea or St. Vitus' dance, and exophthalmic goitre. When they are removed (in certain animals during experimentation) there is a development of tetany, as a result of disturbed metabolism of calcium, increased ammonia in the blood, increased nervous excitability, and acidosis. In eclampsia, that severe condition of convulsions during the pregnant state, these glands are disturbed.

The *spleen* was long thought to have little other function than the making of red blood cells; then it was supposed to have some action in the disintegration of these same cells and of the white blood cells, apparently after they had served their use in the body. But this gland is now believed to have an important internal secretion that stimulates the stomach and the intestines in the secretion of digestive fluids, also the musculature of the intestines, thus increasing peristalsis. This gland has something to do with the digestion and assimilation of food, for in cases where the gland has been removed or seriously affected the appetite is increased and more food is consumed, and yet there is no gain in weight and there may even be a slow and gradual loss of flesh. The iron content of the blood is reduced where the spleen is lessened in activity, and the gland is thus involved in the development of many cases of anemia. Defective spleen action is thought to cause or aggravate cancer and tuberculosis. This organ is frequently enlarged in infections, indicating that it is one of the active fortifications of defense against infection; typhoid fever and malaria are two diseases in which this enlargement is especially noticed.

The *mammae,* or breasts, are usually considered as having but the one function of secreting milk for the nourishment of the young. But the results of experiments seem to indicate that they yield a fairly strong secretion that has a controlling effect upon the uterus and ovaries. In cases of fibroid tumors with bleeding, where the menstrual periods come with too great frequency and severity, and in the oozing of the menopause, they have found that stimulation of the breasts to greater secretion will check the loss of blood and, in cases of frequent menstruation, re-establish normal rhythm of the periods.

In the few weeks immediately following childbirth nursing seems to assist greatly the uterus in returning to its normal size. Where the breast is not nursed the uterus is slower to return to normal, and may even remain larger than normal. Also, nursing retards the reappearance of the menstrual function, but if the breasts are not relieved of their milk in the normal manner and the milk secretion is checked within a few weeks, menstruation may reappear within a short time. Fibroid tumors of the uterus usually develop after the breast function has ended or in cases where the breast was never normally active.

The lascivious "spooning" of many young girls is responsible for the disturbance of their menstrual periods, prolongation of periods, with shortened intervals between periods, or profuse discharges, because of the frequent manipulation and excitation of the breasts.

The *prostate* gland is a male gland located around the out-

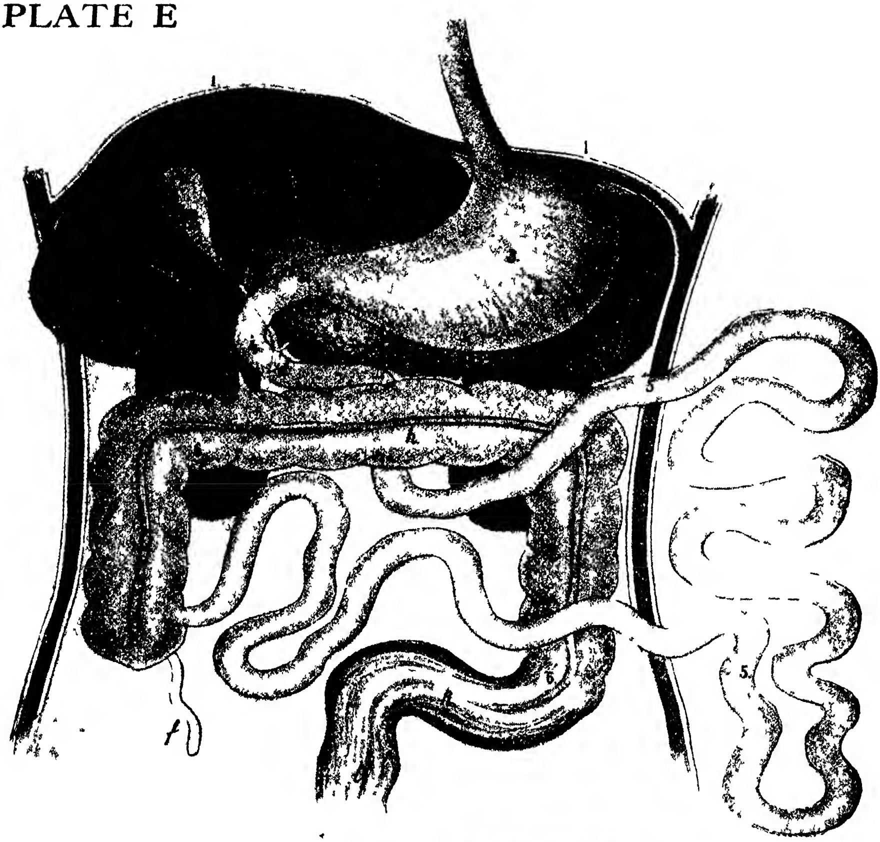
let of the bladder. It has quite recently been assumed to have an internal secretion, as well as its external secretion. It is certain that this gland is very much disturbed in certain cases of neurasthenia and melancholia. Where it is lessened in activity there is lowered blood pressure, loss of strength, lessened potency, and not infrequently suicidal tendency or even suicide. Where the gland is enlarged there is high or increased blood pressure, slower heart action, tendency to cerebral hemorrhages, and genital excitation.

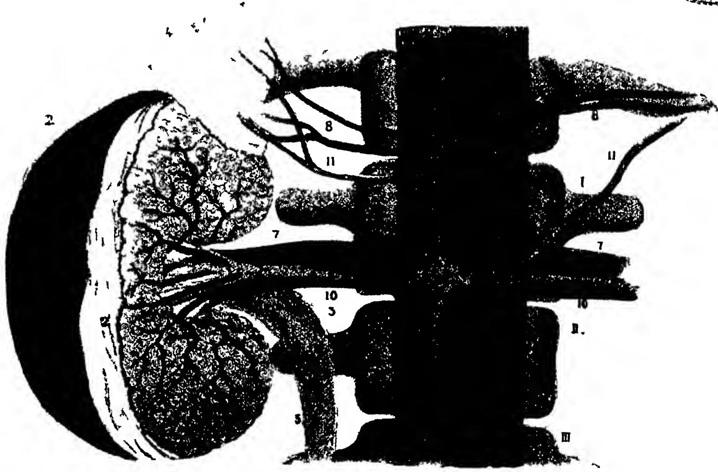
The *liver,* as we know, produces bile—a combination of secretion and excretion—necessary in digestion and as an eliminator of waste materials from the body; but there is thought to be an internal secretion also. Where the liver is inactive there is a much greater tendency to hemorrhage—nose bleed, bleeding from the lungs and stomach, mucous membranes, and into the skin, etc., and in hemophilia or "bleeder's disease"; also skin disorders, diabetes, and certain intoxications arising within the intestinal tract. It is thought that this internal secretion of the liver has a stimulating effect upon the secretion of bile itself.

While the pancreas is known to be responsible for the majority of cases of diabetes, there are other cases in which the liver is at fault. Deficient hepatic secretion is supposed to be responsible for some few other conditions, one of which is that painful affliction, gout.

There are still other glands which are thought to yield important internal secretions, among which are the *stomach, duodenum,* and *intestines.* In these cases the secretions are presumably activators of other glands of digestion, apparently no less important for the welfare of the body, however, than some of the ones discussed more fully.

PLATE E





Upper Illustration. Organs of Digestion.

1 Diaphragm
2 Œsophagus
3 Stomach
  a Entrance
  b The greater curvature
  c Pylorus
4 Duodenum
  d Duct of the gall bladder
5 Small intestine
6 Large intestine
  e Cecum
  f Vermiform appendix
  g Ascending colon
  h Transverse colon
  i Descending colon
  k Sigmoid flexure
  l Rectum
7 Spleen
8 Liver, parts cut away
  m Gall bladder
  n Common bile duct
9 Pancreas
10 Right Kidney
11 Left Kidney

Lower Illustration. Right Kidney and Surrounding Parts.

I II, III and XII Vertebræ
1 Cortex
2 Capsule
3 Fat
4 Suprarenal capsule
5 Ureter
6 Abdominal aorta
7 Renal arteries
8 Suprarenal arteries
9 Inferior vena cava.
10 Renal veins
11 Suprarenal veins

CHAPTER IX.

THE ORGANS OF DIGESTION.

THE human digestive system, upon close study, reveals itself as a marvelously efficient and competent mechanism, considering the work which it accomplishes. Its wonders are much like those of other parts of the body; the more we study and observe them, the more remarkable do they seem. Consider the functions of the digestive organs in their relation to the rest of the body, how they labor faithfully day after day, month after month and year after year, often under a handicap of persistent, unstinted abuse, in order that the other organs and tissues of the body may be supplied with new material with which to reconstruct themselves, new fuel to keep alive and aflame the glowing spark of life.

In the very lowest forms of life the entire animal is practically nothing else than a stomach, after its kind, or, more accurately, a mass of jelly-like cells which have the power of assimilating organic matter that it may come in contact with, except when it is itself digested by some larger creature. But in man the stomach is a highly specialized organ, acting as a part of a complex and perfect whole, and performing the work of digestion for all of the other organs, just as they in turn perform their respective services for the stomach and the other parts of the body. It will be seen that the modern industrial plan of "division of labor" was worked out by Mother Nature infinite ages ago, and much more perfectly than we have been able to learn it in the labors of human society. In speaking of the stomach, here, we should have referred to the entire digestive system, including not only the alimentary canal but also the supplementary organs, the salivary glands, the liver and the pancreas.

Just think for a moment of the tissues of which the body is comprised, even of the hand alone, the remarkable strength of those small bones, the gripping, elastic muscles; their tendons and the ligaments and cartilages that reinforce and protect the joints; and the wonderful structure of skin, which may be as firm and tough as leather or softer and finer than any silk or velvet. Think of the varied and complicated structure of the many organs, the delicate cells of the lungs, the finely organized tissues that go into the unique mechanism of the ear, the transparent fluids of the organs of sight, with the incomprehensibly fine chemical processes which make possible the power of sight, and more remarkable still, the tissues of the brain and nerves themselves, more fearfully and wonderfully made than all the rest.

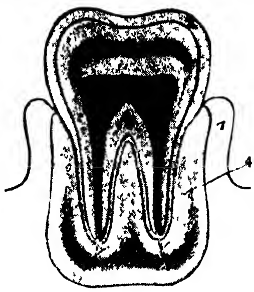
Then turning for a moment from this picture to the food before it is eaten, the wheat and the walnut, the pea and the potato, the asparagus and the apple, and the other varieties of food, just see what a change must be wrought before all these can be made over into the marvellous living human tissues that we have mentioned. And yet it is just this wonderful thing that our digestive organs accomplish, converting these various commonplace vegetable growths into the fine building material which is sent to every remote part of the body, and from which is made up the very blood, bone and sinew of ourselves.

Not one of the least remarkable features of the human stomach is its phenomenal powers of endurance. This faculty of endurance and sustained vitality is likewise characteristic of the other organs and tissues of the human system and of the body as a whole, but it is the more obvious in the case of the stomach because of the exceptional abuse to which it is subjected. Much has been said, both in jest and in earnest, concerning the alleged invulnerability of the gizzard of the ostrich, and to the ears of many of us has come the fame of the goat and the alligator, both creatures with iron-clad stomachs. But though we are glad to give credit where credit is due, and are pleased to concede much in this respect to these far-off cousins of our universal animal kinship, yet we must remember that their dissipations are, after all, more or less limited in variety, and, at least from a chemical standpoint, probably far less serious than our own. It is extremely doubtful if even the brilliantly plumed biped which we have mentioned would have much chance in a competition with those other bipeds who sometimes wear the stolen plumes of the former.

But if men and women can day after day abuse their assimilative organs by eating indigestible dishes, and still remain alive, or half-alive, then how might they not improve and perfect their health and increase their vitality by following out the intentions of Nature in regard to the use of wholesome and strengthening foods. A very large part of the disease and weakness which we find almost universally throughout the world is the result of ignorance in regard to the needs of the stomach and the dietetic dissipations and errors which arise from this ignorance. The student of Physcultopathy, who naturally wishes to avoid any wastes of vitality, and to raise the standard of his health and physical condition to the very highest possible, should have a good general knowledge of his digestive organs, their location, their action and physiological requirements. By knowing these things, he will understand that there is something out of order almost before there is anything wrong, and he will know just what to do to set it right.

We find that the organs involved in the work of digestion are many and elaborate. The digestive machinery is made up of the alimentary canal and the organs directly connected with it. From a physiologist's standpoint, the canal consists of the mouth, pharynx, œsophagus, stomach and intestines. The supplementary organs are the salivary glands, liver and the pancreas.

A detailed study of the anatomy of the mouth is hardly necessary here. We may say briefly that it is divided into three parts, the vestibule, which is the part in front of the teeth, enclosed by lips and cheeks, the mouth proper, and the back of the mouth. The study of the teeth may be left to specialists, with the advice that they be frequently examined to see that they are not in bad condition. They should be kept scrupulously clean, and we should not forget that they were intended for a purpose and should be used for that purpose,



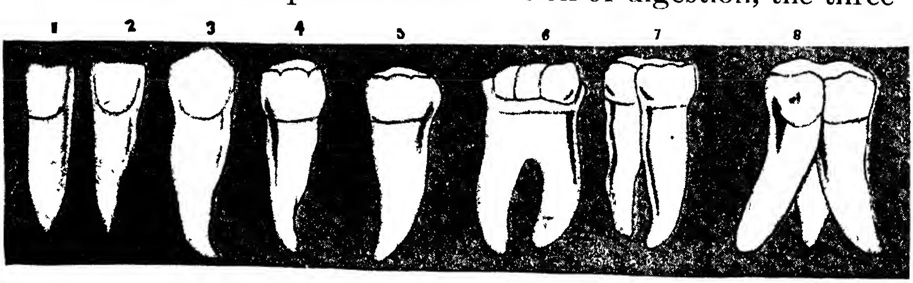
Section of a Molar Tooth and Jawbone.

1. Dentine.
2. Enamel.
3. Cavity with canals.
4. Cement.
5. Ingoing nerves and blood-vessels.
6. Jawbone.
7. Gum.

not only for their own welfare but for our general bodily welfare. If the teeth are used vigorously, and if the body is properly supplied with the food elements required to build bones and teeth, in short, if one's circulation is active, his blood pure and his condition sound in every way, his teeth will keep in good condition, except where decay has commenced.

The mouth proper contains the tongue, forming the floor of the cavity, and consisting chiefly of striated muscle-fibers. It is one of the most remarkable of our muscular organs, and will be considered further in the discussion of the sense of taste, among the other organs of special sense. The tongue is also the chief and indispensable organ of speech. The palate forms the roof of the mouth, the anterior, bony part being known as the hard palate, and the posterior, movable part the soft palate. At the posterior edge of the soft palate is a conspicuous elongation, hanging down like an inverted cone, called the uvula, which is of little or no importance. The act of swallowing, by raising the soft palate, completely closes up the uppermost part of the pharynx and the nasal cavity.

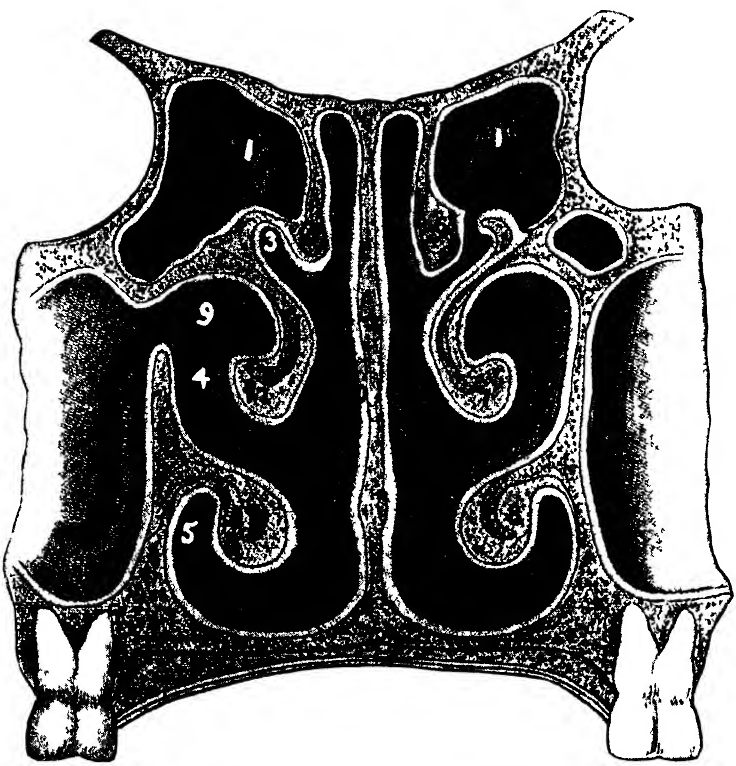
From the standpoint of the function of digestion, the three



Formation of the Teeth of Adults.

1, 2. Incisors.
3. Canine.
4, 5. Premolars.
6, 7, 8. Molars.
a. Crown of tooth.
b. Neck of tooth.
c. Root of tooth.

salivary glands on each side of the mouth are the most important features of this cavity, acting in connection with the work of the teeth in grinding and mashing the food. These glands secrete the saliva, which pours into the mouth freely when food is introduced, its purpose being to lubricate the mouth, to moisten the food, but especially to bring into solution the starchy ingredients of the food and to convert them into a form of sugar, known as maltose. The largest salivary gland on each side is the parotid, a flat, triangular gland placed just in front and below the ear, its excretory duct emptying



Cross Section Through the Nasal Cavity.

1 Ethmoidal sinuses
2 Septum
3. Upper nasal canals
4 Middle nasal canals.
5. Lower nasal canals
6. Upper turbinated bones.
7 Middle turbinated bones
8 Lower turbinated bones
9 Entrance to the antrum
10 Sensory epithelium

into the mouth just opposite the last molar tooth. The submaxillary gland is placed just within the angle of the lower jaw and the sublingual glands lie upon the forward floor of the mouth, just under the tongue, as the derivation of their name would signify. Saliva is a colorless, odorless, tasteless fluid, and it is the ingredient known as ptyalin which acts upon the starches.

The upper part of the pharynx is exclusively a part of the system of respiration, but the middle and lower parts act also as a passageway for food. After its treatment with the saliva, the food passes through the back of the mouth, through the pharynx, and thence into the œsophagus, or gullet, a cylindrical tube some nine inches long, through which the food is forced by involuntary, peristaltic muscular action, into the stomach.

There are two openings to the stomach, the first known as the cardiac opening, close to the heart; the other, the pyloric opening, which is at the farther end of the stomach. The illustrations will give the reader an excellent idea, not only of the location of these openings, but of the organ in general. The food enters the stomach at the cardiac, and leaves by the pyloric opening.

The Parotid Gland.

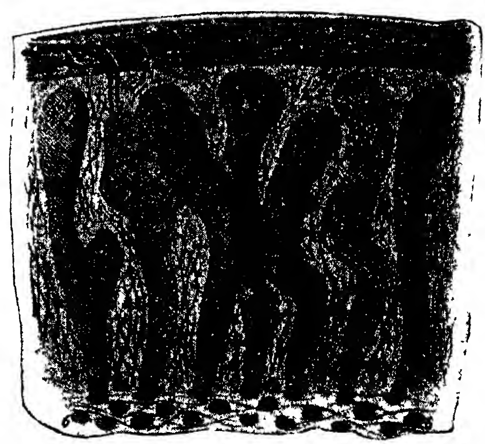
1. Parotid gland.
2. Accessory parotid gland
3. Duct leading from the gland
4. Opening of the duct on the inner side of cheek-muscle.
5. Lobules of the gland.
6. Masseter muscle.
7. Risorius muscle.
8. Sterno-mastoid muscle.
9. Trapezius muscle.
10. Facial nerve.

There are four coats to the stomach. The outer one is called the peritoneum, a thin, smooth membrane which also lines the abdomen; the second coat consists of three layers of involuntary muscles; the third coat, known as the submucous, binds the fourth coat, called the mucous, to the muscular coat.

Now, when the stomach is empty, the mucous coat lies in folds. When the organ is dilated with food or water, the coat gradually unfolds. In it are a myriad of tiny glands, between each of which is a net-work of microscopic blood vessels. When the stomach is empty, the mucous coat is nearly colorless, but when food enters it blood rushes to all the little vessels and the coat takes on a rosy appearance. This added blood sets the glands—gastric glands they are called—in action. They open and tiny drops of gastric fluid trickle out, mix with the food and aid in the process of digestion. It should be said here that when food enters the stomach, both the cardiac and pyloric openings close automatically.

At this stage of the work, the muscular coat of the stomach begins to contract and relax, and by repetition of the movement sets up a sort of churning that thoroughly mixes the gastric juice with the food. Gastric juice contains two ferments, pepsin and rennet. Pepsin, in the presence of an acid (there is one-fifth per cent. free hydrochloric acid in the gastric juice) dissolves all of the proteid elements in the food. All foods that contain nitrogen are proteids. Nitrogenous foods, in some forms, are absolutely essential to life. Meats, nuts, eggs, peas and beans are familiar samples of nitrogenous foods.

The gastric juice has no action on starchy foods; in the case of fats it dissolves the albumen in the walls of fat and sets the fat itself free in tiny parti-



A Section of the Wall of the Stomach.
(Greatly magnified.)

1. Long muscle fibers showing cells.
2. Vascular coat.
3. Gastric glands.
5. Blood supply to the glands.
6. Openings of glands.

Photograph Showing Outer Layers of the Stomach.
1. Œsophagus.
2. Cardiac orifice.
3. Anterior surface.
4. Cardiac portion.
5. Pylorus.
6. Beginning of the duodenum.

cles. When completely churned and mixed with gastric juice the food contents of the stomach soon becomes a thick liquid of grayish color, and is called chyme. The action of rennet, the other ferment in gastric juice, is to cause milk to curdle—a process that must take place before the milk is ready for assimilation into the system. Within an hour after the food has entered the stomach, some of it is in a condition to be received into the blood. This is done by a very curious process. When in the body liquids of different densities have the power of exchanging particles through the thin walls or membranes of vessels. Thus from the various compounds ingested, the blood vessels of the stomach are able to take up or absorb such particles as the different salts and sugars.

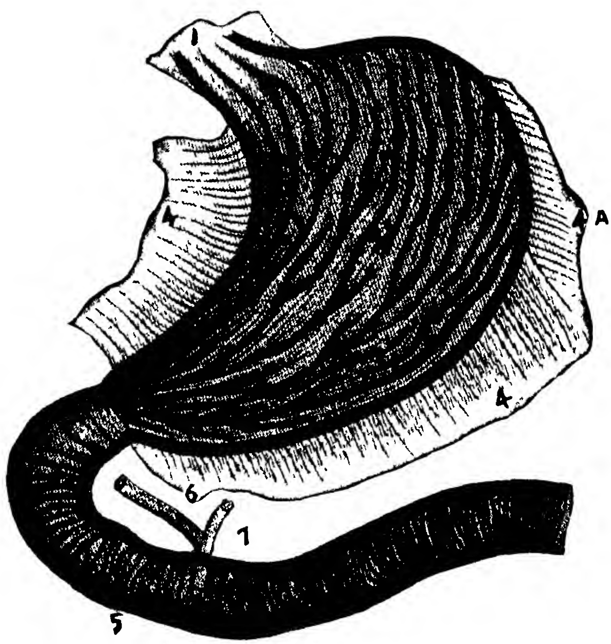
In return for this the blood vessels expand and allow more blood to flow to the muscles of the stomach, which renews the churning process with greater activity, thus increasing the efficiency of the gastric processes of digestion. In about an hour or so after the food has entered the stomach, the pylorus opens and by the contraction of its ring-like muscles, forces waste matter and such portions of the food as are still undigested into the small intestine, so-called because it is only an inch in diameter. In this intestine, the process of digestion is continued in a very involved and remarkable manner.

The organs of the digestive tract, in common with nearly all portions of our anatomy, have been given such names as would incline one to the opinion that they were adopted to render their study as difficult—instead of as simple—as possible. This fact makes the study harder to grasp than is necessary, and thus prevents an easy understanding of bodily functions with which all should be familiar. However, we are forced to describe the various organs under those titles by which they are known to science, as, otherwise, the reader would be unable to recognize the allusions to them which he may encounter in further study or discussion of the subject.

The small intestines are twenty-five feet in length and for descriptive purposes may be divided into three parts, the duodenum, the jejunum and ileum.

The *duodenum* is about nine inches long and starts from the pyloric end of the stomach, running obliquely backward and upward to the under surface of the liver. From thence it proceeds downward on the anterior surface of the right kidney, turning again horizontally to the left and across the lower portion of the spinal column.

The *jejunum* is the continuation of the duodenum. It is pinkish in hue and its walls are thicker than the following portion.



Section of the Stomach and Duodenum.

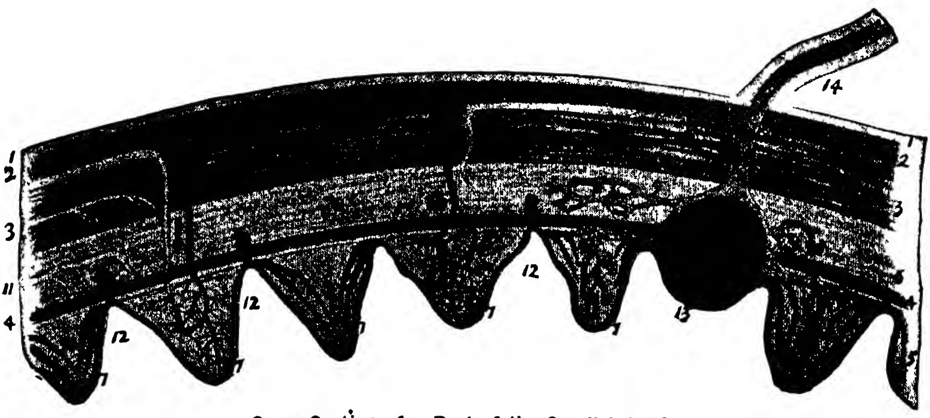
1. Cardiac orifice.
2. Pylorus.
3. Rugae.
4. Lesser omentum, in upper part of figure
4A. Greater omentum, in lower part of figure
5. Duodenum.
6. Common bile duct from liver
7. Duct from the pancreas.

The *ileum,* or final portion of the small intestine, is smaller in diameter, finer in texture and paler in color than the foregoing. It ends in the cecum, the first part of the large intestine, by means of the ileo-cecal valve. This valve is situated at this place for the purpose of preventing the backward flow of material from the large into the small intestine.

As in the stomach, the intestines, large and small, are composed of four coats, the outer or peritoneal, the muscular, the sub-mucous, and the mucous or inner lining.

This inner or mucous lining is of very much larger extent than the others and hence is thrown into folds, or valves, giving a very much increased surface. Immediately below this mucous lining we find an immense number of small glands called *villi.* These *villi* are composed of a network of vascular tissue surrounding a central space called the lacteal.

The large intestine is five feet in length, and is also divided into three parts, the cecum, colon and rectum. The cecum, or first portion of the large intestine, is so called because it is a blind pouch. It is situated in the right pelvic region, begin-



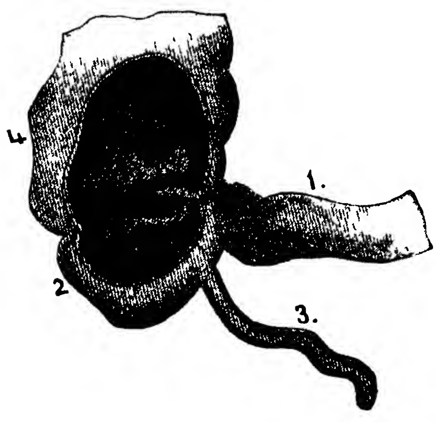
Cross Section of a Part of the Small Intestine.
(Detailed reproduction)

1. Peritoneum.
2 External circular muscle-layer
3 External longitudinal muscle-layer.
4-5 Inner muscle-layer.
6 Submucous layer
7 Villi covered with epithelial cells
8. Blood-vessels branching in the villi.
9-10 Lymphatic capillaries.
11. Nerves.
12 Crypts of Lieberkuehn.
13. A follicle.
14. Lymphatic vessel

ning at the right haunch bone. From the lower and inner side of this organ extends a small wormlike process about two or three inches in length, called the vermiform appendix.

Very little is known of the real purpose of the vermiform appendix, if it has any. The opinion has been expressed that it is something in the nature of an oil sac, containing a lubricant for the colon, but this is doubtful, especially since such lubricants are supplied from other sources. Medical opinion declares that the appendix is not only unnecessary but a source of danger. In case of inflammation in this region, the usual practice is to operate and remove the appendix. As to the wisdom or folly of this we shall speak later, in another volume, when we consider the detailed natural treatment of appendicitis. We may say here briefly, however, that appendicitis is only the result of aggravated constipation in nearly every case, and that the advantage of cutting out any part of the body machine, no matter how insignificant or apparently useless, is questionable.

Continuous with the cecum, we have the colon. This is divided into three portions, the ascending portion proceeding upward from the cecum to the under surface of the liver. Here, bending to the left, it becomes the transverse colon, crossing under the liver and stomach to the region of the spleen. Bending downward again it becomes the descending colon, until it reaches the left haunch bone. Here, becoming "S" shaped, it is called the sigmoid flexure. This ends in the rectum or the final reservoir, the mouth of which is called the anus, and which is guarded by a sphincter, or surrounding muscle. This muscle is continuously contracted,



Cecum Opened to Show the Junction of Small Intestine With the Large Intestine.

1. Small intestine
2 Cecum
3 Vermiform appendix.
4 Large intestine.
5. Ileo-cecal valve.

opening only at certain periods for the discharge of the stored up excrementitious material.

The process of digestion which is accomplished in the small intestine is by far the greatest part of the whole process and is very complex in nature. The chyme, which comes from the stomach through the pyloric valve, consists of macerated food, a small portion of the albuminous material contained in the food having been partly digested in the stomach.

All the starches, sugars, fats and undigested albuminous material now come in contact with three digestive fluids. These are the pancreatic juice, bile and the intestinal juices.

The bile has a number of functions. First, it is antiseptic; in other words, it keeps the food in this warm, moist intestine sweet while being digested; second, it causes the peristaltic or vermiform motion of the intestine; third, it emulsifies the fats; and, fourth, a portion of the bile is reabsorbed to aid in the chemical changes produced in the liver tissue.

The pancreatic juice has three ferments. The first, known as trypsin, acts upon albumens, changing them into soluble albumens, or peptones, fit for absorption. The second is amylopsin, which by its action converts starches into sugars. The

Pancreas.

1. Tail of the pancreas.
2. Head of the pancreas.
3. Duct (canal of Wirsung)
4. A second duct, not commonly found.
5. Opening of duct.
6. Duct from the gall sac.

third is steapsin, which changes the fats into fatty acids and glycerin.

The intestinal juices have their action almost wholly upon the albuminoid material. This material, after reaching the small intestine in a digested form, is now ready for absorption. This process is carried on by the *villi,* as previously explained. The emulsified and changed fats are absorbed by means of the lacteals, the central vessels of each of the *villi.* From these they are gathered together and brought into the thoracic duct, which empties its contents into the large veins at the root of the left side of the neck. Thence this fatty material enters the blood stream and becomes food for the tissues, the same as protein or starch. The detritus, or the material which fails of digestion, passes on through the rest of the small intestine, becoming more solidified as it passes through the large intestine, finally being deposited in the rectum, which, at stated periods, evacuates its contents.

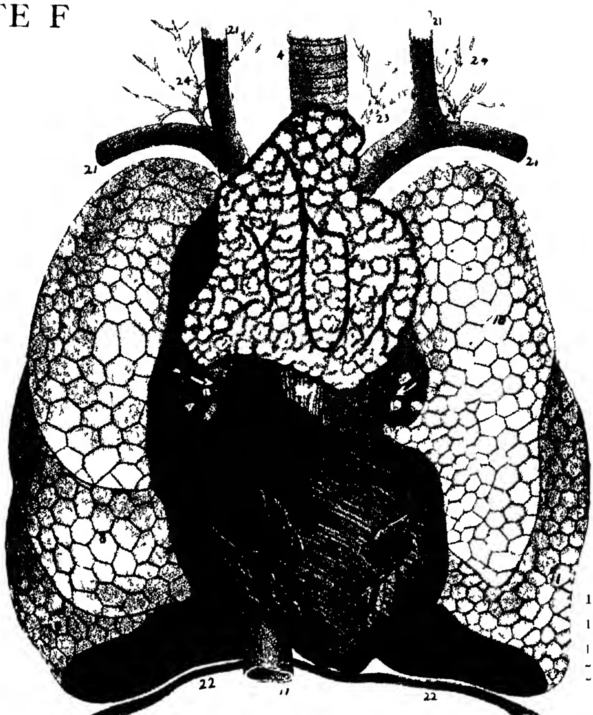
The liver is the largest gland in the body. It is so-called because it secretes, that is, produces a certain fluid necessary for the vital processes of the body. In normal human beings, it weighs about four and a half pounds. It is brown in color, sometimes stained yellow by the bile. It is divided roughly into four lobes or parts—two large and two small. It is situated on the right side, immediately under the diaphragm or muscular partition between the chest and the abdominal cavity, being protected by the free border of the lower ribs at the right side and back. It has a double blood supply, rather different in character from that of any other organ of the body. This is because of the fact that all the blood from the intestines, into which has been absorbed the food made soluble by digestion, needs to be carried to the liver to have these absorbed foods changed. Hence, there is a blood supply known by the name of portal, and another blood supply similar to that of other organs, for the nourishment of the liver itself brought by the hepatic artery.

The work done by this organ is of various characters: First, it produces or secretes what we know as the bile, which we referred to briefly a few moments ago. This is a yellowish, opaque, viscid liquid produced in the cells of the liver and stored up pending the necessity for its use in what is known as the gall-bladder. This latter is a pouch-like reservoir situated at the anterior and under surface of the liver. The bile is poured from this into the small intestine during the process of digestion. The uses of this bile were detailed in our discussion of the digestive work carried on in the small intestines.

The second class of work done by the liver is what is known as the change of the absorbed foods into such material as may be assimilated or used by the tissues themselves in all parts of the body. The absorbed foods which are changed by the liver are, first, absorbed sugars, technically known as dextrose. When this material reaches the liver, having been brought from the intestines, that portion of it which is not needed immediately by the tissues, is changed back into a form of animal starch known as glycogen, and stored up in the cells of the liver for future use. Second, the albumins which have been brought from the intestines after being digested, are chemically changed in the liver to such proteid material as the tissues are capable of assimilating.

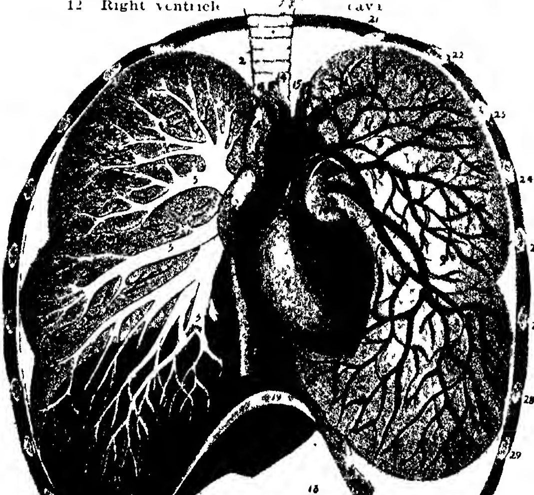
The third class of work done by the liver is connected with the excretion of broken down tissue of the body or worn-out-bodily tissue. The blood from all parts of the body carries to the liver, worn out or broken-down tissues. These particles, which are useless, are changed in this organ to a material called urea, which can naturally be filtered out of the blood by the kidneys. This urea, manufactured in the liver in normal conditions, is sent by the blood current to the kidneys, there to be excreted. In abnormal conditions many diseases, such as rheumatism, gout, neuralgia, disturbances of circulation, heart trouble, etc., are caused by a failure of the liver to complete this work properly, so that instead of producing urea from the broken-down materials of the system, uric acid and its salts are produced, and these not being filtered out by the kidneys, are backed up into the body and deposited in many tissues, poi-

PLATE F



Vital Organs of a One-Year-Old Child.

4 Trachea
5 Thymus gland, developed fully in a two-year-old child. After that it diminishes in size
6 Bronchi
7-8 9 Respectively, upper, middle and lower lobes of the right lung
10 11 Respectively the upper and lower lobes of the left lung
12 Right ventricle
13 Left ventricle
14 Right auricle
15 Left auricle
16 Superior vena cava
17 Inferior vena cava
18 Pulmonary artery
19 Pulmonary vein
20 Aorta
21 Branches of the superior vena cava
22 Diaphragm
23 Thoracic duct (lymphatic)
24 Lymphatic vessels



Branchings of the Bronchi and the Blood Vessels of the Lungs.
The tissues outside the cavity of the ribs are not shown
(The front wall of the chest has been removed.)

1. Larynx
2. Trachea
3 Bronchi, dividing into bronchial tubes
4 Superior vena cava
5 Inferior vena cava
6 Right auricle
7 Right ventricle
8 Pulmonary arteries of the left lung.
9 Pulmonary veins of the left lung
10 Left auricle
11 Left ventricle
12. Aorta.
13 Right subclavian artery
14. Right carotid artery
15 Left carotid artery
16. Left subclavian artery
17 Liver
18 Stomach.
19 Abdominal wall
20 Diaphragm
21-27 True ribs
28-29 Two false ribs
30 Cartilage of the true ribs.
31 Cartilage of the false ribs.
32 Part of pleura.

From the study of the digestive system it will be seen that the problem of the selection of appropriate food is of importance in more respects than one. Not only is it essential that we have foods which are pure and rich in the elements required for the rebuilding and repair of the tissues of the body, obviously the most vital consideration, but the consumption of indigestible foods and of those containing only a small proportion of nutriment involve such a strain upon the digestive organs as to use up an excess of vital energy in the work of digestion, if not indeed to bring about a deranged or diseased condition of them. And, as must be apparent at once, any disorder of the digestive system must inevitably affect the condition of the body as a whole, since the state of the blood and of every part depends upon the perfect functioning of these organs.

In later chapters we shall take up in detail the discussion of food values and the requirements of the body in this direction. It is a tremendously big as well as a vitally important subject, and should have the careful study of every one interested in his own physical welfare.

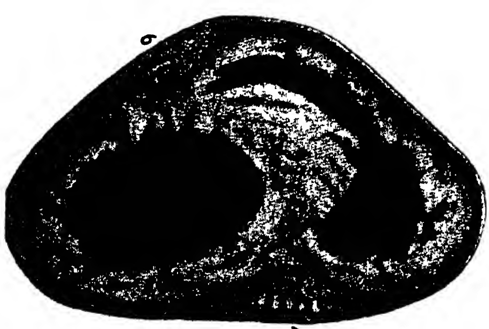
CHAPTER X.

THE CIRCULATORY SYSTEM.

AS we contemplate the many wonders of the human body, the different organs, tissues and systems, we cannot fail to be impressed with the importance and remarkable mechanism of each one of them. Each one, as we study it closely, is seen to be an absolutely indispensable part of the complex, perfect and almost awe-inspiring whole. Surely, in all of the intricate and ingenious devices of man, wizard that he is, there is not and cannot be anything that is even a tiniest fraction of one per cent. as wonderful as man himself.

In the study of the structure and workings of the heart and vascular system we are impelled almost to cry out our admiration of such a delicate, elaborate, and at the same time faultless system of incessant transportation, and to conclude that the heart is the most important of all the organs of the body. But it would be a mistake, in truth, to try to discriminate between various parts or systems of the body, all of which are absolutely essential to life. As we have seen, the center of life and of human power is undoubtedly the nervous system, and yet in order to maintain life in the tissues it is essential that they be continually supplied with the new materials necessary to keep them in constant repair, it being the province of the blood to carry to every minutest part of the body this new building material, which we call nutrition, and also the vitalizing oxygen, at the same time carrying away the poisonous waste products, which, if not removed, would instantly clog the action of the vital machinery, with disastrous results. And since it is the heart that keeps the blood in constant movement, or as we say, circulation through every part of the body, men have commonly come to regard this organ as the most vital of them all. We know that if the circulation is interrupted for an instant because of a failure of the heart to perform its function, either through violent injury or other cause, then the life of the individual terminates abruptly. The hunter who wishes to kill seeks, above all things, to pierce the heart of his prey with an insignificant lead missile, because he knows that this means the immediate and absolute cessation of life. Truly, is it not enough to cause one to marvel, when he ponders upon the uninterrupted action of the tireless central organ and the continuous, incessant movement of the vital fluid through every infinitesimal particle of his own being, when he contemplates the fact that through all the far reaches of the years that he has lived, the vigorous, vital activity of the circulatory system has not for one moment faltered or stood still?

The human heart is really a powerful pump, indeed, a double pump, as we shall see from its structure, and the most remarkable example of muscular vigor in the entire body. It consists of involuntary muscles, as we have already learned; in other words, muscles which are not subject to the volition of the individual. It appears to be tireless, or practically so; for certainly in any condition of the most extreme muscular fatigue the heart is the very last part of the body to become exhausted. It is possible for the heart to become badly fatigued, to such an extent that its efforts are either somewhat or very weak, and in such a case its fatigue is seen by the face and other parts of the body becoming extremely pale, showing that this great life-sustaining organ is not able to propel the blood through its channels with normal rapidity. Such a condition of fatigue of the heart is most unusual except as the result of the greatest bodily exertion, prolonged excitement producing utter exhaustion of the entire body generally. Such

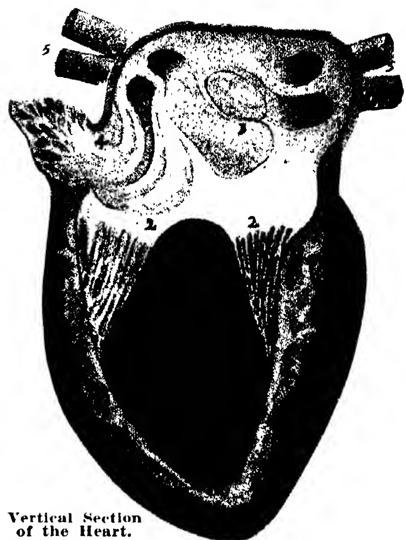


Transection of the Heart.
1. Left ventricle.
2. Right ventricle.
3. Partition.
4. External wall of right ventricle.
5. External wall of left ventricle.
6, 7. Coronary arteries and fat in anterior and posterior furrows.

PLATE G

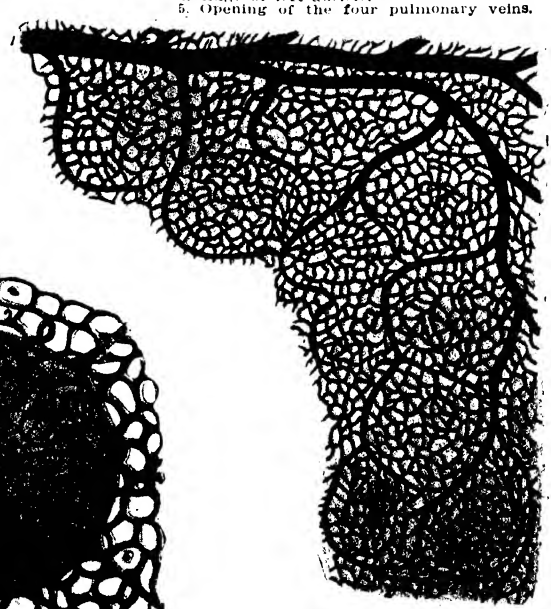
External Muscles of the Front of the Heart.

1 Muscular wall of the right ventricle.
2. Muscular wall of the left ventricle.
3. Muscular wall of the right auricle.
4. Muscular wall of the left auricle.
5. Left auricle.
6. Pulmonary vein.
7. Superior vena cava.
8. Inferior vena cava.
9. Pulmonary artery showing the semilunar valves (white).



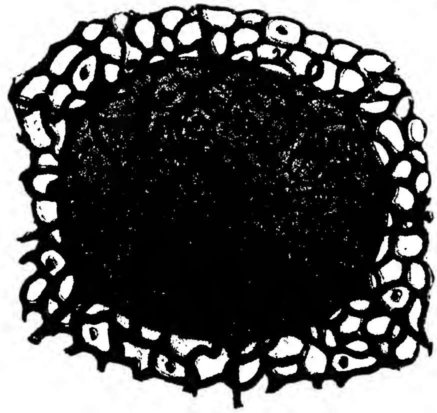
Vertical Section of the Heart.

1. Left ventricle laid open, showing the internal muscle bundles
2. Bicuspid valve.
3. Left auricle opened.
4. Edge of left auricle.
5. Opening of the four pulmonary veins.



A Single Lung Lobule With Its Network of Capillaries.
(Very highly magnified.)

1. Partitions between the lobules.
2. Looped capillaries.
3. Capillaries in which the blood is purified by oxygen.



Distribution of the Blood Vessels in the Lung.
(Detailed reproduction, highly magnified.)

1. Blood vessels.
2. Meshwork of capillaries.
3. Sections of lobules.

sudden and extreme fatigue of the heart as to suspend its action is a possibility, as for instance when one who is none too strong is compelled to exert himself violently in very cold water. But all such cases are out of the ordinary, and for purposes of a normal, everyday existence, the heart appears to be practically tireless.

The heart has something of the shape of a large pear, situated in the central forepart of the chest, with the lower end, which might be termed the apex of the somewhat cone-shaped organ, turned toward the left side. The work of pumping the blood and thus propelling it through the blood vessels is accomplished by the muscular contractions of its walls, each vigorous contraction being succeeded by a very brief instant of relaxation. It is this mere instant of relaxation of the muscular tissues of the heart, between each "beat" or contraction, which enables the organ to recuperate completely and to continue its work without any apparent rest. The act of contraction causes the apex of the heart to strike against the front chest walls, not altogether unlike the action of the "kick" or recoil of a gun, and it is this striking that we can feel and hear, and which we speak of as the "beating of the heart," in common parlance.

The heart is generally about the size of the clenched fist of its possessor, or perhaps a little larger. It is supported in a bag consisting of a double layer of membrane, which enables it to contract and relax without friction. This sac is known as the pericardium. But we shall now consider the organ itself in greater detail.

The heart is a hollow, muscular organ, the interior of which is divided by a partition in such a manner as to form two chief chambers or cavities, one to the right and one to the left. Each of these chambers is again subdivided into an upper and a lower portion, called respectively the auricle and ventricle, which freely communicate one with the other. The aperture or point of such communication, however, is guarded by a sort of valve which allows the blood to pass freely from the auricle into the ventricle but not in the opposite direction.

Thus there are four cavities altogether in the heart—two auricles and two ventricles; the auricle and ventricle of one side being quite separate from those of the other. The right hand auricle communicates with the veins of the general system and also with the right ventricle while the latter leads into the pulmonary artery, the orifice of which is guarded by a valve. The left auricle, on the other hand, communicates with the pulmonary veins and with the left ventricle, the latter leading directly into the aorta, the large artery which conveys blood to the general system and whose orifice, like that of the pulmonary artery, is guarded by valves.

A little consideration of this arrangement of the heart's valves will show that the blood can pass only in one direction, which is as follows: From the right auricle, it flows into the right ventricle and thence into the pulmonary artery by which it is conveyed to the capillaries or minute blood vessels of the lungs. It may be interesting to note that the pulmonary artery is the only one in the body which carries impure or so-called venous blood. From the lungs the blood, now purified and altered in color, is gathered by the pulmonary veins and taken to the left auricle, from which it passes into the left ventricle and thence into the aorta, by which it is distributed to the capillaries of every portion of the body. The branches of the aorta, which are distributed throughout the general system, are called systemic arteries, and from these the blood passes into the systemic capillaries, where it again becomes dark and impure. Next, it flows into the branches of the systemic veins, which at the point of their union form two large trunks called the superior and inferior vena cava, from whence it is discharged into the right auricle, from which the blood started in the first instance.

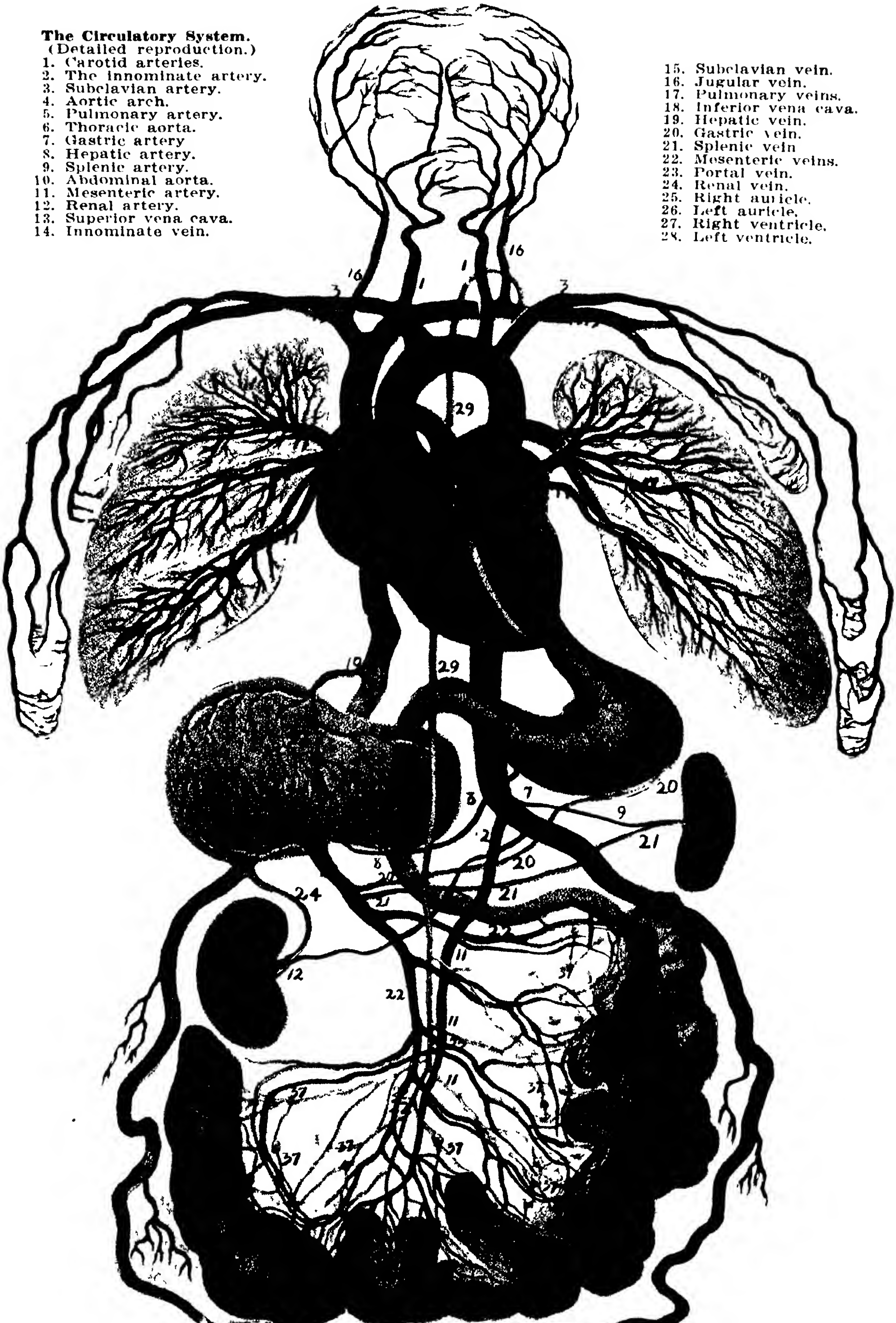
The heart's action in propelling the blood consists in the successive and alternate contractions and dilatations of the muscular walls of its two auricles and two ventricles. The auricles contract simultaneously; so do the ventricles.

The heart beat naturally varies with different individuals according to temperament, vigor and other factors, but as a

PLATE H

The Circulatory System.
(Detailed reproduction.)

1. Carotid arteries.
2. The innominate artery.
3. Subclavian artery.
4. Aortic arch.
5. Pulmonary artery.
6. Thoracic aorta.
7. Gastric artery
8. Hepatic artery.
9. Splenic artery.
10. Abdominal aorta.
11. Mesenteric artery.
12. Renal artery.
13. Superior vena cava.
14. Innominate vein.
15. Subclavian vein.
16. Jugular vein.
17. Pulmonary veins.
18. Inferior vena cava.
19. Hepatic vein.
20. Gastric vein.
21. Splenic vein
22. Mesenteric veins.
23. Portal vein.
24. Renal vein.
25. Right auricle.
26. Left auricle.
27. Right ventricle.
28. Left ventricle.



29. Thoracic duct.
30. Stomach.
31. Spleen.
32. Liver.
33. Kidneys.
34. Duodenum.
35. Ascending colon.
36. Descending colon.
37. Abdominal glands.

general average we may say that it beats seventy times a minute, four thousand two hundred times an hour, one hundred thousand eight hundred times a day and over thirty-six million times a year. At each beat of the heart, over two ounces of blood are thrown out of it, one hundred and eighty ounces a minute, six hundred pounds an hour, and about eight tons per day.

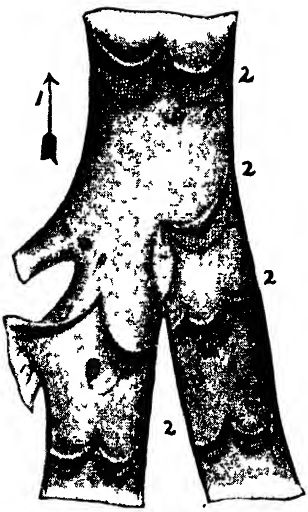
All the blood in the body passes through the heart in three minutes.

This little organ, by its ceaseless industry, pumps each day what is equal to lifting one hundred and thirty tons one foot high, or one ton one hundred and thirty feet high.

The aorta subdivides into several large arteries, these subdivide into smaller ones, and so the division goes on until the ultimate arteries are so fine that they cannot be compared even to a hair in size. As the arteries carry the blood out from the heart so the veins carry it back again after it has performed its work of rebuilding the cells of the body. The veins exist everywhere in the body as canals supplementary to the arteries.

Between the veins and their corresponding arteries lie tiny blood vessels—hair-like canals—that connect the veins with the arteries, and these are the capillaries which I have already referred to. They are so infinitesimally fine that they can be seen only with the aid of a powerful microscope. It is these capillaries that carry the new nourishment to be absorbed by the cells of tissue, and between the capillaries and the cell-walls lies the useful lymph. But we shall take up the study of the lymph later on.

The blood is forced from the arteries into the capillaries by means of the contraction of the very elastic walls of the former. One of the great difficulties of extreme old age lies in the fact that the walls of the arteries lose or tend to lose this elastic quality. It is this quality also which enables one to "feel his pulse," for as the contraction or so-called "beat" of the heart forces another two or three ounces of blood into the arteries it causes this wave, which we feel in the pulse, to pass through all of the arteries. The walls of the arteries expand with each such wave of blood, but so remarkable is their elastic and contractive power that in the scant interval of a part of a second elapsing before the next wave or pulse, they have forced the excess of blood through the capillaries and decreased their size. By counting the pulse of any artery to be reached conveniently one can count the number of heart beats per minute. Everyone is familiar with the manifestation of the pulse at the radial artery, near the outer side of the wrist, when the palm is turned upward.



A Vein Laid Open.
1 Arrow shows the direction in which the blood is flowing
2 Semilunar valves (They prevent the return of the blood to the capillaries)

Blood itself consists of a liquid plasma, which is of a light straw color. The bright red color of arterial blood is due to the presence of red corpuscles, and the red coloring matter of these corpuscles is called hemoglobin. These red corpuscles are disks that are concave on both sides, and of an average diameter of 1-3200 of an inch. They are so elastic that they can be forced readily through openings of diameter less than their own. Once on the other side of the opening the corpuscles resume their natural shape. So tiny are these corpuscles that millions of them will lie in the space of a square inch; were all of these corpuscles in a healthy adult person arranged in a single, continuous line, they would cover a distance of one hundred thousand miles. The important work of the red corpuscles is to carry oxygen to all parts of the body.

Exercise creates a demand for more oxygen and thus forces the inhalation of greater quantities of air; this oxygen naturally must be carried through the body, and this increases the work of the red corpuscles. Nature meets this greater demand upon the red corpuscles by supplying more of them to do the work. Up to the limit of beneficial exercise the number of red corpuscles is steadily increased. When exercise is carried past the point of benefit, and exhaustion begins, the number of red corpuscles diminishes. Scientific physical trainers sometimes examine under the microscope samples of blood taken from athletes in various stages of exercising. It is possible, thus, to determine, approximately, the extent to which any exercise is carried with benefit. I shall, however, refer to this matter later.

There are also in the blood colorless corpuscles, generally known as the white, and scientifically as leucocytes. These are somewhat larger than the red corpuscles, averaging 1-2500 of an inch in diameter. They are irregular in shape, are constantly changing their shapes, and appear to be very active. Leucocytes increase immediately after feeding, and are much less numerous when the stomach is empty. The functions of the red corpuscles is to carry oxygen and possibly other nourishment to the body cells, and carbon dioxide to the lungs. While the functions of the white blood cells are not fully understood, it is known that they protect against infection by combining with or destroying toxic elements.

The Lymphatic System of the human body is in actuality a supplementary circulation. The blood current of the general circulation is the common carrier of the body as the railroads are in a country. The blood at various points in the system, such as the lungs and intestines, picks up the various nutriment necessary, such as oxygen and digested foodstuffs, and, carrying them to the various tissues, there unloads them. At the same time, while in the tissues, the various broken-down products of human life are picked up by the blood current, and carried to those several organs, namely, skin, lungs and kidneys, by which they are excreted. Thus, we see that the blood circulation is a continuous round of action. The lymphatic system, on the other hand, differs from the above by beginning the flow of its contents in the tissues, steadily converging toward the center of the body and ending in the depths of the chest. The lymph is formed by the fluid constituents of the blood passing through the walls of the blood vessels. It may be described as blood fluid without the red corpuscles.

Anatomically, the lymphatic system consists of three parts, lymph spaces, lymphatic vessels, and lymphatic glands. The lymph spaces are cavities, mostly of microscopic size, situated between the cellular elements of the tissues. The lymphatic vessels are delicate tubes with transparent walls formed of the same three coats as the arteries, and found in all parts of the body, except the nails, superficial skin, hair and cartilages; they are provided with numerous valves, like the veins which open only toward the center of the body and which give a characteristic beaded appearance to these vessels.

The lymphatic vessels found in the abdomen, connected with the stomach and intestines, are called lacteals, from the Latin word for milk, because during digestion the fluid which they carry is white, like milk, owing to the fact that it is by this means that the absorbed emulsified fats are taken into the system. It must be remembered that while some nourishment is absorbed from the stomach directly into the blood, yet that organ is more concerned in the work of *digesting* food. It is in the small intestine that absorption is most active.

Embedded in the mucous lining of the small intestine are millions and millions of villi. (Villus is the singular form of the word.) These villi are so tiny that hundreds of them are to be found in a space half an inch square. Each villus consists of a cluster of blood vessels and one vessel called the lacteal. The lacteal absorbs from the chyle in the small intestine the nourishment that it wants, and infinitely minute particles of fat are taken up. The lacteal fluid is not yet in proper condition for combination with the blood, so it passes from the lacteals into the mesenteric glands. These glands, each about the size of an almond, and some one hundred and fifty in number, are situated in the mesentery, a membrane suspended from the rear wall of the abdomen.

It is supposed that in the mesenteric glands the lacteal fluid is filtered; afterward the fluid flows into a reservoir, known as the receptaculum chyli, placed against the front of the spinal column in the upper portion of the abdominal cavity. From this reservoir there runs a large lymphatic vessel, called the thoracic duct, upward and to the left along the spinal column, where it ends by a guarded mouth in the junction of the great veins at the root of the left side of the neck; thus pouring its contents directly into the blood current on its return to the heart. This thoracic duct, besides bringing this milky fluid from the lacteals of the abdomen, is also the final conveyor for all of the lymph from the lower extremities, abdomen and chest. It is about fifteen to eighteen inches long in the adult, and is guarded at its termination by double, half-moon shaped valves. On the right side of the neck, symmetrically placed with the termination of the thoracic duct on the left, is a short, large lymphatic vessel known as the right lymphatic duct. This is the virtual terminus of the lymphatic vessels of the head and upper extremity of the right side. It also discharges its contents into the junction of the great veins at the root of the neck, but on the right side. Its terminal opening is guarded similarly to that of the thoracic duct.

Situated in the course of these lymphatic vessels, chiefly in the great cavities of the body, along the course of the great blood vessels in the spaces near the larger joints and distributed in the neck, are small, solid, round or oval bodies called lymphatic glands. These glands are composed of an outside fibrous capsule, which sends partitions inward in all directions forming irregular spaces in which lie the gland-pulp or lymphoid tissue. The latter consists of a web-like network of fine fibers, holding in its meshes the lymph cells. These lymph cells resemble in every particular the white corpuscles of the blood, and, in fact, are the direct parents of the majority of these corpuscles.

When a lymphatic vessel arrives in the neighborhood of one of these glands, it breaks up into several branches, which enter the gland, and there further divide into a network of very small vessels resembling the capillaries of the blood circulation. When about to leave the gland these tiny vessels reunite into several tubes resembling those which entered the gland. And these again in turn unite to form a single lymphatic vessel continuing its way toward the center of the body. The lymph, or the fluid which is carried by this supplementary circulation, is formed by the filtration of the liquid of the blood through the walls of the capillaries into the lymph spaces, which lie outside the capillaries and between the cells of the various tissues. This lymph thus carries to the tissues the nutriment which they need for their organic activity, and, losing that part of its cargo, takes up from the tissues the waste products of animal life and carries them onward and inward, finally to pour them into the blood current at the root of the neck, from thence to be taken by the blood to the various excretory organs.

By this time it must become evident to the reader, that while the blood circulation is the common carrier of the body, the lymphatic system is the main distributing and collecting agency.

The lymphatic glands, which have previously been described, have a function in the human body peculiarly their own. Situated as they are in the course of the lymph flow and forming a part of the channel through which that fluid must go, they act as filters of that liquid. This filtration is accomplished in two ways: First, mechanically; and, second, organically, When anything foreign or deleterious to the wellbeing of the system at large is picked up and carried inward by the lymph current, the first lymphatic glands with which this antagonistic material comes in contact attempt to bar its progress. As a result of this work, the glands swell, become tender and painful and in many cases soften, break down and discharge, through the surface of the body, a fluid resembling pus; by this means removing the offending material from the interior of the system and making void any possibility of danger from its previous presence. Examples of the foregoing function of the lymphs are of more than daily occurrence.

With this understanding of the action of the lymphatic glands, we will still further appreciate the value of Physcultopathic methods in the treatment of disease, as compared with any of the old-time orthodox measures. As I have noted in an earlier chapter, there is really only one disease, in spite of its thousands of varying manifestations, and that is a defective condition of the blood. When the latter is impoverished or impure, it is utterly impossible for any part of the body to be in the right condition, since the minutest tissues and cells of every organ depend absolutely upon the circulation. If, when struggling with disease, we relieve the lymphatic glands of their burdens as much as possible, and assist the depurating organs in their work of eliminating wastes and poisons by natural methods, then we hasten the process by which the body returns to its normal state.

The quality and purity of the blood stream, perhaps next to the possession of an adequate supply of nerve-energy, is the most important of all factors in the preservation of health and life. In truth, the degree of nerve energy and the state of the blood are so interdependent that one is scarcely justified in attempting to consider them separately and independently. Either one is impossible without the other, as we have already shown. If the blood is kept pure and rich, and if it circulates actively and vigorously, then every part of the body will be perfectly provided for, the nervous system will be charged with vital energy, and it will be impossible for any part of the entire human system to become deranged except through the accident of external violence or the introduction of poisons, either directly into the blood or through the stomach.

Can the heart be strengthened? This is a question that belongs rather to another part of this work, dealing with the practical application of our knowledge of the body and its functions, in the treatment of disease and the building of the highest degree of health and physical energy. However, I should say briefly that the condition of the heart can be strengthened and improved in every way by Physcultopathic methods, the circulation thereby becoming more active and vigorous. The condition of the heart and also the elastic and vigorous state of the walls of the arteries, will be influenced by anything that tends to build constitutional vigor and to promote the welfare of the body as a whole. I may say that the heart is influenced in two ways. For one thing, the heart, like any other organ, will be invigorated and improved by the possession of an exceptional degree of vital or nervous energy and a pure and perfect condition of the blood. Further than this, however, it is able to do its work much more easily when the entire body is in a normal state. When other organs and tissues are overworked in the struggle to cope with any disease, the heart is likewise compelled to work much harder, and the excessive strain is likely to prove detrimental.

The heart, as we have seen, is necessarily a very powerful organ. Even in those cases where it is supposed to be "weak," it is still a muscular organism of remarkable power, for otherwise life could not be sustained. Many cases of supposed heart trouble are really the result of other conditions. Let the possessor of a "weak heart" take courage, therefore, for if it were really weak it is unlikely that he would ever have survived his infancy. If it has enjoyed sufficient vigor to go on with its incessant and arduous labors year after year until he has attained his maturity or middle age, then he can rest assured that by the rational methods which it is my pleasure and privilege to teach in these volumes, he will be able to bring it up to and maintain it in a normal degree of strength and power.

CHAPTER XI.

THE RESPIRATORY SYSTEM—THE CHANNELS OF PURIFICATION.

THE absolute and uninterrupted persistence of the act of respiration is one of the wonders and also one of the most imperative essentials of life. Its cessation for only a few moments means death. We can give our stomachs a rest if we choose, even for days, and we might be able temporarily to suspend some of our other functions, but breathing must be continuous. For this reason we are accustomed to speak of the lungs along with the heart under the classification of vital organs.

Just think of the mysterious and wonderful organization of the lungs, perfect and ready for service in the body of the babe even before it comes into the world. Then when it is finally ushered into this environment of earth and air, when the tiny passages and infinitesimal cells of its wee lungs are first ventilated with our fluid atmosphere, and the first expulsion of this air gives rise to that never failing little cry—to its hearers the most affecting and at the same time most joyful of all cries—the new little man or woman begins the breathing which will cease only when life ceases. Truly, no more dramatic moment could be conceived.

Think of the newness of those diminutive and delicate baby lungs, and at the same time of their faultless mechanism. Think also of their strength and enduring power, how they serve unfailingly through all the years of infancy and childhood, through rough and boisterous boyhood or romping girlhood, through the active endeavors of youth and the labors of adult life, persisting and struggling on for years and years, in spite of confined rooms and vitiated air in many cases, and finally, even through the feebleness of extreme age, when the muscles falter, the limbs are palsied and the sight is dimmed, how still they keep up the uninterrupted function which commenced on that momentous day of birth.

The processes of life depend, among other things, upon chemical action, requiring most of all a constant supply of oxygen in order that the essential combustion may be carried on and waste eliminated. This oxygen is supplied to the blood from the air through the marvellous mechanism of the lungs. But not alone this, for the lungs are the medium through which the body is relieved of waste-poisons which are constantly being produced in the processes of living, and which, if not eliminated, would mean the cessation of these processes within a few moments.

As the blood circulates through the body, nourishing all the tissues and supplying to the organs of secretion the materials necessary for their special work, it not only loses its nutritive quality but it also becomes charged with the waste matter and impurities mentioned. The purification of the blood is accomplished by the various excretory organs, the office of the lungs, the most important of these, being to relieve the vital fluid of one of the most important of these impurities, namely, carbonic acid. It is for this reason that, when one has been compelled for some time to breathe the confined air of a small room, this atmosphere becomes so charged with carbonic acid gas that it is unfit to breathe. The breathing of this gas, if persisted in without change of air, would prove fatal.

As previously stated, the lungs supply the blood with oxygen at the same time that they enable it to get rid of this poison. The oxygen not only burns up much of the waste and refuse matter that gathers in the body, but in addition stimulates the action of the organs in general and does other work in preserving health and vigor. It will be seen, therefore, that the lungs are most essential and important organs, being so intimately identified with the circulation upon which life depends.

Later in this chapter we shall consider the other purifying or excretory organs, the kidneys, the skin and the helpful service of the intestinal tract. It will be noted that the functions of the skin are not limited to those of waste elimination, but its service in this respect is of very great importance and it will therefore be taken up in this chapter.

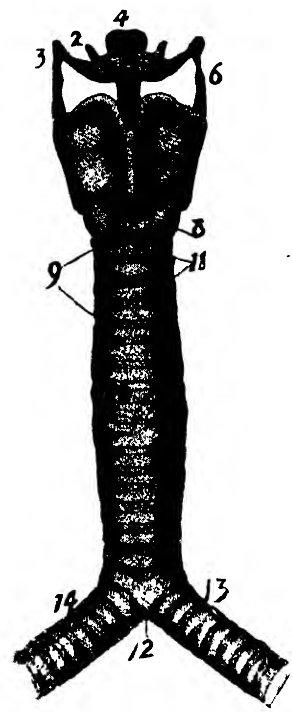
From the standpoint of Physcultopathy, an understanding of all these channels of purification is most essential. The relation of these special organs of elimination to the conditions which make disease a possibility will be obvious from what has already been said in previous chapters. As we have shown, there is fundamentally but one disease, and it lies in the impure and defective condition of the blood stream. When we speak of different diseases, we really mean only the varying manifestations of impure, impoverished and devitalized blood. If the blood be kept absolutely pure and charged with the nutritive elements necessary to sustain every part of the body, so that the important organs will be provided with the materials and energy with which successfully to accomplish their respective functions, and every tissue be kept clear and clean of accumulating wastes, then there can be no such thing as disease.

In the study of the science of Physcultopathy we learn of sundry natural methods of helping the body to eliminate accumulated poisons, reinforcing, as it were, the natural organs of depuration and hastening their own activities. In time of acute illness there is almost no limit to the wonders that can be performed by the various branches of Physcultopathy intelligently applied, but we can best accomplish these results only when we thoroughly understand the nature and action of these excretory organs, so that we can truly assist them. Furthermore, if we are truly alive to the condition and requirements of these organs, seeing to it that they are normally active and vigorous at all times, then in most cases we shall be able to avoid any trace of sickness under circumstances where we would otherwise suffer seriously.

Physcultopathy recognizes that errors of diet have much to do in the majority of cases in the causation of disease, and insists upon a knowledge of food value so that we may be able to secure the maximum of strength and energy from what we eat. At the same time, our more thorough study of all the needs of the body have shown us that it is a mistake to assume, as have many food reformers, that the entire question of health and physical vigor depends only upon the selection of a suitable diet. A faultless diet will go far, it is true, but even the most perfect diet cannot prevent a lapse from one's best physical welfare if the functions of elimination are not properly carried on. It is not to be forgotten that an ideal diet will so tend to keep one in a condition of strength and health that the depurating organs will act under favorable conditions, that is, so far as the body may be affected by proper foods. But the most hygienic diet ever known cannot keep one in health if he is not normally active from a muscular standpoint and his habits otherwise are not such as to keep these excretory organs active and in the best of condition. Perfect and constant elimination is one of the most imperative essentials of life and health. Each and every human being should individually know and understand these things, and should make it a point to see that his depurating organs are working at their greatest possible efficiency.

Let us consider, first, the work of the lungs in relieving the body of carbonic acid, and simultaneously supplying oxygen. Just how important is this work, did some one ask? It may be seen very quickly by the experience of choking or suffocating, by means of which the breath is shut off and the process stopped. In a few seconds a dreadful condition arises, accompanied by the terrible and desperate sensation of smothering. The lungs can no longer purify the blood stream which surges through them continuously at the rate of two to three ounces per second, or at the remarkable rate of four to five quarts per minute; the entire blood supply of the body becomes saturated with the rapidly accumulating poison; even the blood in the arteries loses its pure, bright scarlet, arterial color, this giving place to the dark crimson of the venous blood; and the natural color of the face, perhaps a bright pink or rosy flush, is changed to a dark purple. And all in a few seconds! If one struggles or exerts himself while choking, then the process is all the more rapid, the accumulation of the poisons being accelerated in proportion to the intensity of the effort. A diver, with a normal, full breath of fresh air, and with the advantage of the special training of his lungs, may survive on a single breath of air for a couple of minutes. But if one is caught and choked unawares, with a shallow supply of air in his lungs, and if he then struggles violently, unconsciousness comes in a few moments, with death following immediately if the situation is not relieved with the introduction of a full supply of fresh air into the lungs.

The lungs occupy the greater portion of what we call the "chest," this being the uppermost of the two great cavities into which the trunk of the body is divided. Somewhat between the lungs, and to the front, lies the heart, completing the group of vital organs contained in the chest and protected by its walls. The division of the trunk or torso into the two cavities referred to is accomplished by the diaphragm, a rather remarkable structure which forms the floor of the upper or lung and heart cavity, and the roof of the cavity beneath containing the digestive and other abdominal organs. There are convenient openings in it through which pass the œsophagus, the aorta, the vena cava, and other important channels. The diaphragm is chiefly a muscular structure, though partly tendinous, being perhaps best described as a membranous muscle. It has somewhat the form of a large shallow bowl inverted, so that with its contraction it flattens, pushing down upon the organs underneath, and causing the expansion of the body below the waist line that is observed in natural breathing. With this contraction, thus

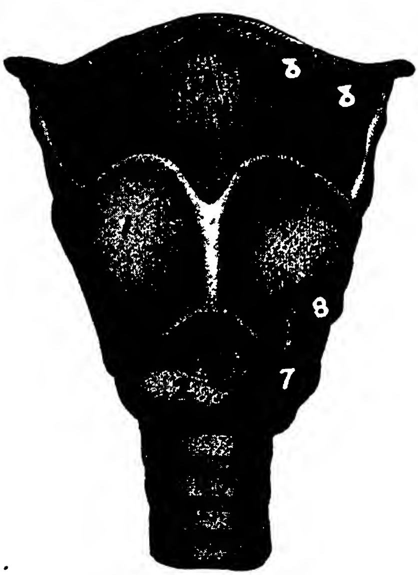


The Larynx with the Hyoid Bones and Trachea.

1. The hyoid bone
2-3. Small and large cornua.
4. Epiglottis.
5. Thyroid cartilage.
6. Superior horn of thyroid cartilage.
7. Cricoid Cartilage.
8. Crico-thyroid membrane.
9. Cartilage rings of trachea.
10-11. Trachea.
12. Division of trachea.
13. Left branch of trachea.
14. Right branch of trachea.

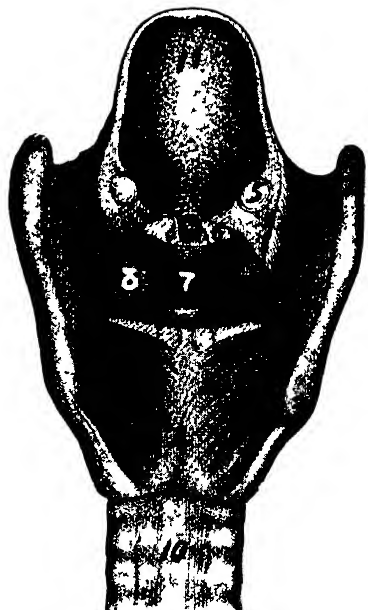
lowering the floor of the lung cavity, a partial vacuum is created which causes the external air to rush in. This is normal and natural inspiration. As a rule, the expansion of the chest for the same purpose is not required except during the need for an exceptional amount of air. But the practice of breathing, with special exercises, for the improvement of the lungs, and, through them, of the entire body, will be taken up in another place.

The lungs are of a spongy, elastic texture, but appear to the naked eye as if they were, in great part, solid material. As a matter of fact, they are hollow organs, not unlike two bags containing air, each bag communicating by a separate opening with an air tube, the *trachea,* through the upper por-



The Larynx Viewed from the Front

1 Thyroid cartilage
2 Cricoid cartilage
3 Trachea
4 Hyoid bone
5-6-7 Muscles of larynx.
8 Muscles of epiglottis



The Larynx Viewed from Behind, Showing Muscles

1 Epiglottis
2-3 Cornua of thyroid cartilage
4 Cricoid cartilage
5 Cuneiform cartilage
6 Cornicula laryngis
7-8 Oblong and transverse bundles of the arytenoideus muscle, respectively
9 Thyro-arytenoideus muscle.
10 Trachea

tion of which, the *larynx,* they are put in touch with the outer atmosphere. The aperture of the larynx can be opened or closed at will by an involved system of muscles.

Each lung is enveloped in a sort of fibrous bag, which has a very smooth lining. The lung itself has an outer surface which is very smooth, and which moves easily over the inner surface of the bag, or *pleura,* that envelopes it. Nevertheless, the relation of lung to pleura is so intimate that there is no actual space between the surfaces of the two except after death or as the result of some diseases.

The trachea, the large tube which is popularly known as the "wind-pipe," and through which the air passes into the lungs, divides into two branches or *bronchi*—one for each lung. These bronchi divide and subdivide into a number of small branches penetrating every part of the lungs until they end in the fine subdivisions of the latter, called the *lobules.*

Each lung is partially divided into *lobes,* the right organ having three and the left two. A lobe is composed of a large number of minute lobules. A lobule may be considered as a microscopic lung, inasmuch as it contains a branch of the bronchial tube as previously stated, air cells, blood vessels, nerves, lymphatics, etc.

On entering a lobule, the division of the bronchial tube keeps on dividing until its walls become an extremely thin membrane, pouched into small dilatations, called air-cells.

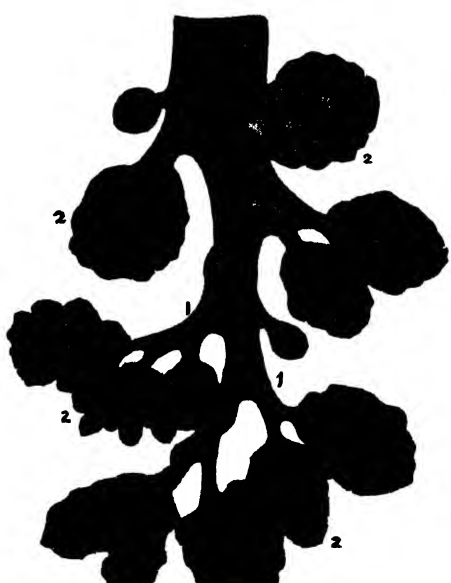
Without going into a technical description of the mechanism of the air-cells, it may be briefly stated that outside of them is a network of pulmonary capillaries, or minute blood-vessels. Air, on being inhaled, comes in contact with the blood in the lung-capillaries by means of a very wonderful device of Nature, by which there is an interchange of oxygen of the air for the carbonic acid in the blood through the membrane of the air-cells. This carbonic acid is exhaled, there is a distribution of the oxygen, and so the process of respiration continues indefinitely. The enlargement of the chest in inhalation is a muscular act, the muscles concerned being chiefly the diaphragm, the external intercostal muscles, a portion of the intercostal muscles and some others. The relaxation of the muscles after such effort brings about expiration, under normal conditions.

In singing, sneezing, coughing, etc., certain other muscles are brought into play, however, the chief of which are to be found in the abdominal region, together with those that depress the ribs.

The blood is conveyed to the lungs by the pulmonary arteries to be purified in the former in the way described. The blood needed for the nutrition of the lungs and their connective parts is supplied by the bronchial arteries, and having fulfilled its purpose is carried into the pulmonary arteries and is purified and vitalized in due course.

The blood, as it passes through the lungs, changes greatly in color, the dark crimson of the venous fluid being exchanged for the bright scarlet of the arterial blood. In addition, the blood, as intimated, gains in oxygen, loses carbonic acid, becomes one or two degrees warmer, coagulates sooner and more firmly, and contains more fibrin.

The oxygen which is absorbed into the blood from the atmosphere through the action of the lungs is combined chemically with the hemoglobin of the red blood corpuscles. In this condition it is carried in the arterial blood to the various parts of the body and brought into contact with the elementary portions of the tissues. In so doing, it co-operates with the process of nutrition and in the removal of disintegrated tissue matter during which a certain proportion



Bronchial Tubes With Their Lobules.
(Highly magnified.)

1. Bronchus.
2. Lobules.

of the gas disappears and a like amount of carbonic acid and water is formed.

The venous blood, charged with this same carbonic acid, returns to the lungs where the gas is exhaled and a fresh supply of oxygen is secured.

The stopping of the respiratory movements from any cause results in the retarding of the circulation and finally venous congestion of the nervous centers, with resulting death.

Considering the vital character of the function of the lungs, it will be seen how important it is that we provide natural and favorable conditions for their exercise, and also that we use them freely. Men and women, especially those confined to indoor occupations and sedentary habits, commonly neglect their lungs by persistent shallow breathing. This is none the less detrimental because it is thoughtless. The only surprise is that those who are guilty of such neglect get along as well as they do. It is only another proof of the wonderfully efficient character of the lungs that they do so well under such unfavorable circumstances.

With the knowledge that we have just gained we will realize better than ever before the incalculable value of pure air, particularly the atmosphere of the great outdoors. Everyone should be in the open as much as possible, but those who cannot spend their days outside should at least make it a point to have their rooms and places of business so ventilated that there is a continuously renewed supply of air. Even the man who operates a factory would find it an advantage, from a business standpoint, to provide for his workers in this way, for they would be able to accomplish more and better work for him. It is true that in severe winter weather the demands of proper ventilation will require a greater expense of fuel in order to keep a place comfortably warm, by the common methods of heating, but the gain in health and working energy will more than offset this. Furthermore, with a more universal appreciation of these facts, we may anticipate that in time there will come a radical revolution in the popular methods of heating, steam radiators and old-fashioned stoves giving way to intelligently arranged systems by which the outdoor air is warmed and then, still fresh and pure, introduced into the room. Many progressive people already use this method.

In the practice of special breathing exercises it is important to avoid holding the breath for more than a moment, for reasons which our study of the actions of the lungs has just made clear. To hold the breath is to defeat the very purpose for which one may take breathing exercises, inasmuch as it is only a form of temporary suffocation. To hold the breath is to produce a condition in the lungs similar to that in an enclosed room in which most of the air has been vitiated by repeated breathing.

There is also a special reason why one should take some moderate, healthful exercise, if possible, in connection with his daily breathing exercise. This is because we can by this means more perfectly accomplish the oxygenation of the blood and the combustion and elimination of the wastes of the body. We all know how much more rapidly we breathe when taking vigorous exercise, for under such circumstances we consume and require far more oxygen than when physically passive or at rest. Two wrestlers, for instance, will probably consume as much oxygen as a score of idle spectators in the same room. When taking voluntary breathing exercise with the body otherwise in a condition of comparative rest, we accomplish a more perfect change of the air in the lungs (there is always a certain residue of air in the lungs, for they are never entirely emptied), but this does not mean that all of the available oxygen inhaled is taken up by the blood. The oxygen is there in larger quantities than usual, and this is an advantage, as is also the greater facility thus offered for giving up the carbonic acid, but no matter how well filled with air the lungs may be, the blood cannot take up much more oxygen than is called for by the demands of the body and the degree of combustion that is going on through all of the various tissues. This need or demand for oxygen might be referred to in colloquial terminology as a condition of oxygen-hunger, and the degree of this will determine just how much oxygen will be absorbed from the air in the lungs. Active exercise will create this condition of oxygen-hunger and the deep breathing which naturally ensues under such circumstances is far more beneficial than that taken in a state of general bodily rest, although this, too, as we have seen, is highly to be recommended. The amount of oxygen absorbed, of course, is partly a matter of the activity of the circulation, for the red corpuscles are always well supplied with the vitalizing and electrical gas, and always leave the lungs in a bright scarlet condition. When we need more oxygen, then the heart beats faster and the blood streams through the capillaries of the lungs much faster, picking up the oxygen from the air-cells more rapidly and giving up the poisonous gas with equal speed and in similar volume.

Excretory Organs.—Working in connection with the lungs, as already noted, are the kidneys and the pores of the skin, removing the other wastes of the body. The intestines are sometimes regarded as of a depurgating character, but they are properly digestive and assimilative organs, their excretions having to do chiefly with the waste matter of the foods and digestive fluids. However, they do assist somewhat in the general work of elimination, and especially during diseased conditions, where there is an excess of poisons in the body. Under such circumstances, when the appetite fails, the tongue is coated and the breath bad, one may surmise that the entire alimentary tract is brought into service for the purpose of elimination. The advantage of drinking water freely in such a case is obvious, although the increased supply of water in the body generally is favorable to the more efficient action of the kidneys and skin as well.

The Kidneys are the organs of the human body by which the major part of the broken-down or waste material resulting from physical activity is excreted or cast off from the body.

These organs are situated deep in the loins, one on either side of the spinal column, embedded in a mass of fat. Each measures about four inches in length, two and one-half inches in breadth, and about one inch and a quarter in thickness. They weigh, in the average adult, about five ounces, and their approximate shape is that of the well-known kidney bean. The kidneys lie with their greater convexity toward the sides of the body, and the depression, or nick, toward the middle line, each facing the one on the opposite side. In this depression, all the blood vessels and nerves of the kidneys have their entrance or exit, and from it comes a tube, called a ureter, which carries the urine from the kidney to the bladder.

The right kidney is situated directly behind the liver, and the ascending portion of the large intestine; while the left has, in front of it, the large end of the stomach, and the first part of the descending portion of the large intestine.

The lower tips of both kidneys are two inches above the upper edge of the haunch bones.

The naked-eye appearance of a longitudinal section of the kidneys shows a picture of which Plate E (page 242) is a reproduction. The line at the extreme circumference represents a fibrous capsule which envelopes the entire kidney, and which, sending projecting partitions within, forms the framework of the organ.

Next you will notice a rather narrow band, which is called the cortical, or outer portion of the kidney. This is composed of convoluted, or twisted and straight, tiny tubes, each of which arises in a spherical, hollow capsule of minute size, containing a bundle of twisted capiliaries or small blood vessels. The central or medullary portion, as may be seen from the picture, is composed of pyramids, eight to eighteen in number, with their peaks or points directed toward and located at the depression, or sinus, on the internal edge of the kidney. These pyramids are composed of bundles of miscrocopic straight tubes which finally join together in one opening at the apex of the pyramid. The fibrous capsule previously described as investing the whole organ dips into the depression on the inner edge of the kidney, covering each and every pyramid's point, but at each such point there is a mouth, or opening, from the final tube of each pyramid. Surrounding all of these openings, and narrowing as it leaves the kidney, is a fibrous funnel, known as the pelvis of the kidney, which unites at its narrow end with the ureter, or pipe of transmission to the bladder.

The circulation of the blood in the kidney, being of prime importance in this organ, calls for special description. The renal or kidney artery, which is a branch from the largest artery in the body, divides on its entrance into the depression of the kidney, into five branches, which as they pass up between the pyramids subdivide again and again, finally terminating in two sets of capillaries. One of these sets may be found occupying the cavity of the minute spherical capsules previously described, while the other capillaries ramify about the twisted and straight tubules. The blood is re-collected from these capillaries by little veins, which join each other as they descend between the pyramids, finally to combine into one, called the renal vein, which ultimately pours its contents into the largest vein in the body. Thus, you see that the circulation through the kidney is directly from the largest artery in the body to the largest vein in the body.

The broken-down or waste material of the various tissues of the body goes through various processes before it is prepared to be excreted by the kidneys. As any tissue breaks down and wears out, the used-up portion is dissolved by the blood at the place where it was produced, and carried by the blood current to the liver. In this organ the waste materials from all parts of the body are collected, and so chemically changed or transformed that they are fit for filtration from the blood by the kidneys. These changed materials, the most noticeable of which is urea, are again dissolved in the blood at the liver and carried from thence to the capillaries in the kidneys.

The walls of these capillaries, especially those of the first set described, are exceedingly thin, and the pressure in the blood vessels being much greater than in the cavities of the tiny spherical capsules and minute tubes, the water of the blood (containing in solution the urea and other waste products) passes through this thin wall, leaving the solids and albuminous constituents of the blood behind, and flowing down through the little tubes, is known as urine.

Human urine is a straw-yellow, limpid fluid, transparent, with a mild odor, acid and weighing, normally, about one and one-fortieth times the weight of pure water. Diseased conditions, not only in the kidneys, but in the heart, in the brain, in the lungs and in the arteries of other parts of the body, as well as natural changes in the blood pressure in distant parts of the body, cause great modifications in the quantity, as well as the quality of the urine excreted. For example: In summer, when the skin of the body, owing to the external heat, is filled with blood, sweating is profuse, and the quantity is markedly diminished. In winter, when the skin is chilled and the blood vessels in it contracted, the amount of urine is increased. Under stress of nervous shock or emotion, the urine is many times greater in quantity. Disease or disturbance of the digestive organs, especially of the liver, cause a defective transformation of waste materials into the urea, producing by-products, such as uric acid and urates, which, when excreted in the urine, cause the latter to become darker, very acid, and to deposit the well-known brick-dust sediment. This is one of the greatest causes of stone in the bladder. Diseases of the kidneys themselves, wasting diseases of the general system and any temporary stress of over-work or worry is liable to cause albumin to appear in the urine. Disease of the nervous system, in some of its many forms, causes sugar to make its appearance in this excretion and its permanent appearance therein is a symptom of the disease known as diabetes.

THE SKIN.—The human skin, with its appendages, covering, as it does, the exterior of the whole body, is a most marvellously and ingeniously constructed tissue. Not only is it arranged and built in a general way to fulfill all the claims which may be made upon it, but it is also modified in various special localities so as to perfectly serve special functions.

For purposes of description the skin may be divided into three layers: First, the outermost one, called the epidermis or cuticle; second, the middle one, the derma or true skin; and, third, the subcutaneous layer. (See Plate A, page 124.)

The epidermis, or cuticle, being the most exterior, is in continual contact with all the constant rubbing and pressure to which the body is subjected. It is, therefore, from a purely mechanical point of view, the protector of the body. Owing to the constant rubbing and pressure of this layer, there is a steady loss from its surface by destruction and scaling of the living cells of which it is composed. In order, therefore, that under normal conditions this covering be not totally lost, there is a steady growth from the bottom upward of these cells. The structure of this layer consists of one class of cells, called *epithelial* (which have already been noted in the classification of the tissues of the human body), but whose shape varies very markedly from within outward. At the inner surface of this layer, the cells are cylindrical in shape and soft in texture, growing more spherical and less soft as we reach the middle, while at the surface the cells become flat, dry, and in some cases almost horny in consistency. The outer surface of this layer is virtually smooth, while its under or inner surface is undulating, dipping in between and rising over the prominences of the derma or true skin. In the innermost layer of this epidermis, we find the coloring matter which gives the lightness or darkness of shade to the human skin. This coloring matter is the same for all races, black, yellow or white, the difference of shade being produced by the amount of it present. Sunlight has the effect of causing more color to be deposited in the skin upon which it shines.

The nails on one's fingers and toes are but modifications of this epidermal layer of the skin. They consist of the same epithelial cells, but are more flattened, more closely packed together and more horny in structure. At the base of each nail. there is a so-called root, embedded in a fold of the skin, from whence comes the growth in length of the nail, and underneath its concave surface is the *matrix* or "quick" of the nail, which is very full of blood vessels, and by means of which the nail grows in thickness. These nails on the human body, which at the present time merely protect the ends of the fingers and toes, were, in the early ages of human existence, intended also to serve, not only as tools, crude though they were, but as weapons of offense and defense. (See Plate A, page 124.)

The second layer of the skin, the derma or true skin, is a tough, flexible and highly elastic tissue, protecting the underlying parts, acting as the chief organ of the sense of touch and effecting by its various glands, not only the excretion of sweat, but of an oily material whose purpose is to prevent the too-rapid drying of the epidermis. Throughout the derma are tiny muscular fibers that contract the skin.

This true skin consists of two layers. First, the *papillary layer*, situated upon its free surface, presents innumerable, minute, conical eminences, called papillæ, which are very full of tiny blood vessels and whose average size is 1-100 of an inch in length, by 1-200 of an inch in diameter at the base. These little mounds are very thickly arranged in paralleled curved lines, forming ridges, in the more highly sensitive regions, while in the less sensitive parts they are more thinly and irregularly distributed. In each of these minute mounds are found the terminations of the sensitive nerves or nerves of touch. It is from the blood vessels of the papillæ that the flow of blood comes when the skin is scratched. There are no blood vessels, lymphatics or nerves in the outer skin, the epidermis. There can be no pain in any of the cell layers of the epidermis, and such pain as is felt in the skin is inflicted, through the epidermis, upon the dermis. Second, the *reticular layer* contains interlacing bands of firm, white fibrous tissue, with yellow elastic fibers wherever hair exists, also lymph spaces and blood vessels.

Beneath this true skin is the *subcutaneous layer*. This consists of an open network of fibrous tissue, connecting the true skin with the tissues underneath and holding in its meshes a greater or smaller number of fat cells.

In the true skin, or the subcutaneous layer, we find multitudes of sweat glands. Each of these has a single excretory duct and a little coil. The duct passes up between the little eminences and opens on the free surface of the epidermis.

Some sweat glands are found in the fatty tissue directly under the true skin. The sweat gland is a tube about a quarter of an inch in length, and the inner end is closed. These little tubes lie coiled in balls that are something like one-sixtieth of an inch in diameter. From the ball the tube extends wavily outward through the epidermis. At the back of the neck there are about 400 sweat pores to the square inch, while in the palm of the hand there are some 3,000 to the square inch. The pore is the tiny open end of the gland in the outer surface of the cuticle. The sweat itself is made up of moisture, some salts, a little urea (which is the most important waste product of the body), and the skin also depurates about one-fiftieth as much carbon dioxide as do the lungs.

The direct relation between the skin and the kidneys is shown by the fact that the more perspiration there is on the skin the less fluid is eliminated by the kidneys. In the winter, when the skin does not perspire as freely as in summer, the secretion of the kidneys is greatly increased. Conversely, it will be noted that when the kidneys are very active there is not present as much perspiration on the surface of the body. Exercise, therefore, is of direct benefit to the kidneys, inasmuch as it relieves the latter organs of much of what would otherwise be their work.

It must be understood that not all of the perspiration from the sweat glands is visible to the eye. Much of this perspiration passes off from the body in the form of vapor. It is to be understood, also, that perspiration must always result in the cooling of the skin. It requires heat to convert fluid into vapor, as in the case of the fire that is needed under a boiler in order to convert water into steam. The heat that is used in converting the liquid of sweat into vapor is drawn from the skin, and thus the skin must be left cooler through the act of evaporation.

We are now in a position to understand why normal health is impossible unless the skin be healthy. With a "bad" skin one of the important eliminating organs of the body is out of repair, and the work of depuration that is thrown thus upon the other organs can be only partially performed by them.

Nourishment by the proper foods is the first essential of a healthy skin, since the bodily fluids that carry the nourishment are incessantly engaged in the process of revitalizing the skin. Exercise brings profuse perspiration to the skin, thus vigorously eliminating waste matters, a portion of which would remain otherwise in the skin and become poisonous to the entire body.

The hairs, which, like the nails, are modified portions of the epidermis, are found everywhere in the skin, except the palms of the hands and the soles of the feet, but vary greatly in size. Each hair consists of a root and a shaft, all situated in a deep, narrow cavity, known as a hair follicle. This follicle traverses the whole thickness of the skin, beginning generally in a subcutaneous layer and opening on the free surface of the epidermis. Into the deeper part of this follicle, there generally open from two to five glands, known as sebaceous glands, which secrete the oily substance previously mentioned. Each hair has attached to its base a minute muscular fiber by which it may be raised to an erect position. The sebaceous glands are found wherever there is hair, and are most abundant in the scalp, face, arm-pits, and around the various openings of the body. Although generally opening into the hair follicles, they frequently open on the free surface of the skin. These openings become very noticeable when plugged with dried secretion and discolored black by dirt, when they are known as "blackheads."

The skin of the human body has quite a number of various duties to perform. The most manifest of these functions, aside from that of depuration, is that of protecting from harm the more delicate structures that lie beneath it. This protection is accomplished in two ways: First, mechanically, by means of the cuticle or epidermis. This takes up the persistent constant rubbing and pressure which is applied to it every moment of the being's life, the outer cells being constantly destroyed or rubbed off, while new ones steadily take their places. Second, the end-organs of the sensitive nerve-fibers in the papillary layer being of three kinds, namely, nerves of sensation, nerves of heat, and nerves of cold, these receive corresponding sensations of pressure or pain, heat or coldness, and by transmitting these sensations to the central nervous organism, serve as a warning to the individual economy that danger from injury, or extremes of heat or cold, is present. This warning, being followed by activities of various sorts, guards the human body from destruction.

The tonsils are composed of a lymph tissue and are supposed to supply phagocytes or toxin-digesting cells to the oral cavity, where they combat the bacteria entering the mouth. This would account for their rapid and extreme enlargement in some cases. While the tonsillitis thus produced may apparently be injurious to the system, it is impossible to determine how much more serious diseases are warded off through this extreme endeavor of the tonsils to fortify the gate of entrance.

The mucous membranes are now thought to be eliminative structures in certain conditions, particularly in fevers and the fast or reduced diet. Intestinal elimination during a fast proves this to be true. Even when no solid material will be eliminated for days, the enema may bring forth considerable mucus, which is darkly tinted as a result of an accumulation of poisons or waste materials being carried to and eliminated through the intestinal mucous membrane. An instance of elimination through the mucous membrane is with catarrah and colds. Substances ranging from a thin, watery discharge to a thick, yellow, pus-like accumulation, are expelled through these membranes.

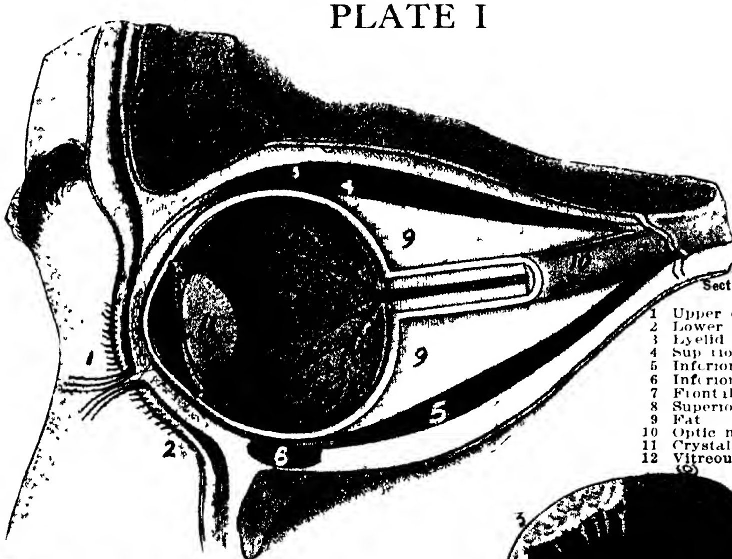
CHAPTER XII.

THE ORGANS OF SPECIAL SENSE.

AMONG the most interesting of all the organs of the body are those of special sense, or, in other words, those by means of which we are able to see external objects, to hear the noises which they may cause, to smell their odors, to taste them if placed in the mouth, and to feel their form, texture and temperature. I have already referred to the functions of the sensory nerves having their end organs in the skin, providing for the sense of touch by which we are able to "feel" things, and therefore it will not be necessary to consider them further in this chapter. It may be said, even of the other organs, that through them we literally feel external objects, that is, we "feel" the sensations produced upon our sense organs by the vibrations of light or of sound. In the case of sensations of taste and smell, we "feel" directly the qualities of the objective matter, on the one hand, and the gaseous or dust-like emanations from it on the other.

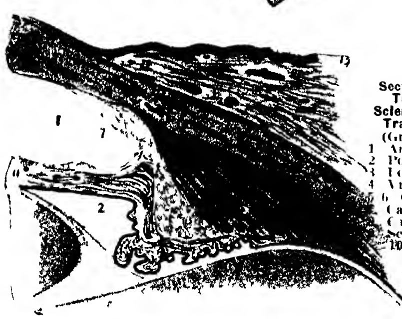
The sense organs have an importance which is peculiar to themselves, inasmuch as they perform a kind of service which is utterly distinct from that of any of the other organs of the body. It is through them that we perceive our relations to the outside world by reason of which we are able to use and direct the voluntary muscular system, the immediate servant of our own volition, in an effective manner. Just think—all that we know of the great world is what we have learned through these organs of sense. They give us our conceptions of everything, even the pictures of our imaginations being necessarily combinations made up of the various sensations that we have experienced through these sense organs. Fancy, indeed, into what a dark, dead and meaningless existence we would be plunged were we deprived of the aid of these various senses. We all know of some unfortunates who are deprived of one of them, and, surely, life cannot mean much under such circumstances; but were one to suffer the loss of all his special senses, then certainly would existence mean noth-

PLATE I



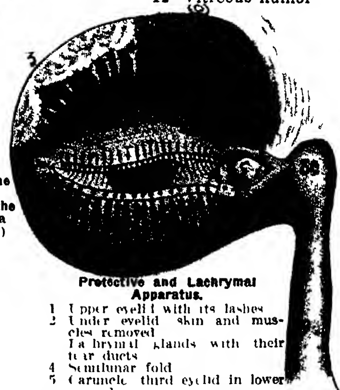
Section Through the Right Eye

1. Upper eyelid
2. Lower eyelid
3. Eyelid lifting muscle
4. Superior rectus muscle
5. Inferior rectus muscle
6. Inferior oblique muscle
7. Frontal bone
8. Superior maxillary bone
9. Fat
10. Optic nerve
11. Crystalline lens
12. Vitreous humor



At Left is Section Showing the Transition of the Sclerotic Coat into the Transparent Cornea
(Greatly magnified.)

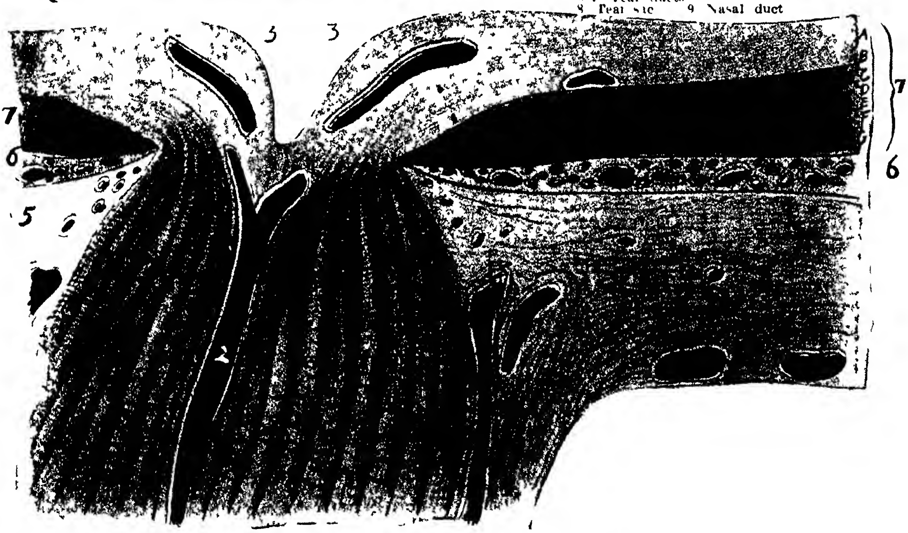
1. Anterior chamber
2. Posterior chamber
3. Lens
4. Vitreous humor
5. 6. Ciliary muscles
7. Canal of Petit
8. Canal of Schlemm
9. Sclerotic coat
10. Cornea
11. Iris
12. Conjunctiva
13. Epithelium



Protective and Lachrymal Apparatus.

1. Upper eyelid with its lashes
2. Under eyelid, skin and muscles removed
3. Lachrymal glands with their tear ducts
4. Semilunar fold
5. Caruncle, third eyelid in lower animals

6, 7 Tear ducts
8 Tear sac 9 Nasal duct



Section at the Entrance of the Optic Nerve.

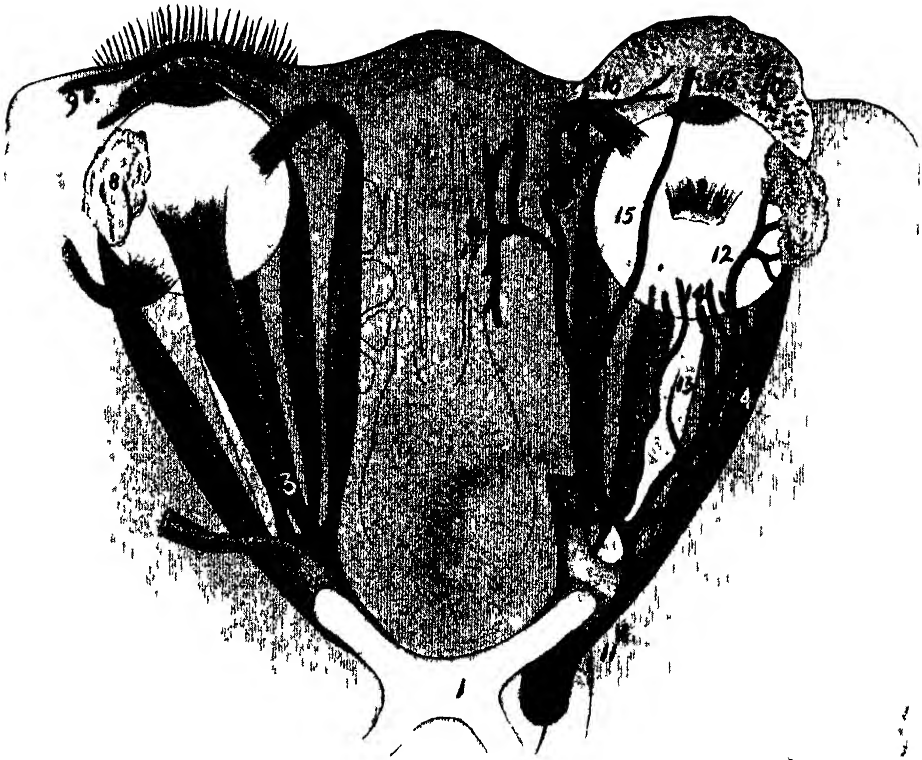
1. Optic nerve.
2. Retinal blood vessels
3. Slight thickening of the retina
4. Nerve sheath
5. Sclerotic coat
6. Choroid
7. Retina

a. Nerve-fiber layer
b. Ganglion-cell layer
c. Inner-reticular layer
d. Inner-nuclear layer.
e. Outer-reticular layer
f. Outer-nucleated layer
g. Layer of the rods and cones.

ing. If we could picture one born in such a condition, and growing up through childhood without ever having possessed any of these five senses, it would be impossible for him to be educated, to have any idea of his relations to others or even to know that there were others. He could know nothing, and, as a matter of fact, such an individual would scarcely be able to survive infancy.

These organs are of special value in furthering the welfare of the body, especially in a protective way for preserving life. The sense of sight enables one to know the whereabouts or presence of objects so that he may avoid injury by involuntary contact with them. The sense of hearing places him in communication with external objects in another way, perhaps warning him of the approach of anything from behind him, that is naturally out of his range of vision. The senses of smell and taste enable him to judge of what will be beneficial to him in the way of foods. The sense of touch, indicating temperatures and other external conditions, likewise helps him to adjust himself to the requirements of his environment, as we have already seen.

But important as are these organs of sense, in these respects, they do not have the same relation to the health and vitality of the body as do the other so-called vital and functional organs. They may be defective through some local condition or derangement, and yet without interfering materially with the general health of the body as a whole, whereas any such impairment of the heart, lungs, stomach, liver or kidneys would seriously affect every other part of the body. It would seem from this that in our study of the means of building health and increasing the vital powers of the body, the organs of special sense do not assume the importance of those considered in previous chapters, though they are naturally of great importance in themselves. This, however, does not apply in the same way to the skin, for this is not only the organ of the sense of touch, but it has the other functions of protection and depuration. When the latter is interfered with, it must affect the entire body detrimentally.



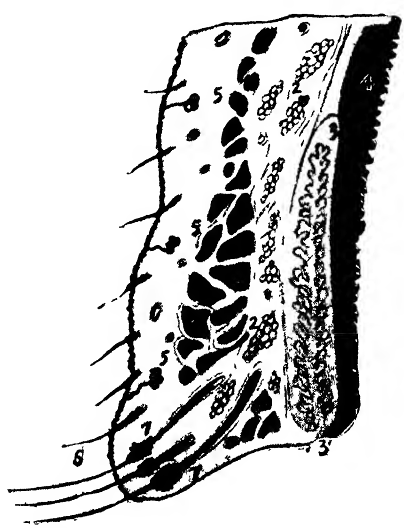
View of Eyeballs from Above, Showing the Muscles and Arteries.

1 Crossing of the optic nerve
2 Superior rectus muscle
3 Inferior rectus muscle
4 External rectus muscle
5 Internal rectus muscle
6 Superior oblique muscle.
7 Inferior oblique muscle.
8 Lachrymal glands
9 Eyelid in section
10 Eyelid from inside
11 Infra-orbital artery
12 Branch to the tear gland
13 Branch to the retina
14 Branch to the iris
15 Branch to the upper eyelid
16 Branch to the eyebrow
17 Branch to the cavity of the nose.

The Eye, or the organ of vision—which, like other special sense organs, is double—is situated in two conical-shaped bony cavities in the front part of the skull, one on either side of the root of the nose. The eyeball is an almost spherical-shaped mass, held in place in this cavity by three pairs of muscles, and the optic nerve, or nerve of sight; it is surrounded by loose fatty tissue and protected in front by the eyelids, whose lining membrane is reflected over the anterior portion of the eyeball.

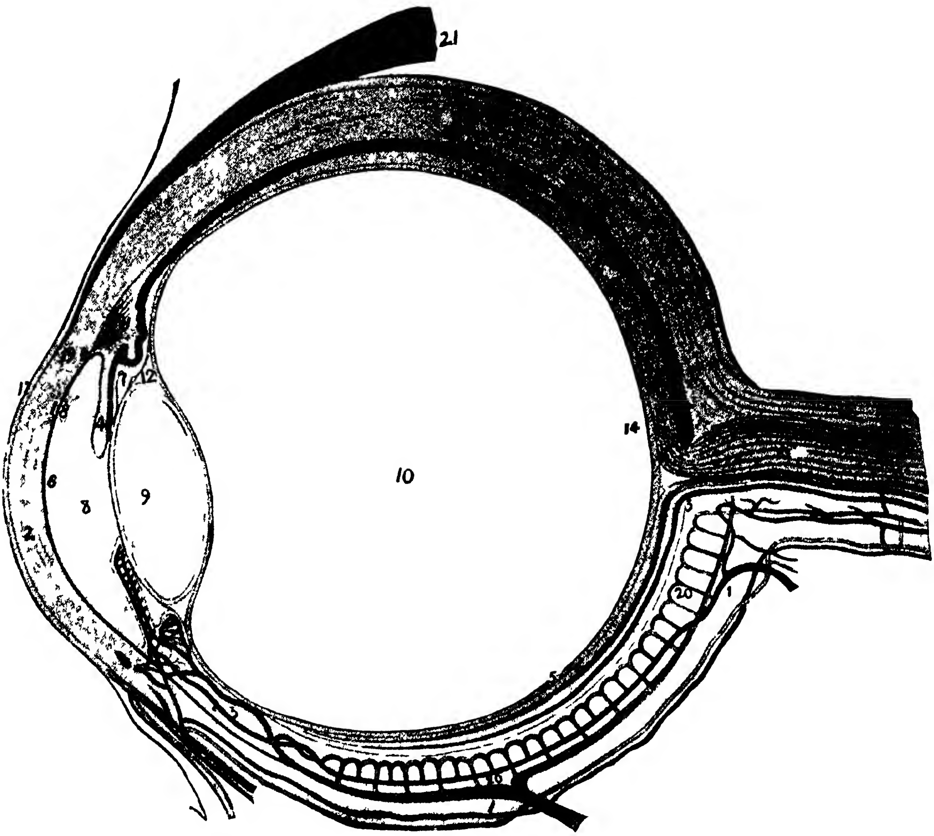
The lids are composed, on their outer surface, of skin, and on their inner surface, of mucous membrane, held loosely together by connective tissue and reinforced at their edges by thin semilunar cartilages. At the junction of the two membranes is a row of stiff hairs, known as eyelashes, which protect the eye, serving as a screen, from the entrance of foreign bodies. At this edge there appear also the openings of little glands which secrete an oily material to lubricate the edges of the lids and these hairs. A stoppage and inflammation of one of these glands is commonly known as a stye.

On the upper, outside corner of the bony cavity containing the eyeball, which is known as the orbit, is a large gland known as the lachrymal, or tear-gland. This secretes tears, a slightly salty, watery fluid, which at all times keeps the anterior surface of the eyeball moist and at times, under the influence of certain emotions, is poured forth more or less copiously. The main duct from this gland leads to the cavity of the nostril on the



Cross Section Through the Upper Eyelid.

1 Muscles cut across
2. Fibers of involuntary muscles in adipose tissue.
3 Meibomian glands.
4 Conjunctiva
5. Sweat glands.
6 Eyelashes.
7. Fat glands.



Horizontal Sectional View of Structure of Eye.

Upper part of figure shows outer tissues, lower part of figure shows blood-vessels exposed

(Detailed reproduction)

1 Sclerotic coat
2 Cornea, or second coat
3 Choroid coat.
4. The iris
5 Retina
6 Anterior chamber
7 Posterior chamber
8 Pupil
9 Crystalline lens
10. Vitreous humor
11 Ciliary body
12 Canal of Petit
13 Optic nerve.
14 Yellow spot
15 Nerve sheath
16 Capsule of Tenon
17 Conjunctiva
18 Membrane of Descemet.
19 Canal of Schlemm
20 Capillaries of the choroid coat
21 External rectus muscles

same side, so that in the main the waste secretion discharges into the nose.

The muscles of the eye, as said before, consist of three pairs to each eyeball, and by acting in concert or antagonism cause the motions of the eye from side to side, up or down, and circularly on its own axis.

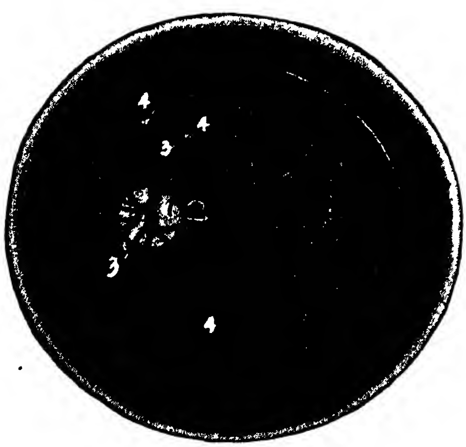
The eyeball itself is spherical in form, having a portion of a smaller sphere engrafted on its front part. The larger sphere, which forms about five-sixths of the globe, is opaque, while the smaller, consisting of about one-sixth of the surface, is very transparent and is known as the cornea, or the window of the eye. The cornea is the projecting anterior portion of the eye and is set into the other portion of the outer coat of the eye, much as a watch-glass is set into the case of a watch.

In general, the eyeball consists of two parts: an envelope and its contents. The envelope is called the coat of the eye, while the contents is called the humors of the eye. The eye has three coats, which compose its envelope. The first, known as the *sclerotic* or hard coat, is composed of firm, white opaque fibrous tissue, and is the protecting coating of the eye. This coating covers five-sixths of the globe of the eye, being continuous in front with the cornea or window of the eye. It is thicker behind than it is in front, and is continued in the rear as the covering of the optic nerve. To this coat are attached the various muscles which move the eyeball, and over its anterior portion, and the front surface of the cornea, is found an exceedingly thin reflection of the mucous membrane lining of the lids. This is so thin that the whiteness of the sclerotic coat shows through, giving the appearance which we call the whites of the eye.

Underneath this white coat we come to the second, known as the choroid coat. This is formed mainly of blood vessels which are very numerous and very small, and among which is a heavy deposit of purple-black coloring matter. This choroid or dark coat completely lines the sclerotic everywhere, but at the junction of the latter and the cornea it projects inward toward the axis of the eye, and at this point there is a circular opening in it, known as the *pupil* of the eye. This opening or pupil of the eye is to allow the entrance of light into the interior.

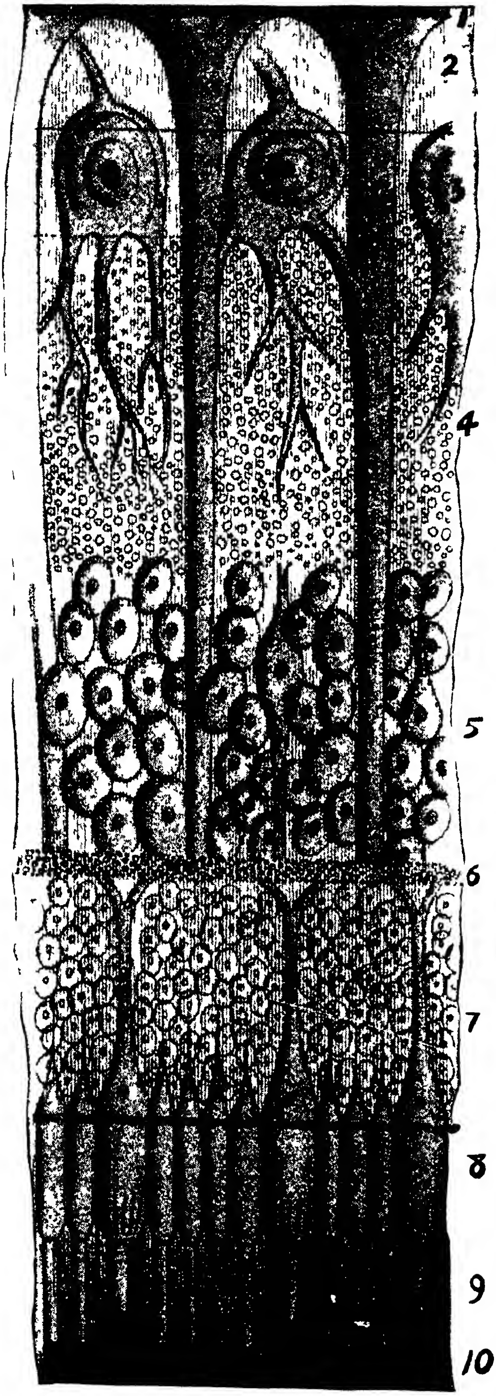
Owing to the transparency of the cornea, that part of the choroid coat which depends upon the junction of the sclerotic and the cornea, and which is pierced by the pupil, can be distinctly seen in every human eye. This visible portion is known as the iris, which means rainbow, and is so called because of the various colors it exhibits in different people. The iris differs from the main portion of the choroid coat in this particular—that it contains two sets of very fine muscular fibers. One of these sets runs in concentric circles around the opening known as the pupil, while the other set runs in radial lines, like spokes of a wheel, from the center of the pupil as a hub. When the circular fibers contract, the opening of the pupil is much narrowed, while on the contrary, should the radial fibers contract, the pupil is enlarged. By means of this mechanism, the amount of light allowed to enter the eye is increased or diminished according as the source of light is less or greater in intensity.

The third coat of the eye, the *retina,* or innermost coat, is composed almost exclusively of the tip ends of the fibers of the optic nerve specialized in such manner as to receive not only sensations of gradations of light, but also of color. This membrane is transparent, is much more sensitive in the rear portion, and disappears at the junction of the sclerotic and cornea in front. In the posterior parts where the nerve fibers come together to form the optic



The Retina, as in Life, Viewed Through the Ophthalmoscope.

1. Entrance of the optic nerve.
2 Yellow spot.
3-4. Blood vessels of retina.



Section of the Retina.

(Very highly magnified)

1. Internal limiting membrane.
2. Nerve-fiber layer.
3. Ganglion-cell layer.
4. Inner-reticular layer.
5. Inner-nuclear layer
6. Outer-reticular layer
7. Outer-nuclear layer.
8. Limiting membrane
9. Rods and cones.
10. Pigment layer.

nerve, we have what is known as the blind spot, because we have no specialized nerve endings there.

Directly behind the iris we find what is known as the *crystalline lens*. This is a solid body, absolutely transparent, and resemblng in shape the lenses in an opera glass or telescope. Both of its surfaces, anterior and posterior, are convex, but the anterior one is at all times more so than the posterior. This lens is held in place by processes of the choroid coat of the eye, and its convexity is increased or diminished by the muscular processes mentioned, allowing of clear vision of near or distant objects.

In the space between the back of the cornea and the anterior surface of the crystalline lens, into which space the iris projects, there is a thin, watery fluid known as the *aqueous humor*. Should this be lost by any untoward accident it is immediately replaced by a new secretion of the fluid.

Back of the crystalline lens and completely filling the balance of the cavity, is what is known as the *vitreous humor*. This is a denser liquid than the aqueous and is contained in a very thin transparent envelope known as the *hyaloid membrane*. From the inner surface of this membrane partitions jut out into its interior in every direction, forming irregular, transparent wall cells, which contain the vitreous humor. Contrary to the case of the aqueous humor, should anything allow the loss of the vitreous, it can never be replaced, but is irretrievably lost and the eye is ruined.

It is evident that the condition of the eye depends largely upon the condition of the general health, the quality and purity of the blood, the circulation and the degree of available nervous energy. The eye requires a very full and perfect supply of blood, and when it is deprived of this or is supplied with blood of defective quality, as in the case of a diseased condition of the rest of the body, the signs of the disturbance are clearly indicated to the trained observer, or even to the casual onlooker, in the appearance of the organ. It loses its lustre, its color changes and in other ways it gives evidence of the general lack of wellbeing. The eyes, furthermore, owing to the constant nature of their service, and their exposure to such great quantities of light (for the sensations of sight are the result of the chemical action of light upon the delicate materials of the surface of the retina, much as the photographic plate is affected by light), consume a tremendous amount of nervous energy, and in that way are closely related to the general condition of the body. Excessive strain of the eyes sometimes causes headaches and other serious nervous disturbances. They are such invaluable servants that we cannot take too good care of them.

In cases where the eyes are weak, therefore, Physcultopathic methods will usually accomplish remarkable results. We have known innumerable cases in which those who had formerly been compelled to wear glasses have been able to discard them, because of the increased strength of the eyes following upon the building up of general constitutional vigor and the increase of nervous energy. In cases where there is a radical mechanical defect, however, no improvement in the quality of the blood or the condition of the general health will be of avail, and it will be necessary to correct the defect as well as we may by mechanical means. We should say, however, that even in cases of myopia we have often known a material improvement to be made by reason of the increased strength of the little muscles which control the focusing of the sight, through special exercises for these muscles.

THE EAR—the special organ of the sense of hearing—is, like most other organs of special sense, double, one being situated on each side of the head. Anatomically considered, it consists of three parts, viz., the external, middle and internal ear.

Sound being the result of vibrations of air, the mechanism for hearing is so constituted as to receive these vibrations, concentrate them and transmitting them into the deeper portion of the skull, communicate them to the end-organs of the special nerve of hearing which carries them to the brain, there to be recognized as sound.

With this understanding we can more clearly comprehend the different portions of the mechanism of hearing.

The external ear consists of that portion which we see attached to the outer side of the head and the canal which leads from it inwards. The outer portion consists of the well-known shape attached to the surface of the head. This is composed of cartilage, more or less trumpet-shaped, and more or less convoluted and covered with skin. This apparatus is fastened to a bony ring on the surface of the skull, which is the outer limit of a bony canal, extending inward and forward for about three-quarters of an inch to terminate in a blank wall, formed by the drum-head. This canal is lined with skin continuous with the covering of the outer ear, but specialized by having glands in it for the production of so-called wax.

Around the margin of this opening, one finds a number of stiff hairs forming a perfect screen over the opening. The object of this waxy secretion and the hairy screen is the prevention of the entrance of insects and other foreign material into the canal.

The trumpet-shaped cartilage is called the *auricle* and is for the pur-

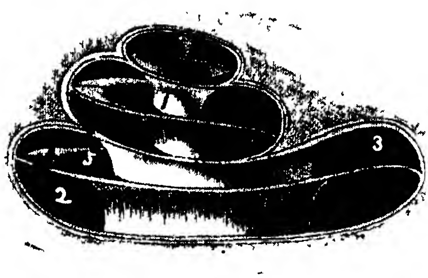
Tympanum, Ear Bones and the Labyrinth.

1. Inner view of the tympanum.
2-3-4. Hammer.
5-6-7. Anvil.
8. Stirrup.
9. Vestibule of the labyrinth.
10. Foramen rotundum.
11. Superior semicircular canal.
12. Horizontal semicircular canal.
13. External semicircular canal.
14. Cochlea.

The Labyrinth Opened.

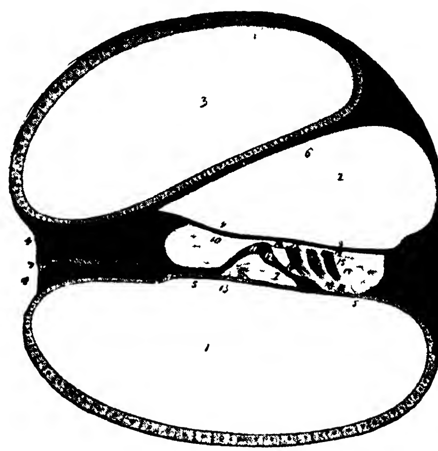
1. Foramen rotundum.
2. Scala tympani.
3. Scala vestibuli.
4. Summit.
5. Vestibule.
6. Fovea hemispherica.
7. Fovea semi-elliptica.
8. Aqueductus vestibuli.
9-10-11. Ampullæ of the semicircular canal.

pose of collecting and directing the waves of sound into the previously described canal, which is known technically as the *external auditory canal.* Surrounding this auricle and attached to it are remnants or relics of muscles, which in the lower animals are freely used to give motions to this part. As an example, notice the motility of the ears of the horse. The middle ear consists of an irregular, bony chamber situated in the temporal bone, having five walls of bone, and one of membrane. This membrane, the drum of the ear, is known as the *membrana tympani,* and forms the inner wall of the external ear and the outer wall of the middle ear. In the anterior wall of the bony cavity is an opening from which a trumpet-shaped cartilaginous tube leads to the throat, the broad end of the trumpet being in the throat. Through this tube the mucous membrane lining of the throat extends to



Section Through the Cochlea.

1 Central axis.
2. Scala tympani
3. Scala vestibuli.
4. Outer edge of thin membrane of lamina spiralis.
5. Bony part of lamina spiralis.



Section of One Turn of the Cochlea.
(Highly magnified, shows the organ of Corti.)
(Detailed reproduction.)

1. Scala tympani.
2. Scala medius.
3. Scala vestibuli.
4. Bony part of the lamina spiralis.
5. Membrane of the lamina spiralis.
6. Reissner's membrane
7. Auditory nerve.
8. Denticulate lamina.
9. Membrane of Corti
10. Spherical cells
11. Inner pillars of Corti.
12. Outer pillars of Corti.
13. Inner nerve-cells.
14. Reticular membrane.
15. Hair cells of Corti
16. Supporting-cells of Deiters.
17. Cells of Claudius.
18. Spiral ligament.

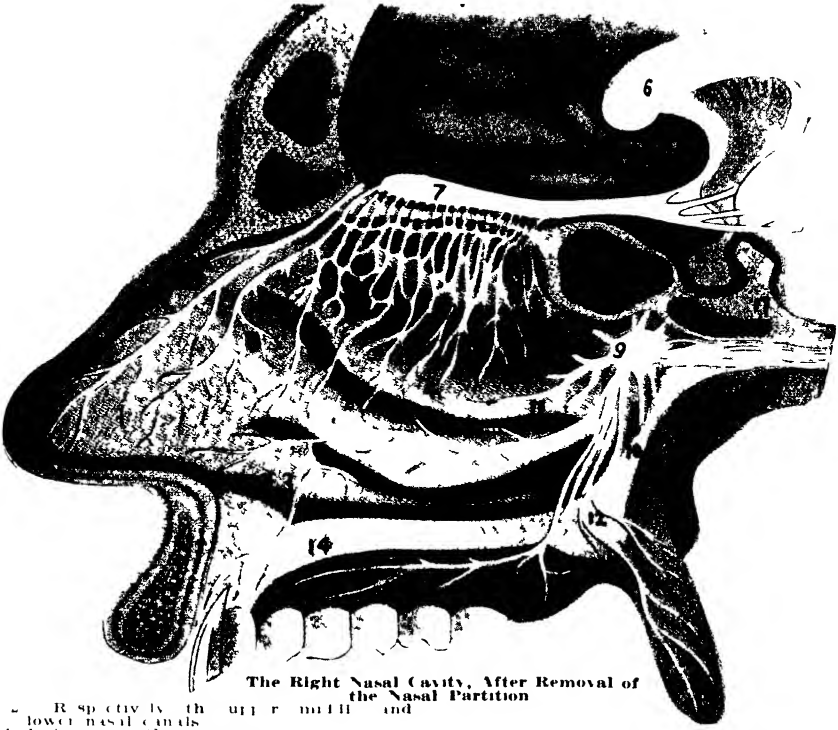
and lines the middle ear. This tube is called the *eustachian canal,* and is for the same purpose as the small round hole which is placed in the side of a bass drum, that is, in order that the air pressure in both sides of the drum-head shall be equal and allow of proper vibration when this drum-head is struck. In the inner wall of this cavity are two small openings, one oval in shape, the other circular, and both covered with membrane. Thus we see that this middle ear has one communication with the air, viz., through the Eustachian canal to the throat, and is, therefore, filled with air. Crossing this cavity of the middle ear from its outer to its inner wall is a chain of minute bones called *ossicles,* attached loosely to each other. These ossicles are given names according to their shape, namely, the hammer, the anvil, and the stirrup. The hammer is attached at one end to the drum-head, at its other to the anvil, while the anvil is attached also to the stirrup, and the stirrup to the membrane covering the oval hole in the inner wall. To these bones are attached minute muscles, which make tense or relaxed this chain of bones, tensing or relaxing at the same time the drum-head.

The internal ear, or the innermost portion of the organ, consists of an irregular bony cavity—divided into three parts, the first portion, known as the *semi-circular canals,* three in number, occupy the rearmost portion. They are three tubes, half-circle in shape, about one-twentieth of an inch in diameter, placed at right angles to each other and one end of each joining with one end of another in a common opening.

The second portion of the internal ear is known as the *cochlea,* and forms the most anterior part of this cavity. It is somewhat similar in shape to a snail shell, and consists of a circular gallery, which makes two-and-one-half turns in rising from the base to the peak of this snail shell-like cone. In this cavity, we find multitudes of fine nerve fibers, the end-organs of the nerve of hearing.

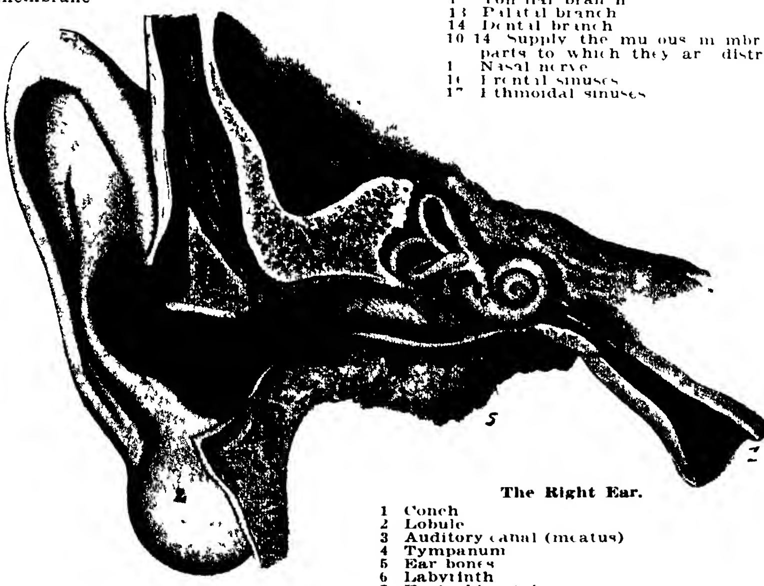
The third portion of the internal ear is a more or less oval-shaped cavity situated between the two spaces previously de-

PLATE K



The Right Nasal Cavity, After Removal of the Nasal Partition

1-3 Respectively the upper, middle and lower nasal canals
4 Entrance to the antrum
5 Convolutions of the cerebrum
6 Corpus callosum
7 Bulb of the olfactory nerve
8 Branchings of the nerve in the mucous membrane
9 Meckel's ganglion
10 Pharyngeal branch
11 Nasal branch
12 Tonsillar branch
13 Palatal branch
14 Dental branch
10-14 Supply the mucous membrane of the parts to which they are distributed
15 Nasal nerve
16 Frontal sinuses
17 Ethmoidal sinuses



The Right Ear.

1 Conch
2 Lobule
3 Auditory canal (meatus)
4 Tympanum
5 Ear bones
6 Labyrinth
7 Eustachian tube

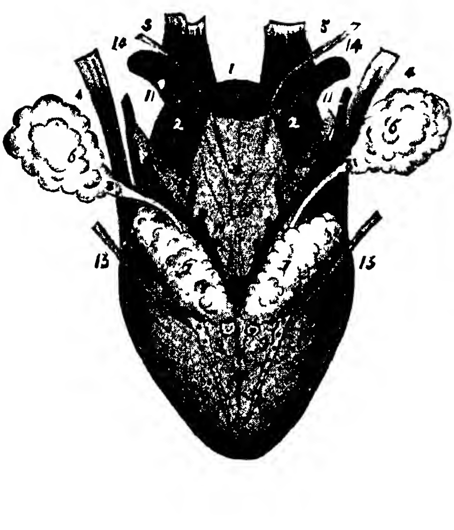
scribed, and connecting their cavities. This is known as the *vestibule.*

Lining the vestibule and the semi-circular canals is a closed membranous sac, of identical shape with the cavities, but much smaller in dimensions, so that there is a space left between the outer cavity. Within the membranous sac is a fluid, known as *endo-lymph,* while without the sac and surrounding it is a similar fluid, known as *peri-lymph.* This latter fluid extends also within all the spaces of the cochlea. Running in from this internal ear to the cavity of the skull is a small bony tunnel which gives passage to the auditory nerve or nerve of hearing, on its way from the ear to the brain.

When waves of sound impinge upon the auricle, they are first concentrated and then guided into the opening of the external auditory canal. Passing through this tube they pass upon the drum-head, causing it to vibrate in unison with them. The vibrations of the drum-head, the latter being connected to the chain of ossicles, cause them to move at the same rate and thus communicate identical motion to the membrane covering the oval hole in the inner wall of the middle ear. The vibrations of this membrane are communicated to the perilymph of the internal ear, are picked up by the nerve-end-organs in the cochlea, carried by the auditory nerve to the brain, where they are recognized as sensations of sound. The semicircular canals are the special organs of the sense of equilibrium or balance and are concerned in every change of position of the human body. The disturbance of these organs, combined with that of the sense of sight, is mainly responsible for seasickness.

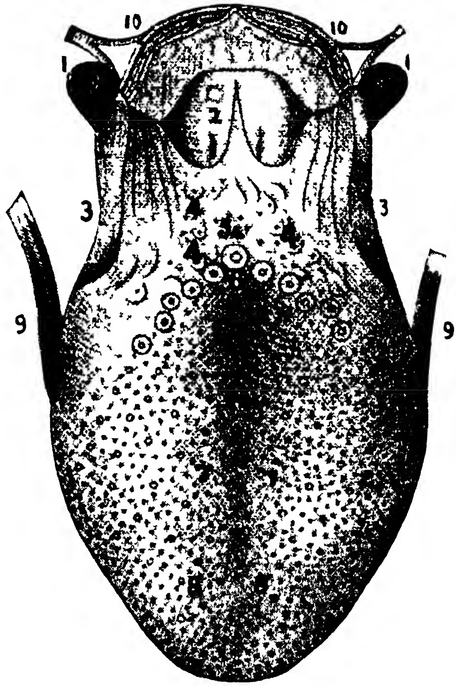
A local derangement of the ear, such as an injury to the membrana tympani, may not affect the health of the rest of the body. But at the same time, in case of disease of this part, a more perfect blood supply and a high degree of nervous energy will usually assist greatly in the process of cure. To a large extent the derangements of the ear are caused by catarrhal conditions, which extend first from the nasal cavities into the eustachian canal, and then, embracing the ear, give rise to inflammations and other trouble. For this reason, therefore, Physcultopathic methods will be of very great service.

Smell and Taste.—Sight and hearing are made possible through the remarkable structural mechanisms of their respective organs, but the senses of smell and taste are more nearly akin to the sense of touch. As I may say, they actually feel the materials perceived by them, the foods directly, in the case of the taste, and the vaporous or dust-like emanations from them, in the case of the sense of smell. In this service, however, the nerves are infinitely more acute and delicate than those which "feel" through the skin. Through the olfac-



Tongue Viewed from Below.

1. Hyoid bone.
2-3-4-5. Muscles.
6 Submaxillary gland.
7. Sublingual gland
8 Ducts of submaxillary gland.
9. Ducts of sublingual gland
10. Glands at tip of tongue.
11. Lingual artery
12. Hypoglossal nerves.
13. Lingual nerves.
14 Superior laryngeal nerves
15 Frænum linguæ



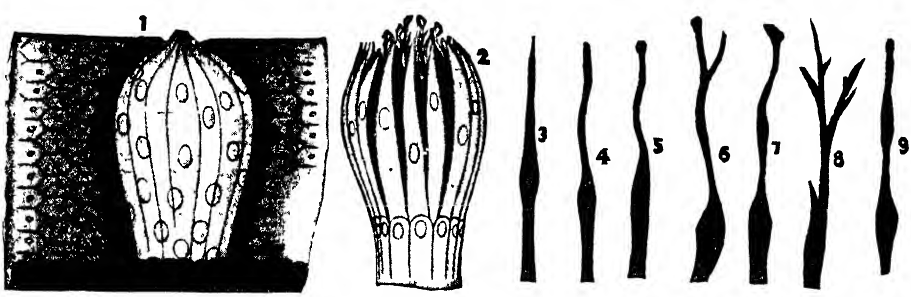
View of Upper Surface of Tongue.

1 Great horn of hyoid bone
2 Epiglottis.
3. Root of the tongue.
4 Mucous glands.
5 Foramen cecum.
6 Circumvallate papillæ.
7. Filiform papillæ.
8. Fungiform papillæ.
9. Stylo-glossus muscle.
10. Glosso-pharyngeal nerve.

tory nerves, when both the body and the organ itself are in a state of good health, we may discern the most subtle and refined of fragrances, and through the taste the finest shadings and variations of flavor.

The upper part of the nasal cavity is the seat of the organ of smell. Here the terminal branches of the pair of olfactory nerves spread out, their end-organs being found in the tiny peripheral processes of the olfactory cells placed among the epithelial cells of the mucous membranes, these end-organs thereby coming into touch with the air.

The tongue we know to be a wonderful muscular organ, the organ of speech, taken in connection with the larynx and the vocal cords, but it is also the seat of the sense of taste. The mucous membrane of the tongue is characterized by multitudes of very fine processes, called the papillæ of the tongue, of which there are several classifications. In some of these, the so-called circumvallate papillæ, are the so-called gustatory cells, with tiny processes containing the end-organs of the nerves of taste. Gustatory or taste sensations are produced by the excitation of these bodies. In the tongue also there are other nerve end-organs which have to do with the sense of touch which is likewise located in the tongue. These are substantially the same as those of the sense of touch in the skin of the external body, except that there are very many of them here and this sense is very acute in the tongue.



Taste Goblets and Gustatory Cells.
(Greatly magnified.)
1. A taste bud, from the wall of a circumvallate papilla, closed.
2. A taste bud opened, showing the gustatory cells.
3-9. Various forms of gustatory cells.

CHAPTER XIII.

THE DEVELOPMENT OF MODERN FOOD SCIENCE.

THE most immediate and constant need in the life of man is the air he breathes. His next most immediate and frequent need is for the water he drinks. But air being ever present and invisible the untutored man scarcely realizes his need for it. Except in desert regions water is also abundant and requires little labor for its getting. But food, the third essential of life, more laborious to obtain, more pleasing to partake of, impresses its importance upon the mind of the untutored savage.

BUILDING UP DIET LORE.—The subject of food or diet is therefore inevitably one of intense interest to man in all stages of development. To the simpler food instincts which natural man shares with the animals were added the lessons of experience, and as man developed language, they were handed down from generation to generation. But to the simpler lessons of instinct and experience were also added the results of man's speculation. Superstitions and taboos originated by some of the brighter minds became the laws of the tribe. Beasts were divided as clean and unclean. Certain animals, and more rarely plants, becoming the objects of religious adoration, were forbidden as food. Other articles of diet were, as the result of child-like processes of reasoning, accredited with superior virtues. It was a natural and inevitable logic that convinced primitive man that he would acquire some of the attributes of the beast whose flesh he ate. Where peaceful people developed, as in India, it was equally logical that they should come to abhor the promiscuous eating of flesh because of the obviously cruel and bloodthirsty means that were required in obtaining such a diet.

It would be easy to fill a volume with the accounts of the origin of various unscientific notions regarding food and diet. But such ideas do not interest us today except from the consideration that our own modern and supposedly scientific ideas of food are closely interwoven with the inherited folklore of previous ages of ignorance and superstition. On the contrary, we will err if we insist on throwing away all this accumulated though inaccurate wisdom of the past, whether that wisdom be inherited in the form of instincts or be handed down by word of mouth from past generations. The science of dietetics is not yet a complete or accurate science, and any efforts to prescribe a dietetic regimen wholly and directly from scientific theory would be hardly more likely to bring health and efficiency than would be the blind and ignorant following of instinct and inherited notions. It is only by the cultivation of natural instincts and by the liberal rather than dogmatic interpretation of popular notions regarding food and diet that we can establish a sound basis for the utilization of the learning of modern science.

When the subject is approached in this manner we will find that modern science has many practical lessons for the student of dietetics, and that the careless food habits approved by custom can be decidedly bettered by those who seriously seek for health and efficiency.

But the subject of food science is complex. When a man discovers a new fact or set of facts he is prone to become so enthusiastic over his newly found knowledge that he elevates it and gives it undue prominence. This is the origin of fads. The word "fad" is also used by the intellectually lazy as a term of reproach for all those who seek seriously after better ways of living. The health faddist or crank, so called. is the man who gives more attention to the subject of health than does his indolent and careless neighbor. Yet where there is one man who becomes so obsessed with ideas concerning his health that he neglects all other interests in living, there are a thousand who so neglect the subject of health as to make miserable their own lives and the lives of those upon whom they inflict themselves. The term "food faddist" or "diet crank" is likewise applied to any man who gives serious attention to this most important phase of the broader subject of health. But no man really deserves this term of reproach nor has cause to be ashamed of its application, unless, through his interest in this one subject, he neglects other and equally important phases of healthful living.

Within the narrower field of food and dietetics we may also have the faddist who seizes upon a single phase or aspect of the subject, which does not reveal the whole truth. In this narrow sense the food faddist is in danger of missing the true goal of health, efficiency and happiness, not so much by error in what he believes or practices, but by failure to consider the subject in its entirety and hence apply to himself a well balanced and complete knowledge.

If with these general considerations in mind we review the comparatively recent developments of food science, we will find a series of ideas developed by successive stages of scientific progress, and in each of these limited viewpoints we will find some important truths which deserve consideration, as they form a basis for a complete understanding of the subject and make it possible for us to adopt a practical regimen of diet.

Vegetarianism is a very ancient dietetic cult and has perhaps attracted more attention in the history of the world than any other idea regarding food. Vegetarianism was originally founded on sentimental or emotional grounds, and, before the days of modern food chemistry, the arguments for it were derived wholly from the humane reaction against the killing of animals for food. The earliest applications of modern science to dietetic problems were arguments pro and con on the subject of vegetarianism. Word battles were waged by analogies from the feeding habits of animals, and the patient strength of the ox, or grass-eating animal, was compared to the roaring fierceness of the lion. The flaw in such reasoning was that they did not take into account the fact that the difference in the characteristics of the herbivorous and carnivorous animals is due to the difference in the method they are compelled to use to secure their food, and hence there was no real proof that the characteristics were derived from the physiological effects of the food eaten. Moreover, the fact that the digestive and assimilative functions of various species of animals are adapted

Harvesting rice in India, where this grain forms the staple food of the native population.

to the habitual diet make the application of such reasoning still more faulty.

EVOLUTION AND VEGETARIANISM.—With the development of the Darwinian theory of evolution sounder arguments for vegetarianism were found by tracing man's diet back to the ancestral racial types akin to the ape. Apes are essentially fruit and nut eaters, although many species add small quantities of birds' eggs and perhaps occasional young birds to this diet. But the ape is not a flesh eater and no scientist has ever brought forth evidence to show that the remote ancestors of man differed in this respect from other tree-living and hand-possessing species. The doctrine of evolution, therefore, essentially endorses the arguments of the vegetarian. A rigid following of the diet of primitive man is hardly practical for the world today. But the *natural* diet of fruits, nuts and tender succulent vegetables, all taken in an uncooked state, is far nearer the ideal for human nutrition than is the conventional bill-of-fare of the modern civilized household. For this statement there is ample scientific justification. It is quite well established that changes in the inherited physiological functions occur very slowly with the evolution of the race, and that we are born today with essentially the same digestive powers that were slowly developed through long ages of our evolutionary past. If we, therefore, depart in our present lives too far from the eating habits of our ancestors we must pay the penalty by the shortening of our lives and the increase of our sufferings. The fundamental truth of this view will be obvious if we stop to consider what would happen to the man who would attempt to live upon the diet of a vulture or a goat.

But in all other phases of living modern man has found ways to improve upon the habits of his primitive ancestors, and why then may he not likewise be able to improve upon the diet of his primitive ancestors? The question brings out the other side of the argument. To get the whole truth and reach some conclusion, we must therefore realize that while the nut and fruit diet is the natural diet of man, and appeals to our fundamental instincts as being the ideal diet, yet we are justified in modifying this diet by accepting such changes as civilization has brought, provided these changes are in harmony with the general physiological laws of the human organism.

A careful study of the natural diet of man will therefore result in the discovery of certain general principles which we will do well to respect. But it does not necessarily follow that all the recently attained habits of civilized man are harmful, or that we may not discover further means, even though they seem quite artificial, to improve our eating habits.

Moreover, though man's natural primitive diet be considered as perfectly adapted to his primitive condition, it does not follow that the same diet would be exactly suited to men today. Though our inherited physiological functions may be the same, our habits of living in other matters than the diet are not the same, and our environment and habits in matters of climate, housing and clothing, work and play, will complicate the problem and make some change in the application, to the various conditions of modern life, of the lessons we may learn from our study of the food habits of primitive man.

The vegetarian and all those who search for the natural diet of man draw their arguments from science only in its most general aspects. The distinctive contribution of modern science to the food problem began something over a half century ago with the development of organic chemistry and the chemical analysis of foods.

There are more than eighty chemical elements in existence, some fifteen of these are found in human food and in the human body. Of these fifteen elements only four are present in the body and in foods in any considerable quantity. These are oxygen, carbon, hydrogen and nitrogen. From the air we secure oxygen in an uncombined form, from water we secure oxygen and hydrogen in a simple combination, but food substances contain these two elements combined with carbon, and sometimes with nitrogen also, in various complex and almost innumerable compounds.

Just as a chemical element is the simplest form to which the matter can be reduced in the laboratory, so a definite chemical compound is the simplest form in which matter has constant chemical properties. Oxygen or carbon can never be changed into anything else. They are elements or fundamental substances. Water or cane sugar are chemical compounds always containing exactly the same proportions of the elements that form them, and always having the same properties. But the greater majority of food substances are neither elements nor simple chemical compounds, but are very complex mixtures of many chemical compounds. Even as simple and apparently constant a substance as pure olive oil or the white of egg is made of many chemical compounds intimately mixed.

The purpose of science is to reduce numerous seemingly confusing facts to a simpler system. Therefore, the early food chemists divided food substances into five general groups, carbohydrates, fats, proteins, "ash" or minerals, and water. The chemists also worked out methods of determining the heat or energy value that foods yield on oxidization, and this was expressed in the physicist's heat unit known as the calorie. This division of food substances into general chemical groups and the reckoning of its caloric content does not tell the whole story of food chemistry, to say nothing of the even more complex story of physiological and biological chemistry. But by finding group names, or pigeonholes in which to pocket confusing facts, science made a distinct advance and there was speedily developed a school or system of food chemistry. This scientifically conventional school of food chemistry achieved a special prominence in the United States through the extensive publications of the U. S. Department of Agriculture. It is "government bulletin" food chemistry and was considered as the truth, and the whole truth, but one short generation ago.

We have not today disproved the facts discovered by the early food chemists, but we have discredited much of the supposedly practical teachings of that school, not by showing disproof of that which they had learned, but by discovering much further knowledge which revealed that the earliest efforts at practical application of chemical knowledge were one-sided and incomplete in conception of the problem.

GOVERNMENT FOOD CHEMISTRY.—The chief practical effort of this government school of food chemistry was the idea of the balanced ration and the establishment of dietetic standards. Said these chemists, "If we but knew the correct quantity and proportions of these food groups which man should consume, it would be possible by analyzing his food to prescribe a perfect diet." But not knowing the amounts or proportions of food elements that man should partake, and having no way in a chemical laboratory to find out, the chemists hit upon the rather stupid plan of determining dietetic standards by analyzing the diets of many individuals and striking an average. It would scarcely have been more absurd had moralists by stealthy research determined that a Wall Street broker had stolen a million and his bookkeeper ten thousand, and an East Side sweated slave a loaf of bread and a pair of shoes. Averaging the stealing of mankind in general it might have been found that the total stealing of the human race would average $1,000 per capita. So with our Sunday schools conducted on a basis of a standard so derived, the child would be dutifully instructed in the necessity of maintaining the average thieving of the race! The analogy is a little far fetched, but it will serve to show the absurdity of attempting to set up a perfect standard by averaging the imperfect habits of men. Yet this is just what the food chemists of a generation ago did, and the results were generally accepted in good faith and taught in our schools.

The American dietetic standards so determined were excessive because Americans were a comparatively wealthy and well-fed people and because the prolific animal industries of our grazing lands led to an extensive production and consumption of meat. Many critics, and especially the vegetarians, pointed out that such American dietary standards, supposedly essential to health and strength, prescribed an excessive food quantity and particularly an excess of protein, largely derived from meat. If these American standards of diet were correct, argued the critics, then the eating habits of many other races, notably the Japanese, could not support life.

In passing we should note the development of another school of thought regarding food, and this is the teachings of the ordinary cook book. The early cook books made no pretensions of a scientific sort, but merely sought to give the methods of preparing dishes that had found favor with the taste and had become incorporated in the eating habits of the race. With the establishment of cooking courses in our schools and colleges, these old-fashioned cook books were rewritten by college graduates and the recipes of our grandmothers interpreted and expounded in the light of the "balanced ration" and "dietary standards." With this combination we had another viewpoint on foods, but in neither of these schools of thought was any serious attention given to the matter of health and efficiency except the general notion that there was a standard diet of established quantities and proportions which should be consumed, and that good cooking was essential to good health.

Vegetarians and the followers of the idea of natural food argued against these orthodox teachings and argued largely in vain, as science seemed to be on the side of those whose main philosophy was that every man should follow the average habits of his parents and neighbors. Among other things the critics of this orthodoxy maintained that the American habitually ate too much, particularly that he ate too much meat, and lastly that cooking, and especially complex cooking, was not always beneficial but often destroyed the true properties of natural foods.

Within the last ten or fifteen years food science has developed very rapidly, and many discoveries have been made that have shown how insufficient, if not actually erroneous, were the first attempted applications of the limited knowledge of food chemistry. Fletcher, Chittenden and Hinhede demonstrated by human experimentation upon themselves and upon athletes and soldiers that the old dietary standards calling for relatively large amounts of protein were ill-founded, and proved that superior human efficiency could be attained by very greatly diminishing the amount of protein, particularly the meat protein, ordinarily consumed.

Out of the remarkable work of Horace Fletcher also came another series of interesting developments in relation to the importance of appetite, mastication, and the tasting of foods. Pavlov, working along similar lines but experimenting on animals, developed a new branch of science which we might call the psychology of digestion. These revolutionary lines of thought brought out many new findings and greatly broadened the field of food science.

About 1906 occurred a great popular awakening in the general interest in food that had to do, not primarily with dietetics, but with the problem of food purity and commercial honesty in the manufacture and sale of foods. Dr. Harvey W. Wiley was largely responsible for this important development of interest. The increase in the complexities of the processes of the manufacture of prepared foods had introduced many evils of adulteration and substitution which were offensive both to sentiment and to honesty, to say nothing of the harmfulness to health. For the period of some six or eight years previous to the European war this question of food purity was the dominant element of interest in the food problem for the average individual, though it was certainly only one of many important phases of the whole problem.

HEALTH AND NATURAL DIET.—Just prior to the beginning of the European War the scientists stumbled upon another discovery, which, like much of the recent work in food science, had been anticipated and forecast by the physical culture or natural school of dietetics. Those who had been interested in food, primarily from the standpoint of their observed effects upon health, had long realized that there were food factors seemingly of vast importance which were in no sense measured or appreciated by the conventional school of food chemistry that dealt only with carbohydrates, protein, fats and calories.

Natural diets, that is, those containing large proportions of vegetables, fruits, nuts and milk and eggs, and particularly of uncooked salad vegetables, had been repeatedly shown to secure results in health, growth and vitality building which the conventional food chemists could not explain but tried to ignore. A faith had been gradually built up that these unexplained benefits of the natural diet were due to the importance of natural salts or mineral elements. Certain ailments now known as deficiency diseases had been definitely ascribed to diets of artificial or denatured foods, scurvy, beri-beri, and pellagra being among the number. By experiments on animals it was found that similar ailments could be artificially induced by diets which contained ample quantities of protein, carbohydrates and fats, and *also mineral salts*, and these very diseases could be cured by the addition of natural foods, particularly dairy products, the outer portions of grains and green vegetables.

The general term vitamines was applied to these chemically unknown elements, the importance of which could be demonstrated by experiment upon living creatures, though they were not detectable by chemical analysis. In this manner a new phase of the dietetic problem was unearthed and scientists were forced to concede the general validity of many of the contentions of the disciples of natural diet at which they had formerly scoffed.

A last phase of interest in the food problem was developed as the direct result of the world famine caused by the war. The high cost of foods, the necessity of maintaining the armies in Europe and of provisioning war devastated regions made it essential for us to give hitherto unparalleled attention to the subject of food economy and to our habits of extravagance and waste, and to strive to secure the maximum of human efficiency with the least possible expenditure for foods. As a result the civilized world became universally and seriously interested in food problems on a scale and with an intelligence quite unparalleled in the history of civilization.

With this brief sketch of the origin of the accumulated and seemingly confusing theories, leading to our present knowledge about food, with this history of the succession of the somewhat one-sided, overlapping and intermingling theories we may now consider the food problem as a whole. Many viewpoints and theories that for a time were considered all important may now be assigned to their proper place and the essential truth winnowed from the erroneous and biased chaff of earlier and ill-proportioned theories. Unquestionably we have much yet to learn regarding food and dietetics, but it is equally certain that wonderful progress has been made and that food science now offers to the serious student of health a far more certain foundation and a more definite basis for practice than has hitherto been possible.

The dietetic teachings of the physical culture school of health have been modified, enlarged and explained by recent scientific progress, but in their essentials they have been established more firmly than ever by modern scientific research. The strictly scientific viewpoint is usually a narrow one because of the tendency of the specialist to over-emphasize the latest laboratory discoveries and to overlook deeper principles established on more direct and more general human observation.

At the beginning of the twentieth century the natural school of dietetics espoused by physical culture, and the scientific school backed by the government food chemists, seemed to be largely contradictory. Today there is a much greater degree of harmony between these two schools, both in theory and in practice, due to the fact that the scientists have reached out from the chemical laboratory into the field of direct observation, noting effects of foods on human health and including in its research direct experimentation upon men and animals, and considering the questions of appetite, flavor, the manner and frequency of eating, and other phases essential to the complete consideration of the important problem of human dietetics.

CHAPTER XIV.

ARGUMENTS FOR A NATURAL DIET.

HISTORIANS say there is a distinct relationship between the food of nations and their stability; that on simplicity and frugality in diet national vigor and power depend, and when nations yield to luxurious and intemperate habits of eating and drinking they surely fall. Gibbon, in his "Decline and Fall of the Roman Empire," gives most graphic pictures of the dietetic extravagances of the Romans which led to their overthrow. Canon Farrar has given similar vivid pictures of the causes that led to the demoralization of the ancient Grecians. The book of the Prophet Daniel clearly indicates the same source of enervation and loss of power in the people of the great city of Babylon, and all history might be cited to contribute its evidence that no nation has preserved its vigor unless its people have lived simply, frugally and temperately.

ADVANTAGES OF FRUGAL EATING.—When it comes to a consideration of the physical strength and endurance of nations, the evidence of history is strongly in favor of non-meat-eating peoples. The world had a wonderful exhibition of this in the Russo-Japanese war. That the tiny nation, which for so many centuries had refused contact with the outside world, could in a few decades so advance itself in the use of the most modern methods and weapons of warfare came as a revelation to the rest of mankind. In mental power, in grasp of conditions and circumstances, in ability to discipline and be disciplined, as well as in courage and physical strength, the Japanese proved themselves on an equality with the most advanced races of the earth. Every writer on the question agreed that it was to the perfect physical condition of the whole Japanese army, officers and soldiers alike, that their wonderful victories were to be attributed, and that it was through the simplicity, frugality and temperance of their diet, largely of cereals, such as rice, and fish, that their physical vigor and health were attained.

Four things stood out very forcefully during this struggle in regard to the Japanese army: 1. The high average of physical strength and health maintained by the soldiers. 2. Their remarkable freedom from every kind of epidemic. 3. Their wonderful endurance in face of the greatest hardships, such as long marches, exposure to the elements, shortness of food, etc. 4. The remarkable rapidity with which bullet and other wounds were healed, thus showing a most perfect condition of the physical system.

As yet the American race is in its youth, possessing all the vigor and energy of a young nation. But if it would preserve these qualities it must not be prodigal of them as the older races have been. It must live temperately, frugally and sanely. Like causes ever produce like effects. If we live the life of luxury, indulgence, sensuality and effeminacy of the later Greeks, Romans and Egyptians, we, too, like them, will decline, and a more frugal, vigorous and simple race will take our place.

Moderation in diet and robust health go hand in hand.

Food and Morals.—Now, the law that applies to nations must apply also to the persons that compose those nations. Hence if a man would preserve his vigor, health and power he must be frugal, simple and temperate. And with this beneficial effect on his physical nature is combined an uplifting of his moral nature. The vegetarians and those who live upon natural foods have many examples to enforce their claim that their diet leads to far greater command over the lower or more animal instincts of man's nature, and that, all things else being equal, the same person living on the vegetarian, as opposed to the meat diet, will give his moral nature far better opportunity for development. The Roman Catholic Church, with centuries of experience behind it, has confirmed this claim by its decrees and recommendations in regard to fasting, and all psychologists agree that a term of fasting now and again is bound to have a considerable influence upon the moral nature of the fasters, in that they will learn self-denial and a certain measure of self-control induced by the cooling of the blood that invariably follows even a short period of abstinence from food.

From another standpoint, diet has a direct effect upon morals. Indigestion, in its manifold forms, provokes ill-temper and irritability, and even leads at times to acts of passion. Gross deeds of cruelty and murder have been due primarily to the indigestion of the perpetrator. A bad stomach may be morally as well as physically the cause of a bad heart. Many men and women are accused of being morose and ill-tempered when they are merely dyspeptic. Carlyle's pessimism was nothing but the physical and mental depression that came from chronic indigestion. A learned physician of California has written an elaborate monograph, in which he shows conclusively that the major part of the wars of Europe for centuries can be directly traced to diseases of the stomach and intestines in the monarchs, prime ministers and statesmen responsible for the conduct of the affairs of the different nations.

It is, therefore, self-evident that, if the diet of any person claiming to be a moral being is found to produce such injurious effects as, first to lower his moral resistance; second, to increase his liability to fall into temptation; third, to render self-control less easy; fourth, to develop an actual fretfulness, irritability and readiness to fall into passion, he should make it his moral duty to change his diet as soon as a better one is pointed out to him.

This is best found in a vegetarian, or a very low meat diet. Avoid all condiments and sauces—even salt as much as possible, for its excessive use provokes thirst, thereby leading to a craving for intoxicants, and destroys the normal taste for foods, causing one to rely upon highly seasoned sensuality-provoking foods instead of natural and nerve-soothing ones. Let the reader who is still unconvinced of the influence diet has upon the moral nature go to the "White Light" region of one of our great cities. (How significant that term!) Let him enter one of the "lobster palaces." He will observe the so-called men and women "about town" eating rich, stimulating foods at midnight when a normal system craves rest. Night is turned into day. It is only at the approach of twilight that such individuals really begin their day. They are always looking for excitement, for something to steady the nerves, and the very happiness that they are all searching for in most cases has long ago eluded their grasp through their inability to recognize it. These poor—though financially rich—victims of perversion are really to be pitied. They are pursued by an eternal dissatisfaction, by a continuous seething, scorching discontent, always wanting to do something, anything, to drown or benumb the terrible unrest that is continually tormenting them. They are not their real selves; they are in the power of their lower natures. In them you see the results of abnormal food products, and if the fire of lust gets into blood already heated to an abnormal degree by an animal diet, who is to blame? Every particle of animal food is inclined to stimulate bestial characteristics, and stimulation, as is well known, ultimately means destruction to the power that it stimulates. The madness that often comes with lust is a product of an animal diet. Many degrees more of strength of character are required for self-control when one's diet is of this nature.

FRUIT-AND-NUT DIET.—Fruits and nuts combined with raw eggs furnished the food of the *alalus,* the anthropoid progenitor of man who swung himself through the treetops of the primeval forest in search of sustenance, and to him the organs of mastication and digestion which we have inherited were adapted by natural selection. They constitute, therefore, the natural food of human kind.

This natural diet is often styled by objectors to it as "raw food," a term which is suggestive of imperfection, and therefore unjust. A bunch of dark red flaming Tokay grapes, or exquisite, green Verdels or Muscats, or delicately tinted Rose of Perus, or hothouse grown black Hamburgs, or delicate, white, elongated Cornichons can scarcely be called "raw" food. They are as truly cooked as if they had passed through the hands of the world's greatest *chef,* even though man, by a second process, may add to the cooking, but the great source of light and heat has already produced a perfect dish. If we had words that would distinguish between things that are cooked by Nature and those that are artificially cooked by man, our vocabulary would be enriched thereby. Where fruits, vegetables and nuts are completely ripened by the sun they are perfectly cooked—not raw—and the latter term is therefore inadequate and incorrect.

A Biblical writer truthfully affirmed that "man has found out many inventions." No sane person will question that many of these are beneficial to humanity, but there are those who affirm that artificial cooking of food has been an invention that we might well have dispensed with. They contend that the fruits, nuts and vegetables brought to a state of maturity by the processes of Nature are in a finished, perfect and ready condition for man's use. As one writer says: "They are perfect, they are not raw, they are done; and when they are cooked they are undone." Another writer on this subject says: "It must be understood that cooking food is not natural, because its chemical constitution is changed by the destructive power applied by the high temperature. The sun energy is dissipated. The volatile essences are exploded. The tonic elements (organic salts) have been freed, mineralized and neutralized. The proteids are coagulated. The starches are rendered so that they enter the circulation undigested. The atomic arrangement of sugar is rendered uncongenial. The oils are fused. Therefore, cooked food readily ferments and decays in the alimentary canal; besides, its consistency does not give the proper exercise to the organs of comminution, digestion and absorption; and it has a tendency to puzzle, confuse, and pervert the alimentary functions—thus laying the foundations of disease."

The claim is made, and it seems to be sustained, that "man's natural foods are the fruits, the succulent herbs and roots, the nuts, and cereals which, in their natural (unfired) form appeal to his unperverted sense of alimentation. Nature has supplied ample variety for each season to delight the senses and prevent monotony." That man can live well on naturally-cooked foods and build up on them a body full of vitality, vim, strength, endurance and vigor, there can be no question. For several years uncooked foods have had a growing number of enthusiastic adherents, who maintain health and efficiency of the highest degree at a minimum of cost and domestic labor.

The contention is made, and not without reason, that few critics of this system have ever given it a fair and honest test. Its advocates claim, with justice, that a test of natural foods combined with artificial foods is no test at all, for the one class of foods nullifies the beneficial effects of the other. There is but one way to test natural foods and that is to eat them and them alone for a sufficiently long period to appreciate thoroughly the result. George Wharton James, in his explorations of the Colorado desert, gave natural foods a thorough test. "Not," as he says, "because of any theoretical objections to artificially cooked foods, but simply to relieve myself of the arduous and difficult task, and the trouble and bother consequent upon taking foods that had to be cooked, together with the necessary utensils for cooking them. Where weight and space are important objects, owing to the somewhat dangerous character of explorations in an almost trackless desert;

where water, both for man and beast, is exceedingly scarce, it was desirable to reduce our outfit as much as possible; I had no fear whatever of the results, as so many people seem to have, of living upon an exclusively natural diet. My companion and I lived principally on cracked wheat, rolled oats and some other cereal. This we mixed up on our plates, sometimes putting a trifle of sugar over it; we ate with this almonds, walnuts, pignolas and pecan nuts, together with figs, raisins and dates. We generally traveled about thirty miles a day, with one pack-animal, and one saddle-animal for the two of us. One would be in the saddle, and the other walking or running. We were hunting for lizards, snakes, tarantulas, Gila monsters and other desert fauna—many of which we had to chase down, often running one, two and three miles at a stretch to do so—hence it is fair to assume that we each went on foot about thirty miles, as well as rode about fifteen miles each day. This was arduous work, yet both of us sustained our strength and vigor; I am as fully satisfied of the nutritive and assimilative qualities of natural foods as I am of any I have ever eaten. Yet I did occasionally hanker for a greater variety than we took along, though, occasionally we were able to take a fair supply of apples, oranges, limes and grape-fruit."

Those who live exclusively upon natural foods claim that the unchanged flavors of such foods, the moment they are placed in the mouth, at once stimulate the delicate and unperverted taste-buds, and excite the secretions of those fluids that are best adapted for their proper assimilation. When the food is cooked these flavors are so changed that in time the taste-buds become perverted and the proper secretions are not always supplied.

Health and Vegetarianism.—Many will tell you that flesh meat is a food absolutely essential to nourish the body; that you cannot live without meat. It is true that if you are accustomed to eating meat, and suddenly change your dietetic régime, an ordinary meatless meal would not satisfy you, because of the need of this stimulant. You miss it just as the drug fiend misses his capsules, yet if you continue to avoid meat this feeling of dissatisfaction after a meatless meal will soon disappear.

Then, too, many will point to vegetarians who look frail, or pale, or delicate, but such examples of this régime are in nearly all cases following an impoverished diet. They are avoiding meat, but they have not adopted the foods that are necessary to take its place, and frequently you will find such vegetarians consuming large quantities of white bread and other unnourishing, indigestible "stuff."

There is a widespread misconception of the nature and scope of the so-called "vegetarian" diet, and a consequent belief in the inconsistency of its advocates when they add such animal products as eggs, butter, cheese and milk to their dietary. The term does not mean that a "vegetarian" must eschew all foods except those of a vegetable nature, any more than the term "librarian" implies a custodian of books (*libri*) alone, to the exclusion of all other literary treasures, such as letters, prints of drawings, etc. The use of such a word is justified if it describes the characteristic element in it, and if the minor elements are not inconsistent with the principle exemplified in the main one. Now, the principle of vegetarianism is that animals should not be killed for food. The use of eggs and milk and its products does not impair this principle, but rather conserves it, leading to the preservation and increase of animal life through calling on it for food supply. The theory upon which vegetarianism is founded is that in the original food, as provided by Nature, there is stored a certain amount of material that can be converted either directly into food proper, such as milk and the albumen of eggs, or into muscular energy. When converted into energy a certain proportion of the energy is used up. Therefore, when the animal is slain, those who eat its flesh secure only the unexpended balance of the original amount of energy.

Be this as it may, it has been found that a purer quality of blood is made from a vegetarian than from a meat diet. There seem to be various elements in flesh foods which deteriorate the blood and increase depuration.

Again, there is less danger from over-eating when one lives on a vegetable diet than when eating meat. There seems to be some quality in the meat itself of an immediately stimulating character, and the stimulation is not always healthful. Few men need to be stimulated to eat any more than they do eat. In fact, it would be a good thing if the majority of mankind could be induced to eat very much less than they do.

The charge is often made that vegetarians are not so aggressively robust and so forcefully vigorous as meat-eaters. This may be largely true, but we must remember that the diet question rarely receives consideration until it is forced upon one because of poor health; therefore vegetarians would hardly represent the most robust class. I freely admit that meat-eaters among both animals and men are more aggressive than those which live on a vegetarian diet, yet aggressiveness is not always a desirable quality. The lion and tiger and other carnivorous animals are strong and vigorous, but they are also bloodthirsty and cruel. The elephant, the fruit and nut eating bear, the grass and grain eating horse and ox are all powerful and strong, and if it comes to a question of endurance would undoubtedly surpass the carnivorous lion and tiger, but they are less aggressive than the carnivora, and possess none of the bloodthirsty and cruel characteristics of the latter.

The comparison holds good in the case of meat-eating and vegetable-eating races of men. The meat-eaters possess nervous activity and, as a result, are aggressive and combative. The beef-eating Englishmen have penetrated to all parts of the world, subjugating and colonizing wherever they have gone. On the other hand, the non-meat-eating Hindus, while they have attained to a high degree of intellectuality, have been unable to withstand the fierce and vigorous onslaughts of the meat-eating Britishers, and therefore have been subjugated and ruled by the latter for many years.

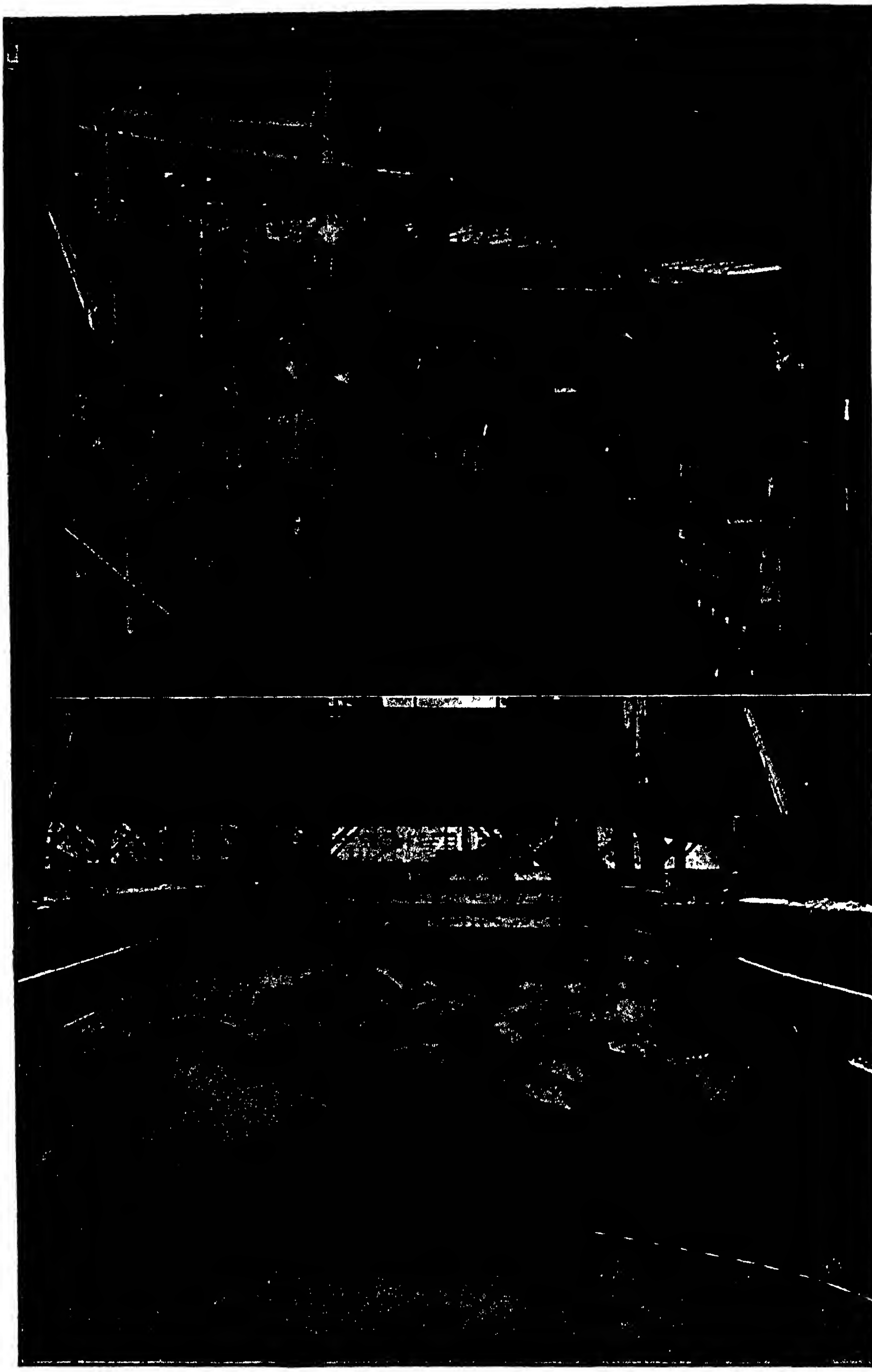
While, therefore, the non-meat-eaters may seem not to possess a bold, vigorous aggressiveness, this by no means implies that they lack in the slightest degree courage, strength, energy, vigor and progressiveness. Indeed, in the long run, it will be found that they possess these qualities more surely and constantly than their meat-eating brothers. Their persistence will be more steady, their endurance greater, their energy more under control, and at the same time they will be less inclined to "ride rough-shod" over those who stand in their way.

That the vegetarian possesses as much strength as the meat-eater has been proved in so many hundreds of thousands of cases, that it is no longer a question worthy of a moment's discussion. Many of the strongest men the world has ever known have been almost life-long vegetarians. And there are too many men in all the various walks of life who never eat meat, to place this once agitated question aside forever.

MEAT-EATERS' HANDICAP.—Experience has also demonstrated the following facts in regard to the relative merits of the two diets. Meat-eaters are more often addicted to the use of alcohol than vegetarians; they are more apt to be sensual and gross in their lives; they are more easily subject to disease; they are harder to cure when diseased, and in order to hasten their recovery, the first and wisest step is to put them on a vegetarian diet. On the other hand, the vegetarian, while perhaps less combatively aggressive than his meat-eating brother, is physically his equal and sometimes his superior, has a clearer mentality, is less liable to the temptations of the flesh, and need not always be worrying lest he contract this, that or the other disease.

There have been many conclusive demonstrations of the superiority of the vegetarian over the meat-eating diet. In 1902, in a race of 125 miles between Dresden and Berlin there were thirty-two entries, twelve being meat-eaters and twenty vegetarians. The race was won by a vegetarian nearly eight hours in advance of his best meat-eating competitor. Out of the twelve meat-eaters, only three succeeded in finishing the race within the prescribed time of forty-five hours, though there were ten out of the twenty vegetarians who accomplished the feat. The winner in this race subsisted almost entirely on an uncooked diet of fruits and nuts and he distanced his nearest competitor by over two hours. He was a vegetarian twenty-eight years of age and had been a vegetarian for nine years, taking but two meals a day. At the age of seventeen he was a weak and sickly-looking boy, but regular gymnastics, combined with a rational vegetarian diet, worked wonders with him. For two years he had even discarded from his bill of fare animal products such as eggs, butter, cheese and milk. He asserted that pulses, which are generally taken as a substitute for meat, require too large an amount of vital force for digestion and are therefore not well adapted for a daily food, especially for those who depend for their livelihood on indoor work. His bill of fare consisted of fresh and dried fruits, fruit-juices, whole-wheat bread, also other well prepared cereals, and nuts (peanuts, filberts and almonds, generally taken in the form of butter), four ounces of the latter being enough for the daily needs of the body. Wine, beer, brandy, coffee, tea, cocoa and similar stimulants were of course rigidly excluded.

During a long march at a high rate of speed, against the usual habit of two or three daily meals, every two or three hours, he took some light nourishment, such as fruit juice or sweet fruits. He especially commended California dried fruits such as figs, peaches, prunes, pears or apricots, which had been soaked in water just long enough to bring them back to their original volume. His scientific reason for the use of sweet fruits and juices for this purpose was as follows: Experiments have amply furnished the proof that the main function of fruit sugar, as found in the blood, is the production of heat and energy. By ingenious devices the blood going to and from a muscle of a living animal may be analyzed, and it is thus shown that more blood traverses an active or working muscle, and that more sugar disappears from it than is the case with a muscle at rest. It has also been shown that all starch must be converted first into fruit sugar before it can be used in the system. Sweet fruits are therefore always advantageously substituted for starch foods, since the former do not burden the digestive tract and less force is required for their digestion. A large amount of vital force is thereby saved



The upper photograph shows a corner of a room in one of Chicago's great packing plants, and the lower photograph shows a drove of hogs ready for the slaughter.

which can be used in the voluntary muscles, thus increasing endurance.

Objections Against Meats.—The objections against meat-eating which are urged with more or less force by those who abstain from its use are as follows:

First. It is a stimulating diet. By this is meant that it not only supplies nutriment, but that it contains an artificial and unnatural stimulant, which entirely differentiates it from all vegetable and fruit foods, which healthfully nourish, without stimulation.

Second. It lessens endurance. The tests of vegetarian athletes scientifically recorded fully demonstrate the truth of this statement, showing that in severe physical contests those who abstain from flesh-eating have the greatest power.

Third. It shortens life by hardening and rendering brittle the arteries and other tissues, thus preventing them from doing their work in a manner consistent with perfect health.

Fourth. It is far less cleanly than a vegetarian diet, for, no matter how healthy the animal from whom the flesh is taken, it is impossible that a certain amount of the products of elimination should not remain in the tissues at the time it is eaten.

Fifth. Even though the greatest care is exercised, it is impossible always to tell whether an animal is healthy or not; hence the constant danger that the meat-eater may expose himself to the partaking of disease through the flesh of the animals he uses for food.

Sixth. There are certain parasitic creatures, such as trichinae, in pork, which are often transferred into the living tissues of human beings by partaking of the flesh of animals. Thousands of well-authenticated cases of this kind are known, and many deaths can be definitely attributed to this cause alone.

Seventh. Packers in some instances are neither cleanly, honest nor truthful in the conducting of their business, sometimes palming off upon the people meats that are unfit for human food, and occasionally swindling their customers by falsely labeling sausages, hams, potted and canned meats, etc.

Eighth. The slaughter-house is a place of horrors, and butchers become hardened to pain and suffering. Mankind is not justified in taking any kind of life without potent reason, which reason is not found in the mere fact that we like meat for food. There is a growing feeling that a universal kinship exists between all animate creation and that one cannot violate any part of this kinship without a direct corresponding injury to his own spiritual nature.

It is not our purpose to enter fully into any of these arguments. Those who wish to know the horrors of the packing-houses cannot do better than read Upton Sinclair's book, "The Jungle," and if there is any fear lest this is a one-sided and unjust presentation of the case, let him read the governmental reports of the investigations conducted by experts brought about as the result of the publication of the book.

Even a radical advocate of meat as a food cannot excuse its use more than once a day, no matter what his occupation or how hard he has to labor. It is scarcely possible for any man, unless he have unusual powers of digestion and assimilation, and takes a large amount of exercise in the open air, to get rid of three meat meals a day without direct and positive injury.

Two other strong arguments against the meat diet are found in the facts that it stimulates to over-eating and to alcoholic liquor drinking. It has been proved conclusively in hundreds of thousands of cases, by those who have lived at different periods on both diets, that the meat diet is a great incitement to over-eating. Gluttony is a most common practice, and that meat-eating fosters it no well informed person can doubt. The further result of this is an unnatural craving for alcoholic stimulants. The very stimulation of a too hearty meat diet, the depressing effects that follow, which are materially enhanced by the ptomaine poisons generated by undigested meats in the intestines, and which, vitiating the blood, send their poisons and deadening influences throughout the whole body, give rise to the physical state that calls for a stimulant. This is not a mere theory. Nine-tenths of the drunkards can be restored to normal condition and can get rid of their abnormal appetite if they will rigorously abstain from flesh as an article of diet.

Nevertheless, meat has nutritive value, and, therefore, a place in the dietary, which, in some particular instances, cannot be filled by any vegetable food.

There is one phase of this subject which I feel requires discussion in these pages. This is the exclusive use of meat as a cure for disease. I am free to confess that for years I looked upon this proposition not only with distrust but with scorn. My habitual attitude of tolerance and willingness to investigate did not seem to work in this case, for I was so convinced of the inutility of the exclusive meat diet that I thought it useless to waste any time either in listening to the testimony of others or in experimenting. But at length the matter came to me in such a way that I could no longer ignore it, and after thorough investigation, followed by a great number of experiments with those who were suffering from certain ailments, I arrived at the conclusion that there were cases in which the exclusive meat diet would not only help, but would restore to health as no other regimen that I was familiar with would do.

I do not want my friends to infer in any way that this conclusion has shaken my faith in the statement I have made again and again that a non-meat diet is ordinarily to be preferred. I firmly believe that a healthy person can secure more and better nourishment from a diet from which meat has been eliminated. A vegetarian diet will give more endurance and just as much strength, and there is far less liability to the various diseases that are to a large extent caused by the excessive use of meat, but there are some cases where a diseased stomach will be able to digest animal diet far more advantageously than a non-meat diet. Under such circumstances I advocate the animal diet. I naturally would prefer the use of an exclusive milk diet first, and if this fails, then a diet of milk and eggs, and finally, as a last resort, the exclusive meat and hot water diet. Full details of the application of the meat diet to diseased or debilitated conditions will be found in Volume III, page 1768.

SEASONING THAT IS BAD.—Most condiments and spices are injurious stimulants. Their use violates a fundamental principle of material living, which is, that the natural and simple flavors of all foods shall be untouched and unmolested by outside influences. In other words, the only way to eat an apple properly is to eat it in its natural condition. That is the way to know its real flavor, to taste its special quality.

A man or woman who lives upon food prepared by the ordinary cook or *chef* of a so-called first-class hotel may be called an epicure. The name, however, is a misnomer. Such a person has no more conception of the real flavors of foods than a man with bloodshot eyes can see the real delicate hues of a dainty flower.

The true epicure is one whose taste is so keen, so natural, so unperverted, that he recognizes the most subtle flavors in all the foods that he eats. To such an one the sense of taste will always be a safeguard against impure and improper foods.

It can be laid down as an absolute principle that any condiment that destroys the sense of perception so that one cannot appreciate the natural flavor of any food is bad. Another principle is that those condiments that are largely irritants are particularly injurious and should be avoided.

Tested by either of these standards, black-pepper, red-pepper and mustard must unhesitatingly be condemned. They have no food value, they are irritants, and they destroy or conceal the taste of the foods that are eaten with them. They have but one object and purpose and that is to arouse and stimulate an overworked and perverted appetite so that it shall at least put on a semblance of enjoyment. Food that cannot be eaten without such stimulants had better never be eaten at all.

In regard to pepper: There are three varieties, known as white, black and red. By many people red or cayenne is considered highly injurious, while they nevertheless use white or black; yet, if they but knew the truth of the matter the cayenne is decidedly the least injurious. Black and white pepper, which are virtually one and the same, are the ground immature fruit of a plant found in Ceylon, India, and other warm climates. The only difference between white and black pepper is that the former is the kernel of the seed of the plant, while the black is the fruit and seed ground together.

No peppers are considered by good authorities as wholesome and some contend that they are much less harmful when cooked with the food and thoroughly incorporated with it, than when sprinkled upon it when served. It is alleged that, taken dry, the pepper fastens itself to the mucous membrane, frequently setting up a distressing irritation in either throat, œsophagus or stomach. Indeed, we do not require to eat it to have the irritating action of it clearly demonstrated. One has only to get an accidental whiff through the nose to realize to the full its irritating properties.

Many will be heard to say: "Oh, but pepper adds such a relish to one's food!" True, it seems as if such were the case, but why? Simply by causing the irritation that it does, it excites an abnormal flow of saliva and gastric juice, but the irritation works injury, which, if long persisted in, becomes permanent and thus causes distress and disease.

Everything that has been said in regard to the destruction of the fine perception of taste by pepper and mustard and salt applies equally to the use of such spices as cinnamon, cloves, etc., which are so strong and pungent as to destroy all recognition of simple and original flavors. Nothing is more objectionable to the natural taste than to have baked apples ruined with cinnamon and cloves, or to have either or both of these spices put into a dish of stewed prunes. The natural flavors are lost and the effect of the spices is nothing but harmful and injurious as well as destructive of the pleasure that the unperverted taste finds in all normally flavored foods.

Another serious injury that results from the use of these condiments and spices is that they create an unnatural thirst. While, as I have elsewhere shown, a normal desire for water should be satisfied, even though at meals, yet this is a very different thing from the excessive drinking of tea, coffee, or even ordinarily harmless water, milk, fruit juices or other beverages that condiments and spices promote. Herein is the secret of the downfall, through alcoholic liquor drinking, of many a man and woman who would otherwise have remained an ornament to society. Why imperil manhood and womanhood for the sake of such absurd and unreal compensation as that given by a few moments' titillation of the senses through condiments?

CHAPTER XV.

CALCULATING FOOD VALUES—THE OLD SYSTEM AND THE NEW.

BEFORE we can probe into details of food standards, or consider matters of food economy, it is necessary that we have some standard, other than market prices, by which to compare the real values of foods. Indeed, if actual values of foods were directly proportional to their market prices there would be no problem of food economy to solve, for there would be no opportunity to cut down the cost of living without cutting down the nutritive quality and impairing the efficiency of the diet.

BY BULK OR BY WEIGHT.—It may help in the understanding of why a scientific system of food measurement is necessary, if we first consider the measuring of foods by bulk and by weight. Part of the trickery of food manufacturers consists in making foods bulk up more. Some of the feathery breakfast foods come in this class. Imagine the foods with which you are familiar all being sold by the quart, and prices established on that basis. Then suppose a rival grocer should start selling all food by the pound. Immediately the price of lettuce would go up and the price of molasses would come down.

The difference in the actual specific gravity of foods is slight, with the exception of molasses, not amounting to more than ten per cent, oils being about that much lighter than watery foods. It is therefore easy for us to understand that "a pint's a pound the world around," except when the pint contains air. But as a pint of all dry granular foods contains air in varying amounts, weighing is obviously more accurate than measuring.

Whereas the amount of air changes the quantity of actual food when measured, so the amount of water present changes the actual food quantity when weighed. Watered milk, watered vinegar or watered oysters are obviously dishonest, because the water was added thereto by the hand of man. But if a dairyman could devise a method of feeding cows so that they would give milk containing twice as much water, the product would not be so patently dishonest.

Food weights are meaningless unless we take into consideration the amount of water contained.

Besides these differences in the air or water content, the chief fact that makes one food more concentrated per pound than another is the percentage of fat. There is no such thing as the artificial concentration of food beyond the extraction of the water. One might as well try to concentrate iron or gold. But fat is a substance which is a sort of naturally condensed food, being equivalent in fuel value pound for pound to two and one-fourth times as much as any other food substance.

As the percentage of water and the proportion of fats are the chief reasons why the nutritive value varies for a given weight, it follows that the most variable forms of food are the meats which contain widely varying percentages of both water and fat.

Combine both water and fat variation and the possibilities of variation in nutritive values is very great, as shown by the fact that a pound of oil contains fifty times as much fuel value as a pound of cucumbers.

But before explaining the unit of food values, let us see what we are to measure. If cotton-seed oil has fifty times the nutriment of cucumbers, and cucumbers are worth ten cents per pound, the cotton-seed oil should be worth five dollars a pound. Yet cucumbers may sell for as much as cotton-seed oil. This may be due to the fact that cucumbers taste good, or that people think cucumbers are good for them—though it may develop that cucumbers are bad for them. In short, there are many attributes that may affect the values of foods, other than the common quality by which we can measure them.

Of the functions that foods perform for the human body, the one that demands the greatest *quantity* of food is the supplying of the elements for oxidation, or as we commonly say, for heat and energy. It would be far better if the idea of heat were left out entirely, for heat is produced in the body as a by-product of the expenditure of muscular energy. Moreover, heat to the average mind means temperature, and the control of bodily temperature is a matter not greatly affected by the nature or quantity of food eaten, and hence the measure of food in heat units is misleading. In fact, in so far as the nature of food does affect body temperature, it has recently been found that protein (lean meat) increases it, whereas fat has hitherto been supposed to be a "heating" food, merely because one pound of it will last longer in supplying normal body heat without increasing body temperature at all. If any difference between lean and fat meat is to be observed, we should eat fat meat in summer and lean meat in the winter.

Heat and Energy Value.—Though the terms "heat" or "energy" are misleading if taken literally, yet the comparison of the total heat and energy value of foods is the fairest basis on which the cost of nutrition can be measured. Foods serve many and varied purposes in the body; certain food elements are needed to keep our teeth sound, others to keep the bowels active, yet all such important physiological needs may be met with a small but properly selected diet, and yet starvation occurs from sheer lack of sufficient quantity of foods. But all foods—at least all natural foods—whatever else may be their special contribution to the body's needs, add to the supply of substance to be oxidized or burned up in the muscles to furnish energy and the resulting heat that keeps up body temperature. This use is common in all foods; it is the use that necessitates the most food, and, as it is a factor that can be scientifically measured, it has been chosen by all scientists as the logical measurement of food quantity and as a basis for comparing food costs.

The unit used by food chemists is known as the calorie. It was a laboratory unit, and was determined by burning food in a special apparatus to measure the amount of heat produced. The number of calories so yielded per pound are given in the tables of analysis as published by the government. For the significance of the items of protein, carbohydrates and fat, see Chapter XVI. The ash content given in this table is the total of all mineral elements remaining when a sample of the food is burned. For a detailed discussion of the mineral elements, see Chapter XVII.

STANDARD GOVERNMENT TABLE OF FOOD ANALYSIS.

Composition of common food products.

FOOD MATERIALS (as purchased)	Refuse.	Water.	Protein.	Fat.	Carbo-hy-drates.	Ash.	Fuel value per pound.
ANIMAL FOOD.							
Beef, fresh:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Chuck ribs	16.3	52 6	15.5	15.0	....	0.8	910
Flank	10.2	54.0	17.0	19.0	....	.7	1,105
Loin	13.3	52.5	16.1	17.5	....	.9	1,025
Porterhouse steak	12.7	52.4	19.1	17.9	....	.8	1,100
Sirloin steak	12.8	54.0	16 5	16.1	....	.9	975
Neck	27.6	45.9	14.5	11.9	....	.7	1,165
Ribs	20.8	43.8	13 9	21.2	....	.7	1,135
Rib rolls	....	63.9	19.3	16.7	....	.9	1,055
Round	7.2	60 7	19.0	12.8	....	1.0	890
Rump	20.7	45 0	13.8	20.2	....	.7	1,090
Shank, fore	36.9	42 9	12 8	7.3	....	.6	545
Shoulder and clod	16.4	56.8	16 4	9.8	....	.9	715
Fore quarter	18.7	49.1	14.5	17.5	....	.7	995
Hind quarter	15.7	50.4	15.4	18.3	....	.7	1,045
Beef, corned, canned, pickled and dried:							
Corned beef	8.4	49.2	14.3	23.8	....	4.6	1,245
Tongue, pickled	6.0	58.9	11.9	19.2	....	4.3	1,010
Dried, salted and smoked	4.7	53.7	26.4	6.9	....	8 9	790
Canned boiled beef	....	51.8	25.5	22.5	....	1 3	1,410
Canned corned beef	....	51.8	26.3	18.7	....	4.0	1,270
Veal:							
Breast	21.3	52.0	15.4	11.0	....	.8	745
Leg	14.2	60.1	15.5	7.9	....	.9	625
Leg cutlets	3.4	68.3	20.1	7.5	....	1.0	695
Fore quarter	25.5	54.2	15.1	6.0	....	.7	535
Hind quarter	20.7	56.2	16.2	6.6	....	.8	580
Mutton:							
Flank	9.9	39.0	13.8	36.9	....	.6	1,770
Leg, hind	18.4	51.2	15.1	14.7	....	.8	890
Loin chops	16.0	42.0	13.5	28.3	....	.7	1,415
Fore quarter	21.2	41.6	12.3	24.5	....	.7	1,235
Hind quarter, without tallow	17.2	45.4	13.8	23.2	....	.7	1,210
Lamb:							
Breast	19.1	45.5	15.4	19.1	....	.8	1,075
Leg, hind	17.4	52.9	15.9	13.6	....	.9	860
Pork, fresh:							
Ham	10.7	48.0	13.5	25.9	....	.8	1,320
Loin chops	19.7	41.8	13.4	24.2	....	.8	1,245
Shoulder	12.4	44.9	12.0	29.8	....	.7	1,450
Tenderloin	....	66.5	18.9	13.0	....	1.0	895
Pork, salted, cured and pickled:							
Ham, smoked	13.6	34.8	14.2	33.4	....	4.2	1,635
Shoulder, smoked	18.2	36.8	13.0	26.6	....	5 5	1,335
Salt pork	....	7.6	1.9	86.2	....	3.9	3,555
Bacon, smoked	7.7	17.4	9.1	62.2	....	4.1	2,715

Composition of common food products.—Continued

FOOD MATERIALS (as purchased)	Refuse.	Water.	Protein.	Fat.	Carbo-hy-drates.	Ash.	Fuel value per pound.
ANIMAL FOOD—Continued							
Sausage:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Bologna	3.3	55.2	18.2	19.7	....	3.8	1,155
Pork	....	39.8	13.0	44.2	1.1	2.2	2,075
Frankfort	....	57.2	19.6	18.6	1.1	3.4	1,155
Soups:							
Celery, cream of	....	88.6	2.1	2.8	5.0	1.5	235
Beef	....	92.9	4.4	.4	1.1	1.2	120
Meat stew	....	84.5	4.6	4.3	5.5	1.1	365
Tomato	....	90.0	1.8	1.1	5.6	1.5	185
Poultry:							
Chicken, broilers	41.6	43.7	12.8	1.4	....	.7	305
Fowls	25.9	47.1	13.7	12.3	....	.7	765
Goose	17.6	38.5	13.4	29.8	....	.7	1,475
Turkey	22.7	42.4	16.1	18.4	....	.8	1,060
Fish:							
Cod, dressed	29.9	58.5	11.1	.2	....	.8	220
Halibut, steaks or sections	17.7	61.9	15.3	4.4	....	.9	475
Mackerel, whole	44.7	40,4	10.2	4.2	....	.7	370
Perch, yellow, dressed	35.1	50.7	12.8	.7	....	.9	275
Shad, whole	50.1	35.2	9.4	4 8	....	.7	380
Shad, roe	....	71.2	20.9	3.8	2.6	1.5	600
Fish, preserved:							
Cod, salt	24.9	40.2	16.0	.4	....	18.5	325
Herring, smoked	44.4	19.2	20 5	8.8	....	7.4	755
Fish, canned:							
Salmon	....	63.5	21.8	12.1	....	2.6	915
Sardines	(Oil) 5.0	53.6	23.7	12.1	....	5.3	950
Shellfish:							
Oysters, "solids"	....	88.3	6 0	1.3	3.3	1.1	225
Clams	....	80.8	10 6	1.1	5.2	2 3	340
Crabs	52.4	36.7	7.9	.9	.6	1.5	200
Lobsters	61.7	30.7	5.9	.7	.2	.8	145
Eggs:							
Hens' eggs	11 2 (Shell)	65.5	13.1	9.3	....	0.9	635
Dairy products, etc.:							
Butter	....	11.0	1.0	85.0	....	3.0	3,410
Whole milk	....	87.0	3 3	4 0	5.0	.7	310
Skim milk	....	90 5	3.4	.3	5.1	.7	165
Buttermilk	....	91.0	3.0	.5	4.8	7	160
Condensed milk	....	26 9	8 8	8.3	54.1	1.9	1,430
Cream	....	74.0	2.5	18.5	4 5	.5	865
Cheese, Cheddar	....	27.4	27.7	36.8	4.1	4.0	2,075
Cheese, full cream	....	34.2	25.9	33.7	2.4	3.8	1,885
VEGETABLE FOOD.							
Flour, meal, etc.:							
Entire-wheat flour	....	11.4	13.8	1 9	71.9	1.0	1,650
Graham flour	....	11.3	13.3	2.2	71.4	1.8	1,645
Wheat flour, patent roller process—							
High-grade and medium	....	12.0	11.4	1.0	75.1	.5	1,635
Low grade	....	12.0	14.0	1 9	71.2	.9	1,640
Macaroni, vermicelli, etc.	....	10.3	13.4	.9	74.1	1.3	1,645
Wheat breakfast food	....	9.6	12.1	1.8	75.2	1.3	1,680
Buckwheat flour	....	13.6	6.4	1.2	77.9	.9	1,605
Rye flour	....	12.9	6.8	.9	78.7	.7	1,620
Corn meal	....	12.5	9 2	1.9	75.4	1.0	1,635

Composition of common food products.—Continued

FOOD MATERIALS (as purchased)	Refuse	Water.	Protein.	Fat.	Carbo-hy-drates.	Ash.	Fuel value per pound.
VEGETABLE FOOD—Continued							
Flour, meal, etc.—Continued.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Oat breakfast food	....	7.7	16.7	7.3	66.2	2.1	1,800
Rice	....	12.3	8.0	.3	79.0	.4	1,620
Tapioca	....	11.4	.4	.1	88.0	.1	1,650
Starch	....	....	....	....	90.0	....	1,675
Bread, pastry, etc.:							
White bread	....	35.3	9.2	1.3	53.1	1.1	1,200
Brown bread	....	43.6	5.4	1.8	47.1	2.1	1,040
Graham bread	....	35.7	8.9	1.8	52.1	1.5	1,195
Whole-wheat bread	....	38.4	9.7	.9	49.7	1.3	1,130
Rye bread	....	35.7	9.0	.6	53.2	1.5	1,170
Cake	....	19.9	6.3	9.0	63.3	1.5	1,630
Cream crackers	....	6.8	9.7	12.1	69.7	1.7	1,925
Oyster crackers	....	4.8	11.3	10.5	70.5	2.9	1,910
Soda crackers	....	5.9	9.8	9.1	73.1	2.1	1,875
Sugars, etc.:							
Molasses	....	....	....	....	70.0	....	1,225
Candy (unmixed with nuts, chocolate, etc.)	....	....	....	....	96.0	....	1,680
Honey	....	....	....	....	81.0	....	1,420
Sugar, granulated	....	....	....	....	100.0	....	1,750
Maple sirup	....	....	....	....	71.4	....	1,250
Vegetables:*							
Beans, dried	....	12.6	22.5	1.8	59.6	3.5	1,520
Beans, Lima, shelled	....	68.5	7.1	.7	22.0	1.7	540
Beans, string	7.0	83.0	2.1	.3	6.9	.7	170
Beets	20.0	70.0	1.3	.1	7.7	.9	160
Cabbage	15.0	77.7	1.4	.2	4.8	.9	115
Celery	20.0	75.6	.9	.1	2.6	.8	65
Corn, green (sweet), edible portion	....	75.4	3.1	1.1	19.7	.7	440
Cucumbers	15 0	81.1	.7	.2	2.6	.4	65
Lettuce	15.0	80.5	1.0	.2	2.5	.8	65
Mushrooms	....	88.1	3.5	.4	6.8	1.2	185
Onions	10.0	78.9	1.4	.3	8.9	.5	190
Parsnips	20.0	66.4	1.3	.4	10.8	1.1	230
Peas, dried	....	9.5	24.6	1.0	62.0	2.9	1,565
Peas, shelled	....	74.6	7.0	.5	16.9	1.0	440
Cowpeas, dried	....	13.0	21.4	1.4	60.8	3.4	1,505
Potatoes	20.0	62.6	1.8	.1	14.7	.8	295
Rhubarb	40.0	56.6	.4	.4	2.2	.4	60
Sweet potatoes	20.0	55.2	1.4	.6	21.9	.9	440
Spinach	....	92.3	2.1	.3	3.2	2.1	95
Squash	50.0	44.2	.7	.2	4 5	.4	100
Tomatoes	....	94.3	.9	.4	3.9	.5	100
Turnips	30.0	62.7	.9	.1	5.7	.6	120
Vegetables, canned:							
Baked beans	....	68.9	6.9	2.5	19.6	2.1	555
Peas, green	....	85.3	3.6	.2	9.8	1.1	235
Corn, green	....	76.1	2.8	1.2	19.0	.9	430
Succotash	....	75.9	3.6	1.0	18.6	.9	425
Tomatoes	....	94.0	1.2	.2	4.0	.6	95

* Such vegetables as potatoes, squash, beets, etc , have a certain amount of inedible material, skin, seeds, etc. The amount varies with the method of preparing the vegetables, and cannot be accurately estimated. The figures given for refuse of vegetables, fruits, etc., are assumed to represent approximately the amount of refuse in these foods as ordinarily prepared.

Composition of common food products.—Continued

FOOD MATERIALS (as purchased)	Refuse.	Water	Protein.	Fat.	Carbo-hy-drates.	Ash.	Fuel value per pound.
VEGETABLE FOOD—Continued							
Fruits, berries, etc., fresh:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct*	*Calories.*
Apples	25.0	63.3	0.3	0.3	10.8	0.3	190
Bananas	35.0	48.9	.8	.4	14.3	.6	260
Grapes	25.0	58.0	1.0	1.2	14.4	.4	295
Lemons	30.0	62.5	.7	.5	5.9	.4	125
Muskmelons	50.0	44.8	.3	....	4.6	.3	80
Oranges	27.0	63.4	.6	.1	8.5	.4	150
Pears	10.0	76.0	.5	.4	12.7	.4	230
Persimmons, edible portion	....	66. 1	.8	.7	31.5	.9	550
Raspberries	....	85.8	1.0	....	12.6	.6	220
Strawberries	5.0	85.9	.9	.6	7.0	.6	150
Watermelons	59.4	37.5	.2	.1	2.7	.1	50
Fruits, dried:							
Apples	....	28.1	1.6	2.2	66.1	2.0	1,185
Apricots	....	29.4	4.7	1.0	62.5	2.4	1,125
Dates	10.0	13.8	1.9	2.5	70.6	1.2	1,275
Figs	....	18.8	4.3	.3	74.2	2.4	1,280
Rasins	10.0	13.1	2.3	3.0	68.5	3.1	1,265
Nuts:							
Almonds	45.0	2.7	11.5	30.2	9.5	1.1	1,515
Brazil nuts	49.6	2.6	8.6	33.7	3.5	2.0	1,485
Butternuts	86.4	.6	3.8	8.3	.5	.4	385
Chestnuts, fresh	16.0	37 8	5.2	4.5	35.4	1.1	915
Chestnuts, dried	24.0	4.5	8.1	5.3	56.4	1.7	1,385
Cocoanuts	*48.8	7.2	2.9	25.9	14 3	.9	1,295
Cocoanut, prepared	....	3.5	6.3	57.4	31.5	1.3	2,865
Filberts	52.1	1.8	7.5	31.3	6.2	1.1	1,430
Hickory nuts	62.2	1.4	5.8	25.5	4.3	.8	1,145
Pecans	53.2	1.4	5.2	33.3	6.2	.7	1,465
Peanuts	24.5	6.9	19.5	29.1	18.5	1.5	1,775
Piñon	40.6	2.0	8.7	36.8	10.2	1.7	1,730
Walnuts, black	74.1	.6	7.2	14 6	3.0	.5	730
Walnuts, English	58.1	1.0	6.9	26.6	6.8	.6	1,250
Miscellaneous:							
Chocolate	....	5.9	12 9	48.7	30.3	2.2	2,625
Cocoa, powdered	....	4.6	21 6	28.9	37.7	7 2	2,160
Cereal coffee, infusion (1 part boiled in 20 parts water)†	....	98.2	.2	....	1.4	.2	30

* Milk and shell.

† The average of five analyses of cereal coffee grain is: Water 6.2, protein 13.3, fat 3.4, carbohydrates 72.6, and ash 4.5 per cent. Only a portion of the nutrients, however, enter into the infusion. Infusions of genuine coffee and of tea like the above contain practically no nutrients.

Measuring by Wheat Pounds.—This idea of measuring food by calories seems in practical, every-day use strange and meaningless. It was a unit so small that a day's food supply ran into the thousands of units, while the detailed figures became too complicated to be easily thought of and remembered. With a view to making the scientific measurement of food values more practical, Milo Hastings of the staff of Physical Culture, and formerly of the Department of Agriculture, devised the wheat pound system. By this system the values of all foods are expressed by comparison with whole wheat. A pound of wheat is the unit of measurement, and may be expressed by 1.00. This wheat pound is the equivalent to 1,670 calories, and the value of foods expressed in calories may be reduced to wheat pounds by dividing by six and pointing off four decimal places.

The advantages of the wheat pound system are as follows: First, the unit of measurement seems to mean something practical and comprehensible. Everyone has some idea of the food value and cost of a pound of wheat (or whole-wheat flour), while to conceive of the value of a calorie is a complex process, requiring abstract scientific reasoning.

Second, the wheat pound is a unit of such size as to be significant in the daily bill of fare. One does not sell coal by the ounce or quinine by the ton. To say that a man should eat 2,505 calories in a day seems to lay a stress of accuracy that common sense shows to be impractical. To say that he should eat one and a half (1.50) wheat pounds has the ring of common sense, because the difference between 1.50 wheat pounds and 2.00 wheat pounds is significant and comprehensible.

The third advantage of the wheat pound system is that it greatly reduces the amount of calculation in figuring food values. Wheat is chosen as a unit instead of milk, bread or potatoes for the reason that there are a large number of foods that are essentially equivalent in food value to wheat.

The first practical use to be made of the wheat pound system is in the comparison of food values with the market price. The second use is in computing quickly and practically the total amount of food eaten, so that one may form something of an idea of whether he is under or over eating.

A great deal of time has been utterly wasted in this world by the effort of busy, practical people to apply the complicated and beautifully scientific system of measuring foods by calories.

The scientist worships at the shrine of truth, and like most worshippers he misses the spirit in following the letter of the law.

Thus we are gravely told by the United States Department of Agriculture that very lean loin of beef, as purchased, contains 475 calories per pound. From very lean the classification runs up through lean, medium fat, fat and very fat, and when we reach the last, then we have 1,525 calories per pound. The calorie statement is expressed to an accuracy of less than one-thousandth of the total figure, but the question of judging as to whether the loin is very lean, lean, medium fat, just plain fat, or very fat, is left to the user and leaves room for error of judgment, with a range of a possible inaccuracy of over a hundred per cent. In other words, the scientific recording of the number of calories per pound which have been published in all government tables, and practically all dietetic books, have recorded calories several hundred times more accurately than the probable accuracy of judgment in estimating the fatness of a particular cut of beef. The only way the scientist could make such infinitely painful food chemistry practical would be to produce a breed of cattle that would grow standardized loin cuts!

When the diet of a large portion of our population is known to be from fifty to one hundred per cent in excess of actual needs, and there are grave national and individual reasons for checking the enormous waste of excessive eating, we need some sort of a practical system to enable the food buyer of the household to get an approximate estimate of the food she serves her household.

For this purpose the wheat pound system is feasible and comprehensible, and accurate enough for the work in hand. Careful trial calculations with varied diets have shown that the method of calculating food values in wheat pounds will never involve an error of more than ten per cent, as compared with the most painstaking calculation from government tables. As the variation in particular food samples is as great as this, further accuracy is meaningless.

Below you will find a very much simplified table for calculating the value of all foods in wheat pounds, and following it a table carried to two decimal places for use in more careful work.

TABLE OF APPROXIMATE WHEAT POUND FACTORS.

This brief table gives approximate results sufficiently accurate for every-day use. For more detailed calculations use the table that follows:

To Find the Value in Wheat Pounds:

Multiply the weight (in pounds) of the various foods by the figure given at the head of the group under which the food is listed.

Multiply by 2.5

Pure Oils and Rendered Fats (Lard, Tallow, etc.).

Multiply by 2

Butter, Oleomargarine, Meat Fats (not rendered). All nuts not elsewhere mentioned.

Multiply by 1.8

Cocoanut, Almonds, Bacon, Peanuts (roasted), Peanut Butter.

Multiply by 1.1

Cheese, Doughnuts, Cookies, Crackers, Granulated Sugar, Oatmeal, Popcorn.

Take Weights as They Stand (Multiply by 1)

Dry Cereals, Flours, Beans, Peas, Lentils, Sardines in Oil, Candy, Maple and Brown Sugar, Honey, Dates, Raisins, Figs, Currants, Cakes, Gingerbread, Sweetened Condensed Milk.

Multiply by .8

Biscuits and Rolls, Mince Pie, Molasses, Syrups, Prunes, Salt and Smoked Herring or Mackerel.

Multiply by .7

All Breads, Fruit Pies, Jams, Jellies, Preserves, Average Loin Cut of Beef, Ham, or Mutton, Lean Pork.

Multiply by .6

Eggs (*measured by dozen, not pound*).

Multiply by .5 or Divide by 2

Mature Poultry, Average Veal, Lean Beef, Salmon, Shad, Condensed unsweetened Milk, Custard and Pumpkin Pies, Puddings.

Multiply by .33 or Divide by 3

Salt Codfish, Fresh Halibut and Herring, Young Poultry, Sweet Potatoes, Baked Beans, Cottage Cheese, Fresh Lima Beans.

Multiply by .25 or Divide by 4

Potatoes, Bananas, Grapes, Plums, Corn (green or canned), Crabs, Lobster, Smelts, Trout.

Multiply by .20 or Divide by 5

Oysters, Haddock, Flounder, Cod, Okra, Parsnips, Whole Milk, Peas (green or canned). All fruits not otherwise mentioned.

Multiply by .1 or Divide by 10

Melons, Lemons, Strawberries, Cranberries, Pineapple. All vegetables not otherwise mentioned.

DETAILED TABLE OF WHEAT POUNDS IN ONE POUND OF FOOD.

To determine the food value in wheat pounds of any quantity of food, multiply the weight of the food in pounds by the figures here given.

CEREAL GROUP.

CEREALS AND FLOURS.

Wheat, whole	1.00
Wheat flour, whole	1.00
White flour	.99
Farina	1.01
Bran	.90
Shredded wheat	1.02
Macaroni and spaghetti	.99
Corn or cornmeal	.99
Hominy	.99
Rice	1.01
Oatmeal	1.12
Rye flour	.98
Barley	.98
Popcorn	1.19
Cornflakes	.99

LEGUMES.

Beans, navy	.95
Beans, lima, dry	.96
Peas, dry	.99
Cowpeas	.90
Lentils	.96
Beans, baked	.36

BREADS.

Zwiebach	1.20
Biscuits or rolls	.80
Boston Brown	.60
Corn	.72
Sugar buns	.90
White	.72
Whole-wheat or graham	.72
Rye	.70

PASTRY.

Cakes, average	1.00
Cookies	1.15
Crackers	1.15
Doughnuts	1.20
Gingerbread	1.00
Pies, fruit, average	.75
Pies, custard or pumpkin	.50
Pies, mince	.80
Puddings	.45

SUGAR GROUP.

Granulated sugar	1.12
Brown sugar	1.05
Maple sugar	.92
Candy, average	1.05
Honey	.90
Corn syrup (glucose)	.88
Maple syrup	.80
Molasses, cane	.77

SWEET FRUITS.

Dates	.95
Raisins	.95
Figs	.90
Currants	.90

JELLIES, JAMS, PRESERVES AND MARMALADES.

General average	.70

FAT GROUP.

Olive oil	2.53
Cotton-seed oil	2.53
Lard, or similar fat	2.53
Butter	2.15
Oleomargarine	2.10
Chocolate (dry powder)	1.70
Cocoa (dry powder)	1.40
Ripe olives	.73
Clear beef fat (suet)	2.10
Bacon, average	1.75
Salt pork, clear fat	2.20

NUT MEATS.

Almonds	1.80
Brazil nuts	2.00
Cocoanut, fresh	1.70
Cocoanut, prepared	1.80
Filberts (hazelnuts)	2.00
Hickory nuts	2.00
Peanuts	1.55
Peanut butter	1.70
Pecans	2.05
Walnuts, English	2.00
Walnuts, black	1.90

VITAMINE GROUP.

VEGETABLES.

Asparagus	.06
Beans, fresh, lima	.35
Beans, string	.12
Beets	.13
Cabbage	.09
Carrots	.13
Cauliflower	.08
Celery	.05
Cucumbers	.05
Corn, green or canned	.27
Greens, dandelions, etc.	.15
Lettuce	.05
Mushrooms	.12
Okra	.17
Onions	.13
Parsnips	.18
Peas, fresh, uncooked	.27
Peas, canned	.15
Potatoes	.23
Radishes	.13
Rhubarb	.06
Spinach	.07
Squash	.13
Sweet potatoes	.34
Tomatoes, fresh or canned	.06
Turnips	.11

FRUITS.

Apples	.17
Apples, dried	.80
Apricots	.16
Apricots, dried	.80
Bananas	.27
Blackberries	.16
Blueberries	.13
Cherries	.22
Cranberries	.13
Grapes	.27
Huckleberries	.20
Lemons	.12
Muskmelon	.11
Oranges	.14
Pears	.17
Pineapples	.12
Plums	.24
Peaches	.13
Prunes	.84
Raspberries	.19
Strawberries	.10
Watermelons	.08

ANIMAL PROTEIN GROUP.

MILK PRODUCTS.

Cheese, full cream	1.15
Cheese, cottage	.30
Milk, whole	.19
Milk, skimmed	.10
Milk, condensed, unsweetened	.45
Milk, condensed, sweetened	.90

EGGS.

Eggs	.43

DETAILED TABLE OF WHEAT POUNDS IN ONE POUND OF FOOD.—*Continued*

Eggs, white	.15
Eggs, yolks	1.02
MEATS.	
Beef	
Very lean round steak	.40
Beef, half lean, half fat (as very fat flank)	1.40
Average loin cut	.70
Average round cut	.50
Dried beef	.50
Veal	
Very lean	.35
Breast, average	.50
Leg, average	.40
Mutton	
Very lean	55
Loin (chop) average	1.10
Leg, average	.65
Pork	
Fresh, very lean	.55
Chops, average	.95
Ham, cured, average	.75
Fowls	
Chicken, edible portion	.30
Chicken (based on purchase weight)	.15
Fowls, edible portion	.60
Fowls, purchase weight	.45
FISH.	
Bass (edible portion)	.28
Cod, fresh	.20
Cod, salt	.35
Flounder	.18
Haddock	.20
Halibut	.34
Herring, fresh	.40
Herring, smoked	.75
Mackerel, fresh	.38
Mackerel, salt	.80
Salmon, fresh	.58
Salmon, canned	.54
Sardines, canned	.90
Shad	.45
Smelt	.25
Trout	.27
SHELLFISH.	
Clams	.15
Crabs	.22
Lobster	.23
Oysters, fresh	.14
Oysters canned	.20

No claim is here made that wheat pounds tell the whole story of food needs. Other essentials of a perfect diet must be considered, but the wheat pound system here given tells all the facts of heat or energy values of foods, the chief thing to be considered in figuring food quantity and food economy, and in the calculation of which the more complicated tables of calories are generally used.

In the chapter on "How and When to Eat" you will be told all that science can tell you in regard to how much food you should eat. It will seem a rather confusing problem, as there are so many things that affect the amount of food needed.

You can safely cut down on excessive eating with no other guide except your weight. If you are fatter than you need be, it is important that you cut down your food quantities considerably. Don't be a food slacker and fear little hunger pangs. Thousands of fat people have reduced their diet and thereby reduced their weight, and increased health, vigor and improved their appearance and physical and mental efficiency.

Even those of you who do not seem particularly fat, may be overeating. Try a moderate reduction in food and watch the scales. You will lose a few pounds, chiefly due to an emptying out of the congested intestines, but it will give you more room to breathe and a better chance to think. As long as you do not continue to lose weight to a point of actual thinness, the reduction of food quantities won't hurt you, if the food quality is right.

Overeating America's Favorite Sin.—We have been told repeatedly that we eat too much. The proof of the statement is seen when people who have hitherto given no thought to the quantity of food eaten decide to observe the matter of food economy as closely as they do their bank account. The outcome is that in four cases out of five the food intake is lowered, and genuine improvement in personal efficiency results. Money is saved and health is gained, the business of living shows double profits, just as when a man makes a change in his farm or factory management that cuts costs and at the same time increases income.

The conclusion that the majority of civilized men eat too much may be reached either by a process of general reasoning, or by the observation of individual experiences. The wild man, along with the wild animals, was endowed with an appetite and food receiving capacity far in excess of what would be needed three times a day. Food in the jungle was available by fits and starts, and the meal hours were irregular. The man with the greater appetite and food capacity had a better chance of surviving unexpected delays in the meal hours than did the man of dainty appetite. Hence our instinct as to the amount of food to be eaten is often wide of the mark for present-day conditions.

So today, at least among all of us, save those engaged in heavy muscular labor, the tendency is to overeat. Especially is this true of the man who in earlier life was devoted to athletic sports or engaged in heavy muscular labor, and who, upon changing to a more sedentary life, prides himself on his former capacity for "three square meals a day."

But the most convincing proof of the universal tendency to overeat is the vast number of those who have deliberately cut down their food quantity and gained better health thereby.

Food, when taken in excess of that consumed by the activity of the body, is disposed of in one of three ways. The first and most direct way is by indigestion. The excessive food simply refuses to digest completely and is passed out through the bowels. Once the food is absorbed from the digestive tract there is no way that it can be eliminated from the body, except it be burned up by oxidation. If the food once digested is not burned up, only one other thing can happen. It must be deposited in the body as fat.

The conclusions from the above statements of physiological science are obvious and positive. If we overeat, and do not exercise to use up the surplus, we will get indigestion or get fat. Hence overeating leads to either dyspepsia or obesity, and sometimes to both. Thus we see that the control of body weight becomes a matter of the control of the intake of the food in relation to the amount burned up by muscular activity. If we would get fat we should increase the food and cut down the exercise. If we would lose fat we must decrease the food and increase the exercise. But note this, that few people desire to get fat. Those who wish flesh usually mean that they want to get flesh over a bony form, and that the flesh desired is muscular tissue, not fatty tissue. Hence, in practice, we exercise to gain weight, and we exercise to lose weight, which seeming contradiction is absolutely scientific and proper.

Dietary standards are measured in calories, or in the simpler unit of wheat pounds. Dietary standards were first arrived at by getting the facts as to how much food people do eat. For years such standards were published by the government and generally accepted by the scientific world. This conception of dietary standards was based upon the reasoning that all men should do what the average man does.

In the table below is given a list of dietaries based on investigations of the foods eaten by men when free to eat what they enjoyed eating, or what they could afford to eat. From such investigations the Atwater or government standard of dietaries was arbitrarily derived and were excessive because overeating is a universal sin—and, as the variations below will show, because men come nearer eating what they can afford to pay for than what they need for efficiency.

	Calories	Wheat Pounds
United States: Men at hard, muscular labor	6,000	3.6
Athletes	4,510	2.7
Men at moderate muscular labor	3,425	2.0
Men not employed at muscular occupations	3,285	1.9
Very poor working people	2,100	1.2
Ireland: Workingmen	3,107	1.8
England: Workingmen	2,685	1.6
Germany: Workingmen (hard work)	3,061	1.8
Japan: Laborers	4,415	2.6
Professional men	2,190	1.3
China: Laborers	3,400	2.0

In the last fifteen years a change, in which physical culture has been a leading advocate, has occurred in favor of lighter dietary standards. Now we would make the standard dietary an ideal dietary and not merely an average dietary.

Scientific work, recently conducted, enables us to determine such standard dietaries that are based upon the study of the ideal food intake rather than upon the average. This new standard dietary is not to be accepted as an absolute standard, but only as a basis to work from, for we now realize that there can be no standard applicable to all men, and that each individual must work out his own dietary standard, as affected by season and climate, stature, age, occupation, the degree of muscular activity, sex, and lastly the weight or degree of fatness.

We must have a basic unit to start from. This we call a man-day, which is the amount of food required to keep up the bodily strength and weight of the typical man 5 feet 8 inches in height, weighing 150 pounds and engaged in light indoor labor with exercise equivalent to two hours a day brisk walking in the open air. Such a man-day unit of food, or dietary standard, is 1.5 wheat pounds, or about 2,500 calories. From this basis other standards may be derived by correcting for variations as discussed in the chapter on "Adapting the Diet to Various Conditions."

CHAPTER XVI.

PROTEIN REQUIREMENTS—THE EXTRAVAGANCE OF MEAT

PROTEIN is distinctive from all other food elements in that it is the chief substance or rather the group of substances from which the actual organs and tissues of the body are formed and repaired. The other great groups of food elements, the starches, sugars and fats, can only supply heat and energy or go to form body fat. For this reason, since the early days of food chemistry, the protein group of food substances has always been conceded to be of especial importance.

ANCIENT FAITH IN PROTEIN.—For many years protein was also thought to be the source of muscular energy, for the reason that the muscles are composed of protein. This belief has been known to be erroneous for half a century, yet it had a hold, even upon the scientists, who had difficulty in getting away from the idea that a hungry, hard-working man must have meat to keep up his strength.

The food chemists of our colleges, before 1903, taught that a diet relatively rich in protein was the diet for strength and endurance. As a result the athletic training tables of those days were heaped high with juicy beefsteaks, ham and eggs, and milk and cheese. About this time Horace Fletcher, a retired college and business man, appeared at Yale University and asked to be subjected to strength tests in the Yale gymnasium. Mr. Fletcher at that time was in his fifties, yet he broke strength records made by the young and vigorous athletes of the university. His endurance was far greater than that ever before recorded for a man of his age. Without previous training he was enabled to undergo the most severe ordeals without any of the resulting muscular soreness that commonly follows such tests.

Mr. Fletcher ascribed his superior condition to his eating habits, the chief distinction of which was that he practiced exceedingly thorough mastication and had developed his sense of taste until his food selection was very different from that of the conventional American bill-of-fare. An investigation of Mr. Fletcher's diet showed that he not only was eating a great deal less food than was supposed to be essential to health and strength, but that he was also eating a smaller proportion of protein, about forty grams a day, whereas the dietary standard called for 150 grams for an athlete.

Professor Chittenden of Yale became so interested that he conducted a series of researches which gave most remarkable results and seemed to indicate that protein, instead of being of greater value for strength production than other foods, was an actual detriment, and when taken above the necessary minimum is prone to increase fatigue and lessen endurance.

This revolution in the conventional dietetic teachings was seriously and stubbornly questioned by the orthodox scientists. The Danish government took particular pains to investigate the subject and gave Professor Hinhede a laboratory for such research. Hinhede not only confirmed the conclusions of Fletcher and Chittenden, but went even further in the reduction of proteins and showed that a man could live and thrive for months upon a protein intake as low as 20 to 30 grams per day, not quite equal to four eggs.

These findings in favor of low protein have not been wholly accepted, but practically the entire scientific world has conceded that the former dietetic standards were entirely wrong, and that a much lower rate of protein consumption is desirable than was formerly considered necessary. This faith of science in the lower protein standards had a very practical application in connection with the European War, enabling the warring governments to feed their people upon a diet containing a much smaller proportion of meat and dairy products than would have been considered possible a few years ago. Mr. Fletcher spent much of his time in Belgium during the first years of the war, and he insisted that in spite of the great deprivation and the misery of the Belgians the low protein rations materially contributed to improved physical conditions and a lower death rate.

The question of the amount of protein is, in practice, the question of heavy meat eating and is complicated by the fact that meat foods are highly flavored and that people like these stimulating flavors. Because such foods are expensive to produce and taste good, the rich, prosperous people, whether individuals or nations, consume more of these foods than their poorer brethren.

Meat-eating races, that is, the rich, well-fed of the earth, have been the successful, domineering sort. The poor ape their betters and strive to adopt their habits, and the beef-eating Englishman, who went out and conquered half the earth, has never quite got rid of the idea that his beef was partly responsible for his power. Vegetarian arguments about the strength of the rice-eating Oriental have been copiously printed, but never more than half believed, and the prejudice in favor of meat, backed up by its good taste, has kept alive the notion that the protein foods, especially those from the flesh of animals, are of particular value and potency.

Conservation in War Time.—The vegetarian has eschewed the flesh of animals for physical, mental, or moral reasons, but always for very personal reasons. The social responsibility, the possibility of the vegetarian's peculiarities in diet being of consequence pro or con in the affairs of the nation, has rarely entered into the argument.

When the world war was on we, as a people, felt obliged to see it through, not only for ourselves, but for civilization, and food questions which were formerly personal matters become social and patriotic matters of the greatest importance.

With a view of conserving our food supply, many writers had urged the prohibition of the killing of young meat animals. Germany, at the beginning of the world-wide war, took the opposite policy, and enforced the slaughter of about one-third of her meat-producing animals. But later the Germans, because of the deprivation of fats, altered their policy, and in the third year of the war preserved their young stock, and at great privation to themselves brought the number of domestic animals far back toward the original figures.

But the American situation was different from the German, and we cut down rather than increased our meat production. The isolated German nation represented an unbalanced state of agriculture, in which fat was produced in quantities insufficient for either the nourishment of the population or for the technical needs for fat in industry, and particularly in the manufacture of munitions. How hard put the Germans were was indicated by the report that the Imperial Government used butter in the manufacture of munitions. This may or may not have been true, but the fat famine in Germany was unquestionably the most acute phase of the nation's food shortage during the war.

The United States is a heavy producer of food fats, not only because of her great meat industries, but because of her very considerable output of cotton-seed oil. While dietitians dispute the interchangeability of vegetable and animal proteins, it is generally conceded that fat from vegetable sources is dietetically as good or better than fat from animals—with the exception of butter.

Whenever there is actual shortage of grain for human sustenance, and a comparative abundance of food fats, it is certainly grossly extravagant to feed so much of the food grains to animals. It requires five or six pounds of grain to produce one pound of beef, and beef averages less than twenty per cent of fat. This means that about twenty-five pounds of grain are required to produce one pound of beef fat. Dietetically, a pound of fat is worth two and one-fourth pounds of grain, hence the loss of food value in producing beef fat is in the ratio of ten to one.

In feeding hogs, because of the greater proportion of fat in the carcass, the ratio of loss of food value is not so great, probably five to one.

Because of the more vital need for milk in the diet than for meat, and because, as a whole, including its fat, it is the most economical form of converting vegetable foods into animal foods, milk production should never be curtailed.

There need be no fear of a meat famine at any time, for meat from cows and calves produced as a by-product of the dairy industry, together with our milk, poultry, pork and fish, will more than supply the real needs of our people, and leave a surplus that may be exported.

An article in Physical Culture, 1910, stated: "Savages in cold climates were forced to eat meat and found the natural game of the forest only sufficient for a sparse population. Following the hunter came the herdsman, who thrives only as long as land and grass and grain are so abundant as to make a wasteful method possible. In this new country we became heavy meat eaters, and though our population doubled every generation, our land area was so vast that we kept up the practice for a century. But now the need for land for the direct production of human food has become sufficient to make us think about the future.

"When, in more densely populated countries meat appears rarely upon the bill of fare, we are taught that it was due to poverty, political reasons, or some other far removed cause. As a matter of fact, the people of Belgium or China cannot eat meat three times a day because they cannot afford to produce it. It would take three or four acres of ground to support a man if we depended solely upon meat for the source of human energy. On the other hand, an acre of ground will easily support three or four men when growing a variety of plants."

To bring the question of food patriotism back to the individual, we are bound to conclude that *vegetarianism is quite as patriotic a way to avoid national waste as the skimping and scrap-saving so urgently commended by the government and the press.*

The greatest American extravagance is the excessive consumption of animal protein, chiefly meat, and this waste has received endorsement from the high authorities. A dietary which a leading government food chemist recommended was found to derive forty-one per cent of its total food value from the animal protein group, the cost being sixty-six per cent of the total. As ten per cent of animal protein in the diet is sufficient for healthful nutrition, there is a waste authorized here that amounts to about fifty per cent of the total food cost.

Such a reduction of our excessive meat eating would save from five to ten pounds of grain for each pound of meat not eaten, and hence, not produced.

Cash is readily translated into its equivalent in human life, and we are told that three cents will buy a meal for a starving child. With equal honesty we might placard our butcher shops with the statement that *for every pound of steak which we refrain from eating we release grain enough to furnish a hungry man bread for a week.*

Human prosperity and power is a thing of many causes and we now know that heavy meat eaters eat more because they like it and can get it and are powerful in spite of that fact, not because of it. Some protein food is essential to life, growth and health; the discussion between the old and the new ideas is based not upon its necessity, but upon the amount necessary.

Protein in Excess Harmful.—Protein substances are not altogether different from the other foods. In fact, three-fourths of the weight of protein foods are composed of the same basic carbon and hydrogen compounds that form starches and sugars. When protein is eaten in excess of the body's needs, it is separated into simpler components, and the fourth of it which contains the element nitrogen is discarded and excreted in the urine, while the remainder is utilized as starch and sugar are utilized.

This process of discarding part of the protein eaten in excess of our actual needs is now known to be physiologically harmful. Certainly it represents a great economic waste, for not only is the substance wasted, but it is substance that costs five to ten

An example of the wastefulness of the high proteid diet. French lamb chops—cost twenty cents each; cost of actual food nutrients one dollar and fifty-two cents per pound.

times as much as the substances which it only partly replaces. Both economy and health here argue to the same end—that we should eat only as much protein foods as we need, and that to eat more is foolish, if not actually harmful. Eating excess of protein is like burning the furniture to warm the house. Coal is better fuel and is decidedly more economical.

This question of how much protein we should eat is very important to the man who would cut down the cost of living—as important as would be the question of getting coal if one were heating his house by burning tables and chairs. If you want to save money, patronize the butcher less and the cereal counter and the vegetable man more.

The dietetic teachings now advocated as the "low protein diet" are closely akin to the vegetarian theories. Vegetarians have always shown up remarkably well in athletic competition, especially where the event depended upon endurance. In long-distance races, in America, England and Germany, the percentage of vegetarians who finish in the lead has always been greater than the percentage of winning meat-eaters. About ten years ago, Professor Irving Fisher of Yale put this matter to a definite trial by taking the number of simple endurance tests of vegetarians as against meat-eaters; the resultant showing for the vegetarians was highly favorable to their claims.

A strange inconsistency on the part of vegetarians is the idea that they should have "meat substitutes." If meats are a thing of evil and not part of the natural diet of man, why have meat substitutes? It is hardly fair to accuse the leaders of the vegetarian movement of thus deliberately condemning their own doctrines. It is a more likely explanation that this idea of the need of meat substitutes was adopted by the general public who believed there was something good in both theories and that by eating meat substitutes they would gain the benefit supposed to come from meat and sidestep its evil effects. This idea was undoubtedly strengthened by the belief that large quantities of protein were essential to a healthful diet. We now know that this belief never had a scientific foundation, and that modern evidence indicates that it is exactly opposite to the truth.

The vegetarian in opposing the excessive use of meat agreed with scientific truth in a rather unscientific way. But in practice it is not wise to omit the animal proteins altogether. In modest quantities, preferably from milk and eggs, they are desirable if not actually necessary, and for giving taste and flavor they are essential for us who have been so long accustomed to eating them.

Nearly all vegetable foods in their natural forms contain small proportions of proteins. Were it not for this fact, life upon this globe would be impossible, as all animals would then have to eat each other—a very difficult state of affairs. But the vegetarian animal has a larger digestive apparatus than man. Vegetarians get around this fact either by advocating large quantities of nuts in the diet, or by meeting the meat-eater half way and including milk and eggs and tabooing flesh foods. Others allow fish, on the theory, perhaps, that it doesn't hurt a fish so much to die because it isn't red-blooded.

Dish containing all edible meat secured from three pound chicken. Weight eighteen ounces—cost of chicken per pound, 50 cents. Cost of edible meat per pound, $1.33.

Unedible portion of cooked chicken, weight sixteen ounces.

Entire edible flesh of chicken (dried). Weight, seven and one-half ounces—cost per pound $3.20.

But these are sentimental and rather unscientific aspects of the question. Only a small per cent of Americans are vegetarians by conviction, and the complete adoption of vegetarianism usually involves worries and fears about getting enough protein, and especially about getting the right kind of protein. Animal proteins are the right kind, if not eaten in excess, because the needs of animals are very like our own. Milk and eggs, being created in the scheme of things for the express purpose of nourishing young life, are the best of all, and an effort to exclude them from the diet, especially the diet of children, is a dangerous experiment. Moreover, milk is reasonable in cost and to exclude it from the diet is both bad cooking and false economy.

Further light will be thrown on this question by the consideration of the difference in food quality of the different proteins.

Quality Variation in Protein.—One of the serious errors of the former chemists was the considering of all protein as of practically equal nutritive value. While it has long been known that proteins were highly complex chemical substances of many different sorts, the chemists were until recently unable to analyze them. In fact, the percentage of protein given in the old food tables was not determined as protein at all, but the chemist merely determined the amount of the element nitrogen and estimated the protein by multiplying the amount of nitrogen by a figure derived from the average percentage of nitrogen in the various proteins.

More recent chemical investigations have not only resulted in distinguishing a great number of proteins, but in also determining the more elementary compounds that go to make up the individual protein. To show how immensely complex is the chemistry of these food substances we may consider first the total protein in a given natural food. This is again divided into various individual proteins; for instance, milk contains casein and albumen, wheat contains, among others, gliadin and glutenin, while eggs contain albumen and ovo-vitelin. Each of these particular proteins is again composed of numerous substances known as amino-acids. Some eighteen or twenty of these amino-acids have been chemically isolated and the approximate proportion of each in the different proteins determined. However, this analysis is approximate only, and it is highly probable that not all of the amino-acids have been isolated and named. Enough is known, however, to show the enormous complexity of protein chemistry and to show also why various proteins, or proteins from various foods, are not all of equal value in the diet.

To make this clear it should be explained that proteins are not absorbed from the digestive tract as such, but are broken down into the various amino-acids which then pass into the blood in these simpler forms. From the blood stream carrying amino-acids in varying proportions the cells of the body select those needed to build the various proteins. As the body proteins are also very numerous and complex, we see the reason that the amino-acids from different food proteins will not be supplied in the exact proportions the body requires. Moreover, the requirements for protein building material will vary according to the demands of the body as determined by the various stages of growth and functional activities of the individual.

From this brief sketch of protein chemistry it will be seen that we may expect that some protein foods will be so composed as to supply the bodily needs with but little waste, while with others a large surplus would be required in order that the human cells might find the exact ingredients needed for growth and activity. Moreover, since all proteins do not contain all the amino-acids, it is likely that some would prove wholly deficient and incapable of completely nourishing the body or sustaining normal growth.

All the above theoretical assumptions have been demonstrated by feeding experiments upon animals. The most important protein in corn kernel is zein, which substance is lacking in three amino-acids that are commonly found in the proteins of living animal tissues. On the other hand, the proteins of beans and peas seem from chemical analysis to more nearly approach those of animal tissues. But the chemical knowledge is not sufficiently accurate to enable the chemist to anticipate what will support protein metabolism in the animal body, as revealed by the fact that corn protein proves a better source of growth than that of beans and peas. An account of an actual feeding test will show how such facts are determined: Rats were given a diet complete in every respect as to fats, carbohydrates, salts and vitamines. To such a diet the protein from a single food, and that only, was supplied, and from experimental trials the amount of protein necessary to just maintain the weight of the animal is determined.

The following percentages of protein from various foods were found to be just sufficient to maintain body weight.

Milk	3 per cent of the entire food
Oats	4.5 per cent of the entire food
Millet	4.5 per cent of the entire food
Corn	6 per cent of the entire food
Wheat	6 per cent of the entire food
Rice	6 per cent of the entire food
Flax	8 per cent of the entire food
Beans	12 per cent of the entire food
Peas	12 per cent of the entire food

A similar experiment was conducted with young pigs. But in this case protein from the various sources was supplied in reasonable abundance and the amount retained in the body, or utilized for growth, was determined. The pigs utilized:

20 per cent of the corn protein.
23 per cent of the wheat protein.
26 per cent of the oat protein.
63 per cent of the milk protein.

The striking thing about both of these experiments is the very great superiority in nutrition of the protein from milk. This result, however, is perfectly logical because the milk proteins were built up for that specific purpose of furnishing material for growth, while the proteins in plant substances as well as the protein in meat are created to serve other functions than that of the nourishment. The superiority of milk as a food is not confined to its protein content alone, but its mineral and vitamine contents are equally efficient as will be shown in the following chapters.

Scientists have not, at this writing, made full investigations of the relative value of protein from all food sources, nor can the investigation upon other species of animals apply absolutely to the human nutrition. We can, however, derive certain principles from the investigations thus far made that will be of use in determining the approximate value of protein from various foods. Milk as already clearly demonstrated heads the list for the efficiency of its protein. A close second is eggs. Next in value we may expect to find the proteins of flesh food. This statement may seem contradictory to the general teachings in this work of the evils of excessive meat eating. However, the two statements will be seen to be in absolute harmony when we recall that the conventional meat diet supplies many times the amount of protein actually required for efficiency nutrition. Since the average proportion of protein in a diet of cereals, nuts and vegetables, together with milk and eggs, furnish an ample amount of protein, the use of meat as a source of protein is uncalled for, and such dangers as may be involved in the introduction of disease germs or poisonous waste products of the animal through meat is a danger that may very wisely be avoided. There is ample evidence that there is no quality in meat protein that cannot be better secured through milk and eggs, and since the quantity of protein required is much smaller than that usually eaten, meat is unnecessary as a source of protein, either from a quantitative or qualitative standpoint.

Therefore, when milk and eggs are available the use of meat must be defended upon other grounds than that of normal nutrition. For the growing child the substitution of meat for milk and eggs is never to be advised or tolerated where the purer forms of animal protein can be secured. For the adult meat may be utilized as a source of protein if taken in small quantities and no harm will ordinarily result.

Relative Value of Vegetable Protein.—The relative value of vegetable proteins is a point upon which we still need more light. The present information would indicate that oats rank higher than wheat, and wheat higher than corn. But a more important discovery is that the leguminous foods (peas and beans) have in the past been generally over-estimated as a source of protein. This use of legumes was formerly endorsed on the grounds that they were meat substitutes, a view in harmony with the old belief that a large percentage of protein was essential to the diet. Our modern knowledge of the smaller amount of protein required, together with the later discovery of the lesser value of these proteins, would indicate that this use of vegetable meat substitutes is uncalled for. This does not mean that the leguminous foods are harmful, but merely that they add no great value to the diet. The fact that they are richer in flavor and that our habit of using them as "meat substitutes" may justify but it does not necessitate their continuance in the diet in their accustomed place.

Certain vegetable protein foods were much advocated during the war, such as the soy bean and the peanut, and the meals made from the residue from the oil extraction of these products. These foods are wholesome and the evidence available indicates that the protein quality is somewhat higher than that of ordinary beans and peas. The same general statement may be made regarding the protein of nuts. I advocate the use of all these materials as wholesome and valuable foods as I have found them of practical use in winning people away from their extravagant and excessive use of meat. The teachings of the recent discoveries in this field is merely that meat substitutes are not as essential to healthful nutrition as was formerly supposed.

A further teaching from the recent scientific discoveries regarding the composition of proteins is that a mixture of proteins from various sources will often make good the deficiencies of the proteins from a single food. Hence, as a general principle, we may conclude that the protein requirements on a mixed diet would be less than that of a more limited diet. For illustration, gelatin was formerly said to be of little nutritive value, as it has long been known that it was not a complete protein. While gelatin alone will not support life, it is found that the addition of gelatin to a diet containing only the protein from a single grain will greatly increase the growth supporting power of the grain protein. The proteins of a combination of grains are also found to be better than those from any single grain of the group.

Not much is yet known of the quality of protein from vegetables, though those from the potato have been determined to be somewhat inferior to the protein from grains. Note carefully, however, that no practical application should be made of this statement or of similar discoveries that may yet be made indicating that the protein from this or that fruit or vegetable is not of high quality. The value of protein from fruits and vegetables is relatively unimportant, for these foods are not to be judged by their protein contribution to nutrition.

On the whole the question of protein has received more prominence in dietetic teachings than it really deserves, for while essential to life and growth it is sufficiently supplied in all mixed diets. The practical problem, both from a standpoint of health and economy, is to keep the protein content of the diet from being excessive. The dangers of deficiency in diet is not in protein at all, except in most unusual cases, but is the lack of the mineral salts and vitamines, which will be discussed in the two following chapters.

Substitutes for Meat.—If the use of meats in the quantities ordinarily eaten in American homes is a dietetic evil rather than a benefit, what we want is not meat substitutes to give us an excess of protein, but merely other normal foods to replace the meat eaten.

Because of the reasons fully explained, I no longer advocate the use of high protein meat substitutes. The beans, peas and macaroni that we have been in the habit of calling meat substitutes are no longer so cheap as they once were. Moreover, their dietetic value has been over-estimated. Their proteins are not as palatable nor as well suited to our bodily needs as the proteins of animal origin. The use of proteins from milk and eggs will prove as economical and more healthful than an excessive use of such vegetable protein meat substitutes.

But there is another sort of meat substitute which I deem to be thoroughly sound in theory and often necessary in practice. Our habits of eating require that the meal have a sort of centerpiece or hub which is preceded by the soup and followed by the dessert. In ordinary American cookery the "*pièce de résistance*" or hub of the meal has been a meat dish. With it we have eaten bread and butter, potatoes or other vegetables. There is no real reason why a meal need be eaten in this fashion, but man is not a creature of reason but a creature of habit. To make food economy practical to the largest number of people the efficient thing to do is to require the least necessary change from past habits. Therefore I advise the use of dishes that may be served as the hub of the meal, as meat is usually served. These dishes may truly be called meat substitutes, as they enable one to follow the customary meal habits and leave the table feeling well fed. The exact chemical composition of such dishes is of less importance than is the flavor and manner of serving. If one cannot give up the liking for the taste of meat, use for such meat substitutes may be dishes made of part meat, or of well-flavored fried or baked products which may be served or eaten in the same manner as meat dishes. The general adoption of such dishes in the place of straight meat will result in a saving of from twenty to forty per cent of the food bill.

Butter substitutes may be considered from two standpoints: First, as a food that is equivalent to butter in both the nature and the quantity of the nutrition furnished; and second, a food to be eaten as butter is eaten and which will therefore cut down the amount of butter used.

In the first instance cotton-seed oil, or other cheap cooking fats, used in cakes and other dishes that ordinarily call for butter may be considered a dietetic equivalent for the fat of butter furnishing the same amount of nutriment and being distinguished only by the lack of the peculiar "rich" butter flavor and the presence of the butter vitamine.

To use butter for general frying is an obvious extravagance, yet in many homes it has become the custom to fry certain foods in butter, because lard, which is the only other fat used, gives an objectionable flavor. If cotton-seed oil be substituted for both lard and butter, it would cut expenses in both instances, and the unwelcome flavor which lard gives to certain foods will be no longer an excuse for frying in butter. The only cases in which butter should be used in economical cooking are those in which the other ingredients are very weak in flavor and butter is relied upon to give flavor to the dish.

Because of our universal habit of eating butter spread on our bread, any other spread for bread will reduce the quantity of butter used. In the case where much fat meat is used there is no need for butter to add fat to the diet, but economy may be gained and food be made more palatable if sugar products are used as spreads for bread in place of a large portion of butter frequently used by Americans. An example of such a dish is orange marmalade so commonly used by the English.

The following is a standard recipe for marmalade. Varying proportions of oranges, lemons and grapefruit will give a variety of similar marmalades.

ORANGE MARMALADE.

Wheat pounds 4.61. Cost of recipe 46 cents. Cost per wheat pound 10 cents.

2 oranges.
1 lemon.
5 pints water.
4 pounds sugar.

Slice the oranges and lemon (including the peels) very thin. Let stand over night with the water. Put on stove next morning, boil one hour, let stand twenty-four hours. Then add the sugar, boil slowly two hours longer, and put in jelly tumblers. This amount should be boiled down until it will fill eight glasses. The marmalade keeps well and it is a good plan when oranges are cheap to make up a supply for the winter.

Marmalade is nothing but sugar flavored with oranges, and represents scarcely any cost at all except the sugar. There is a sort of subconscious idea running in the back of our heads that sugar is an expensive food. Even though sugar has doubled in price since the war, it is still much cheaper than most foods, and in nine cases out of ten its increased use would cheapen the diet.

The good old custom of making apple butter on farms where apples are cheap furnishes an inexpensive spread for bread that will reduce the dairy butter consumption. Sorghum and other varieties of molasses also cut down on the butter bill.

Another type of spread for bread is soft cheeses. Some of these cost more than butter, but cottage cheese, made from skim milk and enriched with cream and oil, makes a spread both nutritious and inexpensive. Cheese can also be made of buttermilk.

Heat buttermilk gradually to about 130 to 140 Fahrenheit. Allow it to cool, pour off most of the whey from the curd settled to the bottom, and strain out the rest. This cheese has hardly any fat, yet has a consistency suggestive of fat.

Cottage cheese made from either skim or buttermilk may be seasoned with salt only, or mixed with oil or butter or cream and various seasonings. Chopped olives or pimentos combined with cottage cheese enrich the flavor greatly. Cottage cheese can be used not only as a sandwich, but equally as well for the meaty part of a salad.

Sweet Spreads Unsatisfying.—Where the diet does not contain much other fat, sweet spreads will not satisfy, for as the German experience in the war proved, men crave a certain amount of fat and refuse to feel well fed without it. The following fat-containing butter substitutes may be used as spreads for bread. Some of them you may reject because they are not as tasty as butter, but they are all wholesome and economical and if economy is imperative there is no reason why you need to continue to suffer poverty elsewhere merely to indulge in an inordinate butter appetite.

The first of these is drippings so commonly used by the poorer classes in England. The drippings from fried or baked meats are very flavory and may be used as a butter substitute, both in cooking and as a spread for bread. The latter use will hardly be approved when there is company in the average American home, but the world food scarcity has forced some of us to serve foods we once considered as beneath our notice.

Cotton-seed oil is too flat in flavor and too thin in body to be a suitable spread for bread. It is not so bad, however, for a hungry man as one might think. With a bit of salt, or still better, with a liberal amount of sugar, it is very palatable when eaten with good fresh bread.

There are many grades of oleomargarine, the better ones of which are superior in flavor to the poorer grades of butter. Because of our pride, and the fact that we can afford to be extravagant, oleomargarine was formerly held in bad repute because it was often marketed as butter instead of being sold under its own name. The war brought oleomargarine into better repute and whereas it formerly sold for not over one-half the price of butter, it now sells for three-fourths as much.

There is now on the market a "nut margarine" made from churning cocoanut oil with cream. This sells for about the same price as cotton-seed oleo, and is excellent while fresh, but does not keep well.

Vegetarian cookery brought forth many butter substitutes in the form of nut butters. The oil of nuts is fluid at room temperature, but the solid ingredients of the nut give certain firmness or body to the butter. Nut butters are excellent, but with the exception of peanut butter are more expensive than the dairy article.

Peanut butter is one of the most economical foods on the market. It keeps well and should be purchased in bulk or in large sized packages, as the rate charged for it in the small glass containers is exorbitant. The objection to peanut butter is in its mechanical condition. The solid substances of peanut butter form a tenacious mass which does not spread well, and if eaten in chunks gums up the mouth like corner grocery ginger snaps. The consistency of peanut butter may be materially improved by working it up with oil and water, or milk, or even plain water. The butter in this form will spread better and go farther and is more comfortable to eat. The manufacturers would undoubtedly take advantage of this were it not for the fact that the butter will spoil when water is added. Mixed up in quantities sufficient for a few days only, peanut butter in this form is very excellent and most economical.

The last group of butter substitutes which we highly recommend are those in which gelatin is used to give body to the oil. Cook the gelatin with only one-half as much water (or milk) as is called for in making desserts. Gelatin may be cooked with milk in a double boiler. To the cooked gelatin while warm add the oils or butters to be used and whip with a fork as the gelatin begins to set. You can experiment freely with such combinations in various proportions.

Do not overlook the necessary salt, for if you forget this you will reject the butter substitute for tastelessness when it is merely due to lack of salt.

The adding of water to a butter substitute does not affect the economy except as it makes the oil contained go farther by giving us a larger bulk of material to spread on our bread. As a practical problem we should therefore judge the list that follows, both by the cost per pound and the cost per wheat pound.

	Price per lb.	Price per wheat lb.
Beef drippings	$0.15	$0.07
Molasses	.06	.08
Cotton-seed oil	.24	.09
One-half each cotton-seed oil and sugar	.16	.09
Orange marmalade	.08	.10
Peanut butter, three parts, oil one part, water two parts	.13	.10
Carrot marmalade	$0.08	$0.11
Peanut butter	.18	.11
Gelatin butter, oil one part, gelatin cooking milk one part	.16	.12
Oleomargarine	.28	.13
Nut margarine	.29	.14

I have given this attention to the subject of butter substitutes because the excessive price of butter makes many people feel they cannot afford it. I do not ignore that butter has a certain quality found in no substitute and that is the fat soluble vitamine. But this same vitamine is present in the milk and in green vegetables, so if these be abundantly used in the diet butter is not essential. The entire scheme of separating butter from the milk is an inexcusable practice, since it results in the wasting of the skim-milk which contains food elements equally as important. By using your share of the cow's product in its entirety and an ample supply of green vegetables, you can escape the system of robbery by which we pay for milk, but get only the butter, while the farm pigs get the milk.

TEN RULES FOR FOOD ECONOMY

1. First learn which are the most economical foods.

2. Second, keep a monthly grocery account and see to it that the larger portion of your food is of the economical sort.

3. Third, watch your daily menus and see to it that you plan dishes the chief ingredients of which are these economical foods.

4. Be resourceful and try all manner of new economical dishes to find those that appeal to your palate; then adopt these as regular items of your bill-of-fare.

5. Do not attempt to deny yourself entirely of the foods you like, as it will react and you will go back to extravagant habits.

6. Find out by study and observation the least quantity of food that will keep up your normal weight and, first from deliberate effort and later from acquired habits, learn to eat just the proper quantity of food and that amount only—as a matter of thrift, patriotic decency and personal health and efficiency.

7. Be economical in kitchen labor; two meals a day is enough for all but heavy laborers. A three-course dinner is enough for a millionaire.

8. Serve all foods that will not keep till the next meal as one portion per serving, with no second helping. Let the individual who has appetite for more than is first served him fill up on bread and butter or other foods that can be provided in excess of the amount eaten without involving waste. Those who cannot fill up on bread and butter have no healthy, normal hunger, but merely a pampered appetite.

9. Learn the new etiquette of the table which teaches that in the intelligent, cultured household just enough food should be prepared for the family and just enough served for the individual needs. Have a clean table and a clean plate at the end of the meal.

10. Do not waste your time on schemes to utilize left-overs—use your brains in planning meals and have no leftovers.

CHAPTER XVII.

MINERAL ELEMENTS IN FOOD.

THE composition of the human body as given by the physiological chemists contain fifteen chemical elements. These are present approximately in the following percentages:

Oxygen	65	per cent.	Chlorin	.22	per cent.
Carbohydrates	18	"	Sodium	.15	"
Hydrogen	10	"	Magnesium	.05	"
Nitrogen	3	"	Iron	.004	"
Calcium	2	"	Iodine	Trace	
Phorphorus	1	"	Flourine	"	
Potassium	.35	"	Silicon	"	
Sulphur	.25	"			

The first four elements variously combined form the common food substance known as carbohydrates, fats and protein. These are the organic or non-mineral elements. The remaining eleven elements are minerals or inorganic elements. When food materials are burned these minerals are left in the ash, though in the ash they do not exist as the same chemical combinations as they do when combined with the organic material in food or in the body.

ASH CONTENT OF FOOD.—The older school of food chemistry left all these inorganic elements, or "ash" from the burning of food samples grouped together in the tables of food composition as "mineral salts" or "ash." Such method of food analysis was very incomplete and uncertain and, as recent scientific progress has shown, such lumping together of chemical elements vitally important in nutrition failed to tell us the whole necessary truth. In a vague way the chemists realized that the ash content of food was of great importance and in some particular instances the specific purpose and use of these elements was known to the chemists. The followers of the natural school of dietetics, deriving their knowledge from practical observation of the effects of various diets, emphasized the supreme importance of the mineral elements in foods.

A diet of artificial foods as white flour, polished rice, sugar, glucose, fats and meat may contain correct proportions of carbohydrates, fats and proteins, yet fail to properly nourish the body. On the other hand the natural foods such as milk, eggs, fruits, nuts, entire grain products, and particularly the leafy or salad vegetables, were observed to be highly beneficial in normal diet and particularly useful in the diet of children, and as corrective elements for those suffering from ill health due to the deficiencies of the more artificial and conventional diet.

Of recent years not only has the testimony of the benefit of the such foods which are rich in the mineral elements been repeatedly demonstrated in practice but the laboratory investigations of the physiological and biological chemist have produced an interesting and conclusive fund of knowledge which explains why such benefits have been attained. This knowledge not only teaches us the importance of the mineral content of food considered as a whole, but points out the particular physiological harm that may result from such deficiencies.

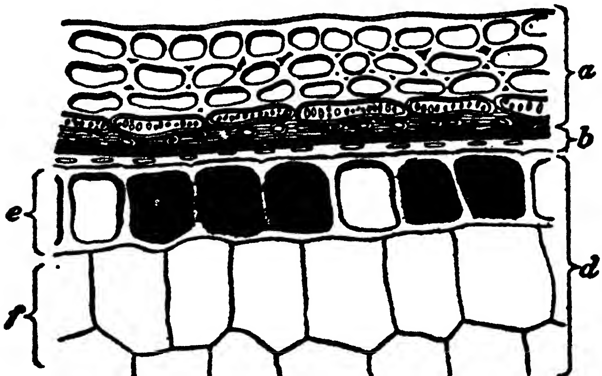
Much of the past argument regarding food minerals has centered about the question of their availability to the human body in inorganic form. Because these mineral elements are found in nature or may be manufactured in the laboratory without the aid of the life processes of plants and animals, there was a general belief among the old school of medical scientists, that mineral elements might be supplied to the body in the form of inorganic or artificial salts. On the other hand, the dietitians belonging to the natural food school held that while the chemical elements of food minerals could exist in inorganic combinations, they were not available to the use of the human body. Neither of these early views was entirely correct.

There are some mineral elements, as the sodium and chlorin of common salt, that can be utilized by the body in the simpler inorganic forms. But the more rare and hence more vitally important elements exist for the most part in complex combination with the organic elements of food, hence deficiencies in such elements can not be made good by purely mineral or artificial products.

Of the eleven mineral elements in the human body, iodine, flourine, silicon, exist in such small quantities that they can be chemically detected by qualitative analysis only, hence any detailed study of their functions is impractical. However, as these elements exist more abundantly in many plant tissues than in the human body it is not likely, with a varied diet supplying the other minerals, that any of these will be deficient, hence we need not consider them further in the present discussion.

This leaves eight elements for further consideration. Two of these, sodium and chlorine, are the components of common salt and are available to the body in that simple form. With conventional man's present custom of liberally salting his food there is no danger of these elements being deficient. In fact, salt requires consideration because of the possible ill effects that may come from the over eating of this common mineral.

The carnivorous animal secures an ample quantity of salt from his diet, for flesh, and particularly blood, is distinctly salty. Many herbivorous animals, both in a wild and domestic state, crave salt. As this is practically the only case in nature in which animals seek food in a mineral form, scientists have searched to find some logical explanation of the phenomena. One view holds that sodium chloride (salt) is craved by animals existing on a vegetable diet because of the over abundance of potassium or potash salts in vegetable substances. That potash is a highly important element in the composition of plants will be recognized by those who recall its great importance to the fertilizer industry and the role played in the world war by



Section of outer coverings of a grain of wheat. a, outer bran; b, inner bran; d, edible portion, consisting of: e, aleuron layer, rich in protein and salts; f, interior starch.

the isolation of the German potash mines. Potatoes are particularly rich in potash, and if the chemists be correct that may be a reason why we crave salt upon potatoes.

COOKING DESTROYS SALTS.—Unfortunately our modern methods of life have so changed our diet from the normal that few people know what a natural diet is, and the result is they do not get in their food a sufficient supply of these natural salts to build up the body to the most perfect vigor. Cooking also removes much of the organized salts, and to complete the cooking processes satisfactorily and make the food taste as it should mineral salt must be added. Where foods are boiled and the natural salts are leached out into the water and then poured away, as is so often the case, the foods do not contain the salts they should, and the body craves those elements in the foods of which cooking has robbed them.

Hence, in the majority of cases, there is an unsatisfied feeling if salt is absent, which most people proceed to satisfy by a too liberal use of an *artificial substitute* for that of which Nature originally gave an abundant supply. This seems to me to be the most rational explanation of the universal desire for mineral salt.

Common salt is unquestionably of supreme importance in the physiological processes. The adult human body normally contains about 100 grams, or one-fourth pound. The presence of salt in the body fluids is essential to the solution of protein. The relation of salt to the solution of protein may be clearly demonstrated with an experiment which any one can perform in the kitchen. Take a small quantity of the white of egg. Place it in a tumbler of water and the albumen will be precipitated showing a milky whiteness. If salt now be slowly added to the water, the albumen will presently be dissolved and the liquid become quite clear. Different concentrations of various salts effect the solubility of many proteins according to the strength of the salt solutions. The normal workings of the body process unquestionably depend upon the proper content not only of sodium chloride but of other mineral salts in the fluids of the body.

Should a perfectly salt free diet be fed to any person, death would be inevitable. But the essentiality of common salt in the diet does not justify its excessive use. When an excess is taken it is quickly excreted, but if the excess be too great it will result in the overstimulation of the digestive secretions and the interference of food assimilation. Excessive salt is also thought to have an unfavorable effect on protein metabolism. In the case of a long fast the salt excreted for the first ten days of fasting was fourteen grams, for the second ten days two grams, for the third ten days one-half gram. Thus between ten and twenty percent of the salt content of the body is rapidly excreted when we cease to take it in the food, while the remainder is husbanded very carefully. This would seem to indicate that we use too much salt.

Salt in connection with flesh gives rise to scurvy, salt-rheum, kidney trouble and other cutaneous and constitutional disorders. Salt is the cause of inflammation under the breasts, in the armpits and under the nose.

Those who habitually live as near to the natural diet as possible experience great discomfort from thirst if what would be regarded as an ordinary supply of salt meat or salt fish is given them at a meal. It should need no argument to prove that the excessive thirst produced is Nature's protest against a too liberal use of salty food.

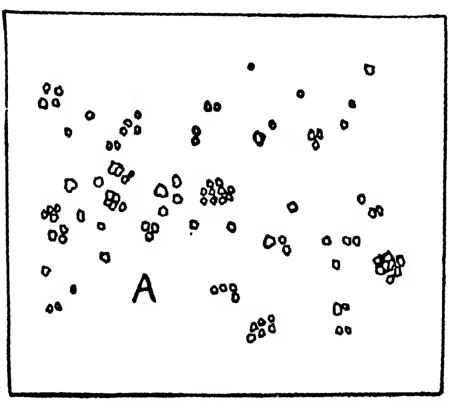
Salt, in liberal quantities, as used frequently, is as directly blinding to the sense of taste as the direct rays of the sun shining in the eyes are blinding to the sense of sight. After a continued liberal use of salt the sense of taste becomes so blunted to the natural and finer flavors of food that nothing "tastes good" unless salted to the requirements of the eater.

Hence I would recommend a reasonable caution in the use of mineral salt. Do not allow the taste buds to become so blunted that foods are not satisfactory to you unless heavily salted. Use enough to satisfy the demands of a reasonably normal appetite and there will then be little danger of your being injured by its over use.

POTASSIUM.—The potassium salts are chemically similar to those of sodium, the most abundant form being potassium chloride. This we do not need to add to the food for the reason that it is abundant in all natural diets and therefore there is no danger of potassium deficiency where other mineral essentials of the food are provided for.

SULPHUR.—Sulphur is distinct from the elements just considered, in that food sulphur is taken wholly in an organic combination. Mineral sulphur has no place in the diet and when administered as a drug passes through the alimentary canal as an entirely foreign substance. Sulphur, while a mineral, exists in food in combination with the nitrogen of protein, and in that sense may be considered as part of the organic foods. The amount of sulphur varies slightly with the different forms of protein, but on the average proteins contain about one per cent of sulphur. The sulphur while taken into the body and utilized in organic compounds is reduced in the process of metabolism to inorganic forms and is eliminated chiefly through the kidneys as mineral sulphates.

As proof that the sulphur in the body exists as a constituent of protein, and not in the simpler forms, we note that in the case of fasting, sulphur is excreted from the body at a rate proportionate to the excretion of nitrogen, both resulting from the destruction of the protein compounds. In the process



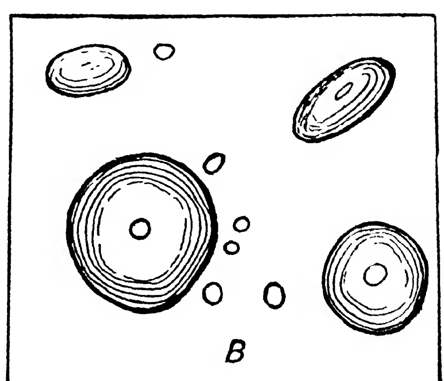


Figure A, starch granules of rice; figure B, starch granules of wheat. Drawings show comparative formation and size.

of this destruction sulphuric acid is developed and must be neutralized into sulphur salts or sulphates. This aspect of the metabolism of sulphur will be considered again under the question of the acidity and alkalinity of the fluids of the body. As a practical dietetic consideration, sulphur need not be considered separately from the question of the protein because it will vary in direct proportion and if the protein needs are taken care of, the needs for sulphur will be automatically regulated.

Sulphur also appears in the decomposition of proteins in the intestinal tract giving rise to organic sulphates and to hydrogen sulphide.

PHOSPHORUS.—The utilization of phosphorus in the physiological processes is highly complex. It enters into the composition of the cell nucleus and all cellular structure. Combined with calcium, it forms the chief mineral substance of the bones. It is a highly important element of milk. It exists in the sexual secretions and in the nerves and brain. From the early discovery of the presence of phosphorus in the brain came the saying of the scientists, "No phosphorus, no thought"; and from this same discovery came also the erroneous impression that fish was a brain food.

Functionally, phosphorus is involved in the process of cell multiplication, in the action of digestive and other enzymes, in the neutrality of the blood and body fluids, in the conduct of nerve stimulæ, in the maintenance of osmotic pressure, surface tension and the circulation of body fluids, with the multiplication of cells and with the processes of absorption and secretion.

In fasting, phosphorus is secreted at a steady rate showing that it is part of the living tissue being metabolized and not merely an excess of salt, as is the sodium chloride. The rate of phosphorus secretion in fasting also reveals the fact that bone tissue is being actually metabolized. The distribution of phosphorus in the body is that of 600 parts in the skeleton, 56 in the muscles and 5 in the brain and nerves. The rate of phosphorus secretion in fasting is such that all the phosphorus excreted could not possibly be derived elsewhere than from the phosphorus in the bones. Hence in fasting, or when phosphorus is absent from the diet, the store in the bones is drawn upon for other physiological needs, in which service the phosphorus is rendered valueless for further body use, hence it is excreted.

It has been shown that milk cows and nursing mothers, on diets deficient in phosphorus, draw upon the supply in the bones, with a resulting weakness of the skeleton. Pigs at the Kansas Experiment Station were fed a diet deficient in mineral ash, and their bones were found to be only one-half as strong as those in normally developed swine.

In the complete diet this element exists in three organic forms, besides the mineral form of phosphorus. The first of these is the phosphorus-containing proteins, notably milk, casein, and ovovitellin of egg yolk. Phosphorous proteins exist in the nucleii of all cells, hence in the proteins of all flesh foods.

The second kind of organic phosphorus is that of phosphorized fats, chief of which is lecithin, a highly important substance found abundantly in the brain and in the yolk of eggs.

Phosphorus also exists in food in combination with carbohydrates. A very surprising recent chemical discovery is that phosphorus in a very small quantity is an essential element in starch.

Experimentation leads us to the belief that phosphorus for bone growth can be absorbed from the simpler mineral forms, but for other bodily uses the phosphorus must be derived from the more highly organized forms. As evidence of this we find that the mineral phosphorus in the milk of different species is in proportion to the rate of growth of the young, and therefore cow's milk is richer in pure phosphorus than human milk, but there is as much phosphorus combined with fat in the form of lecithin in the human milk as there is in the milk of the cow. This may be one of the reasons why cow's milk, when modified, is still not as perfect a food for the human infant as the mother's milk.

A number of experiments have been conducted in an effort to solve this problem of the comparative dietetic worth of food phosphorus in organic and inorganic forms. The results are somewhat contradictory and the scientists are not fully agreed in the matter. Much of the experimental evidence indicates the distinct superiority of the organic forms of food phosphorus, while in no cases does the pure mineral salt show any advantage. The safe course, therefore, is to secure a high phosphorus content in its organic combinations in natural foods.

Efforts to exploit mineral salts as dietetic accessories are frequent not only in human medicine but in the nutrition of domestic animals. A few years ago a grit for chickens composed of rock phosphates was very much advertised. Careful tests by experiment stations proved that such phosphorus rock was of no more value to the chickens than any other form of gritty substance, which the chicken uses for grinding food in the gizzard, and that the rock phosphate would not supply the food phosphorus which the poultryman usually secures from ground bones.

Like sulphur, phosphorus is broken down in the vital processes and is excreted from the body in the form of simple mineral phosphates. The amount of phosphorus needed in human nutrition is at least a gram per day. A study of many diets reveals that the phosphorus content is likely to be below this minimum need particularly when the diet is composed largly of white flour, polished rice, sugar and other demineralized foods. The safest correctives of the phosphorus-lacking diet is milk and eggs.

The following table gives the amount of phosphorus, calcium and iron in selected foods that are particularly rich or particularly deficient in these three most essential minerals. The amounts are not given per pound of the food but for 2,500 calories (1.5 wheat pounds), which is the food requirement of a man for a day. This means that if a man lived wholly on lean beef he would secure five times as much phosphorus as needed, but would secure but one-third the necessary calcium. While if he lived on oranges, he would secure but one-tenth the phosphorus needed but four times more calcium than the body requires, etc.

QUANTITY OF ESSENTIAL MINERALS SUPPLIED BY 2500 CALORIES OF VARIOUS FOODS.

	Grams of Phosphorus	Grams of Calcium	Milligrams of Iron
Spinach	5.40	6.54	375
Lettuce	4.72	4.38	156
Lean beef	4.21	.15	81
Cheese	4.02	5.40	9
Beans	3.61	1.17	49
Milk	3.34	4.35	8
Eggs	3.58	1.35	47
Turnips	3.12	3.97	32
Whole wheat	3.34	.33	35
Carrots	2.51	2.80	42
Oatmeal	2.38	.41	21
Cabbage	2.34	3.55	86
Beets	2.13	1.60	32
Peanuts	1.93	.33	9
Almonds	1.78	.89	15
Potatoes	1.71	.43	35
Walnuts	1.34	.33	7
Oranges	1.06	2.17	10
Prunes	.83	.43	25
Bananas	.71	.22	15
Polished rice	.68	.03	5
White flour	.61	.15	12
Apples	.55	.30	8

CALCIUM AND MAGNESIUM.—Calcium and magnesium are chemical elements of somewhat similar properties. Both occur combined with phosphorus in the bones. Egg shells are composed of calcium carbonate, and the similarity to magnesium is revealed by the fact that hens fed a diet deficient in calcium but rich in magnesium will lay eggs with the shells composed of magnesium carbonate. But in more complex physiological needs, even these related elements cannot be so readily substituted for each other.

The calcium salts in the blood are intimately related to its power of coagulation. The balance between calcium salts on the one hand and those of sodium potassium on the other is thought to be the chemical basis of the control of the heart beat. The calcium salts seem to stimulate the contraction of the muscles, and an excess of calcium causes what is known as calcium rigor of the heart. This statement will show the high importance of the mineral salts in sustaining and regulating the life processes and the actual dangers of possible deficiencies—

for while the body may find ways to rid itself of an over supply, if the elements are not present in the diet it cannot be created in the body if there is an under supply.

As a practical dietetic problem magnesium needs no separate consideration because the quantity required is relatively small and because it is usually associated with calcium in such quantities that if the calcium supply be sufficient the needs for magnesium will be taken care of.

The total weight of calcium in the body is the greatest of any mineral, and, like phosphorus, it is unevenly distributed, being by far the most abundant in the bones. Calcium is also quite irregularly distributed in foods, and hence an ill selected diet creates a danger of a calcium shortage. A study of the usual diets of various groups of people indicates that calcium is the food element most frequently deficient. Many of the cases of malnutrition, especially among children, that were formerly considered to be due to a lack in protein are now known to be caused by a lack of calcium. As in the case of phosphorus, milk so rich in these two elements essential to bone growth, is the article to be first relied upon in guaranteeing against calcium deficiency.

Meat, when free from bones, is not sufficiently rich in calcium to nourish the young of carnivorous animals. The failure of lions to bring forth healthy young in captivity has been found to be due to the habit of feeding them upon meat from which the bones have been removed. Puppies fed pure meat and fat have suffered a check in their growth which has been remedied by giving them bones to gnaw. Pigeons fed food deficient in calcium give an outward appearance of maintaining health, but upon being killed and examined it was found that the bones had suffered degeneration even to the extent of the perforation of the skull.

Earlier scientific investigators failed to realize the full extent of the calcium needs of the body, due to the fact that they assumed that all of the calcium was excreted by way of the kidneys and that the calcium in the feces was an indication that much calcium in the food was not digested. It has now been discovered that the calcium in the food is absorbed and again excreted by way of the intestines, hence the erroneous reasoning which led to underestimating the calcium needs. The body requires at least one-half gram of calcium per day, and a larger amount is a safe estimate because there is greater danger from deficiency and little danger from a moderate excess.

Growing boys from six to ten years of age were found to accumulate calcium in the body from the rate of four-tenths grams per day, which does not account for that required in the various physiological processes and again excreted. An ample calcium supply is highly essential to the pregnant and nursing mother, for if either phosphorus or calcium be lacking in the diet the supply in the bones will be drawn upon to meet the demands of milk secretions.

Iron.—Of all those chemical elements which exist in the body in measurable quantity iron is the rarest. The total quantity in the human body is hardly more than one-tenth of an ounce, or but one part in 25,000 of the weight of the body. But small as is this quantity, it is absolutely necessary to life. Iron in highly organic combination is essential to the composition of the hemoglobin of the red blood corpuscles, the substance which gives them their peculiar power to carry oxygen from the lungs to the tissues. Lack of iron produces anemia, a very prevalent disease symptom due to the decrease in the red corpuscles.

This function of iron has been known to the medical world for many years, and mineral iron in inorganic form was the classic prescription for the cure of anemia. The modern biological chemists have attempted to investigate this problem with a view of determining whether such mineral iron was effective or whether its use was merely a fallacy reasoned from the chemical knowledge of the presence of iron in the blood corpuscles. As in the case of the phosphorus problem, much argument has been waged as to the conclusion to be drawn from this experimentation. Formerly favorable results have been reported from the use of medicinal iron, but the results were not conclusive. The modern view seems to be that the mineral iron is not available for this highly important physiological function, and that such favorable results as have been reported from its use were either due to other causes or that the normal usefulness of mineral iron was merely to spare in some way the destruction of the true food iron. For instance, iron combines with hydrogen sulphide in the intestines, and perhaps the presence of mineral iron may in this manner prevent undue destruction of the true food iron.

The best scientific opinion today concedes that with iron, as with other highly complex mineral food substances, it is a dangerous expedient to attempt to rely on the artificial products of the chemist, as substitutes for the natural organic combination of minerals with food substances evolved in plant life, from which source the human and the animal body under natural conditions secured the mineral elements of nutrition.

Food iron is absorbed from the small intestines and deposited in the pancreas, liver and marrow of the bones, where the red blood corpuscles are formed. The minimum body requirement of iron is about ten milograms a day, which in a normal diet furnishes iron in about the same proportion that it is present in milk. Compared with human needs, iron is more rare in milk than are other essential food minerals. The probable explanation is that the iron of milk exists in a chemical form highly adapted for physiological use without waste, whereas iron in other food substances may be only partly available to the physiological needs. The shortage of iron in milk is explained by some scientists by the reputed presence of a store of iron in the body of the child at birth. It is stated that the young of such animals as have short nursing periods show no such store of organic iron. While this theory does not seem altogether plausible, the fact is clearly established that the iron content of milk is no more than a safe minimum, and that may also have a practical bearing on the poor nutritive value of a diet for the human infant that consists in diluted cow's milk or diet of milk supplemented only with cereal substance and sugar. The use of fruit and vegetable juices to supplement such artificial feeding of children is found in practice to prove a safeguard against malnutrition, which fact may be related to this problem of the supply of organic iron.

The iron content of meat is chiefly in the blood contained in the meat tissues. Moreover, it is doubtful if this eating of the spent blood corpuscles of other animals gives a suitable supply of iron for forming new blood corpuscles.

Wheat is robbed of its iron supply in the milling of white flour, which contains only one-sixth as much iron as whole wheat. In a carefully conducted experiment two groups of young rats were fed white bread and bran bread. The rats fed bran bread gained about four times as much in weight as the white bread rats. They were killed and an estimate made of the red blood corpuscles. Only two-thirds as many of these oxygen-bearing messengers were found in the white bread rats as were found in their bran bread brothers.

Acidity and Alkalinity.—Acidosis is an abnormal condition of the body due to a reduction of the normal alkalinity of the blood and body fluids. It results, among other things, in a strongly acid urine and a failure to absorb uric acid. This problem of the balance of acids and alkalies in the human body is a very complex one, the full theoretical discussion of which cannot be given here. The condition of acidosis may be temporarily and artificially corrected by the administration of common soda. But this, like many medical measures, is in no sense a true and permanent remedy. Soda may be used, however, in diagnosis of this abnormal condition. The urine is normally slightly acid, but a dose of from five to ten grams of soda will result in causing it to give an alkaline reaction to litmus paper. But if the blood be abnormally acid, this amount of soda will fail to turn the litmus paper blue and a condition is indicated which can only be permanently remedied by a correctly balanced diet.

Many chemical substances contribute to the total contents of acid and alkaline elements of the blood. The absorbed carbon dioxide is slightly acid, while the majority of the mineral salts in the blood are alkaline. The true balance gives a mildly alkaline reaction, but the normal blood condition is so near the marginal line of neutrality that the failure of the alkaline yielding salts or an increase of foods that form acids in their metabolism will result in an increase of the acid elements. When body proteins are finally destroyed in the various vital processes, the sulphur content in them is oxydized to the highly powerful sulphuric acid. If this acid remained unneutralized it would prove exceedingly poisonous and destructive to cellular life. In practice sulphuric acid never exists in the body as such in any measurable quantity, but it is constantly being formed and as quickly being neutralized by the alkaline minerals.

Phosphorus plays an important part in this neutralization of the sulphuric acid. But these alkaline salts in neutralizing the acid lose their alkalinity, hence the danger of acidosis when there is too much acid to be taken care of. As a chief source of the acid is from protein, particularly meat proteins—neither meats, fats, sugars, or starches, bear alkaline salts—the natural correctives are the vegetables, rich in the alkaline salts.

The above statements in reference to the danger of acidosis bears no relation to such foods as acid fruits, or sour milk. These acids are composed of oxygen, hydrogen and carbon and are much more closely related to fruit sugars than they are to the mineral acids. These purely organic acid fruits do not appear in the blood as acids at all, but are neutralized in digestion and assimilated and burned in the body much as are sugar, starches and other neutral foods.

CHAPTER XVIII.

VITAMINES—THE BIOLOGICAL ANALYSIS OF FOOD.

THE term "vitamine" was originated by Funk, an English scientist, about 1912. He was investigating the problem of beri-beri, the deficiency disease caused by a diet of polished rice or grains of similar food properties. Other investigators had learned that a similar disease could be caused by a polished rice diet fed to pigeons. They had also observed that the disease could be cured as in man, by feeding whole rice or other natural food substances. The English scientist attempted to isolate and analyze the chemical constituents of the missing food essential in the rice germ, or bran. He was not successful in determining the chemical composition of this mysterious substance, but he learned many of its properties, and that it existed in very minute quantities and was not a mineral salt. He termed the mysterious substance a "vitamine" and conceived the theory that vitamines were specific substances in food, the absence of which would cause specific diseases. The expectations of this investigator were that scurvy, pellagra, rickets and perhaps other diseases known to be caused by a deficient diet could be cured by the specific "vitamine" or missing food element, should it be discovered.

This theory that each food deficiency disease has its particular preventive vitamine has not been established by later investigations. But like many erroneous theories, the vitamine idea has proved of great importance in the stimulation of scientific research. Moreover, the publication of such scientific researches together with the use of the very suggestive term vitamine, turned the popular imagination toward the broad and general problem of the dangers of an artificial, denatured or deficient diet.

ANIMAL EXPERIMENTATION.—In this eager search for food vitamines the scientists have adopted a method of research comparatively new to food problems. It is that of animal experimentation or biological testing of foods as distinct from the older method of chemical analysis. Animals, particularly small mammals that are easily kept in laboratories, such as guinea pigs, white rats and mice, had been extensively used by the bacteriologist in food experimentation as well as in testing the strength and effect of drugs, particularly those which could not be satisfactorily analyzed by chemical methods.

In this chapter will be given not only the facts regarding the unidentified food essentials popularly termed vitamines, but also a general review of methods and results achieved by this school of biological chemists who have investigated food problems by the method of animal experimentation. The general plan followed in such investigations is that of feeding a diet of foods the exact chemical properties of which were known, and to which may be added one or more foods the particular effects and properties of which the investigator wishes to discover.

There is considerable rivalry between this school of food experimenters and the old school of chemists, who confined food investigations to purely chemical analysis. However, it should be noted that it was the achievements of chemical science which enabled such diets composed of selected pure food elements to be prepared, which has made possible the biological researches.

Reference has already been made, in the chapters on protein and mineral salts, to results obtained with animal experimentation. Many of the earlier investigations in this field were with domestic animals and were conducted for the purpose of gaining information on animal nutrition. At the University of Wisconsin cows were fed diets derived wholly from the corn plant and compared with other cows fed wholly from wheat and from oats, in each case the food including not only grain but the fodder or straw. The cows were able to live on all three diets, though the corn-fed animals were the more thrifty. But particularly interesting were the results in the bearing of the young. The calves of corn-fed cows were healthy and normal, while the wheat-fed cows gave birth to their young prematurely, and the young were either born dead or died within a few hours. Oat-fed cows gave birth to weak calves, many of which died at an early date. The corn-fed cows produced nearly three times as much milk as the wheat-fed animals.

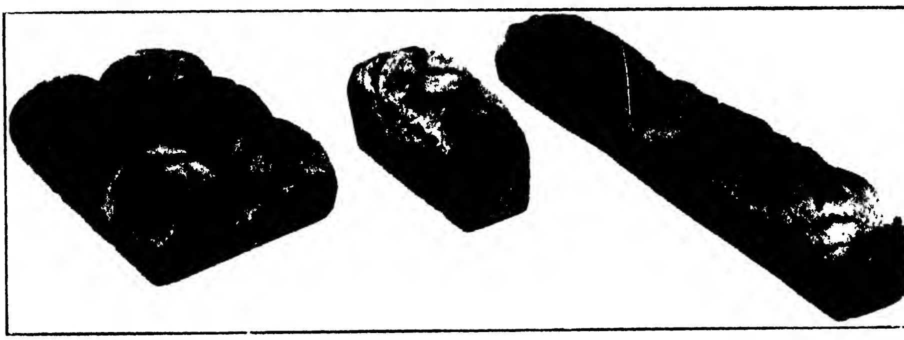
All this was exceedingly interesting and clearly demonstrated the insufficiency of the old food standards which were content to prescribe certain proportions of fats, carbohydrates and protein. The rations from the corn, wheat and oat plant had all answered the older chemical food standards. Here was a mystery that escaped the chemists. Here also was evidence that if food problems were to be solved, it was not sufficient to merely conduct experimentation for a few weeks or months with adult animals or even with the growing young, for the significant deficiencies were only revealed with the process of reproduction. The advantage of conducting such researches with an animal of brief generations, like the rat, is obvious. Moreover the rat is by nature omnivorous, hence the presumption that his dietetic needs are more nearly akin to man's than to those of a cow or dog.

It should be remarked at this point that the biological method of research has emphasized the fact that the fundamental chemical laws of nutrition apply pretty generally to all species, the chief differences between various species being in the mechanical or physical differences in the diet and the consequent adaptation of the digestive organs to various degrees of food bulkiness. Herbivorous animals have large digestive tracts for the digestion of bulky foods. Carnivorous animals occupy the other extreme, while omnivorous animals are intermediate. Some differences also exist as to the proportions of various food elements required, particularly as determined by the rate of growth of the young. But the essentiality of a particular element and the effects of its absence on the organism seems to apply generally to all warm-blooded species, and certainly to all mammals. Hence, while we cannot look upon experiments with pigeons or rats as absolutely applicable to the human species, we must accept the view that fundamental laws can be discovered in this manner. Experimentation requiring feeding for a complete generation or for several generations when applied to humans would involve insurmountable difficulties.

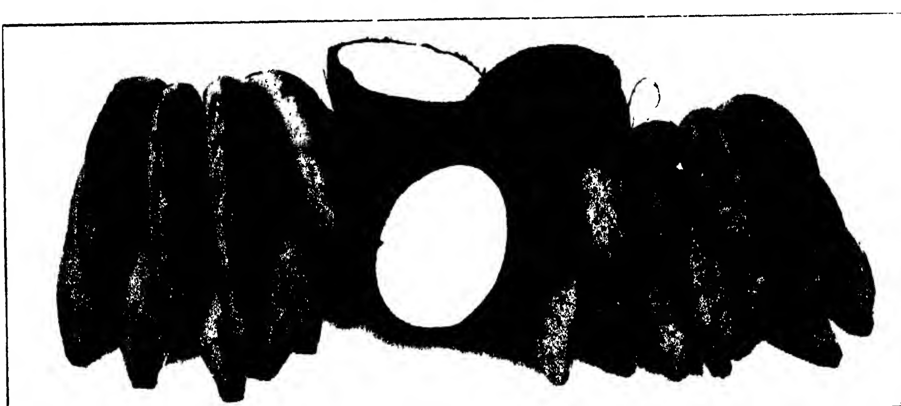
Discoveries by McCollum.—The experiment in feeding cows, above referred to, led E. V. McCollum to undertake exhaustive experiments in systematic biological feeding tests that have resulted in materially furthering the world's knowledge of the science of nutrition. His first discovery that led to important results was that rats would not thrive on a diet of purified foodstuffs, though it included ample skim milk protein and mineral salts; but that normal health and growth could be secured if a small amount of butter was added to the diet. Since the rats were already getting ample fat from vegetable sources it was evident that it was not the added fat of the butter but some unknown substance existing in the butter in small amounts. The view that this newly discovered food essential was some material dissolved in fat was further proved by the fact that egg yolk was found to be efficient in the same way as the fat of butter; lard and vegetable oils failed utterly to support growth. It was thus proved that all fats were not of equal dietetic value, although the chemists had always reckoned them so.

The first impression was that this unknown food essential or vitamine was the same as that discovered by Funk in the germ and bran of rice. But the diet upon which the rats were first fed and which was completed by the addition of butter fat was later found to contain the water soluble vitamine as an impurity in the milk sugar, for when the sugar was more carefully refined it was then found necessary to add the water soluble vitamine also before the diet would sustain life and growth. A further series of careful experiments revealed that there were two food essentials or vitamines of unknown composition, one of which was soluble in water and one of which was soluble in fat. Rejecting the term "vitamine" McCollum named these essential elements "water soluble A" and "fat soluble B." A mixture of refined foods containing carbohydrates, proteins, ordinary fats and mineral salts will not support

Some of the raw breads that are made from the whole grain of the wheat. First dish to the left, raw flaked wheat; second, round cakes of raw bread; third, another form of raw bread; fourth, a variety of raw bread largely composed of bran, especially valuable for remedying sluggishness of the bowels.



Examples of the delicious bread made from the whole meal of the wheat. Note its substantial appearance and rich brown color.



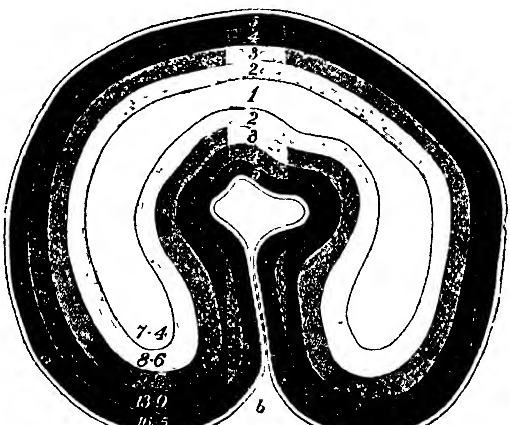
The banana and cocoanut constitute two extremely important factors in the nut and fruit diet.

growth unless both of these vitamine food essentials are present.

The original vitamine theory that held that each deficiency disease was caused by the absence of a particular vitamine was thus disproven, as many such diseases were found to be curable by diets containing, in addition to ordinary fat, carbohydrates, suitable mixtures of protein, and salts, the water soluble vitamine, first discovered by Funk in rice polishings, and the fat soluble, first discovered by McCollum in butter fat

Since a diet may be deficient in the quantity of protein, carbohydrates or fats, and since it also may be deficient in the quality of proteins or in the quality or quantity of any of several mineral salts, and lastly in the quantity of either of the two vitamines, we readily see that the deficiencies in one or more of these varied essentials may cause various symptoms and diseases of mal-nutrition. The complexity of the problem seems to permit of a sufficient explanation of the numerous manifestations of food deficiency that have been observed.

A further important discovery made by McCollum relates to the value of grain or seeds in nutrition. He found, with numerous experiments, that no single grain or combinations of grains was sufficient to sustain normal growth in young rats. Further search of natural habits of animals and the records of feeding tests revealed the fact that no warm-blooded animals in nature or in the experi-



A GRAIN OF WHEAT.

Diagram of cross section of a grain of wheat of the Purple Straw type, showing the location of the five arbitrary "concentric" zones or layers of flour removed by hand. The "core" is shown white, and each successive zone is shown in a darker shade, the outermost zone being represented black. Outside the zones the bran is represented as a narrow white layer. The five zones are numbered 1, 2, 3, 4, 5, and are successively thinner toward the outside of the grain. The percentages of gluten found in the flour are marked on each zone. Zone 1 7.4 per cent; zone 2, 8.6 per cent; zone 3, 9.5 per cent; zone 4, 13.9 per cent; zone 5, 16.5 per cent. The diagram is drawn to scale.

mental laboratory derived complete nutrition from seeds alone. Even seed-eating birds add insects, green leaves and sprouts and minerals taken in the form of "grit," to their diet.

Artificially milled and refined grain product were found to be deficient in the water soluble vitamine, but this deficiency is remedied when the whole grain is utilized. Most whole grains contain some of the fat soluble vitamine, though not enough for complete nourishment. Whole grains are therefore a far better source of nutrition than the denatured milled product. Pigeons when fed white flour bread died more quickly than those kept on an absolute fast. White flour is not a poison, but it is lacking in many food essentials. The birds fed the white flour starved to death for these essentials the more quickly because the added burden of digesting and metabolizing the white flour used up the bodily store of salts and vitamines. The fasting birds lived longer because the store of these elements was conserved. This experiment has been cited as a striking proof of the superiority of the whole wheat and the deficiency of white flour. But the new fact pointed out by McCollum is that the pigeon fed whole wheat will also succumb in the course of time, because even the whole grain, though vastly superior to the denatured product, is not a complete food. Wheat, he maintains, like other grains and seeds, has an insufficient quantity of the fat soluble vitamine and is also deficient in mineral salts, particularly calcium. Both of these faults are remedied by the addition of sufficient milk to the diet, as whole milk contains an ample quantity of calcium as well as both kinds of vitamines.

From McCollum's viewpoint, therefore, the statement that whole wheat bread is a complete food is incorrect, although his experiments show its food value is very much higher than white flour products even when these be combined with sugar, fats and meat.

By investigations of the relative value of natural foods McCollum discovered that the addition of any sort of edible leaves to a diet of grains or meat, or grain and meat, greatly increased the growth sustaining power. A diet of sixty percent of any seed or grain with forty percent of alfalfa leaf flour was found to be greatly superior to any possible diet that could be made solely of grains, legumes, or other seeds. When the diet was composed of fifty percent corn, thirty percent alfalfa leaves and twenty percent peas, the experimental rats were able to complete their growth and reproduce their kind for several generations. This diet for the rat was the best diet of wholly vegetable origin discovered by McCollum. While the rats lived and reproduced upon it, they did not reach a maximum efficiency of growth and vitality. Out of many hundreds of vegetarian diets tried, none were found that would nourish the rat as completely as a diet including some foods of animal origin, particularly those diets that included milk.

ESSENTIAL "PROTECTIVE FOODS."—The same fact had been found to be true in the nutritive of pigs, which like rats are considered omnivorous in their habits. The statement applies equally to chickens and ducks. With all these domestic animals more profitable growth can be secured if some foods of animal origin are given, and with all of them the most efficient of all animal foods is milk. It is interesting to note that in all these species where animal foods are not available, the addition of leafy foods is a great help towards perfect nutrition. The practical observations of animal feeders bear out McCollum's contention of the superior value of milk and green leaves as the essential "protective foods." The addition of milk to a diet of grains makes possible growth and reproduction in all these species, and the same principle undoubtedly applies to man. Where milk is not available the best substitute is leafy foods. Thus we can explain the nutrition of the people of India, China and Japan in whose diets milk has small place, for these people use ample quantities of green vegetables. In practical application the use of both milk and green vegetables is found in animal feeding to give superior results to the use of either alone and the same conclusion we may safely apply to mankind.

McCollum points out the remarkable fact that these highly important discoveries in food science were utterly ignored by the merely chemical consideration of foods as carbohydrates, proteins and fats, etc. He advises that practical dietetics be taught by grouping foods, in accordance with the purpose of the food in the economy of the plant or animal from which it is derived.

By this system milk unquestionably deserves a distinct place as a food of the highest order. Its function in nature is that of a food for the young mammal. No other food product used by man has such a complete natural function. The nearest approach is that of eggs, which are slightly inferior to milk for the following reasons: They contain no carbohydrates, as the chick growing within the shell needs little energy because it is inactive. Secondly, the edible portion of the egg is more deficient in calcium, as the chick obtains a portion of this element required for bone growth by dissolving the calcium carbonate from the egg shell. Lastly, the chick, not being a mammal, may on general principles be considered less closely akin in its nutritive needs to the human kind, than is the calf.

The second food group in McCollum's list is the leafy vegetables. Ample experimentation has proved leafy foods to contain the vitamines and minerals so likely to be deficient in the grain and meat products of a conventional diet.

The third food group in this system is that of seeds or grains. The place of the seed in nature is that of a storehouse of food energy, and this function explains why the seed is rich in carbohydrates, as in the case of grains, or in fats, as in the case of nuts and many other seeds. The seeds, therefore, can supply in economical form the energy requirements of man, but they must be supplemented by other foods rich in the lacking essentials. The bulk of the seed kernel is in the endosperm, which is rich either in starch or in oil. This portion of the seed is merely a storehouse of energy and is not composed of living cells containing the vitally active protoplasm. But the bran and germ of seeds is composed of cells and is a living portion of the plant, hence the use of whole grains is advantageous in the same way as is the use of leafy foods. White flour, polished rice, degerminated corn meal, vegetable oil or extracted sugar are all derived from the plant's surplus store of food energy. None of these foods, nor any combination of them, is sufficient to support growth and reproduction. The use of the whole grain or product which contains the whole of these concentrated energy foods is much less dangerous than denatured foods, but even the use of these whole grain foods is not sufficient for the maximum efficiency in growth and nutrition unless supplemented by other foods.

Milk, eggs and green vegetables used in the diet are the surest means of avoiding food deficiencies. With an ample use of these highly enriched and protective foods even a diet of denatured starches, oils and sugars may become safe. The logical and economical plan to follow is to use the grain and seed products in their natural and entire state and to add also the milk and greens. With such a diet the danger of food deficiency is indeed remote.

We have yet to consider certain further groups. Most vegetables, other than leafy greens, are tubers, roots or the thickened leaf bases, as in the case of cabbages, onions, chard and celery. Like seeds, the use of the roots and tubers in nature is that of a storehouse of energy for the next plant generation. This class of vegetables occupies an intermediate place in dietary value between leaves and seeds. If the vegetable is used in its entirety as in the case of potatoes, when the skin is eaten also, the value is likely to be superior to the grains. But if the raw potato be peeled with a knife, or if the sugar alone be extracted from the beet, we see again the denaturing process of extracting the energy food and discarding the vital cellular elements. Vegetables may also be "denatured" by the custom of boiling them and discarding the water, for many of the valuable elements are thus dissolved and wasted.

Many so-called vegetables, such as melons and tomatoes, are in truth fruit. Fruits may be given a dietary rank just below that of leaves. They are notably rich in minerals and presumably in vitamines, though at this writing they have not been experimentally tested for these elements. The chief value of fruits, however, is in their natural sugars and organic acids, which present a variety of pleasing flavors. A diet might be entirely correct physiologically, and yet be psychologically deficient because of a lack of palatability. Fruits therefore rank especially high in the final dietetic reckoning.

In McCollum's classification nuts are grouped with seeds because they are seeds in nature. In practical dietetics I would suggest that the nuts deserve a separate classification because of their higher fat content, and therefore of their capacity to improve, in that respect, a diet mainly derived from grains in which the energy food is in the form of starch.

Ten young mice at beginning of biological food test

Five of the mice after a month's nourishment on natural foods.

Five of the mice after a month of devitalized food.

Low Ranking for Meat.—The greatest novelty of McCollum's system of food classification is in the dietetic ranking given to meat. This eminent scientist is not a vegetarian, and in fact rejects the vegetarian diet on the assumption that man is by nature omnivorous and that his dietetic necessities are analogous to those of the rats, pigs, and chickens. Neither does he take into consideration the objections to meat in the diet on the ground that it is a source of disease or that it contains the unexcreted waste products of the animal. Yet viewed wholly from the standpoint of its function in nature, McCollum ranks meat as of low dietetic value because meat as consumed is almost wholly made up of the functionally specialized tissue of muscle or stored fat. Neither sort of tissue is as rich in living cell protoplasm as are the active functional organs of the body. Fat meat is obviously a storehouse of food energy and as such is analogous to the stored fats in nuts and seeds. Lean meat is muscle and is composed of active cells. But these muscle cells are highly specialized for one function and hence may not be expected to be a source of complete nutrition for the entire physiological activity. In support of this unique view McCollum points out that carnivorous animals prefer the blood and the physiological active organs, such as the liver and kidneys, of their prey. Moreover, they also gnaw the bones.

Both the chemical analysis and the biological feeding tests seem to support this view of the dietetic insufficiency of meat products such as are consumed by man. Milk is a complete food and will support growth and reproduction in experimental animals. Meat, on the other hand, is a deficient, and requires to be supplemented by the protective foods much as does a diet of seeds.

The conventional diet of civilized man is dominantly one of seeds and meats, to which may be added refined sugar, and oils. If to this diet milk, leaves and fruits be added, nutrition is complete. Without such additions, especially when grains and vegetables are denatured in milling and cooking, the malnutrition and deficiency diseases of civilization result.

Such in brief are the conclusions of the most advanced authorities of the science of nutrition. These conclusions agree with the essential principle of physical culture dietetic teachings. When I began my work in food reform my views were freely ridiculed by physicians and by the food chemists of universities and government laboratories. Today the "natural" food system of dietetics, which I have advocated from the beginning, has been established by the research of highest authorities in those very scientific groups which formerly ridiculed my teachings. At the beginning of the twentieth century vegetarians were looked upon as unscientific cranks. Today the vegetarian diet, when it includes the use of milk and eggs, stands approved by scientists as the most efficient diet known to man. In regard to it McCollum says: "Lacto-vegetarianism, when the diet is properly planned, is the most highly satisfactory plan which can be adopted in the nutrition of man."

CHAPTER XIX.

MILK, MILK PRODUCTS AND EGGS.

MILK, in one form or another, is common throughout the civilized world. It is estimated that fifty-three gallons per year are consumed by every man, woman and child in the United States.

In this country the animal that is generally bred for the production of a supply of milk is the cow. It is not asserted that the milk of cows is any more desirable for human food than that of some other mammals, but their milk producing power is generally more satisfactory. Our preference for cow's milk is undoubtedly owing to custom and acquired taste. In India buffalo milk is used, and in South America that of the llama. In Switzerland and other rough and hilly countries of Europe it is the milk of the goat, while in the faraway frozen North the milk of the reindeer is a staple article of diet. Other lands favor other milk.

AVERAGE COMPOSITION OF MILK.—The average composition of milk obtained from the various mammals is as follows:

Average composition of milk of various kinds.

KIND OF MILK.	Water.	Total solids.	Protein.			Fat.	Carbohydrates (milk sugar)	Mineral matters.	Fuel value per pound.
			Casein.	Albumin.	Total.				
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Woman	87.58	12.6	0.80	1.21	2.01	3.74	6.37	0.30	310
Cow	87.27	12.8	2.88	.51	3.39	3.68	4.94	.72	310
Goat	86.88	13.1	2.87	.89	3.76	4.07	4.64	.85	315
Sheep	83.57	16.4	4.17	.98	5.15	6.18	4.73	.96	410
Buffalo (Indian)	82.16	....	4.26	.46	....	7.51	4.77	.84	....
Zebu	86.13	....	....	....	3.03	4.80	5.34	.70	....
Camel	87.13	....	3.49	.38	....	2.87	5.39	.74	....
Llama	86.55	....	3.00	.90	....	3.15	5 60	.80	....
Reindeer	67.20	....	8.38	1.51	....	17.09	2.82	1.49	....
Mare	90.58	9.9	1.30	.75	....	1.14	5.87	.36	....
Ass	90.12	10.4	.79	1.06	....	1.37	6.19	.47	215

The average composition of milk products as compared with other foods in common use is shown as per Government analyses in the accompanying table:

Average composition of milk products compared with other food materials.

MATERIAL.	Refuse.	Water.	Protein.	Fat.	Carbo-hy-drates.	Ash.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*
Whole milk	....	87.0	3.3	4.0	5.0	0.7
Skim milk	....	90.5	3.4	.3	5.1	.7
Cream	....	74.0	2.5	18.5	4.5	.5
Buttermilk	....	91.0	3.0	.5	4.8	.7
Whey	....	93.0	1.0	.3	5.0	.7
Condensed milk, unsweetened	....	71.3	7.4	8.5	11.1	1.7
Condensed milk, sweetened	....	26.0	8.2	9.6	54.3	1.9
Butter	....	13.0	1.0	83.0	....	3.0
Cheese, American Cheddar	....	33.5	26.0	35.5	1.5	3.5
Cheese, cottage	....	53.0	19.6	23.2	2.1	2.1
Cheese, Swiss	....	31.4	27.6	34.9	1.3	4.8
Milk powder (from skimmed milk)	....	3.0	34.0	3.1	51.9	8.0
Kephir....	....	89.6	3.1	2 0	*a* 4.5	.8
Koumiss	....	90.7	2.2	2.1	*b* 4.1	.9
Infant and invalid foods, farinaceous	....	9.4	9.4	.4	*c* 79.9	.9
Infant and invalid foods containing milk and starches	....	4.3	9.6	3.8	*d* 80.2	2.1
Infant and invalid foods, malted preparations	....	4.2	12.0	1.0	*e* 79.8	3.0
Beef, sirloin steak	12.8	54.0	16.5	16.1	....	.9
Eggs, as purchased	11.2	65.5	11.9	9.3	....	.9
Wheat flour, patent roller process	....	12.0	11.4	1.0	75.1	.5
Wheat bread, white	....	35.3	9.2	1.3	53.1	1.1
Beans, baked	....	68.9	6.9	2.5	19.6	2.1
Potatoes, as purchased	20.0	62.6	1.8	.1	14.7	.8
Apples, as purchased	25.0	63.3	.3	.3	10.8	.3

a Including 2.1 per cent. alcohol and 0.8 per cent. lactic acid.
b Including 1.7 per cent. alcohol and 0.9 per cent. lactic acid.
c Including 6.62 per cent. soluble carbohydrates (sugars).
d Including 49.05 per cent. soluble carbohydrates (sugars).
e Including 48.39 per cent. soluble carbohydrates (sugars).

As the table shows, the three groups of protein, fat and carbohydrates are represented by fair proportions as compared with other foods, the quantities of protein and fat being especially noteworthy, as it is these elements and the mineral matter, ash, which give milk its peculiar value as food.

Milk varies very much in quality owing to the different nutrient elements found. It is entirely possible for one man to pay nearly twice as much as his neighbor for an equivalent nutritive value in milk at the same price per quart, but from different dealers. In other words, if one pays ten cents a quart for milk that contains only half the quantity of nutritive food elements contained in a quart for which his neighbor pays only ten cents, he has paid twice as much as his neighbor.

This is what leads the creameries to buy milk not in accordance with its quantity, but on the basis of the amount of chemical fats it contains. The wise owner of cows, therefore, whose cows are kept for the purpose of giving milk, will make it his effort to develop animals that will produce milk that contains large proportions of the fat elements. The Guernsey and Jersey, both Channel Island breeds, are well known for their rich cream-producing qualities. Yet there are many other breeds that yield milk containing fairly good proportions of all the food ingredients.

It is this variation in the milk of different cows that leads dairymen who supply the milk trade to mix the milk drawn from all the cows of the herd as speedily as possible after milking. This is an advantage to the consumer, as it keeps the milk day by day at a reasonable uniformity.

Where one is purchasing from unprincipled dealers, however, the variation in the quality of the milk is determined by the amount of water added. Sometimes a dealer will allow the milk to stand and remove the cream. While this is not adulteration in the sense of any added ingredient to the milk, it is however adulteration under the law if the product is sold as whole milk, and it is a theft to the consumer because it deprives him of the food values for which he pays.

Cleanliness and Quality Essential.—In those cities that carefully guard the health and pocket of its citizens a certain standard has been established for the quality of milk. Any milk found below this standard is condemned. Every city and town in the United States should have such a standard and see that it is rigidly maintained. Necessarily the higher the requirement, the better for the purchaser. The retail trade might be conducted on somewhat the same plan as the dairies which make butter and cheese, where they buy and pay for the milk according to the amount of fat which it contains. In such a case the milk could be tested by the regular standard and if the milk surpasses the quality required, the price could be correspondingly increased. If it fell below, the price would be reduced. Under such methods both producer and consumer would be fairly treated, and the producer whose uniform product was of an extra high grade would soon establish a reputation that would be of value to him, as well as give the consumer a reliable hint as to where the richest milk could be obtained.

Unless one is perfectly familiar with those dealers who advertise "sanitary" and "hygienic" milk, it would be well to regard their products with suspicion, for it has been found that those dealers who claim the most for their milk in these points often secure their milk from dairies which are in a most decidedly unsanitary condition.

It cannot be too strongly emphasized that one cannot exercise too great care in keeping everything connected with milk in the most cleanly and sanitary state. A properly conducted dairy will be as clean as a well-conducted kitchen. There will be neither piles of refuse nor ponds of vile-smelling liquids to attract and breed flies either in the cow-shed or the nearby yard. The udders and teats of the cows will be washed before being milked and every care taken to see that the milk is kept clean and uncontaminated up to the time that it is placed in the hands of the consumer. This means the scrupulous washing of all utensils that come in contact with it in any way, and more than ordinary care on the part of those handling it. If there is the slightest suspicion in any one of these particulars, the consumer should find a new and more careful dealer.

There are times when milk that has not been mixed has a somewhat unpleasant taste. This can easily be remedied by aerating it. This is done by pouring the milk from one vessel to another half a dozen times, so as to produce air bubbles in it. An improved taste is the result from this contact with air.

Goat's Milk.—Next to cows the goat is the most useful milch animal. It is said that as a food for man, its milk is far superior to cow's milk. It is purer, more nutritious, more easily digested, and more nearly a perfect food for the human system.

In composition, goat's milk has a smaller proportion of water, and a considerably larger proportion of both fat and albumin. In the proportions of sugar, casein, and dry substance, the two kinds of milk are about equal. Some analyses give the goat's milk a higher proportion of sugar. Even if the percentage of sugar is equal, however, the milk of the goat is much richer in nutritive composition.

Goat's milk is particularly wholesome for infants, because its composition is almost the same as that of human milk. Furthermore, as its cream rises far less rapidly, it remains more nearly in an unchanged condition for several hours.

Foreign writers commend goat's milk not only as food for children but also as food for invalids and for use in cooking. Some of them hold that the milk is highly beneficial when used as a medicine for certain diseases and ailments. In a number of sanitariums in France and Switzerland, this milk is considered as an important factor in certain systems of treatment. In these places the goat's milk is used extensively in cooking, and is also given to the patients in large quantities in its natural state.

The whey of the goat's milk is highly commended for its nourishing and medicinal properties. It is held to be especially beneficial for lung diseases and for weakness resulting from innutrition.

On account of the comparatively low cost of keeping, the milch goat is especially valuable to the poorer classes. It is estimated that seventy-five per cent of the families in Germany keep goats. In that country, many people too poor to keep cows are able to have a goodly supply of milk by keeping goats.

Both in relation to the supply of food and in relation to the weight of the body, the goat's yield of milk is exceedingly large, about twice that of the cow. About three quarts a day is a good yield for one goat.

While goats probably require greater gentleness in handling than cows, yet when treated kindly they are exceptionally easy to milk. In some countries, the people train their goats to allow children to suckle.

In the American Southwest, among the Mexican population, goats are largely used, both as milk and cheese-producing animals. Over twenty thousand pounds of goats' cheese are annually shipped from Trinidad, Colo., to eastern markets, besides the large amounts that are made for home consumption.

Invalids and Milk.—A diet of milk has been from the earliest times recommended for invalids in general, and for persons suffering from specific diseases. Hippocrates, the father of medicine, advises consumptives to drink large quantities of asses' milk. We have many records of cures of disease made by celebrated Arabian and Persian physicians by the use of camels' milk and its sour products.

Of late years, physicians in both Europe and America have called attention to the beneficial effects of the use of milk in certain diseases, but there have been few efforts to confine the diet exclusively to milk. The great mistake has been made of combining other foods with the milk, even meat, eggs, vegetables and fruits, with a total want of knowledge and a disregard of the clear evidence that such mixtures not only fail to benefit but are positively injurious.

Experience has demonstrated that where invalids suffering from certain diseases live exclusively upon the milk diet, taking it in as large quantities as possible, at definitely regular intervals, the whole system becomes "flushed" as it were, with the nutrient qualities of the milk, thus eliminating the diseased cells and forcing the body to take on and build new cells, free from disease and full of vigor.

In Volume III of this book there are included full and complete instructions for the use of the milk diet as a curative agent.

Buttermilk has always been regarded as a most agreeable beverage and it is well known that it has a decided food value. Buttermilk is very much like skimmed milk in composition, having about the same food value, but it usually has a mild acid taste because the cream is allowed to sour before churning. During the process of churning the fat globules are brought together by churning and removed, and the thin liquid that remains is very similar in its constituent elements to skimmed milk. An ordinary glass contains about as much nourishment as two ounces of bread, a good sized potato, or a half pint of oysters. Many people find it more palatable than milk, but others find the sour taste unpleasant. It is as digestible as milk and often more so, for its casein forms a more flaky curd than that of ordinary milk. In Holland babies are fed on buttermilk and it often proves satisfactory when the protein of sweet milk proves indigestible. It is a good sign that its use is increasing in this country. Buttermilk ice-cream is considered a delicacy in some parts of the country, being especially favored for invalids.

There is a difference in buttermilk churned from sweet cream and that from soured cream. In the souring process lactic acid is produced. This is caused by a bacterial growth in the cream which feeds upon the milk sugar. Some people prefer the sweet buttermilk, but as far as nutritive value is concerned they are both about equal. There are cases, however, where the lactic acid is an extra aid to digestion in that it supplies to some stomachs, in an easily assimilative form, the acid that it requires.

Buttermilk being a good food and easily digested, aids in the purification of the blood, and thus may be used to give the complexion that healthful purity which is so much desired.

Sour Milk.—Sour milk, known as clabber, although little used in this country, has been a common article of diet in many parts of Europe for centuries. Whether made from whole milk or skimmed milk it is valuable because of its nutritious qualities, but if made from skimmed milk the fat elements are removed and its nutritive value is correspondingly lowered. The souring process produces lactic acid, but this makes no appreciable difference in the fats, whether they are used for the making of butter or are used just as they are for food.

Milk allowed to sour often develops a bitter or otherwise unpleasant flavor. This is owing to the fact that other bacteria besides those which produce the lactic acid are developed at the same time within the milk and cause chemical changes which produce these unpleasant flavors. These bacteria require the air for their development and usually appear in a yeasty mould form on the top of the milk. Hence, whenever one leaves milk to stand for the purpose of making sour milk, it should be carefully kept in an air-tight vessel or bottle, and if a "mouldy" part forms on top it should be carefully removed, since otherwise an extremely unpleasant bitterness will mar the flavor. In 1905 Professor Metchnikoff, sub-director of the Pasteur Institute of Paris, made known to the world the results of a number of experiments with sour milk. As a result of these he made some striking claims for this food beverage, the chief of which was that sour milk preserves the balance between two opposing elements in the blood and so leads to long life.

Sumik, a special form of sour milk used as a beverage, is made as follows: The milk is allowed to turn to a clabber in an air-tight vessel. An ordinary fruit jar can be used to advantage. Simply fill the jar with sweet milk and screw down the lid very tightly, using the rubber ring that is essential for this purpose. As soon as the milk turns to a clabber, it is ready to prepare.

The preparation consists simply in thoroughly beating and aerating the milk with an egg-beater or some similar device. When beaten until it is frothy, like whipped cream, it will in no way taste like ordinary sour milk. Do not forget that if soured while allowed to remain open to the air, the "mould" that frequently forms on the top of the fluid should be removed. If this is neglected the sumik will have a bitter, unpleasant taste.

Since earliest times fermented-milk products have been used as beverages and articles of diet in Central Asia, Turkey and other countries. These products are prepared by allowing special ferments or yeasts to develop in milk, for, like all fermented beverages, they owe their sparkling or effervescent qualities to the carbon dioxide produced by the action of organism. The flavor differs with the process of manufacture.

These fermented-milk beverages have proved very satisfactory in invalid dietetics and are now well known and commonly used. Fermented-milk beverages may be made at home, though they are common commercial products in the United States. In this country cow's milk is almost universally used to make these beverages, but other milk, for instance mare's milk, is more common in Central Asia and other regions.

A carbonated milk, which is made by charging milk with carbon dioxide, is sometimes found on sale, but, of course, it lacks the special qualities which all the fermented products contain.

Some of these fermented-milk products contain lactic acid-forming bacteria in great abundance, and their extensive use has been extensively discussed, because of Metchnikoff's theory and claims as previously stated.

MILK FAT—BUTTER.—Butter is practically the fat of milk largely separated from the liquid. It is one of the most important sources of fat in the diet of most people and is undoubtedly the most palatable and digestible, yet, like all other concentrated articles of diet, there is great danger of one's eating too much of it. If too much is used it is indigestible, and a long-continued course of excessive eating of butter will cause a variety of digestive disturbances, such as biliousness and headache.

The flavor of butter depends upon the milk from which it is made and the bacteria that develop therein. If eaten moderately, butter is a more economical source of food fat than is milk. One great objection to its use is the large amount of salt used in its manufacture. Salt is added because most people prefer the taste, and also because it improves its keeping qualities. However, since cold storage and domestic ice-chests have come into such universal use, butter is less salted than formerly. This is an advantage, for nothing is gained by the excessive use of salt, and much injury often results from it.

In Europe sweet or unsalted butter is very popular, and its popularity is growing in the United States. Such butter has a mild creamy flavor which many people relish. Naturally it will grow rancid if kept too long, consequently it must be used soon after it is made. A large number of people now make sweet butter at home as needed, churning the cream with an egg-beater, or any of the other devices that can be obtained in any hardware store. In some countries a peculiar form of butter, called "ghee," is commonly used. The water is boiled out of freshly made butter and the product is kept for general use, especially for cooking. In the cold, high regions of Thibet, ghee is used in large quantities, lumps of it being put into tea, as the ordinary tea-drinker uses cream. Ghee is very similar to the rendered butter which is used by orthodox Hebrews in kosher cookery.

In keeping butter in a refrigerator, care should be taken that foods with a strong odor, such as cabbage, onions, celery, etc., are not placed near it, as it has the power of absorbing these flavors and thus vitiating its own.

OLEOMARGARIN.—Oleomargarin is a substitute for butter used largely for purposes of economy. It is composed of animal fats from which the fiber has been removed, churned up with milk and cream and a little real butter to give it the appearance, consistency and flavor of real butter. When properly made from pure beef and other fats, it is no more unhealthy than any other animal product, but unless one is convinced of the integrity of the manufacturer, there are so many incitements to use inferior and unhealthful articles that the risk of adulteration is too great to run. Naturally only the poor will use this product and it is a remarkable comment upon the force of example and habit that where economy is necessity, though the food values obtained from oleomargarin can better be gained in cheaper and equally healthful forms of vegetable oils, many people prefer to purchase oleomargarin, as otherwise they seem to be "eating their bread without butter." One should remember, however, that pure butter contains the valuable vitamine not found in substitutes.

Cheese is another of the products of milk that has long been regarded with universal favor. It consists of the casein of

Cheese Ramekin Stir and boil until smooth one cup of bread crumbs and one half cup of milk. Add a small lump of butter and four tablespoonfuls of grated cheese. Salt to taste. Stir until cheese is dissolved, remove from fire. Stir in the beaten yolks of two eggs and then the whites beaten to a froth. Bake in a buttered pudding dish fifteen or twenty minutes.

Rice Croquettes—To two cups of cold boiled rice add one well beaten egg, one teaspoonful of butter and salt to taste. Mix thoroughly and with the floured hands make into little rolls and fry in deep pan of olive oil. Arrange on platter with green peas, garnish with slices of boiled carrot.

milk and small proportions of fat and mineral matters which are precipitated along with it when rennet is added to milk. The flavor of cheese is due chiefly to the action of ferments or bacteria, and, in the case of some of the expensive and highly prized varieties, to the action of moulds. • The richness of the various kinds depends upon the quality of the milk and the proportion of the butter-fats contained therein. When cream itself is converted into cheese, it makes the richest variety, but it will not keep long, and so has to be eaten almost fresh. When cream is added to fresh milk and then converted into cheese, the product is one of the richer varieties such as the English cheese "Double Gloucester" and "Stilton." If new milk alone is used, the cheese is less rich, but is still of high quality, such as the English "Cheddar." When an eighth or tenth of the cream has been taken and the remainder converted into cheese, it produces the average cheese generally purchased. The poorer varieties of cheese are made entirely of skimmed milk. The various methods and the different kinds of milk used in making even these poor cheeses produce such different results as the Dutch cheese, Swiss cheese, Welsh cheese, etc., all of which have about the same nutritive value, although they are markedly different in their general flavors.

When first made, all cheeses are soft and comparatively tasteless since it is during the so-called processes of "ripening" that the bacterial changes occur which develop the flavors. These changes are now so well understood by cheese manufacturers that they are utilized with as much certainty as the housewife feels when she puts by a pan of milk expecting the cream to rise thereon.

Cheese has long had a reputation for indigestibility. It is no more indigestible than any other concentrated food. It has gained this reputation, however, thru the fact that it has been used, not as a regular article of diet, but, like nuts, as a tid-bit at the close of a meal; besides, it is seldom thoroughly masticated and the resulting digestive disturbances are then unjustly blamed on the cheese. A large number of scientific digestive experiments have been carried on with cheese, all of which, without exception, have shown that relatively large amounts, if properly masticated, are thoroughly assimilated without causing any disturbances whatever. Indeed, a good quality of American cheese is a very nutritious food, rich in protein and fat, and it can well be added to the diet of those who wish increased vigor at a low cash outlay, but who are willing thoroughly to masticate a concentrated food to obtain it.

In regard to the use of Limburger and other expensive cheeses of like character, it can only be said that the bacterial and moulding processes have so far continued as to develop a high flavor and smell which are very objectionable to all those who have not cultivated the habit of eating them. Like the taste for the high flavors developed by allowing game to hang, the taste for these cheeses is abnormal and therefore harmful, and the less a health-seeker has to do with such putrefied substances the better.

Cottage cheese, as made at home from sour milk, with or without cream, is a nutritious and palatable food. It is inexpensive and is also an economical method of using sour milk. Neufchatel cheese, while a regular commercial product sold in large quantities in cities, is merely a commercial form of cottage cheese.

Junket is a favorite dish which is prepared by adding rennet to milk and allowing it to stand undisturbed until it thickens or coagulates. If the process is carefully carried out, a thick custard-like product results. If, however, it is stirred, the casein readily breaks up and separates from the whey. Rennet for the preparation of junket may be purchased at any of the large grocery stores and all of those that have been tested give satisfactory results.

Problem of Milk Supply.—All intelligence and all modern scientific investigation agree in rating milk and milk products as of the very highest food value. The milk supply, particularly of large cities, is vitally important to the health and welfare of the inhabitants and is a matter of life and death to the young children. It is important, therefore, that the milk supply keeps pace with the demands, and that the prices of milk in the cities do not increase so as to make milk too expensive for poor people to buy.

If this pressing problem is to be solved, two things must be done. In the first place, dairy farming must be encouraged in regions near to the larger centers of population and a price be paid to farmers for this milk that will meet the cost of production and maintain dairy herds in prime health and vigor. In the second place, less expensive methods must be utilized in distributing the milk in the cities. Closely related to these problems is use of skim-milk for hog food. Butter is one of our best foods but it represents only a part of the milk values. It might be better to use butter substitutes in cookery and a larger portion of the whole milk as food than to use the churned butter, discarding the skim-milk as human food. Each and every child should drink or get in his food an equivalent of one or two quarts of milk a day. Skim-milk is excellent food for growing boys and girls because of its protein and mineral elements.

The practical problem is rendered more difficult by the fact that the most fertile farm regions are too far from our large cities to permit the milk to be shipped in the fresh state. Milk can be cheaply condensed either in the form of the "evaporated" milk or the sweetened condensed product. While not quite equal to fresh, these condensed products are wholesome, as all the milk nutrients are preserved in them; but this does not offer sufficient economy to help much because the condensed milk still weighs about half as much as the fresh article and expensive tin containers are required to preserve and transport it. A much more promising method is the dehydration or drying of milk. In this process the entire water content is removed; the dried milk weighs only from ten to fifteen per cent as much as the fresh equivalent, and may be preserved without canning.

Dried milk, prepared by the proper process, is wholesome and palatable. It is not cooked since the maximum temperature used in the dehydration need not exceed 145 degrees. The vitamines are preserved, and so are the mineral salts and the proteins. Dried milk can be made from either the whole or the skim-milk. The latter keeps perfectly, though the dried whole milk must be kept away from the air, or the fats may become somewhat rancid. The dried whole milk is equivalent to and should sell for not more than seven times the price per pound of the fresh milk. The dried skim-milk is equal to ten times the weight of the fresh skim-milk. By adding one-third as much butter as there is of the dried powder and whipping or churning the mixture, a reconstructed whole milk can be made that can hardly be told from the fresh article. Such means of preserving and reconstructing milk will enable the milk from the western farms and ranches, and from the abundant production of the flush season to be used in distant cities in the time of scarcity. It appears that only by such a system will our city poor be supplied in the near future with sufficient milk.

There is great need for suitable legislation both to discourage the present waste of land and feed in the production of excessive quantities of meat and in the encouragement of the milk-producing industry and the proper preservation and distribution of the product.

Substituting Eggs for Meat.—The place of eggs in the natural dietetic groups has already been referred to in previous chapters. Eggs unquestionably share with milk freedom from the objections made against flesh foods, and are therefore exceedingly valuable in a vegetarian diet. That fact, however, does not warrant us to accept the usual exaggerated claims of the economy of eggs as meat substitutes. The foolish statement that an egg contains more nutriment than a pound of steak has no foundation in the facts as far as its quantity of protein or its wheat-pound value is concerned. Figured on that basis, eggs are about equivalent to lean meat with a small proportion of fat, and are worth about fifty per cent. more per dozen than meat is per pound.

The real value of eggs compared with meat is the fact of the better quality of the nutritive material, and the use of eggs in the place of meat permits the meat eater to discard the extravagant and injurious flesh food for a more delicate and wholesome substitute. Although the most common use of eggs is as a cooked dish used in the meal as is meat, eggs also may be used raw as milk is used. Some people like raw eggs eaten straight or with a pinch of salt; the majority, however, will not find them palatable in this form, but there are many ways of making them palatable while raw, even to the most finicky taste. For instance, an egg-nog can be made of milk, flavored with almost any kind of flavoring that appeals to the taste. Or an egg can be shaken up with any kind of fruit juice. Or if the whites and yolks are beaten up separately, and afterward combined, with the addition of a little sugar or some sweet fruit, the combination is very palatable.

Raw eggs, soft-boiled, or poached eggs, are popularly considered easier to digest than those that are hard-boiled, and so they are if the white of the hard-boiled egg is not thoroughly masticated. When the white is well chewed the hard-boiled egg is as digestible as any other kind. Jorissenne, a French dietetist, states that he regards the yolk of raw, soft-boiled, and hard-boiled eggs as equally digestible. The white of soft-boiled eggs, being semi-liquid, offers little more resistance to the digestive juices than raw white. The white of a hard-boiled egg is not generally very thoroughly masticated. Unless finely divided, it offers more resistance to the digestive juices than the fluid or semi-fluid white. Provided mastication is thorough, marked differences in the completeness of digestion of the three sorts of eggs will not be found.

Eggs are excellent as a separate dish, but they are even more valuable in cookery. This use of eggs depends chiefly upon their quality of viscosity and their coagulation when heated. The latter property is the essential factor in custards. Custard is not only used alone, but as a basis for pudding and for cocoanut, pumpkin and lemon pies. This same property of viscosity in eggs makes them useful in salad dressings, cake frostings and the foamy whips or meringues used to top off many dishes.

These same properties of eggs gives them the power of lightening all sorts of baked products. The following experiment will give you a very clear conception of this property of eggs. Mix a little water in a cup and add to it a spoonful of baking powder. It will foam beautifully, but the foam will immediately die down as the gas bubbles escape. Now stir a little egg white into the water and add baking powder, and the resulting foam will be more permanent. Eggs do not make the "lightness"; that must be secured by gas bubbles of some sort, either by the use of yeast, baking powder, or soda and sour milk. But the viscous property of the egg causes the bubbles to be retained until the material is hardened by heat and made permanently light. There is no other food substance that may be used for this purpose except the gluten of wheat flour.

This lightness, due to the presence of bubbles, adds nothing to the food value, but it accords with our notions of good baking. Because eggs are expensive, many foods, notably corn bread, that we at first think to be economical prove to be expensive on account of the use of eggs. If you cannot afford eggs, you must learn to accept "heavier" breads and cakes. The hygienic value of such lightness has been exaggerated. If baked products are thoroughly cooked so that they contain no raw or soggy dough, and if they are well masticated, and if one does not overeat of them, they will not be indigestible.

Richness is a term loosely applied to dishes such as plum pudding and fruit cakes that are heavy in texture and contain large quantities of both sugar and fat. The proverbial indigestibility of such products has little foundation in fact. Eat carefully and eat moderately and you need not worry.

There is no efficient substitute for eggs in cookery. Use them for this purpose if you can afford them, if not go without —but do not be taken in by the fake egg "substitutes," which are usually made of artificially colored corn starch and cost about five per cent of the price they are sold for, and are utterly worthless.

Unscrupulous Egg Dealers.—The quality of eggs is very important. Like milk they are prone to spoilage, and decomposed eggs are not only harmful but offensive. There is little danger that one will use bad eggs when they are bought in the shell, but when bought in the disguised form of cheap bakery products the amount of bad eggs consumed is appalling. The government and city health departments have long made strenuous efforts to stamp out the trade in spoiled eggs. But because the eggs are high in price and necessary to make conventional bakery products, these worthy efforts are repeatedly frustrated by unscrupulous dealers and bakers. Since bakers' cakes are usually unwholesome in other aspects as well, I should advise one to leave them out of the diet altogether, and so avoid the possibility of eating decayed eggs in this form.

The question of the cold storage of eggs has attracted wide attention, both from the standpoint of wholesomeness and of the supposed injustice done the consumer in this system of the speculative storing of eggs in the season of low prices and their sale to the public in the season of scarcity. As a matter of fact, the egg storers do not make as much profit as is commonly supposed, for, while they make big money some years, they often lose when the season goes against them. It is rather the retailer who offends against honesty here by selling the cold storage eggs either as fresh or at an unreasonable profit over the wholesale price. You can at least know whether you are being mulcted in this manner by consulting the wholesale price of cold storage eggs as given in the market reports and comparing this with the grocer's figure.

As for wholesomeness, the cold storage egg is never equal to the fresh article, because the process slows down and does not wholly stop the deterioration of the eggs. But cold storage eggs are put away in the season of plenty when the prices are falling and eggs are being rushed promptly to market. Hence, when the eggs come out of storage they may be as good or better than so-called fresh eggs that have been marketed in hot weather or have been held on the farms or by the country buyer in the early fall awaiting an advance in price.

While fresh eggs are the only kind that particular people care to use, there are not enough of them to go around in the fall and winter months, and the average consumer must therefore use the cold storage product or go without. In that case I would recommend that storage eggs, bought as such at storage prices, be used in cookery and that fresh eggs be secured for use raw, poached or soft boiled, in which cases perfect flavor is essential to palatability.

There is no need at any time to be fooled into paying higher prices because the eggs are given fancy labels or are done up in fancy boxes. Neither is there any virtue in eggs of a peculiar shell color or from a certain breed of chickens.

For those who wish to economize eggs may be preserved at home. Of the many methods recommended the only one really effective is the preservation in water glass. Details of the process can be secured from the Department of Agriculture. It is not a perfect method of preservation and the product is no better than cold storage, though the eggs are not unwholesome and will serve for cooking purposes.

CHAPTER XX.

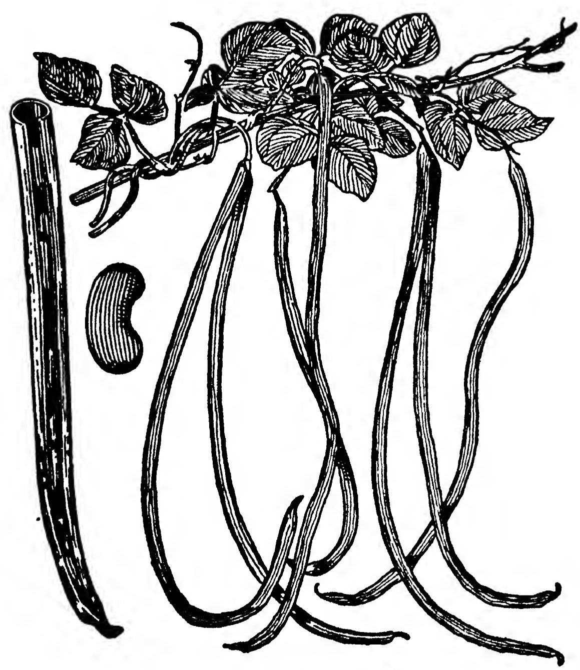
NATURAL FOODS AND THEIR QUALITIES.

THE common potato is by far the most important of the edible tubers, both as to nutritive value and the extent of its cultivation. The sweet potato ranks next to it. It has been estimated that the white or Irish potato (as it is commonly called) furnishes about one-eighth of the total food supply of America. It was first introduced into Europe between 1580 and 1585 by the Spaniards, and some people believe it to be a native of Chili. It is well known to some of the students and exploring botanists of the Southwest that one of its original habitats was in the mountains of Arizona.

When one realizes how large a part it forms in the dietary of the peasantry of Ireland and other European countries, it is hard to conceive that it is only within the last two hundred years or less that it has become so staple a food. Since this time its use has constantly increased, for it is one of the cheapest vegetables to raise, can be kept over the winter, is easy to prepare for the table, pleasant to the taste and very rich in digestible starch. It soon became a staple food among all classes throughout central and northern Europe, so that in the middle of the last century when the black rot wrought its deadly havoc on the potato crops, not only Ireland but large districts in continental Europe were seriously threatened with famine.

It is a fact worthy of mention that, as the potato has been modified by cultivation, it has largely lost the power of producing seeds, and the cultivated potato differs from the wild in seldom producing seed-bearing fruits. This is a disadvantage from the plant breeder's standpoint, as he depends on seeds from blossoms properly fertilized to yield new varieties. From the grower's standpoint it is of little moment, as he always uses the old tubers in planting the potato crop, each "eye" in the potato being a bud on the underground stem which is capable of growing into a new plant.

The corky skin of the potato makes up about two and one-half per cent. of the whole, and the cortical layer eight and one-half per cent., leaving eighty-nine per cent. for the main body of the potato. Theoretically the skin is the only refuse or inedible material, but in practice a considerable part of the cortical layer is usually removed with it, and in the case of potatoes that are lumpy or have shriveled in storage a much greater proportion of the flesh is wasted. When potatoes are baked or boiled in their jackets more or less of the flesh is wasted when the skin is removed, and in this case also the amount of the loss bears some relation to the shape of the tubers. Careful investigation has shown that it is safe to estimate that even with careful peeling about twenty per cent. of the potato is lost. Therefore it is best not to peel potatoes except in the case of those that are to be mashed. A decided flavor that is exceedingly delicious and peculiar to the skin and cortical layers is entirely lost in peeling, and the objection that the potato peeling is indigestible will be found to be groundless when anything like reasonable mastication is practiced.


The Asparagus Bean

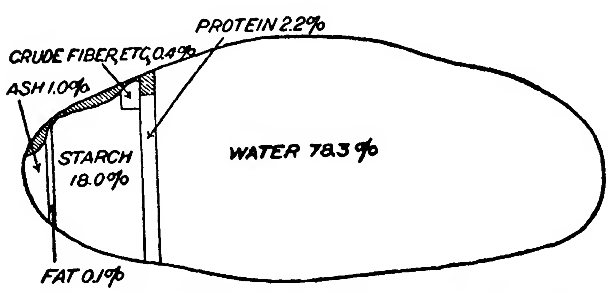
The best method of preparing potatoes is, after carefully washing them, to immerse them in hot water, using as little water as possible, and then allowing all of the water to evaporate during boiling.

The edible portion of the potato as generally used holds on an average about seventy-eight per cent. water, and so only about twenty per cent. of the whole tuber has a direct food value.

Our illustration shows the potato's composition in graphic form, indicating the proportion usually wasted when the potato is boiled.

This diagram shows that the bulk of the potato tuber is water. The stage of growth and other conditions affect the proportion present, young tubers being more juicy or watery than those which are fully developed. When potatoes are stored, they undergo a shrinkage, chiefly owing to loss of water or juice by evaporation.

The carbohydrates are by far the most abundant of the nutrients. Of the eighteen and four-tenths per cent. present less than five-tenths per cent. is made up of cellulose, the bulk being in the form of starch, which is, of course, insoluble in cold water, and small quantities of such soluble carbohydrates as dextrose sugar, etc. In young tubers there is a larger proportion of sugars and less starch than when they have become mature. As the tuber lies in the ground the starch content increases. When it begins to sprout, however, part of the starch is converted by a ferment of the tuber into soluble glucose. Thus, young or early potatoes and old ones both have a smaller proportion of starch and a larger proportion of soluble sugars than well grown but still fresh tubers.



A diagram showing the potato's nutritive qualities.

The protein bodies are rather scanty, as compared with those of cereals and such vegetables as peas and beans. Only about sixty per cent. of the total amount present is true protein—that is, in a form which can be used for the building and repair of body tissue. This means that a pound of potatoes furnishes only about one and three-tenths per cent. or twotenths of an ounce of true protein, and it emphasizes the statement already made that potatoes alone make a very incomplete diet, as the proportion of nitrogenous material would be very small in a quantity sufficient to supply the body with all the energy-yielding material required.

In cooking the heat affects the various constituents of the potato in different ways. The water expands into steam, part of which evaporates from the surface. Within the minute cells that compose the tuber it presses so hard against the walls that the tough cellulose is ruptured just as any air-tight vessel may be broken by the pressure of expanding steam. The starch grains inside the cells are thus released, some of them being also disintegrated, while part are changed into the soluble form of dextrin by the heat, and part are filled with water or hydrated. The protein coagulates or hardens, much as the white of egg does in boiling, and at least a part of it is broken down into simpler bodies. The mineral salts are probably little affected, but some of them are broken down, part of their constituents passing off as gases and part forming new compounds with quite different characteristics. It is the sum of these and minor changes which make the difference between a raw and a cooked potato.

It is generally considered that potatoes, when properly masticated, yield up their nutrient qualities as easily as any other food. Hence the charge that they are indigestible is not borne out by the many experiments that at different times have been made with them. Yet, as has already been stated, they are not a perfect food when eaten alone. It is seldom, however, that any person, no matter how poor, has to live entirely on potatoes. The poorest of the peasantry in Ireland eat them with an abundance of buttermilk which supplies all the protein necessary. Ordinarily they are eaten with other foods rich in protein, such as meat, milk, eggs, etc., and thus they supplement these nitrogenous foods by furnishing the needed carbohydrates. Their abundant mineral matters are also valuable and they contain enough of the C vitamine to aid in the prevention of scurvy. They are easy to cook, and can be prepared in so many ways that they add variety to the list of vegetable dishes, especially in winter, when green vegetables are not common. They have a mild, agreeable flavor acceptable to almost everyone, but which is not sufficiently pronounced to become tiresome. Owing to the ease with which they are grown and their abundant yield, they sell at a price within the reach of all.

THE SWEET POTATO.—Another variety of potato that is growing in popular use in this country, although it is almost ignored in Europe, is the sweet potato. It is also sometimes called yam, a name which really belongs to an entirely different order of plant hardly known outside of tropical countries. The edible portion of the sweet potato plant is not an underground stem like the white potato tuber, but a true root, though its rôle in the life-history of the plant is much the same, namely, to act as a storehouse of plant food for the growth and early development of the new crop of plants. The following table shows the average composition of sweet and Irish potatoes:

Average composition of sweet and white potatoes.

KIND OF POTATO.	Refuse	Water.	Protein	Fat.	Carbohydrates: Sugar, starch, etc	Carbohydrates: Crude fiber.	Ash.	Fuel value per pound.
	Per ct	*Per ct*	*Per ct*	*Per ct*	*Per ct*	*Per ct.*	*Per ct.*	*Calories.*
Sweet potatoes (edible portion)	....	69.0	1.8	0.7	26.1	1.3	1.1	570
Sweet potatoes (as purchased)	20.0	55.2	1.4	.6	21.9		.9	460
Sweet potatoes (cooked)	....	51.9	3.0	2.1	42.1		.9	925
Sweet potatoes (canned)	....	55.2	1.9	.4	40.6	.8	1.1	820
White potatoes (edible portion)	....	78.3	2.2	.1	18.0	.4	1.0	375
White potatoes (as purchased)	20.0	62.6	1.8	.1	14.7		.8	310

Sweet potatoes contain on an average about nine per cent. less water, and nine per cent. more carbohydrates than Irish potatoes. They supply a lot of tissue-building material for the body. They also contain considerable quantities of sugar, a part of which is cane sugar, and part invert sugar or glucose. The proportion of sugar and starch varies with the climate.

The warmer the place in which the plant is grown, the greater the proportion of food laid by in the form of sugar. Tropical sweet potatoes sometimes contain almost equal quantities of sugars and starch. Those grown in New Jersey, on the other hand, probably do not average more than five or six per cent. of sugar, or about one-fifth of their total carbohydrates.

The changes which cooking makes in sweet potatoes are similar to those which take place in white potatoes. One point is generally noticeable—the longer the cooking is continued the more moist does the root become. This is probably due to changes in the carbohydrates. Part of the starch is doubtless changed to soluble carbohydrates by the heat and then dissolved in the juice, and the cane-sugar is inverted—that is, split up into simple sugar. The very sweet Southern varieties become so moist during baking, that a sirup frequently exudes through the skin.

Experiments have shown that sweet potatoes are easily digested when not eaten with too large quantities of butter. Their dryness often induces people to add too much butter. This makes a rich mixture that doubtless accounts for the claim which is often made that they are indigestible.

Considering both their composition and digestibility, it may be said that the nutritive value of sweet potatoes is much the same as that of white potatoes, and that they are well fitted to occupy the same place in the diet, and furnish a palatable substitute for white potatoes. Further, their characteristic and pleasing flavor is an additional advantage. In the North they frequently cost somewhat more than white potatoes, but are still among the cheaper vegetables. In the South they are quite as cheap or cheaper than white potatoes, and merit their extensive use.

THE ONION.—The onion is a most useful vegetable and cannot be too highly commended. While its nutritive value is not great, it compares favorably with other vegetable foods and at the same time contains elements that are highly beneficial to the stomach, intestines, liver and brain. Like cabbage, it is one of Nature's provisions for winter as it is a vegetable which can be stored for many months without losing either its flavor or food value. While the pungent volatile oil is objectionable to some people, its positive quality is highly beneficial, both to the healthy body and in most cases of disease.

As a blood purifier, it is one of the best of vegetables. While it may be eaten in any manner that is agreeable to the taste, it exercises its beneficial influence better when eaten raw than cooked. The best onions to eat are the young spring onions direct from the garden. If necessary they may be chopped up, tops and all, and either eaten separately or added to any vegetable salad. If chopped up fine, they may be sprinkled to advantage over almost any kind of cooked vegetable just before the cooking process is completed. When young onions cannot be obtained the larger and milder species which are sweet, such as the Teneriffe. Barletta, Rocca and California-Bermuda, may be used. These may be cut up and used in the same manner as the spring onions, or sliced and eaten with a little salt. Where the taste craves a little acid with onion, as with cucumber, do not use vinegar but squeeze a little lemon juice over them.

The onion is best flavoring food for vegetarian cookery.

Asparagus is credited with prompting the function of the kidneys to a marked degree.

Cabbage is rich in vitamines and supplies roughage for bowel elimination.

The natural opiates found in onions, if these are eaten with well masticated food, produce a soothing effect, without any after injury, as is the case where artificial sedatives are used. Insomnia has been overcome by giving the patient a large basin of Bermuda onions, well sliced and cooked until they are quite soft, without throwing away any of the water in which cooked. The soup should be thickened by the addition of a little milk and corn meal. In the cooking of onions for this purpose, however, as little butter and salt as possible should be used, olive oil being preferable to butter.

ASPARAGUS.—Asparagus is well known as a most palatable and useful vegetable, owing to its action upon the kidneys. It also has a marked tonic effect, at the same time soothing the nerves of those of excitable temperament or those whose occupations make great demands upon the brain.

CABBAGE.—Cabbage in its natural state makes a most delicious dish, and those who become accustomed to eat it thus, when sliced or chopped up, prefer it to cabbage in the cooked state. To those inclined to constipation it has a very beneficial effect and at the same time cools and purifies the blood.

MUSHROOMS.—Few people realize the value of mushrooms as an article of diet. Among the wealthy, they are generally used for flavoring purposes, but both wild and cultivated they are a highly desirable, nutritious and tasty food. The Russian peasant finds in the mushroom one of his chief articles of diet and experience demonstrates that it has great food value.

OKRA.—Although used in the Mediterranean regions of Europe for many centuries, okra, or gumbo, as it is commonly called, has only within comparatively modern times been imported into this country. Its food value is not great, but as it adds a very pleasant taste and mucilaginous consistency to soups which render them most palatable to many people, its use will doubtless materially increase in the years to come. It is raised in the South, but it is found that certain varieties grow very successfully in the middle and northern sections of the country. According to W. R. Beattie, of the Bureau of Plant Industry, the principal use of okra is in soups and various culinary preparations in which meats form an important factor, as in the so-called gumbo soups, to which the young pods impart an excellent flavor. But it is equally useful where meats are not used. The young seeds are occasionally cooked in the same way as green peas, and the very young and tender pods are boiled and served as a salad with French dressing. Both the stem and the mature pod contain a fiber which is employed in the manufacture of paper.

No copper, brass or iron cooking vessels should be employed in preparing okra, as the metal will be absorbed and the pods discolored or even rendered poisonous. The cooking should be done in agate, porcelain, or earthenware.

Other Vegetables.—Beets, parsnips, turnips, rutabagas, pumpkin, squash and artichokes are all rich in nutrients and at the same time have decidedly beneficial effects upon the stomach and liver.

Salads.—Vegetables in their natural condition are Nature's correctives for any of the lighter ailments to which man is subject. Tolstoy called his vegetable garden his "medicine chest."

Vegetables have distinctly soothing, strengthening and healing effects that render them very valuable as regular articles of diet. All of the salads, such as lettuce, endive, radishes, green-onions, water-cress and the like have a decidedly beneficial effect upon the body. Everyone has seen dogs, cats, and chickens eat grass, thus showing Nature's leadings, by instinct, towards the green foods of the earth. What instinct does for the lower animals, reason does for man in that it shows him that these foods help keep his body in that perfect health that every man desires. When the blood is thick and sluggish with overfeeding or wrong feeding, nothing seems to cool it and reduce it to its normal consistency better than lettuce and the other salads mentioned.

All people are familiar with the sedative effect of the salads, especially lettuce and onions. There is enough in these of a perfectly harmless narcotic to induce healthful and restful sleep without any fear of future injury. If those who suffer from insomnia and nervousness would refuse to eat any other food than a light salad for their evening meal, it would not be long before they would be sleeping as perfectly as a healthy baby.

THE CARROT.—The carrot has long been considered a most healthful vegetable, especially when eaten in its natural state. The best way to enjoy a carrot is to walk out to a vegetable garden at least five miles distant from your home, if possible, and while the blood is circulating freely as a result of the walk, pluck the carrot from the ground, wash or scrape it and immediately eat it, giving it the most thorough and complete mastication. Near Paris a well known ex-actress has long conducted a "Carrot Cure." Her establishment has gained considerable fame because of the many patrons she has of both sexes who have found vigor, health and rosy complexions under her care.

A most delicious dish which is as nutritious and invigorating as it is tasty is made by grating young carrots and apples together. A good salad is made by combining carrots, apples, celery and nuts.

CELERY.—Celery is another of the wholesome and palatable additions to the bill of fare that of late years has been growing in popular favor. No matter how eaten, if properly masticated, it is always beneficial. Originally celery was for a long time considered poisonous, but now it is largely cultivated as a most healthful food in every civilized market in the world.

As ordinarily grown the celery plant has no true stem, the chief endeavor of the grower being to enlarge the root and increase the size of the succulent basic leaves. It is the stalks or stems of these leaves which form the edible part. The seeds of celery also are very largely used for flavoring salads, soups and a variety of dishes. The fleshy root of the celery plant is used in soups; it is also prepared as a separate dish, being cut in small pieces, boiled until tender and then served like asparagus with a dressing of cream.

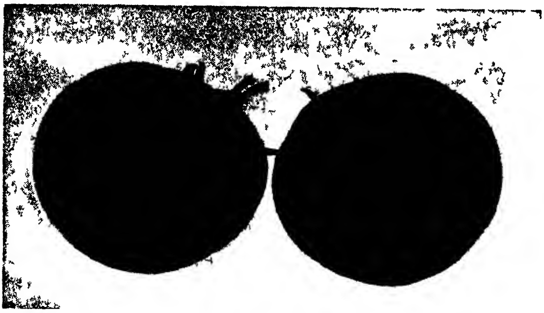
There is a special turnip-rooted form of celery, known as celeriac, which produces a large root and very small leaf stems. This is more suitable for cooking than the common celery, although the edible portion of the latter makes a very palatable dish when stewed in butter with salt and pepper to taste. The principal value in celery, however, lies in its excellence of flavor and other desirable qualities when well blanched and served in the natural state.

While celery may not possess much actual food value, it is very attractive, and its use is an important one from the fact that it furnishes an essential vegetable ingredient of a well regulated diet. To those who engage largely in brain work its effect is both soothing and invigorating.

THE CUCUMBER.—The cucumber is generally regarded as indigestible. The celebrated Dr. Abernethy is said to have given the following recipe for the preparation of cucumbers: "After peeling the cucumbers, slice them as finely as possible. Then sprinkle them well with salt. Place the salted slices inside a soup plate upon which place an inverted soup plate. Now shake the plates vigorously for five minutes, allowing the moisture to drain from the cucumbers. When this is done, shake them again. Now put them in a clean dish and pour plenty of vinegar over them with another dash of salt and pepper, then—*throw them into the ash barrel!*" Cucumbers prepared in this and similar fashions are undoubtedly indigestible, but when eaten as one would eat an apple, without any "fixings," without any additions whatever, except perhaps a little salt, they are palatable, nutritious and digestible. Even the skin which most people remove is perfectly digestible, and those who become accustomed to its flavor claim it is very palatable.

THE TOMATO.—One of the most popular and common of the vegetables in use to-day is the tomato. It is supposed to have come from Peru. For a century or more it was cultivated chiefly as an ornamental plant, the food being regarded as poisonous and liable to cause cancer, and it was not until this strong but foolish and ignorant prejudice was removed, and people learned by experience its tastiness and harmlessness that it became a popular article of diet.

Tomatoes are universally recognized as an invalid food by



Tomatoes keep the blood pure through the medium of the mild acid and cathartic juices they contain.

medical men. This for the reason that their pulp and juice is not merely digestible, but contains an acid, which is at once a mild aperient and a promoter of gastric secretions. The late Dr. Bull, of New York City, always used to order raw tomatoes for his patients when they reached the solid food stage of recovery, because of their blood purifying and intestinal regulating powers. At the General Memorial Hospital, New York City, better known as "The Cancer Hospital," because the institution makes a specialty of treating cases of the disease, tomatoes in season constitute an important part of the diet of convalescing patients.

As a blood-cleanser and stomach regulator, lettuce has few rivals.

The following eulogy of the tomato was delivered by Professor Charles Wickenham, formerly of Guy's Hospital, London: "It is both vegetable and fruit, partaking of the beauties and dietetic advantages of both. It makes superb soup, either alone or with other materials. It also makes ideal salads, catsups, pickles—green or ripe—sweet, spiced, and sour, or in mangoes. The tomato is equally delectable if sliced, baked, escalloped, dried, fried or stewed. It is a food for the athlete, and a delicious dish for the invalid. It is a food for the sick and the well, the old and the young,

No matter how eaten, celery is always beneficial.

the rich and the poor, the leisurely and the laboring, the saint and the sinner. It is the best of all vegetables as an article of diet. For the sick, especially if they suffer from stomach troubles, it is a gift from Heaven."

A dish of nothing but sliced tomatoes is one of the most healthful articles of diet, especially when eaten with what has been called a physical culture dressing. This dressing is made in a similar manner to French dressing, simply using lemon juice as a substitute for vinegar. The best way to make this dressing is to squeeze and strain the juice of one lemon, then mix and dissolve salt to taste, after which add from two to four times as much olive oil as you have lemon juice and stir in thoroughly. Many prefer a small quantity of mustard with the dressing, and if this is desired it can be added though it is not recommended. However, this dressing can be made even without the use of salt if one so desires, and if some very finely chopped onions are added its tasty quality will be highly enhanced.

Various combinations can be used with tomatoes to advantage; for instance, tomatoes and lettuce make a splendid salad. Tomatoes and cabbage can also be recommended. Tomatoes and water-cress go well together. In fact, almost any of the green vegetables that are ordinarily used for salads can be combined with tomatoes and the combination will, in every instance, have a splendid flavor.

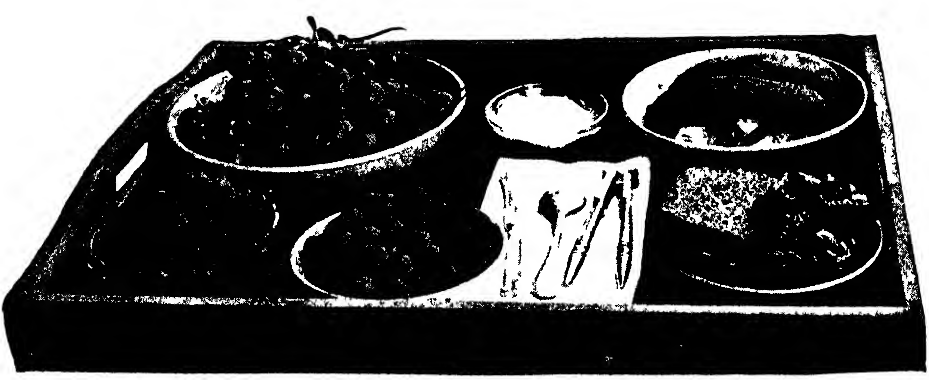
Herbs.—Parsley and mint have healthful qualities which make them beneficial in salads, though owing to their strong flavor very little is required for each dish. Most people regard these merely as garnishings for other dishes, but they may well be combined with other salads and eaten with pleasure and advantage.

Water-Cress.—The anti-scorbutic properties of water-cress have long been known, and this tasty and delicious "brook-grass" is used all over the world, not only by civilized but by aboriginal people, for its palatability as well as healthful qualities.

Another material for making salads is rapidly coming into vogue in the form of sweet peas with edible pods. When these are of the rich sweet variety, they form the basis for a most delicious salad. Spinach, young okra pods and leaves, kale, sweet peppers and chicory leaves may also be used as foundations for salads, or additions to others.

WILD SALADS.—There are a number of wild salads that can be added to the products of the garden with most beneficial effects. Among these may be mentioned the following: The leaves and tender stems of dock make a fine blood tonic, being rich in iron and other organic salts. Dock leaves can generally be picked wild from the middle of April to the middle of June, but if raised in a garden and not allowed to run to seed, tender leaves can be picked all through the summer into the late fall. Dandelion leaves and hearts are not only tasty but healthful. From time immemorial the dandelion has been used as an antiscorbutic and excellent blood-purifier and in no form is it so beneficial as when eaten in its natural state. Its slightly bitter taste gives it an appetizing quality that many people much enjoy. Dandelion flowers have also been used to good advantage in salads, both flowers and stems being used.

Sour knot-weed, shoots of young woodbine, shepherd's purse, nasturtium leaves, flowers and seeds, oxalis or wood-sorrel, mustard leaves, plantain, winter-cress, salad burnet, pimpinella, yarrow and the like can all be used to good advantage in salads.



A vegetarian repast, consisting of cherries, figs, plums, bananas, hazel nuts, pudding and bread.

NUTS.—It is only a short time ago that nuts were considered merely as a "digester" to be eaten at the close of a meal, or as a luxury to be eaten between meals. The idea that they should have a distinct place in one's dietary was held by but few. It is a pleasing sign that this mental attitude is changed and thousands of people are making of them a regular article of diet, while the proportion of those who are living entirely upon a fruit-and-nut diet is rapidly and constantly increasing.

There has been a wonderful change also in the common disregard with which our native nuts were held, such as the hickory and butternuts, walnuts, chestnuts, pecans, etc. The demand for foreign nuts, also, which used to be so small that few were imported, has so increased that the supply has grown until now they are within the reach of persons in all walks of life.

This increase in the demand for nuts is due to the growing number of vegetarians, physical culturists and others who have learned that nuts are an excellent substitute for meat and other nitrogenous and fatty foods. The large use of nut-butters, nut-salads, nut-cakes, etc., and the use of nut-stock for soup have also increased the demand, as has the manufacture of special nut foods, such as malted nuts, protose and other meat substitutes.

Of late years the pinyon nut, which for centuries has been used by the Indians of the Southwest as one of their chief articles of diet, has come extensively into use. A similar nut, though a little larger and not quite so rich in flavor, is the European species of the same nut, commonly known as the pignolia. It is a pointed white nut and may now be obtained, properly shelled and ready for use, in the majority of first class stores.

The pistachio nut, largely grown in California, has long been used and prized by confectioners for its delicate flavor and attractive green coloring. It is commonly used as a coloring and flavor in ice cream.

In purchasing nuts the proportion of refuse is important, as it varies from 16 per cent in chestnuts to 86 per cent in butternuts.

Nuts are a highly concentrated food, containing little water and much fat. They are rich not only in protein, which enables them to supply all the nutrient qualities gained from meat, but when one masticates them to the point of complete

Average composition of nuts and nut products.

KIND OF FOOD.	Refuse.	Edible portion. Water.	Protein.	Fat.	Carbohydrates. Sugar, starch, etc.	Crude fiber.	Ash.	Fuel value per pound.
Nuts and nut products:	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Acorn, fresh	17.80	34.7	4.4	4.7	50.4	4.2	1.6	1,265
Almond	47.00	4.9	21.4	54.4	13.8	3.0	2.5	2,895
Beechnut	36.90	6.6	21.8	49.9	18.0		3.7	2,740
Brazil nut	49.35	4.7	17.4	65.0	5.7	3.9	3.3	3,120
Butternut	86.40	4.5	27.9	61.2	3.4		3.0	3,370
Candle nut	....	5.9	21.4	61.7	4.9	2.8	3.3	3,020
Chestnut, fresh	15.70	43.4	6.4	6.0	41.3	1.5	1.4	1,140
Chestnut, dry	23.40	6.1	10.7	7.8	70.1	2.9	2.4	1,840
Horn chestnut or water chestnut	....	10.6	10.9	.7	73.8	1.4	2.6	1,540
Chufa (earth almond)	....	2.2	3.5	31.6	50.2	10.5	2.0	2,435
Cocoanut	34.66	13.0	6.6	56.2	13.7	8.9	1.6	2,805
Filbert	52.08	5.4	16.5	64.0	11.7		2.4	3,100
Ginkgo nut (seeds)	....	47.3	5.9	.8	43.1	.9	2.0	940
Hickory nut	62.20	3.7	15.4	67.4	11.4		2.1	3,345
Lichi nut	41.60	16.4	2.9	.8	78.0		1.9	1,510
Paradise nut	45.70	2.3	22.2	62.6	10.2		2.7	3,380
Peanut	27.04	7.4	29.8	43.5	14.7	2.4	2.2	2,610
Pecan	50.10	3.4	12.1	70.7	8.5	3.7	1.6	3,300
Pine nut, Pinyon	40.6	3.4	14.6	61.9	17.3	....	2.8	3,205
Pine nut, Spanish, or pignolia (shelled)	....	6.2	33.9	48.2	6.5	1.4	3.8	2,710
Pistachio	....	4.2	22.6	54.5	15.6		3.1	3,250
Walnut	58.80	3.4	18.2	60.7	13.7	2.3	1.7	3,075
Almond butter	....	2.2	21.7	61.5	11.6		3.0	3,340
Almond paste	....	24.2	13.1	23.9	29.4	7.8	1.6	1,900
Peanut butter	....	2.1	29.3	46.5	17.1		5.0	2,825
Malted nuts	....	2.6	23.7	27.6	43.9		2.2	2,600
Cocoanut candy	....	3.9	2 4	11.9	76.7	4.5	.6	2,000
Peanut candy	....	3.0	10.3	16.6	66.9	2.1	1.1	2,115
Chestnuts, preserved (marron glacé), air dried	....	18.2	1.3	.5	79.7		.3	1,530
Walnuts, preserved in sirup, air dried	....	16.9	13.6	20.0	48.6		.9	2,780
Cocoanut milk	....	92.7	.4	1.5	4.6		.8	155
Cocoanut, desiccated	....	3.5	6.3	57.4	31.5		1.3	3,125
Peanut coffee made from entire kernel	....	5.1	27 9	5.1	12.3	2.4	2.2	2,805
Almond meal	....	8.5	50.6	15.6	16.0	2.9	6.4	....
Commercial nut meal	....	3.0	29.0	51.7	12.1	2.0	2.2	....
Chestnut flour	....	7.8	4.6	3.4	80.8		3 4	1,780
Cocoanut flour	....	14.4	20.6	2 1	45.9	10.1	6.9	1,480
Hazelnut meal	....	2.7	11.7	65.6	17.8		2.2	3,185

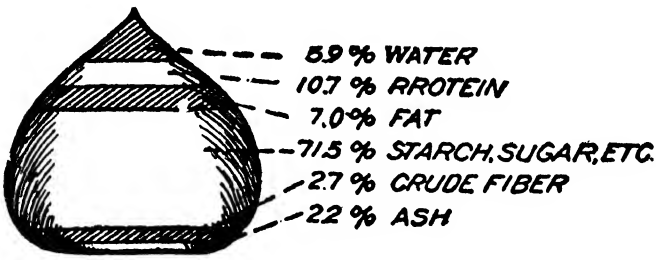


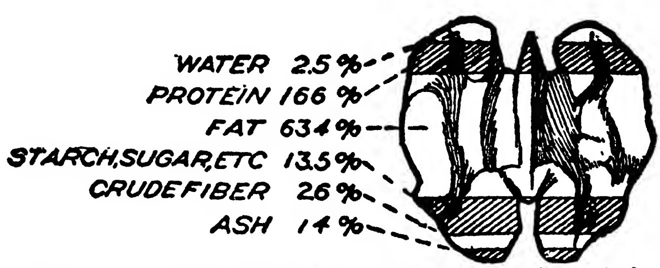
Diagram illustrating constituents of the chestnut.

emulsification and liquification, they are far better for the nourishment of the body than the finest and most nutritive cuts of meat. Indeed, it is claimed that nuts contain chemical salts and other properties that are especially valuable in keeping the muscles of the arteries elastic and pliable and thus preventing the deposition of limy substances in the arteries which, more perhaps than any other one thing, makes men grow old.

The flavor of nuts largely depends upon the oils which they contain, though a few species have a distinct flavoring matter of their own aside from the oils. As the oil in nuts readily becomes rancid, they should never be kept too long or be exposed to a higher temperature than necessary, as this hastens the process by which they become rancid. Those who have eaten a rancid nut know how intensely disagreeable the flavor is.

Some nuts, like the chestnut, peanut, tabebuia, etc., are generally eaten roasted, and the roasted flavor that most people enjoy is largely dependent upon the browned oils, starches or other carbohydrates.

Nuts have a reputation for indigestibility, but this comes from their imperfect mastication. When people have eaten a hearty meal and then hastily swallow a handful of nuts, these are likely to produce indigestion. Thor-



Analysis of a walnut showing the relative proportions of the various food elements.

oughly masticated they are the most digestible of foods. In experiments conducted by the United States Government the protein of nuts was found to be more digestible than that of fruits.

The popular belief that the eating of salt with nuts renders them more digestible is a pure superstition which has no foundation.

Nut Products.—There are several nut products, such as nut-butter, nut-oils, nut-milk, nut-pastes, nut-preserves, nut-flour, nut-candies and nut-coffee, which, having decidedly nutritive values, are growing rapidly in popular favor.

There is such a demand for peanut butter that it is now sold in many cities in ton lots.

Nut-butter may be easily made at home. There are a variety of mills for grinding nuts from which one may select at any first class hardware store, though if it is not convenient for one to use a mill, the nuts may be pounded in a mortar. Many of the staple food-grinders are provided with special discs for grinding nuts that may be inserted at will. Nut-butter will keep well if sealed in glass or earthenware jars. Tin cans may also be used, but they are not quite so desirable.

It is well here to call attention to one point in connection with the use of nut-butters which is little known. It is better to take the amount of butter that one expects to use at a meal, and instead of serving it in its original ground condition, to mix it thoroughly with about the same quantity of cold water with a tiny pinch of salt. This makes a delicious cream of it, is more easily spread upon the bread and more readily masticated, and, because of its dilution with water, is in a far better condition for the average person to digest than in its highly concentrated form. If one likes the flavor of olive oil, a little of this may be added to the water.

These nut-butters are entirely different from the so-called cocoanut or cocoa-butter which is sold under a variety of trade names and is made by extracting and refining the fat of the cocoanut or copra. It resembles fine beef-fat in appearance and is naturally white in color and is solid at ordinary temperatures. It is used as a substitute for butter and in various culinary ways.

Chocolate and cocoa are both products of the cocoa bean, the former being much richer in fat than the latter. The fat that is extracted in the manufacture of cocoa is called cocoa-butter, but is an entirely different product from the cocoanut butter before mentioned.

In many parts of Europe, South America and elsewhere salad oils are made from the almond, walnut, beechnut, Brazil nut, cocoanut and peanut. These nut oils, which are practically pure fat, have a very high fuel value, and, being readily assimilated with other food materials, may be made to constitute an important energy-yielding constituent of one's diet.

Cocoanut-milk is practically water stored in the cocoanut shell, containing only a little mineral matter, sugar, etc, in solution. It is very pure, and is a far safer beverage in the countries where it grows than is water from the springs or streams which are often more or less contaminated with organic matter. This liquid, however, is not at all the same as the nut-milks which are often referred to in books devoted to nut cookery. These latter are nothing more than nut-butters reduced by mixing them with water.

A delicious milky liquid may be obtained by pouring about a pint of boiling water on a freshly grated cocoanut, allowing it to stand until cold, and then straining it. If allowed to stand long enough a cream will rise to the top and this may be served with fruits and used in other ways. Those rigid vegetarians who wish to exclude even milk from their dietary will find this liquid and cream both palatable and invigorating.

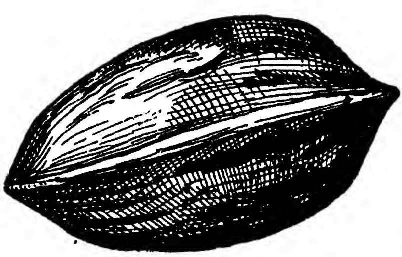
Nut-pastes and nut-preserves are generally made only by confectioners, and while they contain large nutritive qualities they are generally made so rich as to belong rather to the needless and harmful luxuries than to the beneficial articles of a sensible man's diet.

Nut-flours and nut-meals are coming into more general use, though as yet they have but a limited sale. As a rule they are made from the ordinary nuts by blanching, thoroughly drying and grinding. There is a great difference between "blanching" nuts and "bleaching" them. The former means the simple process of immersing nut-meats for a short time in hot water and then rubbing off the skins; the latter is a process of sulphurizing nuts for the purpose of improving their outward appearance and thus commanding higher prices. This is often done by exposing the nuts to sulphur vapor, or treating them with a mixture of sal-soda, chloride of lime and water. This latter in no way increases the food value of the nuts, and will doubtless be continued no longer than the public desires it.

Nuts sold in their shells should be washed before being put on the table. Where shelled nuts are purchased in bulk, they too should be washed before being used. Hot water poured over them not only imparts a fresh flavor and appearance, but also removes any acrid taste.

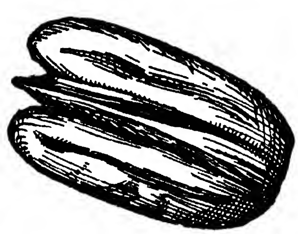
Nut-and-Fruit Diet.—Change to the nut-and-fruit diet should be made gradually. If one cares to go through a milk diet for a few weeks as a preparation, a full diet of fruit and nuts will usually prove agreeable and satisfactory.

Beginners upon the nut-and-fruit diet, if they are habituated to taking three meals, should make the first meal of the day on an orange, an apple, a banana, or a small saucerful of berries only. The principal meal should be eaten at noon. A small variety of nuts, such as peanuts, walnuts,



Showing the pecan in its shell. The pecan is one of the most valuable of the nuts, having a high percentage of fat and protein.

A cross section of the pecan.



Kernel of the pecan after outer shell has been removed.

filberts, almonds and Brazil nuts should be taken with such fruits as bananas, figs, dates or raisins. The greatest care must be taken thoroughly to masticate these foods to a complete liquid. This is essential also for the emulsification of the fats which form a large part of the nutritive element of nuts. These fats are digested easily if properly emulsified in the mouth and mingled with the saliva. Otherwise they are difficult to digest and liable to cause intestinal indigestion. Supper should be similar to breakfast. If the two-meal-a-day plan is adopted, the first meal can be eaten about 11 A. M., and the principal meal at 6 P. M.

The following table gives the daily record of one fruit-and-nut eater, whose experience extended over a considerable period and who lived upon two meals a day with one kind of nuts only at each meal. If unusual mental or physical effort was to be made, the quantity of food was slightly increased.

	WEIGHT IN OUNCES.								
FOOD.	Meal one	Meal two	Total.	Water.	Proteids.	Fats.	Carbohydrates.	Salts or Ash	Heat Units.
Brazil nuts	1½	1½	3	.159	.510	2.000	.210	.117	612
Dates	2	3	5	.770	.105	.140	3.920	.065	505
Figs	2½	½	3	.564	.129	.009	2.230	.072	276
Bananas	8½	6½	15	11.300	.195	.090	3.300	.120	435
Apples		8½	8½	7.190	.034	.043	1.210	.026	153
Olives, ripe		2⅔	2⅔	1.720	.045	.796	.114	.090	200
Time	a. m. 7.00	p. m. 6.00							
Totals			37.273 oz.	21.703	1.018	3.078	10.984	.490	2181

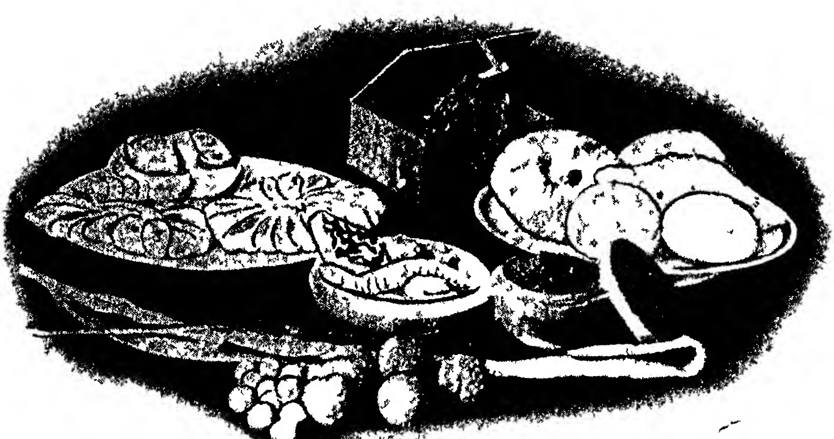
Total food, less contained water, 15.57 ounces.

REMARKS: Before eating each meal general physical exercise was taken for fifteen minutes. After each meal 5 ounces of water were drunk. A feeling of exhilaration followed each meal.

As to the pecuniary economy resulting from the use of nuts, scientific experimentation indicates that nothing is to be said in favor of the nut, except in the case of the peanut and this is not a nut at all, but a legume, one of the family of peas and beans. Still, it is popularly considered as a nut, and will be so treated here. Ten cents spent for peanuts will purchase more than twice the protein and six times the energy that can be gained from ten cents worth of porterhouse steak. In comparison with the almond, the peanut is far more to be desired. The almond supplies only about one-fourth the protein and less than one-third the energy supplied by the peanut.

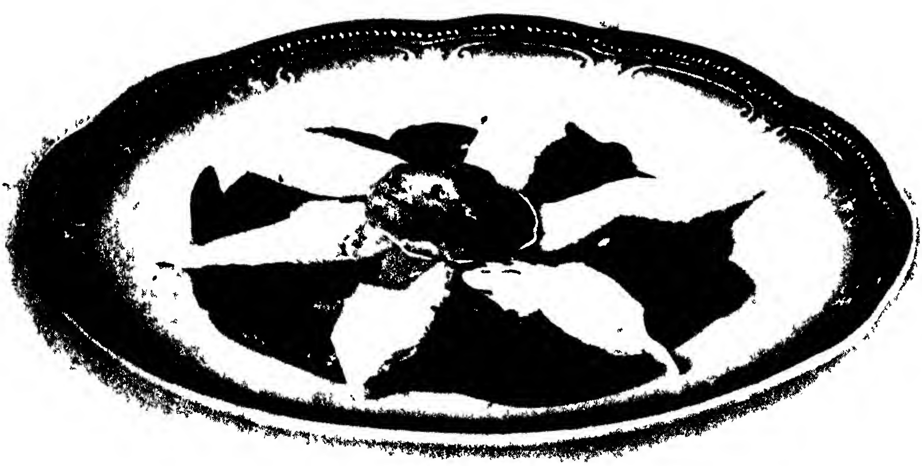
PEANUTS.—The American people are now using yearly about four million bushels of peanuts, at a cost of $10,000,000. This quantity is all the more enormous in view of the fact that nearly all these peanuts are eaten at odd times, as a delicacy, and not as a regular food at meal-time. The majority of the people who thus use them also eat extensively of meat and other foods containing the same elements found in peanuts. So, by using the peanut as a regular article of diet, and by getting along without these between-meal extras, thousands of people could greatly decrease their living expenses and remarkably increase their health and efficiency.

As food, peanuts may be used in a great many ways. They are very good shelled and eaten as ordinary nuts, either raw or roasted. If any variety of candy is healthful, surely those kinds of confectionery composed largely of peanuts—such



A Chinese repast of nuts, fruits and vegetables.

Stuffed Beets—Boil as many beets as needed until tender. When cold peel and cut slice from stem end so beet can stand. Scoop out center. Fill with lemon juice and let stand. Meanwhile prepare chopped celery with mayonnaise and when ready to serve turn out lemon juice and fill with celery. Serve on bed of lettuce.

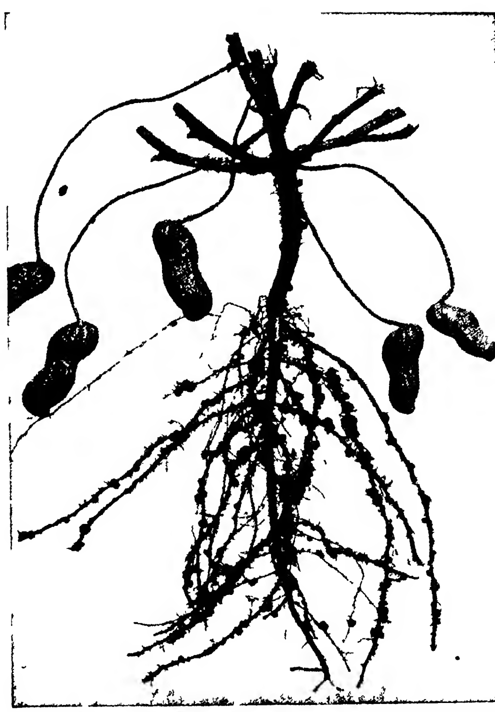


Brussels Sprouts Wash and carefully pick over the sprouts and cook in boiling salted water for twenty minutes. Drain chop finely, reheat and season with butter, pepper and salt. Decorate with hard-boiled egg arranged as petals as in illustration.

as peanut crisp (made of peanuts and sugar and sometimes cocoanut), and the chocolate-dipped meats—ought to be wholesome. Then there is peanut butter. While non-physical culturists generally consider peanut butter as a sort of picnic dainty, many people use it regularly as a substitute for ordinary butter. Chopped peanuts, not made into butter, make an excellent ingredient for sandwiches. These chopped meats are also delicious when baked in bread. They may be combined with sweet fruits for making wholesome fruit cakes, or with many fruits and vegetables as salads.

Another way in which peanuts are used as a food is in the form of peanut oil, which is often used as a substitute for olive oil. The peanut possesses other virtues than those of a dietetic sort, and, unlike many crops, it enriches instead of impoverishing the soil in which it grows.

Uncooked peanuts are much more nutritious than are those that have been subjected to the action of fire, and what is more, they are appetizing and even delicious when one becomes accustomed to them. A taste for roasted peanuts is artificial. It is due to custom rather than natural desire. But to get the true flavor of the peanut and to extract from it all its nourishing qualities, you must eat it *au naturel,* that is, before it has been steamed or roasted or what-not. Of course, a raw peanut calls for much more mastication than does one that has been cooked, but this is a mani-



Roots of peanut vine, showing the root nodules by which this plant gathers nitrogen.

fest advantage in a dietetic sense. If you try to "bolt" an uncooked peanut before your teeth have done their full duty to it, your digestive organs are likely to suffer in consequence. On the other hand, a well chewed raw peanut is most digestible.

After a time, you will prefer the raw to the roasted nut, and as the nutritive value of a food to a very great extent depends on our enjoyment of it, this too is quite a consideration. It is perhaps unnecessary to add that the brown-red skin which surrounds the kernel should be removed before eating.

FRUITS.—In most families fruit is used more as a food-accessory, an appetizer, or a luxury, than because of its distinctive food value. This is a great mistake. Instead of being looked upon as a "side-dish," fruit should be regarded as one of the most important and principal articles of diet.

Indeed, the acreage of fruit-growing lands in the United States should rapidly increase to many times its present extent, invading the vast, sparsely settled territories now devoted most uneconomically to the raising of animals for food, since the American people ought to consume five times the amount of fruit they now do, to the exclusion of other and less beneficial articles of food. Certainly the result would be a tremendous increase of their healthfulness, vigor and consequent happiness.

To every unperverted taste fruit is palatable, stimulating to the appetite and health-giving. It is a natural food, rich in all nutrient elements, easily digestible to the normal stomach and with nothing disagreeable in its handling from the time of the planting of the tree from which it comes to the moment of its appearing on the table of the consumer.

Edible fruits show great range in form, color, and appearance, and are found in almost countless varieties; yet from the botanist's standpoint all our fruits are the seed-bearing portion of the plant. The edible fruits of temperate regions fall into a few groups—stone fruits, like cherries and plums; pome fruits, like apples and pears; grapes; and berries, like strawberries, blackberries and currants.

There are several products, such as muskmelons, cantaloupes and watermelons, sometimes classed as fruits and sometimes as vegetables, which, of course, would not belong to any one of these groups. Tropical fruits are not so easily classified, though the citrus family (oranges, lemons, etc.), includes many of the more common kinds.

There are a few vegetable products, which are not fruits in any botanical sense, but which by common consent are included in this class of food products, since their place in the diet is the same. The most common of these products is rhubarb, and there are few uses of fruit which the acid rhubarb stalk does not serve.

As a country becomes more thickly settled, less and less reliance can be placed on the output of wild fruits, and the market gardener and fruit grower become of increasing importance. In the United States, strawberries, blackberries and raspberries are examples of fruits which are still growing wild and are cultivated as well, and cranberries have so recently come under cultivation that many persons still think of them as a wild fruit.

The commercial fruit grower, of course, desires a fruit of good appearance, having satisfactory shipping and keeping qualities, and too often the consumer is satisfied to accept a product in which such qualities predominate. Discriminating purchasers, however, will insist on good flavor, texture, and cooking qualities as well, and such demands should be more often urged in order that quality may replace appearance as a standard in cultivating fruit for market.

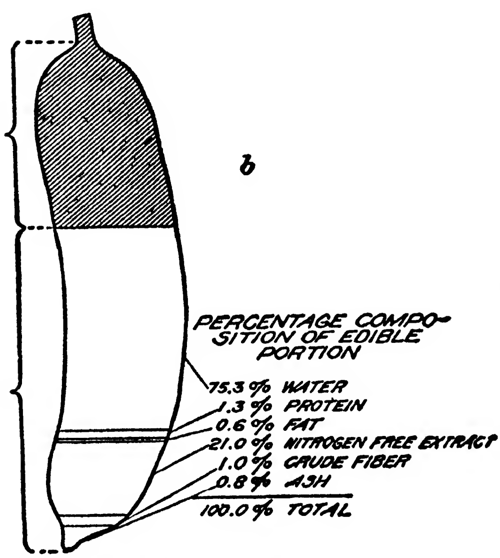
Fruit Market Improvements.—The fruit market has been very greatly modified and extended by improved methods of transportation and storage. A man need not be so very old to remember well the time when, at least in the Northern States, bananas were a comparative rarity outside the large cities, and oranges and lemons, though commoner commodities, were still luxuriously high in price. In the summer there was an abundance of the common garden fruits, but in winter apples were virtually the only fruits that were at all plentiful. A few years have witnessed a great change, and now there is hardly a village so small that bananas and other tropical and sub-tropical fruits cannot be purchased at reasonable prices, all the year around.

Indeed, bananas are now sometimes spoken of as "the poor man's fruit." The exceedingly low cost of this fruit is due to the wide distribution of the plant, its continuous and prolific yield, and the adaptability of the fruit to easy and cheap transportation, since it can be sent in the hardy, green state, and ripened after arrival at its destination.

At the present time there are a number of fruits, such as avocados, or "alligator pears," mangoes and sapodillas, which are fairly well known in our large markets but seldom seen in smaller towns. The enormous development of the fruit-growing industry in California and Florida, which includes the products of both temperate and warm regions, as well as the possibilities of supplying the northern markets with tropical fruits from Porto Rico and Hawaii, make it probable that within a few years the avocado, the mango, and other tropical fruits will be as well known as the grapefruit or the pineapple.

Improvements in transportation have materially lengthened the season of many fruits, such as strawberries, which cannot be stored for any considerable period. Furthermore, improved methods of culture and transportation have extended the growing area of old and well-known varieties.

In preparing such fruits as plums, peaches, etc., for the table, the skin may be readily removed, without injury to the flavor, by first immersing them for a short time in boiling hot water.



Courtesy of Department of Agriculture.

The banana contains 65 per cent nutritive elements and 35 per cent refuse matter. The dark portion (b) represents waste product.

A silver knife should always be used for paring apples, pears and other fruits. When a steel knife is used, the acid of the fruit acts on the iron of the knife and frequently causes a black discoloration, and there is also very commonly a noticeable metallic flavor. If pared or cut fruit is exposed to the air, it rapidly turns dark in color, owing to the action of oxidases (as some of the ferments normally present in fruits are called) upon the more readily oxydizable bodies, which are also normal fruit constituents.

FRUIT SUGARS.—It should be noted that the principal sugars in fruit are cane-sugar, grape-sugar, and fruit-sugar, and that the kind and amount of these sugars depend largely upon the state of growth and degree of ripeness to which the fruit has been allowed to come. Unripe fruit has much less food value, especially in the sugars, than ripe fruit, but, on the other hand, over-ripe fruit has already begun to lose its palatable, healthful and nutritive qualities by the process of fermentation.

As fruits grow to their full size and ripen they undergo marked changes in chemical composition, both as to the total and the relative amount of the different chemical properties present. A knowledge of these changes, not only while the fruit is on the tree, but after it is placed in storage, is very important both from the housekeeper's and from the commercial standpoint. After being stored some fruits materially improve while others deteriorate very rapidly. Every intelligent housewife should seek to inform herself as to these matters so that she will avoid the loss consequent upon errors. For instance, certain pears and plums improve and ripen after being picked, while other varieties of fruits rapidly deteriorate the longer they are kept. As every housewife knows, under-ripe fruit is most satisfactory for jelly-making, since artificial cooking is a completing of the natural sun-cooking, while fruit that is to be eaten raw should always be as ripe as possible.

Studies made to determine the ease or rapidity of the digestion of different fruits in the stomach indicate that fruits compare favorably with other common foods in these respects.

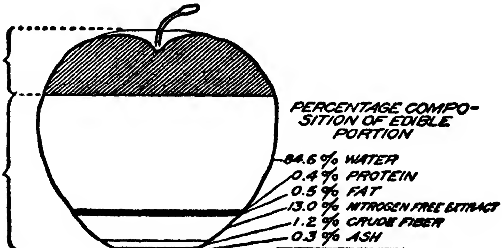
Digestion, of course, is influenced by the nature of the fruit and its stage of ripeness.

Beaumont states that sour apples eaten uncooked require two hours for digestion in the stomach and mellow apples one and a half hours. Another observer notes that about five ounces of raw ripe apples require three hours and ten minutes for digestion in the stomach, but that, if the fruit is unripe, and consequently contains a high proportion of cellulose, a much longer time may be required.

Little is definitely known regarding the relative digestion and absorption of fruits in the intestines, but experiments indicate that as a class ripe fruits are quite thoroughly digestible, and it is evident that, generally speaking, fruits, like other foods, usually remain in the intestinal tract long enough for the body to absorb the nutritive material present, and that therefore the rate of intestinal digestion would not be a matter of special importance.

Over-ripe fruit is often injurious, very probably because of fermentation having begun, and stale or partially decayed fruit is obviously undesirable for food purposes. In addition to a deterioration in flavors there is always the possibility of digestive disturbance if such fruit is eaten raw.

It has been found that the injurious effects of raw unripe fruit are not so much due to the chemical constituents, but rather to the unusual proportions in which the constituents occur, and especially the large percentage of hard cell tissues, which, if imperfectly masticated, may be a source of digestive derangement. Possibly the excess of acid in the green fruit is also a cause of digestive disturbance. Cooked green fruit was found to be practically harmless, being especially palatable and wholesome when cooked with sugar.



The shaded portion of the apple shown above represents refuse. Only twenty-five per cent of the apple is non-nutritious.

Investigations have shown that fruits exposed to street dust and to other unfavorable conditions become covered with bacteria, which are always present in such dust-laden air, and may become sources of contagion. Flies and other insects are also known to be a source of dirt and contamination.

It is often urged that the washing of fruit destroys its flavor. On the other hand, skillful housewives maintain that if properly done the loss of flavor is inappreciable, and on the grounds of common sense and cleanliness it would seem best to sacrifice a little flavor, if necessary, for the sake of removing filth and possibly dangerous bodies, even if the amount of dirt present is too small to be offensive to sight or taste.

THE APPLE.—Of all fruits the apple is one of the most widely cultivated and best appreciated. It is hardy and grows in localities too cold for either the plum or peach. In its wild state it is known as the crab-apple, and is distributed throughout America, Europe and Western Asia. Charred crab-apples are found among the kitchen refuse of the prehistoric Lake-Dwellers of Switzerland, showing that they were a common article of food in the most ancient times.

That fruit is healthful is stated rather forcefully by an English writer, who says: "It will beggar a doctor to live where apple orchards thrive." Mr. John Burroughs gave statistics showing that certain operatives in Cornwall, in a time of scarcity, found apples in some manner a substitute for meat. They could work on baked apples without meat, when a potato diet was not sufficient. To its healthfulness he bore witness: "Especially to those whose soil in life is inclined to be a little bit clayey and heavy is the apple a winter necessity. It is a natural antidote to most of the ills the flesh is heir to. It is a gentle spur and tonic to the whole biliary system."

It may be safely said that, excepting the various kinds of grains, there is no product of the earth in this country which is so good for food as the apple. This noble fruit is no mere palate-pleaser; it is very nutritious, as it contains acids mild and gentle, as well as pleasing to the taste, which act in a beneficent manner upon the whole animal economy.

The apple acts beneficially upon the liver and will correct a sour stomach almost immediately. It is valuable in curing hemorrhoid disturbances and prevents the development of stones in the bladder and liver. It agglutinates the surplus acids of the stomach, and helps the kidney secretions.

THE BANANA.—But few understand the value of bananas as a food. In hot countries, where it usually grows, it is a staple article of nourishment, and there it can be obtained completely ripened. In this condition it has a delicious taste that is very seldom found in the bananas that are secured throughout North America and England, where in nearly all cases it is eaten entirely too green. As a rule it is not allowed to ripen properly. In many cases it is cut too green, though usually the bananas that come to America, if they are ripened under proper conditions, will retain nearly all the nutritive properties as well as delicious flavor of the fruit. I have known many athletes of more than ordinary ability to live almost entirely on bananas for an extended period, and their strength was kept up to a high degree under the influence of the food.

The most delicious bananas that we get here are raised in Jamaica. When the bananas arrive, they are very green. They are stored away in warehouses and allowed to ripen until they are ready for eating. This ripening process is most important, if the banana is to retain its full, delicious flavor. Where they have been cut too green, they never acquire a proper flavor and under such circumstances they often ripen with a dark, solid substance in the center. When this dark substance is noted, the banana has not been properly ripened, or else it has been cut before it was sufficiently matured. Happily, the habit of cooking the banana has not as yet developed. It is far better in its raw state.

A banana that has been ripened properly, has in nearly all cases the appearance of the complexion of a much-freckled boy, the only difference being that the freckles on a banana are black instead of brown. When you can find bananas that are freckled in this manner, you will know that they are properly ripened, and if you will buy them and put them away until the skin becomes very dark or, in fact, actually black, if the inside of the banana still remains solid, you will be amazed at the palatability and flavor of the fruit.

Even those bananas that do not freckle as they ripen will develop a flavor that will be pleasing in every instance, and in many cases even delicious, if you place them in a dry atmosphere with a moderate temperature and a certain amount of sunlight; also cut off the lower part of the stem and place it in water. This process will enable the bananas to retain their life as long as possible, so that the fruit will secure its full supply of flavor. It will then taste like nothing you have ever eaten before. It will have almost the same delicious flavor that it possesses when picked ripe from the tree.

Some of the ordinary yellow bananas eaten everywhere are nothing more than green fruit. When the inside of a banana begins to decay before the outside starts to blacken it is a sign that it has not been properly ripened and is therefore not fit to eat.

There are various ways of eating bananas that increase their value as a food, and add to the delicious qualities of the fruit. Sliced and eaten with cream they make a delicious dessert. Sliced and mixed with a chopped acid fruit of any kind—oranges, apples, peaches, pears—likewise makes a delicious dessert if slightly sweetened and eaten with cream. Sliced bananas are especially delicious with olive oil. If the sweet taste is not especially pleasant, a little lemon juice can be added to the oil. Bananas, combined with sliced acid fruit, if eaten with olive oil, make a very delicious dish. Bananas and pitted dates with cream make a splendid combination. Bananas mixed with any of the sweet fruits, with olive oil added, will be found delicious.

Bananas make a splendid sweet salad, and when sprinkled with ground nuts and some chopped acid fruit, they will be found delicious. Dried bananas can be purchased everywhere throughout England, though they are not sold to any great extent in America. In this form they are almost as sweet as a fig. Flour has been made from bananas and can be used for various dishes, just as ordinary wheat flour is used. Coffee made of bananas—which makes a delicious substitute for the ordinary coffee without its stimulating qualities—is also manufactured.

Grapes.—Grapes are not only a rich and delicious luxury, but have great value as an article of food, either in their fresh condition, or when dried and called raisins. Fresh, ripe grapes contain much sugar, sometimes nearly twenty per cent, in its purest and most digestible form.

Whether grapes are eaten fresh or one partakes of their juice, the physiological effects upon the body in health or disease are of inestimable value. The juice not only contains considerable nutritive value, but the healthful and natural acids promote excretion and secretion, stimulating the healthful action of the kidneys, liver and bowels, and have a decidedly enriching and purifying effect upon the blood.

The dextrin contained in grape-sugar promotes the secretion of pepsin and in this way is a helpful aid to digestion. The phosphoric acid which it contains in large quantities feeds the brain and nerves, healthfully stimulating them to perfect and complete action. To those who use grapes or grape-juice habitually, the use of cathartics or pernicious mineral-waters will be unnecessary. Grapes healthfully produce the natural bowel movement that the cathartic and mineral-waters produce artificially and injuriously.

In the cure of disease, grapes and grape-juice rightfully hold a most honored place. Indeed, the "grape cure" has been in operation for many years, both in this country and in Europe, and thousands of grateful and happy people, relieved from the incubus of disease, can be found singing loudly praises of the treatment.

This cure is being used successfully as a remedy in cases of catarrh of the stomach, intestinal catarrh, diseases of the digestive organs, heart affections, dyspepsia, loss of appetite, sluggish movement of the bowels, hemorrhoids, jaundice, suppressed menstruation, affections of the skin, and in numerous other diseases. The sum and substance of the grape cure is that it is a cleansing and purifying of the system. Fasting or an abstemious diet is recommended in connection with the grape treatment.

The cure is begun by eating one or two pounds of grapes the first day, then increasing the daily allowance one-half pound each day until the desired quantity is reached. Usually the amount of grapes varies between three and nine pounds daily. A prescribed diet or a complete fast should precede the treatment, though benefit will, of course, be derived even if this suggestion is not followed. The treatment should not be dropped suddenly after a cure is effected. Instead, the quantity should be gradually diminished each day.

The fruit used in treatment must be completely ripe. The grapes should not be crushed by the teeth, but pressed by the tongue against the roof of the mouth. There are a considerable number of people who feel an aversion for grapes because of the blunting sensation of the teeth that follows eating them. In cases of this kind, freshly pressed juice is advised. Under ordinary conditions, when grapes are eaten in small quantities and with other food, it does not make much difference whether or not the skins and seeds of the grapes are swallowed, but where grapes are made to be the exclusive, or nearly exclusive diet, as in the grape cure, it is advisable to reject the skins and seeds.

In the systematic cures practiced in the sanitariums in Europe, the day's allowance of grapes allotted to each patient is divided into three portions. The first portion is substituted for breakfast, or, where the patients cannot be induced to omit their breakfast, the grapes are taken an hour later; the second portion of grapes is taken in the forenoon, an hour before the regular meal; the third portion is taken in the afternoon between three and four o'clock. In some sanitariums a fourth portion of grapes is allowed to be eaten late in the day.

Olives.—The olive is a most useful article of diet. Unfortunately, in this country its use has been confined largely to the unripe green olive, eaten not as an article of definite food value, but as an appetizer or tid-bit. Fortunately, a great campaign of education has been carried on by the State of California showing the value of ripe olives and olive oil as regular articles of diet, so that their use is rapidly increasing.

The so-called Greek olives have but a limited sale in America, being almost exclusively used by citizens of foreign birth, and those who have acquired the taste abroad. These olives are picked when ripe and dried like prunes. They are then sprinkled with olive oil and so eaten. The flavor is peculiar but appetizing. Greek olives are invariably sold by weight, whereas the ordinary olive is sold by the bottle or jar.

The ripe olive, preserved in brine, is practically a Californian product. It has a tint akin to a ripe damson plum, and a nutty, rich flavor of a unique kind. Also, it contains much oil. Cut it across and gently squeeze it and the oil becomes very evident to the eye. Like all home-grown olives, there seems to be some little difficulty in preserving it in the ordinary way. So that, after undergoing a proper process of "pickling," it is placed in tins or bottles in company with a weak solution of brine, and "processed" or hermetically sealed.

As has been intimated, olives when ripe are true nutrients. The California station of the Department of Agriculture has recently issued an analysis of the relative nutritive qualities of the ripe and green olive as follows:

	Fat (oil) per cent.	Carbohydrates per cent.	Protein per cent.
Ripe	25.52	3.75	5.65
Green	12.90	1.78	6.91

By this it will be seen that while the ripe olive is very rich in the elements that make warmth and "energy," it is by no means deficient in the flesh-forming protein. The green olive lacks fat but also has its due share of protein. In both forms, it compares favorably with the great majority of the most nutritive of vegetable foods.

In all the olive-growing countries of Europe, the pickled fruit—green or ripe—is used as a staple article of diet. In Spain, for example, the peasant takes a piece of brown bread and a pocketful of small olives and labors in the fields all day without any other nourishment. In Europe, Central and South America, the use of the olive as food—not a relish—is far more general than it is in the United States.

The green olive in its raw state is bitter and astringent. The ripe, raw olive has a sour and persistent bitter flavor also. In both instances, the unpalatable quality is removed by a pickling process. The fruit averages from 150 to 250 to the pound. Both pulp and pit contain oil. In the case of all other fruit, it is only the pit that furnishes oil. Only the ripe olive is used for oil-making purposes, the green fruit having but very little oil in its pulp. In the case of the ripe olive, the oil will run as high as eighty-eight per cent; with the green it rarely rises above two to four per cent.

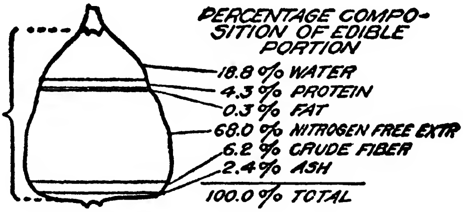
In this country, the olive is eaten as a relish before or during meals, with salads, as an accompaniment to cold dishes, and so forth. Some beverages are served with an olive in the bottom of the glass as a sort of agreeable aftermath to the drink itself. A variety of delicious sandwiches may be made with the help of the olive. Thus, there are walnut and olive, lettuce and olive, cheese and olive, and plain olive sandwiches. But the olive is worthy of a better place than that of a side dish. A dozen or less of the ripe fruit, a couple of slices of whole meal bread, and a glass of milk make a lunch that is at once tempting, satisfying and healthful. The ripe olive also furnishes a new sensation to the vegetarian epicure. One medical enthusiast declares that: "No product on earth contains as much nutrition as the ripe olive. The oil is equal to meat; the pulp is as good as bread."

Olive Oil.—Pure olive oil, like the olive itself, is a true food. What is more, its elements are such that it can be used in quantities that, in the case of practically all other fats, would cause nausea. When employed for cooking purposes, it imparts some of its agreeable flavor to the edible. It mellows salad dressing, and can be used as a palatable and wholesome adjunct to a number of other foods. It is especially useful when taken in connection with those nutritives that, while possessing plenty of protein, lack carbohydrates or fats, such as beans, peas, lentils and the like. In the case of pastry, the oil "shortens" readily. To those vegetarians who object to the use of animal fats of any kind, olive oil is a boon indeed.

Within a comparatively recent period, olive oil has taken its place among rational and certain curatives. Its mild nature and fine flavor commends it to those who have weak digestions, and it is frequently used by those who wish to gain weight. As a remedy for constipation, when combined with other physical culture methods, its power for good is remarkable. It is now used by a large number of medical men as a remedy for indigestion and nervous dyspepsia. In the case of any troubles of the digestive organs, its continued use brings benefit. When taken judiciously, it will almost always bring about a change for the better in the appearance of those who are unduly thin.

The mineral salts are contained in fruits in the most perfect form for immediate assimilation into the body, and for growing children whose bony structure is not yet complete a large use of fruits cannot fail to be highly beneficial. There is also a natural desire for acids in the body which is as persistent as is the desire for food itself, and these acids are supplied to perfection in the citric, malic and other acids found in fruits. Especially are the citrus fruits valuable to meet this demand. These are the orange, lemon, grape-fruit, kumquat (a small orange which is eaten entire, both skin and pulp) and the lime.

To those who are in the habit of abstaining largely from the use of mineral salt in their dietary and who refuse to use vinegar, these fruits fill their places in most healthful and satisfactory manner. The salts of the orange are clearly discerned by those whose taste buds are not vitiated by the overuse of mineral salt, and the lime and lemon are immeasurably to be preferred in the making of salads to any kind of vinegar.



Courtesy of Department of Agriculture.

As illustrated above the fig contains little waste matter, and is almost entirely composed of nutritive elements.

Serving Fruit.—There are many different ways of serving fruit, from those varieties that are never eaten except when raw, such as muskmelon, water-melon, etc., to cranberries and the ordinary varieties of the quince, which are never eaten raw. Methods of preparation are quite varied, including drying, or evaporating, and baking, boiling and stewing, while quantities of fruit are used in puddings, pies and other dishes and for preparations of jams, jellies and preserves. Fruit-juices form the most healthful beverages, and fruit ices make a most appetizing and healthful dish, if the ice is held in the mouth long enough to be perfectly "tasted," and warmed so as to prevent chilling the stomach. Some fruits, notably the ripe olive, are prepared for the table by pickling in brine.

The temperature at which fruits are eaten is largely a matter of fashion or individual taste. In summer time it is well always to keep them in a cool cellar or in an ice-chest, provided that in the latter they are not allowed to become too cold. Not only does over-chilling lessen the delicate flavor and accentuate the acid taste in fruits, but if they are not thoroughly masticated fruits so treated chill the stomach, and thus arrest the process of digestion.

The best time to gather fruits for the table, if for immediate use, is in the morning. If they are to be kept over night, or longer, they should not be gathered until the close of the day.

Dried Fruits.—While fresh fruits and vegetables possess more advantageous qualities as human food than their chemical analyses alone seem to indicate, it is not always that one can secure these even at a time when they are most needed. The next best substitute is to have them dried. Prunes, raisins, peaches, apricots, pears, apples and many other forms of dried fruit are regular articles of commerce that can now be purchased in any city or village in the country. These can be washed and soaked in clean water and then served without cooking; while they are not quite so appetizing as when eaten fresh, they more nearly approximate the fresh fruit than when prepared in any other way. Few people use dried fruit in this simple fashion. They invariably cook it and think it cannot be served in any other way. This is a mistake, as soaked dried fruits are both palatable and wholesome.

Care must be exercised in purchasing dried fruits, as some mercenary packers put up kinds that are unfit for human food. They are full of refuse and waste, and are often vile with grubs and worms. Then, too, much dried fruit—such as peaches, sliced apples, etc.—has been subjected to a process of sulphurizing to keep it from turning dark, and until we learn to buy food for its nutritive values rather than its appearance, the packers will continue this deteriorating process. Prunes, too, are often dipped in a solution of lye, salt and sugar to make them "glisten," and until this is washed off they are not fit for human consumption.

Of the highest food value are the dried sweet fruits, such as dates, figs and raisins. The dietary of every person seeking health and vigor, or desirous of maintaining it, should include a large proportion of these excellent foods.

DATES.—Dates can rightly be termed condensed energy. They contain a large amount of fattening and energy producing elements. Some people deem them too rich for their stomachs, but this is owing to the fact that they are not properly masticated. A date should be masticated to a liquid before swallowing, if the digestion is to be carried on satisfactorily. Dates are especially valuable in combination with an uncooked diet. They are not only highly nutritious and very palatable but they can be mixed with various articles of food as sweetening, instead of sugar. The ordinary sugar purchased in the market is refined to such an extent that nearly all the nourishing elements have been destroyed, or brought into such a condition that the digestive organs find it difficult to assimilate them.

There are various kinds of dates, but the most palatable and the most easily digested are those termed Persian dates. These dates are cheaper than any other kind, and when they are clean and fresh they are by far the best. When in good condition they contain but little fiber. Fard dates are smaller, contain more fiber, are harder and darker and more difficult to masticate. They are not so easy to digest, and are not so satisfactory a food as the Persian dates. One who is fond of sweets should avoid sugar and substitute dates.

Dates can be used to sweeten puddings, and cakes, etc., and, if you have no device for grinding the date meat to a pulp, they can be soaked in water and the water added to whatever you desire to sweeten. They can be used to sweeten coffee or tea or any one of the food coffees.

Date coffee can be made by adding one quart of water to about one-half pound of dates. Allow the dates to soak for a few minutes. Then with a potato masher, or something of the kind, break up the dates until they are reduced to seeds and fiber. Strain the liquid, heat to near boiling point. Then add cream or milk in accordance with taste. This makes a splendid drink with about half milk. To those who lack energy this will often help to bring about surprising results.

Figs and Raisins.—Figs and raisins are equally valuable as palatable and healthful sweeteners and, being easily digested, as nutritious foods. Properly masticated they are very valuable foods and should be better known, more widely appreciated and far more largely used.

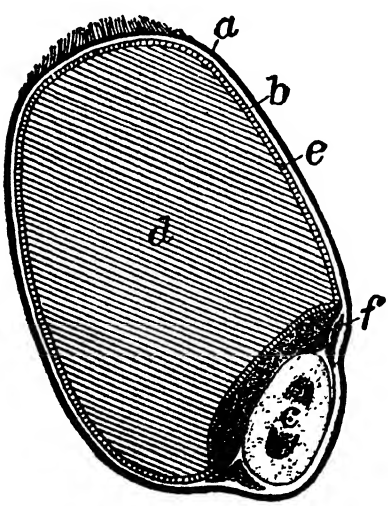
Cereals.—There is no part of the world, except the Arctic regions, where cereals are not extensively cultivated. From the oats and rye of the North to the rice of the hot countries, grains of some kind are staple foods. This universal distribution would seem to imply that the cereal is a natural food well adapted for man under all conditions, circumstances and climes. Scientific investigation justifies this assumption.

Cereals are cheaply and easily grown; they are readily prepared for the table; they are palatable and digestible. Owing to their dryness, they are compact and easily preserved without deterioration. They contain good proportions of the necessary food ingredients with a very small proportion of refuse. In their natural state, they are usually not considered pleasant to the taste and are thought to be difficult to digest, although there was never a greater fallacy than this, as will be shown.

Breakfast Foods.—Until a comparatively recent time, oatmeal, corn meal, or ordinary flour were stirred into hot water and made into porridge or mush. The Scotch use the double boiler and keep the porridge cooking continuously. Then came the grains which were steamed or otherwise partially cooked before being ground or rolled. The third form includes those preparations called "breakfast foods" which have been more thoroughly cooked and sometimes acted upon by malt, which induces a greater or less chemical change in the starch present.

It is not necessary to enter into any explanation of the grains used for porridge and mush. Barley is, perhaps, one of the least used except in soup. Corn has always been largely used, especially in the South. Oats are a distinctly northern cereal and keep better than other food of this kind. Wheat has always been largely used in England, both cracked and ground.

The growth of the modern breakfast food is one of the most remarkable of the many phenomena connected with the history of food. During the youth of many people who by no means regard themselves as "old" the cereal of the morning meal was mush or porridge, made of either coarsely ground wheat, or oats, or of corn meal. The wheat and oats took a long time to cook.



Vertical cross section of a grain of wheat. The outer coats a, b and e, together with the germ (c) and other nutritious parts, are destroyed in ordinary process-milling in order to produce white flour.

In the course of time, these grains were replaced by the so-called rolled oats and wheat prepared by being swelled with steam and then crushed by hot rollers. The two latest developments have been in the preparation of the so-called malted breakfast foods and in the "ready to eat" corn flakes, rice flakes, puffed rice, etc.

The methods of preparing this latter class of foods are many and varied, and the exact details in some instances are the secrets of the manufacturers; but one can generally give a fairly correct idea of the processes followed. Some are made of grains dried and crushed after being cooked in water; others are made of the mixture of different grains; while still others have salt, malt and sugar, molasses or other sweetening material added to them. Wheat flakes, corn flakes and rice flakes are cooked by steam and while still wet are run between hot rollers and pressed into thin flakes. One well-known food is made into a dough, baked, dried, brushed and recooked. The shredded preparations are made with special machinery, which cooks and at the same time thoroughly grinds or crushes the grain, and then deposits it in shreds. The "malted" or "predigested" preparations usually have malt or some other such substance added during the processes of manufacture. The diastase of malt has the power, under certain conditions, to change the starch, which is insoluble in water, into various soluble forms, which it is claimed are more easily acted upon by the digestive juices than the original starch.

Although the wholesomeness of these modern preparations is sometimes interfered with by too much cooking, predigesting, etc., they certainly possess one great advantage over the old style. This is absolute cleanliness. In the modern food factories the most scrupulous care to exclude dust and dirt is exercised both in manufacture and packing. In these processes human hands scarcely touch the product in any way whatever and they reach the consumer in the most hygienic and sanitary condition.

In the milling of many of the grains the bran is often eliminated. This is a mistake, as bran is effective as a "scouring" element in digestion. Accordingly it is well for the ordinary vigorous person, especially if he is inclined toward constipation, to mix bran with his breakfast cereal, after soaking it awhile in cream to render it palatable.

The following table gives the comparative composition of the various cereals:

Average composition of cereal grains.

KIND OF CEREAL.	Water.	Protein	Fat.	Total carbohydrates.		Mineral matters.	Fuel value per pound.
				Starch, sugar, etc.	Crude fiber.		
	Per ct.	*Per ct*	*Per ct.*	*Per ct*	*Per ct.*	*Per ct.*	*Calories.*
Indian corn	10.8	10.0	4.3	71.7	1.7	1.5	1,800
Barley	10.9	11.0	2.3	69.5	3.8	2.5	1,735
Buckwheat	12.6	10.0	2.2	64.5	8.7	2.0	1,600
Kaffir corn	12.5	10.9	2.9	70.5	1.9	1.3	1,630
Oats	11.0	11.8	5.0	59.7	9.5	3.0	1,720
Rice	12.0	8.0	2.0	76.0	1.0	1.0	1,720
Rye	10.5	12.2	1.5	71.8	2.1	1.9	1,740
Wheat	10.6	12.2	1.7	71.3	2.4	1.8	1,750

CORN.—From this table it will be seen that corn holds a high place as a nutrient. Corn, or maize, as it is properly called, is a characteristic American product. About one-third of all the land under cultivation in the United States is devoted to corn. The annual crop is valued at about three billion bushels, which is thrice that of the wheat crop, which is next to it in value.

The major portion of the American corn crop is not used as human food but as food for farm animals. Indeed we would not be able to consume corn in anything like the proportion in which it is grown, without an undesirable increase in carbohydrate foods. Whole corn products would be better than the denatured white flour. Yellow corn is better than white for vitamines.

While meal, hominy and similar products are the principal corn foods, there are a number of others of much importance. "Corn on the cob" of certain sweet varieties is a favorite vegetable dish during the season. A large amount of popcorn is consumed, and there are very few substitutes for coffee in which roasted and ground corn does not form a part.

Corn meal is cooked in a great variety of ways, but most of the dishes fall under two general heads, namely, bread prepared by baking, and porridge or puddings made by boiling. In the case of the ready-to-eat corn breakfast foods the cooking and general preparation have been done at the factory.

This usually consists in rolling or flaking and sometimes parching and flavoring the thoroughly steamed or boiled and softened grain.

Composition of corn preparations, compared with wheat bread.

KIND OF MATERIAL.	Water.	Protein.	Fat.	Carbohydrates. Starch, sugar, etc.	Carbohydrates. Crude fiber.	Mineral matters.	Fuel value per pound.
	Per ct.	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Per ct.*	*Calories.*
Hominy, boiled	79.3	2.2	0.2	17.8		0.5	380
Hoecake	52.8	4.0	.6	40.0	0.2	2.4	885
Johnnycake	29.4	7.8	2.2	57.5	.2	2.9	1,385
Boston brown bread	43.9	6.3	2.1	45.7	.1	1.9	1,110
Corn breakfast foods, flaked, (partially cooked at factory)	10.3	9.6	1.1	77.9	.4	.7	1,680
Corn breakfast foods, flaked and parched (ready to eat)	7.3	10.1	1.8	77.2	1.2	2.4	1,735
Indian pudding	60.7	5.5	4.8	27.5		1.5	815
Cornstarch blanc-mange (made with cornstarch and water)	87.3	2.9	.1	9.5	....	.2	230
Parched corn	5.2	11.5	8.4	72.3		2.6	1,915
Popped corn	4.3	10.7	5.0	77.3	1.4	1.3	1,880
Hulled corn	74.1	2.3	.9	22.2		.5	490
Granulated corn meal	12.5	9.2	1.9	74.4	1.0	1.0	1,655
Wheat bread	35.3	9.2	1.3	52.6	.5	1.1	1,205

In digestibility corn and corn products compare favorably with other grain foods, and in cheapness of cost far exceed them.

Rice.—As an article of diet, rice is one of the most important foods in the world. It is habitually used by over 120,000,000 people, and is the chief article of diet of about one-third of the human race. Otto Carque says:

"So far as it is known rice was the first cereal used by man. Probably the Aryans carried it with them in their migratory marches from the cradle of the human race in the earliest dawn of history. We know that it was introduced into China about five thousand years ago; that it was grown in the valley of the Euphrates over two thousand years ago; that the Arabs took it to Spain, and sustained by its marvelous powers of nourishment, planted their victorious banners in many lands. It was introduced into Italy in 1468. Sir William Berkeley first cultivated it in Virginia in 1647. Today it is the staple article of food of the millions of India, Siam, China, and Africa. In the Mediterranean countries, and in the tropical and subtropical regions of North and South America, it is cultivated as a principal means of subsistence. It is the chief diet of the wonderful Japanese soldiery whose strength and prowess compel our admiration and wonder.

"The main reason for the superiority of rice over all other forms of foods is its ready digestibility, plain boiled rice being assimilated in one hour, while the other cereals, legumes, and most vegetables require from three and one-half to five hours. Rice thus enables a man to economize fully seventy-five per cent of the time and energy expended in the digestion of ordinary food, thus adding it to the reserve force of the system. A rice diet is generally prescribed for any inflammation of the mucous membrane, whether of the lungs, stomach or bowels. It is but self-evident that these statements particularly refer to unpolished rice as it is used by the Oriental nations. Unfortunately, Americans and Europeans are still ignorant of the great difference between polished and unpolished rice.

"Estimated according to standard food values, the parts removed by the polishing process are nearly twice as valuable for food as polished rice. This polish contains the germ and the cuticle and, as in all other grains and fruit, it is the sweetest part. In a hundred pounds of rice 'polish' there are, besides water and starch: 11 pounds of protein, 7.2 pounds of fat, and 5.2 pounds of mineral elements. In a hundred pounds of polished rice there are only 7.4 pounds of protein, 0.3 pound of fat, and 0.4 pound of mineral elements.

"The unpolished rice is, on an average, ten times as rich in organic salts as the polished rice of commerce. As the flavor is in the fats and organic salts, it is easy to understand the lack of it in commercial rice and why travelers universally speak of the excellent quality of the rice they eat in Oriental countries.

"Of the mineral elements lost in the polishing process silicon is especially valuable. Silicon in the form of silicic acid constitutes a large part of the solid surface of our planet. It is indispensable for the growths of plants and it is likewise important in the animal body. It makes the muscles firm, for it protects them against chemical decomposition, and has, consequently, an antiseptic action; it warms the blood by isolating and keeping together the electricity by its salty constituents. Sulphur and silica are found in the hair, making the latter a non-conductor of heat and electricity. Iron, which is also removed to a great extent with the polish, is necessary for the formation of the red blood corpuscles, magnetism, and heat. Sodium is found in unpolished rice in a higher percentage than in any other cereal; this element combines with the carbonic acid which is constantly formed by the oxidizing processes in the body, and enables this gas to be properly discharged through the lungs. Sodium protects the blood from acidity which is the cause of many diseases. Calcium, magnesium, and phosphorus are also predominant and these elements are important for building up our bones and teeth.

"From an economic point of view the production of rice should be favored. When compared with the annual return from an acre of wheat, corn or oats, rice appears to excellent advantage, and its cultivation too is not attended with danger of loss from drought that attends the growing of other cereals, because the rice grower is not dependent on the elements for the necessary water supply, having an abundance of water at hand during the entire season for use as needed. Wheat exhausts the soil rapidly; ten to fifteen years continuous cropping, even in the fertile prairies of the Northwest of America, reduces the annual yield to scarcely paying quantities. On the rice lands of Louisiana and Texas, one man with a four-mule team can plant and harvest one hundred acres of rice and, if well tended, his crop will net him from one hundred and sixty thousand pounds to two hundred thousand pounds of hulled rice, enough to sustain five hundred people for one year.

"Japan, with a population of forty-five million people, produces and consumes approximately twenty-two billion pounds of rice annually. China consumes about one hundred billion pounds. India demands as much as China, and including Burma and Siam, exports about seven billion pounds to Europe. The United States is using for food about five hundred million pounds of rice annually, the per capita consumption being about six pounds, while in Japan it is over four hundred pounds or over one pound a day per head of the population."

Where rice is not the chief dish of an Oriental meal, it is always its accompaniment. It also enters largely into the composition of soups, cakes and all sorts of fancy dishes. More than bread it deserves the title of the "staff of life" from the far greater number of people for whom it forms the chief article of diet.

Bread.—The baking of bread has been practiced from prehistoric times. Not only have archæologists discovered stones for grinding meal and baking bread in the excavations of the lake dwellings of Switzerland, but the bread itself, baked in that almost inconceivable antiquity, has been recovered in liberal quantities, preserved by the accident of having been charred or carbonized, probably in the fires which sometimes destroyed the pile-dwellings of these primitive folk. The forms are small round biscuits, about an inch to an inch and a half in diameter. The material used was grains of barley more or less crushed. The bottoms of these little cakes indicate that they were baked by placing lumps of dough upon hot stones, then covering them over with glowing ashes.

This primitive bread has not been improved upon since. It could not be improved upon, because it was the simple baking of Nature's own product, uncontaminated by adulterants and robbed of none of the valuable constituents of the grain. And the more substantial breads of the present time do not differ essentially from those primitive little loaves, except in the use of a special oven, instead of heated stones. The coarse, unleavened breads of some nations of the world to-day are made either of crushed grains, or of grains ground only into a simple meal, mixed with nothing but water, and with not an atom of the valuable food material removed.

For instance, some of the Norsemen of the present time use a hard-tack bread made of unground rye. The grains are first soaked, then merely mashed by pounding, after which they are baked in disks of about a foot in diameter and an eighth of an inch in thickness—or thinness rather. In the center of each piece is a hole, so that the bread may be stored away on thin poles after baking, or hung up on strings below deck in the fishing smacks. This hard tack is used chiefly by the fisher folk.

In the remote country districts of Scandinavia, also, the poor people bake "flad-brod" only twice a year, storing it away for future use. Their diet is chiefly bread and porridge, with a little herring or other dried fish. The bread is made either from rye or from a mixture of barley, rye and pea-meal, baked in thin layers, and is as hard as flint.

The extreme poverty of the peasantry of Russia in some sections is such that they cannot even enjoy the pleasures of a whole-meal rye bread, but are compelled during parts of the year to mix their meal with ground birch bark, husks or pounded straw in order to make it go farther, or to last until the next harvest. Pitiful as this is, however, it may really not be very much worse than a diet of simply white bread and tea.

Barley will grow farther north than any other cereal, and is consequently much used by the Norwegians for bread. But for the most part, rye is used in Austria, Russia, Lapland Northern Scandinavia and parts of Siberia, as wheat is used in the United States, and chiefly in the form of black bread. It may be said just here that the so-called black bread is not literally black, but varies from a dark golden brown to a *very* dark golden brown, the term "black" being used to distinguish it from white bread.

It is usually considered that the whole grain of wheat is a more perfect human food than that of rye, approximating more nearly the exact chemical constituents of the human body; but this black rye bread disputes the claim, for its eaters possess remarkable vigor, and live to an advanced age. It is said that reindeer sledge parties subsist upon it, in combination with unsweetened brick tea, for weeks together, with only the occasional addition of a bit of fish. Among the peasantry in many sections the almost exclusive diet of black bread is modified by the addition of onions or garlic.

There is such a large Russian-Jewish population in New York City that there are many bakeries which supply the same bread which is used so largely in Russia. This black "pumpernickel," as it is called, is baked in enormous round loaves about eighteen inches in diameter and weighing from sixteen to twenty pounds each. These loaves are cut up and sold by the quarter loaf, or smaller "chunk," at a relatively low price. They are heavy and solid, and have the purest rye flavor, even though somewhat sour, the sour taste being developed by the rapid fermentation of the sugar contained in the rye. From each baking a small piece of dough containing live yeast plants is retained to mix with the next batch, the whole-rye flour being mixed with

Huge loaves of black "pumpernickel," plain, rather unattractive, but very nutritious bread made of rye flour.

nothing else, except water, and allowed to stand for six hours before baking. This is a bread that not only may be but *must* be masticated; otherwise one could not eat it at all. Another rye bread of a rather lighter character, somewhat soured also, but more leavened, is likewise much used in certain sections of New York City; it is sold chiefly in round loaves of eight to ten inches in diameter, at eight and ten cents a loaf. This also is superior to the so-called sweet-rye commonly sold in bakeries, the word sweet being applied not because it is sweetened, which it is not, but to distinguish it from the sour rye bread. There is a Bohemian rye bread very similar to the rye bread described, though a little heavier, perhaps less leavened, and yet not solid like the pumpernickel.

SWEET PUMPERNICKEL.—There is also to be had in the various delicatessen shops of New York a sweet pumpernickel, so called only because it is not soured. To the American taste, not accustomed to the acid character of the Russian black bread, this is much more satisfactory. It is, indeed, perhaps as near to ideal bread as anything could be, outside of a whole-wheat loaf made in a similar manner.

In addition to the black bread of Siberia a small ringed hard-tack is used considerably. It does not even contain any salt, and, after being first steamed, is baked to render it thoroughly dry. It is sometimes soaked in hot tallow to increase its heat-imparting properties, and is then especially valuable as a cold weather food. It can also be made to give both heat and light directly, as a candle does, by inserting waxed strings and touching a match to them.

The Italian coast-working population uses a disk-like hard-tack, with a hole in the center for storing, known as macaroni *pane duro,* which is usually soaked in their cheap wines before it is eaten. It is of a light color, like that of the regular strip of perforated macaroni, and may be used similarly in soups, though in this way is not as satisfactory.

The Italian breads for the most part are fairly substantial, though not so much so as the darker and more solid breads of Germany, Austria and the more northern countries. Some of their loaves are narrow and very long, while others take the form of large rings, the "family" loaves being large enough to put one's head through with ease. For feasts and special occasions they are sometimes made of enormous size, frequently two or three feet in diameter.

Oat cakes, which are still used somewhat in the rural districts of Scotland, are made by mixing up oatmeal, warm water and salt into a stiff paste, kneaded into a thin cake, first fired on a hot plate or griddle, and finished in front of an open fire. In the towns, and even a part of the country, this wholesome form of bread and the old-fashioned porridge have now been largely displaced by the increased use of white bread and tea, and there can be no doubt that the present decreased vitality and lower standard of health in the Scotch people can be attributed largely to this cause. Cereal vendors in the United States are now endeavoring to introduce the idea of oatmeal bread as a novel and wholesome food, to further their business interests, but the recipes usually call for as much white flour—sometimes twice as much—as of oatmeal, in order to satisfy the craze for light and puffy bread. However, even this must be better than the unmixed white bread.

The corn-breads and "johnny-cakes" with which we are all familiar are invariably made with a certain proportion of white wheat flour, and are not bad, even at that, but it is necessary to go to Mexico for a real corn-bread. The much appreciated *tortillas* of Spanish-American countries are flat cakes made simply of roughly ground maize, salt and water. In connection with milk or coffee they form practically the entire breakfast of the people of Mexico, regardless of race or physique, and are also much used by the native Indians.

In parts of Asia and Africa the natives make bread of several varieties of millet, a grain which in our own and many other countries is used as food only for animals. East India consumes more millet than all other grains put together. Great numbers of the more poverty-stricken classes of northern China, who cannot afford rice, grind up millet for bread and for porridge, and during a Russian famine some years ago millet bread was for a long time the only food which remained between the peasantry and starvation.

Bread may be made from buckwheat, though this is commonly used only for griddle cakes. It is not a grain, but a herbaceous plant botanically related to the rhubarb and sorrel. The name was originally beech-wheat, owing to the three-sided, angular shape of the seed.

Among the Japanese and Chinese rice is frequently ground into a flour from which both bread and cakes may be made. A bread can also be made from potato flour, which is made by slicing, drying and grinding potatoes to a powder.

Boston Brown Bread.—One of the best and most wholesome of American oven products is the "Boston brown bread," made from rye, graham flour and corn meal, with black molasses, and usually served very hot. Graham breads and so-called whole-wheat breads are commonly sold at up-to-date bakeries, though in some cases they are not much better than the white loaves retailed at the same places. Some are darkened by molasses.

So much attention is directed to the task of satisfying the popular taste for light, spongy bread, that manufacturers of whole-wheat flours endeavor to give their customers a product of the same consistency as the white flour, and so it is hard to get a genuine whole-wheat flour. The best plan is to buy a small wheat mill that will enable one to grind his own meal and have it fresh every few days.

The flour thus made contains the bran and all the rougher elements of the grain, which are of decided advantage in supplying nutriment for the teeth and bones, and is also healthful because it demands proper mastication.

The human alimentary canal requires a certain amount of waste products to assist in the proper digestion of the food. Whenever a highly concentrated food is used, especially if it is hurriedly masticated, it is a source of danger. The peristaltic activity of the bowels requires a certain amount of coarse or fibrous material in order to secure proper digestion and assimilation. This is furnished very thoroughly by the bran or woody fiber, which is found in the covering of wheat and all other grains. When this has been removed, and the usual hurried process of mastication is followed, there is defective digestion and assimilation, and slowly but surely functional defects develop which in practically every case finally result in some chronic disease more or less serious in nature.

Hot bread made from whole meal of wheat or from any of the other grains is wholesome in every case if thoroughly masticated. Graham gems, for instance, make a splendid article of food, wholesome and nourishing, and one could make an entire meal on them with the greatest physical advantage. Bread made from whole meal is usually compact and rich in nourishment. It is not light and frothy, as you generally find white bread. Therefore, if you do not have a distinct appetite, you do not enjoy eating bread made from whole grains. If, however, you have a healthy and normal appetite, if you really need nourishment, then you will find that there is a sweet, nut-like flavor to bread made from whole-wheat that you can not possibly find in white bread. Wheat bread becomes really and truly a staff of life only when it is made from the whole grain.

Beyond a doubt, many will inquire what one should do for pastry, pies, puddings, etc., if not able to use bolted white flour. You will find that the whole meal of the wheat can be substituted for white flour in your recipes in practically every case, and that the results will please you. Delicious pies can be made from the whole meal of the wheat which have a tastiness about them that far surpasses those made from white flour. For the hot rolls and hot biscuits that are so delectable to the ordinary appetite when permeated with quantities of melted butter, the whole-wheat meal can be substituted, and although the product resulting therefrom may not be so light, it will be even more delicious, if you have a genuine appetite.

There is one kind of bread furnished ready-made by Mother Nature, or at least all ready except the baking, namely the "bread-fruit," originally native of the South Sea Islands, but now transplanted to countries throughout the tropical regions of both hemispheres. It grows on a tree of moderate height, and is similar in shape to a football, and almost as large. The fruit is gathered for use just before ripening, when it is packed with starchy matter. It may be prepared for use in many ways, and in its fresh condition is frequently baked entire, in hot embers, whereupon the interior may be scooped out; this has a soft smooth consistency and a flavor not unlike the taste of potatoes boiled in milk. It combines well with fruits and other ingredients for puddings. In the tropical isles of the Pacific bread-fruit takes the place that cereals hold in temperate latitudes. It is commonly preserved for use by cutting it into thin slices, which are dried in the sun. These dried slices may then be made into flour at any time, from which bread and biscuits may be prepared much the same as from any other flour, or the slices themselves may be baked and eaten without grinding. Its flavor is so pleasing and delicate that one never tires of it.

WHITENING OF FLOUR.—The word "bread," however, to most Americans still connotes the baked product of white wheat flour. Unfortunately stress is laid upon the quality of whiteness as a prime essential in the flour. To this predilection millers have pandered, inventing new processes for eliminating in milling the parts of the grain which would give the flour a dark color, even though these contain the most nourishing elements of wheat. Combined with this they have more and more employed injurious and even poisonous chemicals for bleaching the flour—alum, nitric acid, etc.

To understand fully what the modern miller does to the grain as it comes from Nature's stores, let us examine and analyze the wheat as we find it and then see what the flour is that is sold in its place. We find in the wheat cereal the following primary elements, viz., bran, phosphates, gluten and starch. Under a strong magnifying glass we first come in contact with a very slight woody-fibrous covering outside the bran proper. There is no food value in this, nor in the fuzz at the blossom end of the berry, which also contains a minute amount of dust. These may properly be termed waste, and as they are easily removed, machinery has been designed that thoroughly removes and cleanses the wheat of this and other foreign substances which get mixed in with the wheat, by screening, scouring and winnowing. This covering removed, we come to the bran itself.

Now, wheat bran is not only easily digested by any normal stomach, but has valuable food qualities, being rich in proteids, certain minerals, etc. This fact is recognized by the very millers who eliminate it from flour, in advocating this bran and middlings, offals as they are commonly termed (middlings being mainly fine particles of bran and the germ of the wheat), as the best of food for stock. Wheat bran contains 12.5 per cent digestible protein, middlings 12.8 per cent, whereas corn contains only 7.9 per cent. Bran and middlings therefore form, *par excellence,* the feed for the dairy, furnishing the qualities so much needed in the formation of milk.

Now, is it not a little strange that these offals should be of such inestimable value to stock, have such beneficial food values, and yet be so unfit for man? If these prime elements, protein, phosphates and minerals, are of such value to cattle and horses, why are they not to men also? Besides, an eminent authority has demonstrated that wheat bran contributes something to the composition of the enamel of the teeth, and if we always lived on entire wheat flour we would have few decayed teeth.

Next we notice the germ of the wheat, which is found at the stalk end of the berry, uniting the end of the berry to the ear. Wheat, like all other cereals, contains a germ, that living and life-giving element, which germinates and reproduces itself. Chemistry tells us it is the phosphates of the grains which feed the brain and nerve centers of our being. If our brain and nerves are not properly nourished, we cannot have physical vigor and health, and we become mere weaklings susceptible to all the ailments that strew our pathway.

Third, the gluten. This is a gluey or gelatinous substance which contributes to the muscle, sinew and bone, and constitutes the base of animal tissue. It is scattered all through the internal part in minute globules, but the greater part lies next the bran and adheres tenaciously to it. An illustration on a preceding page shows a cross section of a grain of wheat greatly magnified.

Fourth, the starch. This occupies the internal part of the grain. It preponderates in quantity, and is the white portion of the wheat, all the other elements having color. This starch is what makes fat and contributes to the warmth of the body. Thus we see the importance of retaining in our bread all these different elements, and the folly of discarding any of them.

But, not satisfied with the evil they have done in this elimination, the millers add to the injury. Infinitesimal particles of bran find their way through the meshes of the silk through which the flour is passed in the process that is called bolting the flour, and the millers, to get rid of these, resort to bleaching, claiming that this does not affect the flour. Their statements, however, are not true, because in order to change the color of any physical substance there must be a change in the substance itself. Without some chemical change, you cannot make black white. If, then, there are changes, these changes must be in the cell structure of the flour. If so, what are they and what will be the effect of the changes? Sometime ago Prof. Fleurant, one of the most eminent of French chemists, read before the French Millers' National Convention a paper giving an analysis of three different samples of flour that had been subjected to the bleaching process by acids combined with the use of electricity. These samples had been carefully stored from one to four months, and in each case the result was found to be mainly the same. He said:

"The gluten was reduced in quantity, the fatty matter was diminished, and the acidity increased. In each case, the result was the same. The acidity had been doubled, and the effect upon the system cannot be but baneful. This instantaneous bleaching by electricity is simply the introduction of burned air, the electric flame being a convenient method of destroying the oxygen or carbonic acid gas, thus destroying the natural oil so essential in bread."

This whole system of bleaching or otherwise doctoring up flour in order to produce extreme whiteness is mainly the cause of the alarming increase in constipation and the whole train of ailments that follow in its wake. It is a well-known fact—attested by eminent physicians—that constipation, stomach and bowel troubles and nervous prostration have greatly increased since the introduction of this modern extra-fine white flour.

White flour was bad enough to cause our opposition, but when bleaching was added the detriment to the health of the people was so materially increased that we redoubled our fight against it. Then the Government passed its pure food bill, and one of the first things the experts of the Department did was to investigate the methods of making bleached flour. This it did with much thoroughness, its researches extending over a period of many months. The chief result of the reports of the investigators was an announcement by the Secretary of Agriculture to the effect that a large proportion of white flour was artificially bleached, peroxide of hydrogen being the agent usually employed, and that therefore it was an adulterated product under the law, and its makers were subject to incidental legal pains and penalties. In consequence of which the Secretary issued orders that no such flour was to be exposed for sale in the District of Columbia or the Territories, or to be transported by interstate commerce.

Toast.—Bread, especially white wheat bread as found in our bakeries, is usually not thoroughly baked. When, therefore, one is compelled to eat it, it is well to rebake or toast it.

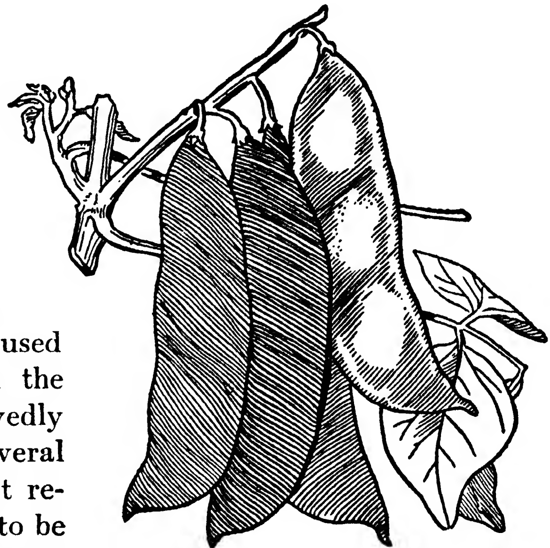
There are comparatively few people among the civilized races who are not more or less fond of toasted bread as an article of diet. It is generally considered more digestible and by many more palatable than untoasted bread. With the Germans and others it generally assumes the form of zwiebach, which simply means "twice baked."

There are many methods of preparing toast, but they should all aim at about the same result. Too hasty toasting browns the surface too quickly, while it leaves the interior almost unaffected by the heat. Ordinary baker's bread, if toasted when new, as is the fashion in many country hotels, namely, by placing it on the top of a fairly heated stove, makes a piece of soggy, steamy, leathery, unpalatable pretense of toast with a mere brown coating which is a delusion and a snare. Toast should never be made from bread less than twelve hours old and should first be dried in an oven and then toasted over a modern broiler, or held in an electric toaster, or on an old-fashioned toasting-fork over hot coals or flame. It is thus thoroughly dried through and the outside browned crisply without being burned.

LEGUMES.—After cereals, the most valuable and widely used vegetable foods are the legumes. The seeds are eaten green, either alone or with the pod, as in the case of string or snap beans and edible podded peas. Others are not eaten until in the fully ripened state, as split peas, dried beans, lentils and peanuts. They are hardy and therefore are found in all climes and countries. They grow rapidly and are cultivated in far northern lands where the summer is short. They also stand high temperatures so that they are found both in tropical and subtropical regions. In middle and northern Europe the pea is the favorite, while in the Mediterranean countries the bean holds first place. In our own country, both the pea and bean are grown extensively and indeed so prolific are our crops that we have an excess which we sell to other nations. One has but to see the vast bean-fields of Ventura County, California, and other nearby regions to realize what a tremendous hold these foods have upon the nation. The lentil is less generally cultivated in the United States and has not yet come into popular favor. But it is one of the most useful of the legumes and for centuries has been known for its high value as a human food.

BEANS.—The bean was cultivated by the Egyptians, Greeks and Romans and it was known to the aborigines of the North American continent long centuries prior to the coming of Columbus. Almost everywhere where the human family exists beans may be found. The earliest cultivated bean is the broad one, known in England as the Windsor bean. It is not as well known in this country as it should be. In

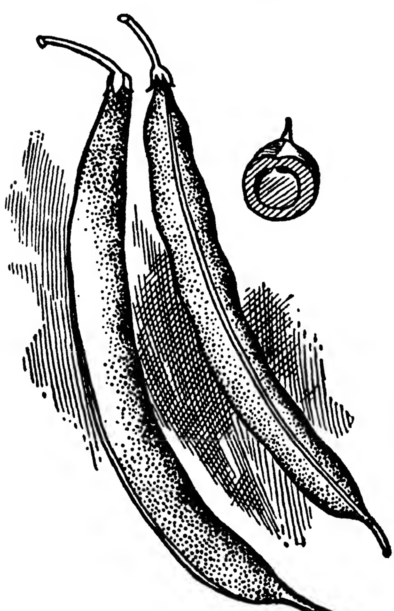
England it is eaten before the seed becomes full grown, being then well-flavored, exceedingly tender, and yet rich in easily digestible muscle-building and heat-forming properties.



The Lima Bean.

The Lima bean is the broad bean generally used both green and ripe, in the United States; it is deservedly popular, though in several parts of Europe it is not regarded in its green state to be the equal of the nutritious green Windsor broad bean.

String or snap beans are extensively used, and form a tasteful and nourishing food which can be eaten with relish either hot or cold. These generally belong to the kidney-bean family. They are supposed to be native of South America, having been introduced from there into Europe in the sixteenth century. The so-called wax-beans all belong to this species. There are certain of these beans that turn dark in cooking. Some people have a prejudice against these dark beans, but it is altogether unfounded as they are most palatable, well-flavored, easily digested and very nutritious.

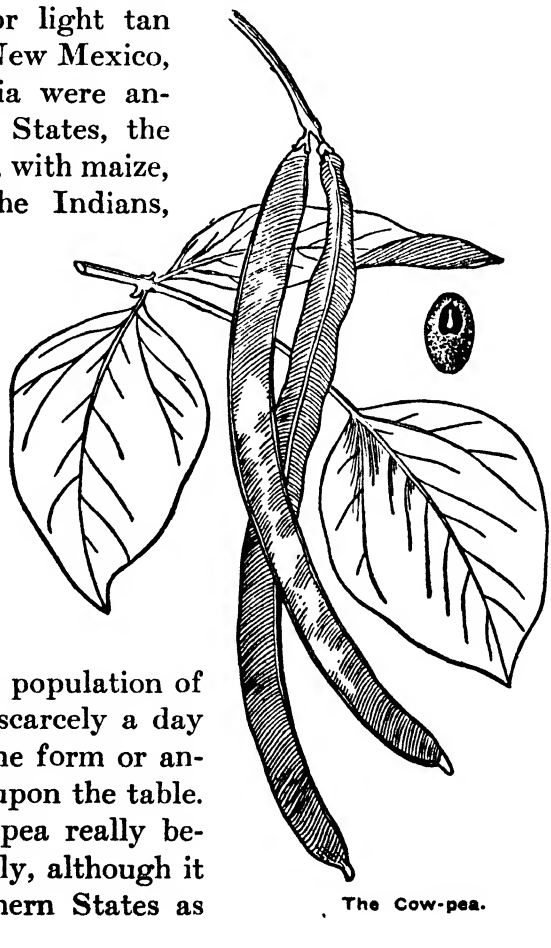


The Snap Bean.

A species that is familiar in the United States as an ornamental climbing vine, but which seems to be almost totally unknown for its food qualities, is the scarlet runner. In England several varieties of these are very much preferred, both as string and shelled beans, to the varieties of kidney beans. When picked early enough they are tender and delicious, and it is time that the American people began to realize how much they are losing by not using this palatable, healthful and nutritious food.

A variety that is very largely used here and is recognized for its palatability and healthfulness is the small, reddish colored bean of Mexico and our southwestern country. To the Mexican it is known as the *frijole* (pronounced free-hó-ly). It is a small, flat bean, generally of a reddish brown or light tan color. When Texas, New Mexico, Arizona and California were annexed by the United States, the *frijole* was found to be, with maize, the staple food of the Indians, Mexicans and Spaniards, and among these people it still holds its former position, at the same time having won considerable favor in the eyes of the more recent American population. At the proper time it is used as a green or snap bean. And among the native population of these regions there is scarcely a day in the year when, in one form or another, it is not placed upon the table.

The so-called cow-pea really belongs to the bean family, although it is known in the Southern States as

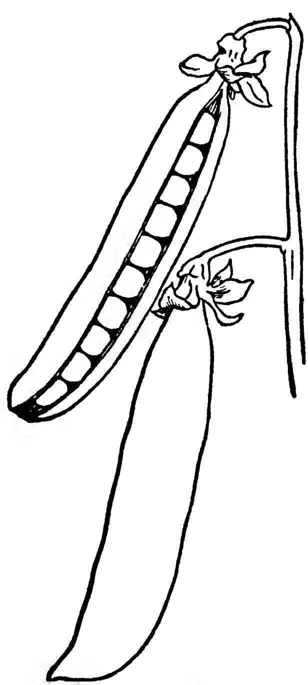


The Cow-pea.

the field-pea. There are many species of this legume which are grown in the South, both as a forage plant and for human food, but mainly as green manure for the soil. Considerable quantities are consumed during the season, being gathered when the pods begin to change color, and before they begin to turn dry. They require a longer season for growth than the kidney bean, and therefore are impracticable for the colder northern climes, but the dry bean might be introduced with advantage into the northern markets and would become a great acquisition to the northern dietary because of its distinct and agreeable flavor.

The soy bean and several other uncommon varieties are used to a very great extent by the Chinese and Japanese, both in their own countries and all over the United States. They are not as well known as they should be, and if more extensively cultivated and placed upon the market they would undoubtedly soon become favorites.

There is still one other bean that is familiar in the American market, the carob or locust bean, which, having formed a chief part of the food of John the Baptist, is often known as St. John's bread. It is grown on the shores of the Mediterranean and the poor people eat it to a considerable extent, though its greatest use is as a food for cattle. When dry it contains about fifty per cent of sugar, and as the flavor is agreeable to many people, children eat it with relish. While differing from it in some regards, the bean of the honey locust of this country is somewhat similar to the carob and is equally as nourishing and palatable.


Garden Pea.

PEAS.—The pea is a most popular food, being found on the table of rich and poor alike, not only during the time it is fresh, but, owing to the perfection of the processes of canning, when it is out of season as well. It is not known where the pea originally came from, but as late as the time of Queen Elizabeth it was not grown in England. Fuller says that peas were brought from Holland and were accounted a "fit dainty for ladies, they came so far and cost so dear." In Europe the dry or split pea is largely used, both as a vegetable and as a basis for soups, though in our own country its use out of season is largely confined to the canned varieties.

The field-pea and the garden pea have a great number of varieties which we have insufficient space to describe here. Those known as the sugar peas are generally the favorites, but all varieties should be eaten as early as possible after picking. The longer they remain uncooked, the less sweet and finely flavored they become.

The Lentil.

Lentils.—The lentil is possibly the most ancient of food plants. It was undoubtedly the reddish Egyptian lentil that furnished the red pottage of Jacob for a mess of which Esau sold his birthright. Owing to the fact that the lentil has a little stronger flavor than peas and beans, some people do not like it, but there are those who pronounce it the most palatable of legumes, as it certainly is the most nutritious. It is not yet cultivated to any large extent in the United States except in Arizona and New Mexico, where it was brought three hundred and fifty years ago by the Spaniards. It is a hardy plant, will grow in sandy soil, and is a prolific bearer.

HONEY.—Honey is a food rather difficult to classify. It is the only food product which we take from the insect world, and yet it is a vegetarian food. We are not eating the bees but appropriating their gather of food stores. It is much as if we would domesticate squirrels and let them gather nuts and then rob their nut stores.

Honey is the nectar of flowers unchanged by the bees except for the evaporation of part of the water. Honey varies slightly in composition and flavor according to the flowers from which it is chiefly derived. Honey usually contains sugars akin to those of the fruits and also cane sugar. With this natural sugar syrup is mixed a small amount of mineral salts and protein elements. Both because of its composition and its fine and distinctive flavor, honey is to be preferred to manufactured sugars and syrups.

CHAPTER XXI.

HOW AND WHEN TO EAT.

THERE is as much difference between normal and natural hunger-appetite and abnormal or unnatural appetite as there is between darkness and light. The one is the natural call of the body for food or drink and the other is an unnatural craving that takes possession of one and the satisfaction of which is fraught with danger. The healthy hunger-appetite can always be satisfied with pleasure and gratification and the results are invariably beneficial and healthful. The abnormal appetite is never satisfied until dulled or satiated and is never gratified with any other than injurious results. If man lived naturally and normally, his appetite could be relied upon to guide him both in the selection of his food and in the amount that he should take.

FIVE RULES FOR EATING.—There are five important points in regard to eating that should never be overlooked. First, *Never eat without a healthy, normal appetite-hunger.* Get rid of the idea that you must eat to keep up your strength. Unless you need food you are far better off without it. To eat three or four times a day because you are in the habit of doing so is a positive crime against the body, for nobody needs three or four meals a day, and to eat when you do not need it is to load up the body with a weight of material that, even if one got rid of it immediately, would require a considerable expenditure of energy. But, unfortunately, an excess of food is not thus easily disposed of. Nature endeavors to teach man the lesson of controlling his abnormal desires by making the excessive food a source of pain and discomfort to him. He suffers from flatulency, heartburn, acidity of the stomach, and a thousand and one other manifestations of indigestion, all of which are sentinel warnings against yielding to the unnatural cravings of abnormal appetite. But it may be asked, How shall I know that my appetite is normal? The test of the normal appetite is this: that one is prepared to eat the plainest, simplest, most unattractive food without appetizing condiments, sauces or strong seasonings, flavors, or sweetening to make it palatable; to eat such food dry and chew it until it becomes delicious and perfectly liquefied so that it can be swallowed without recourse to tea, coffee, cocoa or any other liquid with which we too often wash down our food.

The second rule is of equal importance with the first. *Never eat without enjoyment.* There is no truth more positive and certain in the whole realm of life than the truth that food, to be properly digested and assimilated by the stomach and the alimentary canal, must be enjoyed while being eaten. Contentment should always be present, and never more so than in the process of eating. When food is enjoyed the salivary glands are active and the saliva mingles freely with the food. The gastric glands are active in the stomach and pour forth their liquids in copious quantities and in the best possible chemical condition to perform their important labors. Under no other circumstances are these digestive liquids furnished in the proper quantities, or the proper strength. We all know how one's mouth waters at the thought of some particularly palatable food. The actual necessity for a perfect digestion and assimilation is, that one should be in this condition of "watering of the mouth" before he begins every meal. Food eaten under these conditions is almost sure to be easily digested and assimilated, and can then produce that vigor of body and mind that the normal man and woman so much desire. If you have a craving for those things that you know are unwholesome, substitute for them some article of food containing the same constituents. For instance, if you have an intense desire for candy, it may indicate that you have a real need for sweets, and this craving can be perfectly satisfied by the use of honey or such naturally sweet fruits as dates, raisins and the like.

Third. *Never eat to repletion.* If one follows the normal hunger-appetite, there is very little fear that he will eat too much. But man has for so many centuries perverted his natural instincts of appetite, that it will take some time before he can rely upon his appetite, unguided and uncontrolled by reason. It is better, therefore, to err on the safe side. There is very little danger, if a man enjoys every mouthful of food he eats, that he will take too little. The universal experience of the race is that we eat too much. Hence, there need be no alarm that one will not eat enough. It is far better to stop before satiation than to eat one mouthful more than the body actually requires. Every ounce of food taken into the body beyond its normal requirements, even though it be eaten with enjoyment, is putting a burden upon the excretory organs that have to get rid of it.

The needs of the body vary according to varying circumstances and conditions. When the appetite is normal and healthy it will call for the food that is best adapted to supply the needs of the body. It will adapt itself to these varying circumstances.

Once let a man thoroughly understand and realize that the body is originally self-acting, self-regulating, and that it clearly indicates to the alert mind of its owner what are the exact supplies it needs, and he will be able, after he has once got into a normal condition, to follow the dictates of his appetite with safety, and with most happy and beneficial results.

Now one should eat to live rather than live to eat. By following this policy you can actually increase your length of life from ten to forty years. This statement is not exaggerated. Nearly all diseases begin in the stomach and most diseases continue in the stomach. This organ, when diseased, helps in the process of making impure blood, blood that contains all sorts of poisons. This vile stuff is sent coursing through the body, and yet people wonder why they are not well. In many instances they might more reasonably wonder why they are alive.

The average individual is of the opinion that one must eat three meals a day in order to keep up one's strength. This is a most erroneous and harmful idea. It is not what you eat that keeps up your strength, it is what you digest and assimilate. When you are in the habit of eating more than you need you will actually gain in strength by simply lessening the amount of food you eat. The truth of this statement can be relied upon in every instance. Simply try lessening the quantity of food you are eating by one-fourth, and then test your strength day by day, and you will find there is a perceptible increase. It will not be necessary to change your habits in any way, simply adopt this suggestion, and you will certainly be rewarded by an increase of strength if you are following the usual practice of eating three meals a day whether you need them or not. This result is gained because, when you are eating more than you need you exhaust the surplus energies in ridding the body of the needless food.

If one will learn to eat what he needs, is wise enough to avoid adding poisons to the body through the stomach, he will rarely suffer from chronic diseases. Nearly all filth diseases, nearly all diseases that come from accumulated poisons, are the result of self-poisoning or auto-intoxication.

The fourth rule of diet is to *eat only food that is wholesome.* Many foods popularly considered wholesome are quite the reverse. Of these, white flour products are perhaps the most harmful. It is certainly sacrilegious to call this incomplete food that is made from it the staff of life. It is more like the staff of death. White flour products, if eaten as the principal article of diet, will starve the teeth to death. Unless you possess extraordinary vitality, the teeth will often become mere shells under the influence of a white flour diet, simply because the bony elements needed to nourish the teeth are lacking. Remember, your teeth should last throughout your entire life. There is really no excuse for the decay and loss of teeth that is so frequent, and it is largely caused by the excessive use of white bread and other useless foods.

The fifth rule of diet is to *masticate everything thoroughly.* Food must be chewed thoroughly to secure satisfactory digestive results. Mastication is really a part of digestion. It mixes the food with the saliva. Each morsel of food should be masticated until swallowed unconsciously. The late Horace Fletcher, the mastication expert, proved in an extraordinary manner the value of properly chewing one's food. Many may be of the opinion that he has gone to extremes. He says that you must chew your food until the flavor has disappeared; must continue its mastication until you are able to chew out a certain amount of fiber from almost any food that you ordinarily eat. Mr. Fletcher claimed that the result of masticating your food in this manner is that you can live on one-half the quantity you are accustomed to eating, and secure therefrom a great deal more strength, and better health. Many will say, when told the necessity of mastication, that they have no time to perform it. It is a far greater waste of time to use up the energies of the body trying to digest and assimilate a hastily bolted meal than it would be to take the time required for proper mastication. For instance, if you have but a few minutes to eat, you will often gulp down a large quantity of food, and sometimes for hours thereafter you wish that you had not eaten that meal. Never eat a meal in a hurry. If you do, you are almost sure to regret it, unless you have a stomach of the ostrich character.

How Many Meals a Day?—In America the standard number of meals is three per day. In Germany, at least before the war, it was five, two of them served to workmen in the field or elsewhere. In England, the conventional number of meals is—or was—four. But the European meal is not so likely to be a full meal as the American. Taken as a whole, a prosperous American is probably the most extravagant eater in the world.

The problem of the number of meals per day cannot be separated from the problem of the total quantity of food per day. Regular meal hours, so insisted upon by many writers, finds no foundation in the habits of animals or primitive man. Food was then eaten as it was procured, and varied widely in both quantity and quality. The digestive powers were much greater because of greater activity.

The food problem of the civilized and city-dwelling man is distinctly different from that of our primitive ancestors. The modern man's need for a less total food consumption, and for the stopping of his meal short of the point of repletion, are quite an obvious result of the change in the habits which civilization necessitated. But whether the civilized man who requires the smaller food intake should get it by eating frequently and lightly, or by eating less frequently, is a question which has not been definitely answered by the experience of races or individuals.

The three square meals per day of the prosperous American working man are perhaps not so dangerous, but when he continues to do this after he ceases to work, it is the chief hygienic evil of the American people. This tendency to overeat can most easily be combated by the individual whose general customs and social relations continue to set him down before the conventional three square meals, by the simple step of dropping out one of these meals.

If a man eat his fill he can get enough food in one meal a day to supply him with the necessary nutrition for light labor. But this filling the stomach up to its limit once a day results in a heavy load on digestion and frequently makes the hours following such a meal rather useless for anything else than the function of digestion. Therefore, we find little practical reason for adopting the one-meal-a-day plan.

But, if this quantity of food which the stomach can hold in one meal were divided into two meals, we would have a very practical and efficient amount for the digestive apparatus to handle, and yet would have the feeling that one had eaten a meal and not come away too hungry for comfort.

Inquiry among the readers of *Physical Culture* Magazine has shown that the adoption of two meals results in—first, a decreased quantity of food eaten; second, a marked improvement in health, resulting in both losses and gains in weight, according to the abnormality; third, in the elimination of digestive disturbances, and the related ills due to the eating in excess of the bodily needs. The careful study of these reports leads to the conclusion that for both office and household workers the system of three meals a day, which has been passed down from our pioneer forefathers, is a mistaken plan.

The evidence, however, is not of such nature as would cause a careful thinker to decide that there is any inherent evil in partaking of food as frequently as three times a day. The benefits received from the change from three meals to two meals are more properly to be ascribed to the fact that it is a practical means to cut down the total quantity of food consumed.

The testimony of those who reported on the two-meal-a-day experiment in thirty-two instances stated the amount of food eaten showed a decrease of total food consumed; six reported no change in the amount, and three reported an increase. It is frequently emphasized that the dropping out of the breakfast or other meal has not resulted in increasing food consumption at the two remaining meals. The reports on the amount of the decrease in the amount of food taken range from "slight" to "more than one-half."

LESS INTAKE OF FOOD.—The average of the estimates of those who decreased their food intake was twenty-six per cent less food consumed in two meals than was formerly eaten in three meals. It is safe to say that there are forty million adults in America today who are doing light labor and still eating three meals a day. Fifty cents a day is a low estimate for the cost of their food. A saving of twenty-six per cent would mean a saving of thirteen cents per day for the forty million—which you can figure out. But you will be more interested in the forty-seven dollars per year you could save on your own food.

The economy of time is worth quite as much as the economy of food cost. Being obliged to be at a certain place three times a day and to "get the family together" if one eats at home, and the interruptions and difficulties involved in this third meal, are all absolute wastes of energy.

By cutting out the extra meal you can get that hour a day that you have been needing to devote to much neglected outdoor exercise or a course of reading.

But greatest of all savings of the two-meal-a-day plan is that it gives women an opportunity to escape from one-third of their kitchen labor.

Those who tried two meals a day in this test were almost entirely from the lighter group of workers. Two-thirds at least were those whose work could be classified as clerical. Closely related in the nature of their physical labor were a number of school teachers, a couple of college students, two traveling salesmen, a preacher, a doctor, a barber, a station agent and a weaver. The only men whose work would in any sense be considered heavy were an electrician, a physical director, a sailor, a chauffeur and three farmers. Among the women, over half were housekeepers. The rest were teachers or clerks.

A few of those who had tried two meals a day made the comment that when engaged in extra hard physical labor they find it necessary to go back to three meals. With these exceptions there was almost unstinted praise for the two-meal plan.

The effect of two meals a day, which means refraining from over-eating, is that it tends to bring the body to normal bodily weight. That the same change in eating habits should make lean people fat and fat people lean sounds a little like the story of the satyr who blew on his fingers to make them warm and on his soup to make it cold. But we have not far to go for the explanation of this paradox. The fat man has a digestive system which absorbs surplus food and passes it on to be accumulated as fatty globules in the tissues. But when excessive food is forced upon slightly differently organized digestive organs, the result is a breaking down of the digestive powers, causing dyspepsia, and kindred ills, and these lead to malnutrition and underweight.

The period of rest that comes to the digestive organs from changing to the two-meal plan is secured both from a lessened consumption of food and a greater time interval between meals. The result is that better assimilation develops and when the subject is under weight this frequently results in building up weight.

The weight changes of these two-meal experimenters were studied by comparing the reported weights with the proper weights for the given sex and stature. It is found that the change to two meals a day resulted in gains (averaging eight pounds) for the men whose original weight would indicate that a gain was desirable. For the men who should lose weight there was an average loss of thirteen pounds. There were a number of men who reported that the change in meal plan did not affect their weight. Those whose weights were not affected were found to be already very near the ideal weights for their heights.

In this call for experiences with two meals a day, nothing was said as to which meal should be omitted. Twenty-seven report the omission of breakfast, five report the omission of a noon meal, and four report the omission of the evening meal, while the four remaining report meal hours of mid-forenoon and mid-afternoon.

Practice is pretty evenly divided as to whether "dinner," in the sense of the heaviest meal, is to be eaten at noon or night. There were twenty-one who, when eating two meals, made the last meal the heavier. Against this were fifteen who ate a heavy dinner at noon and a light supper at night.

The reports of those who have tried two meals a day are almost invariably enthusiastic endorsements of the plan. The following are sample comments: "Much improved." "Do not feel so 'stuffed.'" "Tired feeling gone." "Did not feel so ambitious." "I feel invigorated, do not fatigue so easily." "In about one month I gained ten pounds and felt like a new man."

Many observers made note of greater sleepiness in the daytime when eating the three square meals. One comments: "The effect of going without breakfast has been to make my mind clearer, wide-awake. I found it easier to study in the morning—a feeling of mental vigor, whereas with three meals there is a feeling of mental drowsiness—general inefficiency."

Making Two Meals a Day Suffice.—The practical conclusion from all this is that two meals a day is the sensible thing for all those not engaged in heavy manual labor. If for social or business reasons the light worker cannot adopt the two-meal plan, the next best thing is to eat but one full meal a day. For that meal it may be safe to set an abundance of food on the table and eat to a point of reasonable repletion. But the other

Vegetable Turkey Mix together three cupfuls of dry bread-crumbs three cupfuls of chopped nuts and three cupfuls of milk Add one tablespoonful of butter melted one teaspoonful of powdered sage and salt to taste Then stir in six well beaten eggs and bake in a buttered pan for twenty minutes in a hot oven

Vegetable Roast—Put through a food chopper enough walnuts to make one cupful when ground Add four cupfuls of bread-crumbs one grated onion, salt to taste one chopped hard boiled egg one raw egg well beaten, and enough milk to moisten the mixture Mix the ingredients well and turn into a well-buttered mold of desired shape and bake in a moderate oven for about an hour Serve hot with brown sauce Some people like the addition of thyme or sage as a seasoning two meals should consist of definite items set forth in limited quantities. If one determines to breakfast regularly on half a grapefruit and two eggs on toast, the mind and the appetite soon become accustomed to such a restricted food intake and loses the desire to eat a square meal whenever one sits down to the table.

In eating three meals there is always danger that one will eat beyond his capacity to digest. It is impossible for one to know real hunger-appetite unless the food of the previous meal is digested and out of the way. The results that follow eating without this necessary hunger have already been pointed out. These can be avoided by seeing to it that each of the three meals is of easily digested foods and is small enough in quantity to enable the body to fully utilize it; but this requires both care in the selection of foods and self-denial in eating them.

It should never be forgotten that the more food one puts into the stomach above that which is necessary, the less effective become the gastric and other digestive juices. The result is, all the best elements of the food are not extracted for the needs of the body, and at the same time the residue ferments, creating poisons that are often absorbed into the blood, there to become sources of more or less serious disturbances. Very often the "tired feeling" experienced shortly after eating, or shortly before another meal is due, is entirely owing to the effect of the poisons generated by undigested food that the body has been unable to eliminate.

Those who do hard physical labor are better able to digest three meals than those whose work is purely mental, for in the destruction of muscular tissue caused by heavy labor there is a normal demand made upon the assimilative organs for whatever is within their reach. Mental workers, however, make no such demand, and the food must be digested in simple fashion or evil results are bound to follow.

The world at large has been trained to believe that regularity in diet and the eating of three meals a day are essential to keep up strength and preserve the body in perfect health. Neither habit is at all essential. Irregularity in diet is incalculably better than the regularity which forces men to eat three hearty meals whether the normal hunger-appetite exists for them or not. In the former case the most perfect health can be absolutely and certainly maintained. In the latter, there is no power known that can prevent digestive disturbances with their consequent discomforts and diseases.

If the conditions are such that it is necessary for social reasons for one to eat three meals a day, endeavor to follow with the utmost strictness the principles already laid down: 1 Eat only the right kind of food. 2. Eat only when you are hungry. 3. Be careful to eat less rather than more. 4. If there is the slightest suggestion of the approach of illness, miss one or more meals.

It will be appropriate here to give a few suggestions to those workers in the large cities whose occupations take them away from home during the day, where they have to rely upon restaurants, chop-houses, cafés, etc., for their noon meal. There are many who would take their luncheon with them did they have a proper place to eat it, but this is often impracticable or impossible. Some find it inconvenient to follow the plan of eating breakfast at home, going without a noon meal, and waiting until they return home in the evening before partaking of their second meal. They either feel somewhat faint late in the afternoon, or else when they get home at night they are apt to eat more than is good for them. Perhaps for those who come in these categories, it would be better to abstain from breakfast. It is very seldom that the abnormal craving for food, and sensation of emptiness of the stomach, continues longer than a few days, and almost invariably there comes a delightful sense of mental and physical freedom owing to abstinence. At noon one should seek out the most convenient place where he can secure the most nourishing and palatable food. The following foods can nearly always be secured and they form a good and substantial basis from which to select. Other nourishing and palatable dishes can be added as they are discovered.

Whole wheat or other entire grain product with cheese and salad or fruit. Vegetables, salads and stewed fruit or baked apples, etc. Dairy products, milk, cream, eggs, etc. If restaurants are "bad" then patronize the grocery store, where raisins, shelled almonds or other nuts can be secured; also fruit, cheese and cereals. Do not eat in a hurry.

Drink wisely and intelligently, that is, sip very slowly a small quantity of cool (not ice cold) water until satisfied.

It is a common thing for men to follow their noon meal in the city with a cigarette, cigar or pipe, sometimes accompanying this with a cup of black coffee. They feel that such smoking and drinking has a soothing influence and, therefore, may be tolerated. To those who have been the slaves to this habit and who have any desire whatever to be free, let me say that if you will eat the right kind of food in the manner suggested, you will have no desire either for the sedative influence of tobacco or the stimulation of coffee. The craving for both unquestionably arises from a diseased condition of the stomach. When a healthful condition is brought about by proper habits of diet, these cravings are found to disappear totally.

Plan Menus Sensibly.—The old-fashioned American farm family placed everything on the table at once, and passed it around and around again. Theoretically dinner was served as one course, but in practice it was a ten or twenty course meal if one counts helpings as courses.

The more urban fashion of serving a meal is to set forth part of the food, a single dish or combination of dishes that are to be eaten together; to eat this and clear away the dishes and then to serve something else.

Which of these eating habits is followed is a matter of custom and method of service; its dietetic significance lies only in its effects on the kind and amount of food eaten—or wasted. For purposes of the present discussion we can count a dish and what is supposed to be eaten with it as a course and leave the manner of serving to the established habits of the household.

Considered from the practical standpoints of food cost, labor cost and health efficiency, there is little excuse for any meal having more than three courses: First, soup; second, the heavy dish of the meal, conventionally a meat or meat substitute, with its side dishes of vegetables or salad; and third, dessert. This is the typical dinner approved by custom, simple enough for a farmer and fancy enough for a financier. Likewise, a breakfast of fruit, cereal and milk or eggs and toast is sufficiently complicated even for the man who eats but two meals a day.

Such a planning of meals is sensible. It fits in with our habits and is adapted to both rich and poor. Those who have been accustomed to more numerous courses need only to eat larger portions, while if one has been used to simpler meals, he may decrease the size of the servings. The three-course service permits of ample variety and the inclusion of soups which are economical, of vitamine foods, preferably in the uncooked state, and, if the heavy dishes are partly of cereal origin instead of wholly of meat, it is consistent with thrift and economy. In either case the number of courses should not affect the total quantity of food eaten.

Theoretically, we may say that the increase of variety need not affect the quantity of food eaten, yet in practice excessive variety at the same meal tends to both gluttony and waste. Gluttony, because the appetite is stimulated beyond its natural demands, and waste, because there is a slight loss in buying—the grocer sells the paper as meat; in cooking food sticks to the pot; in serving some of the food prepared is often held back for second helpings, and this may not be called for; lastly there are the left-overs on the plate. The more kinds of food there are to be handled in one meal the greater will be the number of such wastes and the greater the proportion of the total food wasted.

Variety as a factor in healthfulness is quite a different matter. Such desirable variety is more economically secured by the change of dishes from meal to meal and from day to day, and not from more numerous courses. Variety therefore does not mean greater food intake but a better selection that the various food groups may find place in the diet.

Though two meals are advised, the author realizes that many will not see fit to adopt that plan. The following standard menu has, therefore, been prepared with three meals, but these meals are such that with a little shifting the second meal can easily be dismembered and divided between the first and last meals. Thus for two meals one would probably transfer the "light meat dish" of lunch to breakfast, and the lunch vegetable could make a second vegetable at dinner, while the bread and butter and sweet dish could be divided as appetite dictated.

STANDARD MENU.—With the qualification that it is for suggestion only, and not to be slavishly followed, I give the following standard daily menu. This menu is given for a family equivalent to four men at light work, which equals in dietetic requirement an average family of husband, wife and three children.

WHEAT POUND ANALYSIS OF DAILY MENU FOR FAMILY OF FOUR.

Substance	Total Wheat Pounds.	Cereal Group.	Sugar Group.	Fat Group.	Vitamine Group.	Animal Protein Group.
FIRST MEAL.						
Fruit	.20	......	.10	......	.10	......
Cereal, milk and sugar	.70	.50	.10	......	......	.10
Bread, butter or fruit jam	.60	.40	.10	.10	......	......
Beverage	.10	......	.05	......	......	.05
Total for meal	1.60	.90	.35	.10	.10	.15
SECOND MEAL.						
Light "meat dish"	.70	.25	......	.20	......	.25
Vegetable	.40	.05	......	.05	.30	......
Bread, butter and sweet	.60	.40	.10	.10	......	......
Total for meal	1.70	.70	.10	.35	.30	.25
THIRD MEAL.						
Soup	.40	.10	......	.10	.10	.10
"Meat substitute"	.80	.04	......	.15	......	.25
Vegetable or salad	.40	......	......	.10	.30	......
Dessert	.40	.15	.10	.05	......	.10
Beverage	.10	......	.05	......	.05	......
Bread and butter	.60	.50	......	.10	......	......
Total for meal	2.70	1.15	.15	.50	.45	.45
Total for day	6.00	2.75	.60	.95	.85	.85
Percentage of total	1.00	.46	.10	.16	.14	.14

The total for the day is 6.00. A rough approximation of the division of food substances among the five food groups is also given. Detailed accuracy here is not practical. The time to check up your diet by the group system is when you go over the monthly food expenditures and not in planning each dish or meal. The idea that it is necessary to health to balance each meal with certain proportions of various food elements has no scientific foundation.

A man can live for thirty days without food, which means that there is stored in the properly nourished body enough of food elements of all sorts to support life for that length of time. This is further established by the fact that deficiency diseases, such as pellagra, which are due to lack of a balanced diet, require several months on such unbalanced diet to develop them. Therefore, if the general average of a month's food intake be well balanced there is no need to worry over the balance of a particular meal or day.

And let me repeat that it is for suggestion only and not to to be slavishly followed, I give the foregoing standard daily menu.

Wise Food Combinations.—A single food rich in varied nutritive compounds is better than a variety of foods eaten at the same meal. In fact, we should aim at simplicity in our diet rather than the reverse. The subject of food combinations, therefore, needs to be considered not so much to learn how to make various combinations, but also to learn to avoid all those that are not actually essential to supplement food deficiencies.

It has been said that "all foods agree with the consumer, but they do not agree with one another"—and this is very largely true!

In preparing proper food combinations no food element should be represented out of its due proportion—but make sure that each group is included.

For instance, an excess of fat in combinations makes foods greasy and heavy and hard to digest, the body can not assimilate excess protein, and rejects it with much irritation and expense to itself; the carbohydrates are stored as fat and persons of good assimilation with a tendency to taking on weight must carefully avoid the presence of too great an amount of the starches and sugar in their diet. The question of the relative amounts of protein and the other elements needed in the diet and the conditions governing amounts of protein and other food elements required will be presently discussed.

The pivots on which to turn in combining foods are: (1), to provide the nutritive properties in their due proportions—proteid, fat carbohydrates and mineral salts, and vitamines; (2) that the combination will be tasteful and attractive and thoroughly enjoyable. Combinations that will meet the test of these two are right combinations, perfect combinations; combinations that can meet only one are not very satisfactory. If the combination is nutritious but not enjoyable, not much benefit is derived from its eating. Only food that is thoroughly enjoyed is well digested. If, on the other hand, it is enjoyable but not nutritious, though it has the advantage of being thoroughly ingested, it will not produce enough energy for the body. Both are absolutely essential.

The problem of food combination involves both the combining of raw materials in the more complex dishes and the effect of combining two or more dishes in a meal. The final effect is the same in the body, but in the earlier stages of digestion it may be made more difficult by complicated dishes. In so far as it is consistent with appetizing food, I would advise the combination be made at the table as the foods are eaten rather than by the cook. Thus I believe it better to eat whole wheat bread with milk or with butter or with eggs, than it would be to add the milk, butter, and eggs to the whole wheat flour and so make a complicated cake.

The staple foods used in the household of the vegetarian or non-meat eater are: vegetables, salad greens, cereals, eggs, milk, flour, fruit, nuts, butter, cheese, and whole wheat. These contain an abundance of vitamines and minerals along with protein, carbohydrates and fat, thus providing a balanced food diet, with succulence and roughage, all of which are important.

If meats are eaten, they should be mixed with potatoes, rice or turnip, foods in which carbohydrates are the chief nutritive elements. Meats are also rich in fat, so, speaking roughly from the standpoint of nutrition, this is an excellent foundation for a meal, and eaten in sufficient quantities with bread will of itself be a satisfactory meal. It is not the most healthful meal, for reasons which have in these pages been brought against the use of meat as a food.

Among the vegetables, the dried legumes, peas, beans and lentils, are the high proteid foods. These articles of diet also have considerable carbohydrates, but with the exception of peanuts, lack fat. When lima beans are cooked plain they should be served with butter, which will balance the dish. Other ways of combining fat with beans are in the forms of purées (in purées, the cooked vegetable is pressed through a sieve and to this smooth, thick pulp seasoning and other ingredients are added). They may also be baked with tomatoes as a flavoring, and the fats added in the form of olive oil or butter. Bean soups are completed by the addition of milk, cream or white sauces, made of butter, flour and water or milk. The bean or pea porridges (purées), if tastefully made, that is, by boiling another flavoring vegetable with them (onion, leek, tomato or celery), are nutritious and make, with the addition of a simple salad and dessert, a complete meal.

The egg is an important food in almost every form of dietary. Its nutritive elements are proteid and fat, but it is lacking in the carbohydrates. To supply this we combine eggs with rice, flour, cornstarch, potatoes, milk and bread crumbs which contain the needed starches and sugars. When eggs do not enter as an ingredient into other foods, but are served as a separate course, soft or hard boiled, poached or scrambled, they are eaten with bread, either plain or toasted. Thus do we supply the missing starch and the bulk.

In the non-meat diet, the animal products, butter, milk, cheese, cream and olive oil and the nuts provide the fat. Butter is combined with foods in various ways. Foods are flavored with it in cookery and it enters into sauces. Almost every form of vegetable may be served with butter or with a sauce. Since butter is more digestible in the raw state, foods should be flavored with it after they are cooked. In the case of vegetables and cereals this is an easy matter. The reason why we can make a satisfying meal on bread and butter and milk or on bread and butter alone, is that in either combination all the nutritive elements are present in sufficient proportions.

Many people consider cheese indigestible. The reason for this is that they often do not realize how highly concentrated a food cheese is. Added to this, we have the statement that cheese is nearly twice as nourishing as meat. Such statements coming from authorities cause people to forget that whereas a pound of meat includes fat, bone, gristle and other inedible portions which are wasted, a pound of cheese contains practically no waste, and therefore can not be used in anything like the same quantities as meat. Many people have argued that though they can eat a half-pound of meat enjoyably, the same amount of cheese afforded them distress, and therefore concluded that cheese was a most indigestible food. Cheese in its ordinary form goes best with bread, especially because it is so highly concentrated. Incidentally, it may be noted that while bread is lacking in fat, the percentage of this element in cheese is almost four-tenths. Cheese is also very rich in protein, and combined with bread is one of those foods of which a little bit goes a long way. It is too rich to be eaten alone. In cooking, cheese is combined with rice, macaroni, spaghetti and similar foodstuffs because they are lacking in fat. In soufflés, rarebits, milk is used to dilute the cheese.

Cream and milk are mixed with foods in ways that have been mentioned, and they will be referred to again. The prime element of most of the nuts is fat, though several varieties contain a fair amount of protein, and some of them are quite rich in carbohydrates. The nut and fruit diet is represented to be an ideal diet, as by this combination, not only are all the elements supplied, but the sugar is supplied in the purest and most digestible form, and the fruit-juices are exceedingly healthful. To my mind, too, the fruits are also valuable because the amount of water they contain serves to offset the richness of the nuts. Both fruits and nuts should be included in the ordinary dietaries. Nuts eaten with bread are an excellent combination, and will be found to be actually delicious.

Those important foods, the cereals and the starchy vegetables, are the chief sources of supply of the carbohydrates. Cereals contain also proteid, and when served with milk or butter and sugar will provide the basis of a nourishing meal. The cereals, because of the amount of starch they contain, are balanced by the addition of fats, and as they are rather insipid, the juicy vegetables are sometimes added for flavor. Thus, rice is baked with tomatoes and cheese; combined with milk, butter and eggs in puddings, etc. The same rule of combination applies to the Italian pastes, spaghetti, macaroni, etc. Rice, barley, farina, oatmeal and other cereal products used in combination with fresh green vegetables make a wholesome dish, which, were the latter used alone, would have very little food value; for instance, fresh green pea soup, with noodles or macaroni; celery soup with barley; tomato soup with rice. Owing to their total lack of fat and protein, potatoes, the chief of the starchy vegetables, should be combined with foods containing these elements. I have cited as an example the use of potatoes and meat together. Their very mild flavor makes them adaptable for combination with various other food stuffs. This is also the case with rice. It will be evident from what has been said in this paragraph that one of the points to be kept in mind in combination is that of using together foods for the purpose of taste and flavoring. The manner in which this may be done is suggested by the examples given.

There is a large class of vegetables and leafy greens in which the percentage of proteid, fat or carbohydrates is practically nil, but they are valuable because of their salts and acids and vitamines. Where economy is an important consideration, these vegetables should not be used except when in season. The green vegetables, like lettuce, celery, cabbage and tomatoes, may be combined with olive oil and lemon juice, or with cream sauces, in the form of salads. In salads we have the pleasing results of the combination of the necessary food elements; protein in the form of the egg, fat in the oil and the mineral salts and vitamines in the green vegetable. Other non-nutritious vegetables, like carrots, turnips, asparagus, Brussels sprouts, squash and spinach, are best simply cooked and seasoned with butter and salt. They may also be served with cream sauces. They are rich in vitamines and minerals.

Fruits have already been touched upon in an earlier paragraph. They can be formed in pleasing combinations, but they are best served in their natural state.

As to combinations that are to be avoided, it is hard to render any strictures in the matter, much depending on individual idiosyncrasies, power of digestion, etc. There are individuals who can not combine sugar with their food in any form, and we have all read the opinion of persons who have declared sugar to be even more unhealthful than meat, and that it has no place in the physical culturist's dietary. To set this up as an absolute rule is utter nonsense, for what should be inferred from such experiences is not that sugar is unhealthful for all (except in excess, and that is an argument against excess and not sugar), but only for the individuals who have found that it has affected them for ill. On the other hand, many persons are made sick by eating strawberries, others still can not abide tomatoes or onions in combination with other foods and even not at all; and so one may go through almost the entire catalogue of foods and find apparently healthy persons who do not like them. This may not be normal, but the fact is to be faced, and when one discovers that certain foods or combinations thereof do not agree with him, no matter how healthful the professors or others may declare them to be, there is only one thing to be done, and that is to avoid them. When a food does not agree with you, no matter what may be said for it as far as others are concerned, it is unhealthful for you. A tendency present in some house-holds is to serve too many sweet combinations, and this tendency should be watched and overcome.

To summarize the statements that have been made, I am presenting a table, grouping the principal foods used in the vegetarian's dietary in such a way as to enable one to tell at a glance the nutritive elements for which the food is especially valuable and suggesting the articles of food that would supplement what they lack. This is merely suggestive and can be expanded by each individual as occasion requires.

FOODS	VALUABLE FOR	COMPLEMENT
Eggs, Cheese,	Proteids and Fat	Sugar and Starch: Rice, Potatoes, Flour, Bread, Etc.
The Legumes: Peas, Beans, Lentils,	Proteid and Carbohydrates	Fat: In the form of Butter and Oil.
Cream, Butter, Olive Oil, Olives, Nuts: Almonds, Brazil Nuts, Filberts, Hickory, English Walnuts,	Fat	Proteids and Carbohydrates: Legumes, Cereals, Fruits.
Cereals: Barley, Buckwheat, Oats, Rice, Rye Wheat, Breads, Macaroni, Etc.,	Carbohydrates and Proteids	Fats: Butter, Cheese, Cream, etc.
Potatoes, Sweet Potatoes, Corn, Parsnips, Sugar, Fruits,	Carbohydrates	Proteids and Fat: Eggs, Milk, Cheese, etc.
Lettuce, Celery, Cabbage, Spinach, Onions, Tomatoes, Cress, Cauliflower, Brussels Sprouts, etc.,	Organic Salts and Vitamins	Proteins, Fats and Carbohydrates.

CHAPTER XXII.

PROBLEMS OF FOOD ECONOMY.

THE problems that center around the question of food and health are many and varied. Diet has in the past been considered too much as a single problem, and any man who had a new or good idea concerning foods was inclined to offer it as a sole requisite to the healthful diet. With the progress of science these narrow views have found their place in the larger science of dietetics, and are now recognized for the partial truth they contain.

Many of these seeming disharmonies have, with further light, been shown to be only different aspects of the same general problem. Dr. Wiley, while doing a great work, for a long time was content to consider foods wholly from the standpoint of their purity.

The orthodox government chemists have considered foods chiefly with respect to their total calorie content and their percentage of protein. These long quoted authorities have been proved to be absolutely in error in advocating a high protein diet when the chief trouble with the American diet was that the protein was already too great.

Vegetarianism has, in its opposition to excessive meat eating, set forth a great dietetic truth, though the reasons given against meat were not always the correct ones.

The science of cookery taught in the domestic schools of the country has been largely based upon the chemical analysis of foods, and thousands of young women have been drilled in laborious calculations of protein, carbohydrates, fats and calories, to a degree of accuracy that was entirely unnecessary and fruitless of practical results in either health or economy.

COST OF LIVING.—The cost of living has been the phase of dietetics that has had the largest appeal in the newspapers, but the solutions offered have usually been to eat rice, cheap meat cuts and various left-overs. Such a program of diet economy is an insult to our intelligence. There should be no left-overs; as for cheap cuts of meat, to eat them may help the individual to economize, but it will not create any more meat in the national larder, but only raise the price of cheap meat, and lower the price of the now expensive cuts—thus taking money out of the poor man's pocket and lowering the food bill of the rich.

The advocacy of the importance of flavor in food, while long recognized economically by the greater price at which highly flavored foods are sold, has not had orthodox backing until recent years, when at the hands of Horace Fletcher and others it began to receive its proper attention.

The claim for a natural diet has always been a leading idea of intelligent health writers, and has of recent years received scientific backing in the discoveries concerning the necessity of mineral salts, the value of vitamines, and the necessity of a proper balance of acidity and alkalinity in our daily menu.

Without pretense at having been an oracle of truth, or miraculously escaping error, it is not without pleasure that

Photograph by Doubleday, Page & Co.

A honey-comb in its natural state, with the bees that produced it.

the writer can look back over the long existence of *Physical Culture Magazine* and realize that its dietetic teachings have been very closely in harmony with scientific facts recently brought to light. The present views favoring low protein are quite in harmony with vegetarianism; undenatured foods which we have long advocated are now shown to contain the essential salts and the vitamines, besides which the importance of a natural appetite to digestion has received high endorsement. These are a few instances where the dietetic teachings of Physical Culture have been vindicated by the recent progress of science. Authorities like Dr. Wiley, the authors of government bulletins, orthodox physicians writing on food, all of which twenty years or so ago wholly ignored the Physical Culture teachings, are today writing food literature closely in harmony with the views which I constantly advocated.

The United States government has copiously issued food bulletins for the dietetic education of the American public. These publications have not only been widely distributed, but have formed the basis for the text-books and teachings of the domestic science courses of our schools.

But the government's entire program of popular food education has been woefully handicapped by a purely theoretical conception of the foundations of food science that rests upon laboratory chemistry, rather than upon direct study of the effect of food upon men.

Early Food Chemistry.—The early food chemists, in their efforts to analyze foods, found such a hopelessly complex array of chemical substances, that they simplified matters by dividing the substances into groups which could be chemically detected by comparatively simple means. These chemical groups, which have for years been considered the orthodox grouping for food analysis, were as follows: Water, Protein, Carbohydrates, Fat and Ash.

The above grouping was selected because it permitted of the adoption of a feasible method of analysis rather than because there was any evidence that the analysis of food into such components would furnish us with knowledge that would solve the problems of human dietetics, and enable the average man or woman to gain increased efficiency from their daily bill of fare.

Briefly, the methods of these analyses are as follows: The percentage of water in the food sample is determined by drying the sample in a stream of warm hydrogen.

The protein is found by analyzing for the element nitrogen, protein compounds in food being the only ones containing nitrogen. The term proteins may include widely different substances, some of which are deadly poisons, others highly essential nutrients, while yet others are inert substances, both useless and harmless.

The chemist next proceeds to determine the amount of fat present by dissolving it out with ether.

The ash is now found by burning the food sample at sufficiently high temperatures to destroy all the organic or carbon compounds. This determination of ash is of little significance from a dietetic standpoint. In the first place, a grain of utterly worthless sand or other impurities will thus register as ash along with organic phosphorus or iron compounds, the presence or absence of which, even in minute quantities, may determine matters of life or death.

After the above analyses have been made, the chemist usually subtracts their totals from 100, and calls the remaining figure the percentage of carbohydrates. As in most of the other food groups, the carbohydrates so found may contain essential, useless or harmful substances. The most soluble fruit sugars register as carbohydrates, along with the indigestible cellulose—yet the human body may need cellulose even more than it needs the sugar, for it utilizes each for a very different purpose.

A last step in the work of the analytical food chemist was the determination of the number of calories or heat-producing units.

The chemist now had a series of analyses of the various foods showing the percentage of water, protein, carbohydrates, fat and ash, and the number of calories per pound. The next task

Mashed Potato Pears.—Boil as many large mealy potatoes as necessary. When done mash thoroughly, moisten with milk, add one tablespoonful of butter and mold into pears, using cloves for stems. Garnish with parsley before sending to the table. Cold boiled potatoes may be used up in this manner.

Cheese Pockets.—A half a pound of pot cheese (any fresh white cheese will do), two cups of flour, a quarter of a teaspoon of salt, three eggs and enough milk to make a dough that can be rolled out to a thickness of one quarter inch. Mix the cheese with one egg, use the other two for the dough.

was to find what to do with all this highly interesting information. Obviously, if he but knew the amounts of these food elements required by the human body, it would then be possible to prescribe a dietary containing so much protein, carbohydrates, etc., thus finding a use for the result of all this laboriously derived information.

But no one knew how much of these elements the human body required. Means of determining the proper amount of food for animals could be estimated pretty accurately by experimentation, but the perfect diet for human beings was harder to establish because human life was too highly valued to be experimented upon as one can with pigs and chickens. Hence, the food chemist, not being able to determine experimentally the minimum, maximum or optimum chemical requirements of the human body, resorted to the expedient of determining how much of these food elements various types of people did eat in their ordinary course of three square meals a day. The resulting figures, especially those derived from American sources, showed the most bountiful consumption of meats, hence of protein, which is a predominating substance in meat foods. From this point on, the reasoning of the government food chemist became quite simple. Working for the American Government, they were perforce extremely full of American patriotism. Reasoned they: First, the American citizen eats more food, and especially more protein food, than any other people in the world. Second, the American people are the most vigorous, intelligent, civilized and important people on earth, hence the enormous supply of ham and eggs they eat must agree with them or they would be sickly, stupid, puny, etc.

Thus, dietary standards were made up wholly oblivious to the fact that the chief fault of the diet of a prosperous people is that of over-eating on things that seem good to the pampered palate. Instead of becoming a corrective factor, *the government food science encouraged the existing evil tendencies in the American habits of eating.*

Food Science Advance.—Within the last fifteen years great strides have been made in food science, much of which has been done by the unofficial efforts of private investigators. Among other things, we have learned that what men do when left to their own blind folly, and what men should do, are as different in the business of eating as in other phases of human existence.

Of late years there has been a growing suspicion on the part of practical dietetic workers that the protein, carbohydrates and fat system of analyzing food was thoroughly impractical as a basis for applied dietetics. It was a case of telling too much and not telling anything practical. To really follow a standard calling for certain amounts of protein, carbohydrates and fats makes the planning and preparation of the daily meals a task in computation hardly less formidable than the work of an astronomer in calculating an eclipse.

So much more fond are we of preaching abroad than of practicing at home, that it is safe to say that not one in a hundred food chemists and dietetic text-book writers knew or cared how much carbohydrate, protein and fat were served upon his own table.

It is not without a smile that we observe that in the case of feeding domestic animals, notably chickens, the government food chemists elaborated a similarly impractical system to the one set forth as a guide for human nutrition. But the poultry feeder must be practical or fail in business, whereas there are too many factors entering into the final success or failure of the human being for the results of good or bad feeding to be so directly observable.

The carbohydrates, fat and protein system of poultry feeding is still published in the poultry bulletins and text-books, and accepted in good faith by the city man who buys a chicken farm and prescribes food for hens as seriously as a young doctor plans the composition of pills. But the poultry growers who have been all their lives in the business received the government bulletins in good faith, made fair test of their workings and discarded them for a simpler system of food prescriptions which is more practical and is in general use on successful chicken farms today.

This system of poultry feeding is one which groups the foods into five groups. This grouping is made in a common-sense way and depends upon the origin of the foods rather than upon detailed chemical analysis. The poultry man thinks of chicken feeds in the following natural groups: 1, Water; 2, Grain; 3, Greens (or succulent vegetables); 4, Meat (or animal protein); 5, Mineral (or grit). The poultry feeder learns what proportion of the above groups his fowls at various ages and conditions should have, and he proceeds to provide these from the most available source in each group. On the Pacific Coast he feeds wheat, while in the East he feeds corn. On the sea coast he feeds fish scrap for meat, whereas inland, packing house meat scrap is used, or in dairy districts, skim-milk. The green foods used may be alfalfa, rye, kale, or any of a dozen others that are cheaply produced.

The poultry man recognized that there is the problem of variety in food forms. Chickens have appetites that must be catered to, though they are less whimsical than the appetites of humans, for appetites are largely of mental origin. This system of chicken feeding applied with common sense is practical and successful. It results in the fowls receiving the essential food elements required for their nutrition, without involving the owner in chemical calculations. It was not so much a question of the chemist being wrong, but for practical use their systems are superfluous.

Serious errors in human dietetics are very common, and become more common the further humanity is removed from the natural selective instincts developed in the early stages of human evolution. The instincts were never entirely right, but they were sufficient to enable the human race to survive. But with the progress of civilization, foods are elaborated and disguised, and human habits so changed that the primitive instincts of food selection become nullified by artificial tastes and artificial habits; hence, we must have some sort of intelligent food guidance to bring us back to an adequate diet. Moreover, there is no reason why it should not be possible for science to improve on nature in matters of diet, as has been accomplished in numerous other phases of human affairs.

The investigation of food chemistry is all right in its place, but in addition we need an every-day system for balancing the diet which would remedy the common errors into which humanity is prone to fall, without troubling the individual with a mass of chemical technology which he cannot understand.

In an effort to enable people to plan their diets in a simple yet efficient way, and to consider at once both health and economy, the Food Department of Physical Culture worked out a plan of considering all foods in the following five natural groups: Cereals, Sugar, Fat, Vitamines, and Animal Protein. About the same time, the government experts at Washington independently worked out and published a food group system that was remarkably similar, differing in fact only in the naming of one group and in the placing of a few items.

The Physical Culture grouping of the various foods is shown in the table giving the detailed wheat-pound figures. This table you will find in Chapter XIV. I give below an extract from a government bulletin which shows their essentially similar system of classification, and explains the use of the system. It will also be interesting to the reader to compare these similar systems with the food groups as worked out by McCollum and stated near the close of Chapter XVII. The chief distinction of McCollum's grouping is the placing of milk in a group by itself. The importance of milk in the diet is such that it really belongs in several groups. For simplicity we retain it in the animal protein group, where it should be considered the most important item. The physical culturist will in fact draw all his animal protein from milk, milk products and eggs, and hence have no need to consider meats as a separate group.

Government Food Group Plan.

If the housewife will group the various foods in her pantry, vegetable bins, and refrigerator into five simple groups and will see that foods from each of the groups appear in each day's meals, she can feel sure that she is giving her family the eight different substances which the body needs for well-being. This grouping will help the housekeeper who wishes to save money or time to simplify her meals without making them one-sided or incomplete. It will enable her to determine whether the meals supply all the different materials needed and will prevent substituting one food for another which has an entirely different use.

Group 1.—Fruits and Vegetables.

Without these the food would be lacking in mineral substances needed for building the body and keeping it in good working condition; in acids which give flavor, prevent constipation, and serve other useful purposes; and in minute quantities of other substances needed for health. By giving bulk to the diet they make it more satisfying to the appetite.

Foods Depended on for Mineral Matters, Vegetable Acids, and Body-Regulating Substances.

FRUITS.	VEGETABLES.
Apples, pears, etc.	Salads: lettuce, celery, etc.
Berries.	Green peas, beans, etc.
Oranges, lemons, etc.	Tomatoes, squash, etc.
Bananas.	Pot-herbs, or "greens."
Melons.	Potatoes and root vegetables.
Etc.	

Group 2.—Meat and Meat Substitutes.

These are sources of an important body-building material, protein. In the case of children, part of the protein food should always be whole milk.

Foods Depended on for Protein.

Milk, skim-milk, cheese, etc.
Poultry.
Eggs.
Meat.
Fish.
Dried peas, beans, cowpeas, etc.
Nuts.

Group 3.—Foods Rich in Starch.

Cereals (wheat, rice, rye, barley, oats, and corn) and potatoes (white and sweet). Cereals come near to being complete foods, and in most diets they supply more of the nourishment than any other kind of food. It is not safe, however, to live only on cereals.

Foods Depended on for Starch.

Cereal grains, meals, flours, etc.
Cereal breakfast foods.
Bread.
Crackers.
Macaroni and other pastes.
Cakes, cookies, starchy puddings, etc.
Potatoes and other starchy vegetables.

Group 4.—Sugar.

Unless some of the fuel is in this form the diet is likely to be lacking in flavor.

Foods Depended on for Sugar.

Sugar.
Molasses.
Sirups.
Honey.
Candies.
Sweet cakes and desserts.
Fruits preserved in sugar, jellies, and dried fruits.

Group 5.—Foods Very Rich in Fat.

These are important sources of body fuel. Without a little of them the food would not be rich enough to taste good.

Foods Depended on for Fat.

Butter and cream.
Lard, suet, and other cooking fats.
Salt pork and bacon.
Table and salad oils.

Some food materials really belong in more than one group.

Cereals, for example, supply protein as well as starch; potatoes supply starch as well as the mineral matters, acids, cellulose, and body-regulating substances, for which they are especially valuable; and most meat supplies fat as well as protein. The lists given above show some of the common food materials arranged in these five groups, according to their most important nutrients. Thinking of foods as belonging to these groups should help to prevent two mistakes—that of serving meals that have not sufficient variety, and that of cutting down in the wrong places when economy of time or money is needed.

The groupings will help the housekeeper who wishes to save money or time to simplify her meals without making them one-sided or incomplete. For example, from these groups, the housewife who has been serving bread, potatoes, and rice or hominy in one meal, will see that one or even two may be left out without omitting any important nutrient. They will show her that a custard which is made of milk and eggs, two foods from Group 2, would hardly be needed after a meal in which a liberal supply of meat had been served, and that a child does not need milk at the same meal with an egg or meat. It will suggest that baked beans or other legumes, or thick soups made of legumes, are substitutes for meat rather than to be eaten with meat.

If, by studying these groups, the housewife finds that she has provided tissue-building protein (Group 2), and the necessary though small amount of tissue-building minerals and body-regulating materials (Group 1), she may safely build up the bulk of the diet from whatever materials from the other groups that seem economical, wholesome, and appetizing.

This method of planning prevents substituting one food for another which has an entirely different use. In general, economy within each group is safer than using an inexpensive food from one group in place of an expensive one from another group.

Group Plan Flaws.—The trouble with this government system is that it does not go far enough. Certainly it is a great improvement over the old carbohydrate, fat, protein teachings, where one was supposed to calculate the elements in each food, an impractical proceeding. But the new plan fails utterly to tell how much of each of the new food groups to use. Shall the housewife spend an equal amount for foods of each group, or buy equal weights of each group, or is it merely sufficient to use some of each group of foods and leave the proportions to chance? A little thought will show that neither health or economy will be materially helped by a mere insistence of considering foods in their essential groups without some guidance as to the proportions of each group to be used.

In an effort to rectify this obvious deficiency I have made an effort to determine the approximate proportions of foods to be derived from each group. The sources of information from which we can start to determine such a proportioning of food, are: First, the total amount of food available in the nation; second, the amount of food selected from these five groups by various individuals; third, the amounts of nutrition of various sorts needed by the body.

America's gross production of cereals, especially of corn, is far in excess of what could be used by us as human food. A diet proportioned on the *total* American production of food products would be quite unbalanced.

Fourteen dietaries (ten of which were submitted in the Physical Culture Low Cost of Living Contest) were averaged and showed the following percentages by food groups—the figures are in wheat-pounds, not pounds.

Cereal group	36 per cent.
Sugar group	12 " "
Fat group	15 " "
Vitamine group	18 " "
Animal protein group	19 " "

A diet based on the total American food production would contain eighty-four per cent of the cereal group, which would be both unbalanced and unpalatable. But by taking the same proportion of cereal foods used in the fourteen dietaries, and drawing upon the other groups in proportion to their aetual availability in the food supply of the nation, we would have a dietary containing the following proportions.

Cereal group	36	per cent.
Sugar group	16	" "
Fat group	20	" "
Vitamine group	12	" "
Animal protein group	16	" "

Considering the physiological need of nutrition, the nation's food supply and the matter of personal economy and palatability we derive the following ideal proportioning of the diet among the five groups:

Cereal group	50	per cent.
Sugar group	10	" "
Fat group	15	" "
Animal protein group	15	" "

This last grouping may be considered as a proper standard for an economical diet. The proportion of cereals is rather higher than most people used to rich food are inclined to take. Cereals are the cheapest of our foods. One-half of our total nutrition may be safely derived from them, but only when they are eaten as whole grains or whole-grain products. This is important. If white flour and other denatured cereal products are used, the proportion of the cereal group would have to be greatly reduced and the milk and other vitamine and protein foods would have to be increased. The arguments of McCollum and others who appreciate the dangers of a deficient diet are for a greater proportion of the "protective foods" only because they realize the dangers of deficiency that come from the use of denatured cereals. The plan of discarding the vitamines (and minerals) of cereals, and making up for this waste by the use of excessive quantities of more expensive foods is indefensible from the standpoint of either health or economy.

How to Save in Food Buying.—You cannot gain food economy through buying alone or through cooking alone. But you must understand both and relate each to the other. By mastering the art of buying you will learn how to secure more food nutrients for less money, but unless those foods be economically prepared, served and eaten, your care in buying will prove a boomerang, for the economical buying will become a tyrant and the appetite will rebel.

The demand of the appetite and the desire for food must be the master, and tell you what to buy; for the appetite will only demand economical foods when you have cultivated it with tasty and appetizing dishes made from the economical products. The efficient way is to buy, or raise in your garden, economical foods that will, by their presence, clamor to be used. Then you must find ways to use them. This leads to the searching of your experience and the experience of others to find recipes and dishes that will use these products. All that you try may not find favor with the appetite, but some of them will, and these you will adopt, and their use will demand the replenishing of the stock of economical food products.

When the end of the month comes around, figure up your grocery bill, and see to what extent you have drawn upon the economical and the expensive foods. Some items will meet your approval; others will show extravagance. Now look over your list and see what economical foods you have neglected. Buy a moderate stock of these and again repeat your effort to find ways to use these.

Don't drive appetite, don't make a martyr of your likes and tastes, but prepare new dishes and try them. Some of them will find favor. As you rebuild your food habits in this fashion, you will learn the essential needs of your table so that you can figure out ahead about what you need. Then you can look about for the most economical form and the most economical quantities in which to purchase your supplies.

I do not intend to recommend any particular system of merchandising, but I can at least advise you to investigate for yourself all places to buy food. There is your local grocer, which all local patriotic community boosters will insist on your patronizing. There are also, if you live in or near a city, the local department stores which usually carry rather high grade goods and charge accordingly. Lastly, there are the great mail-order houses, which now have stores located to cover practically the entire country. These great systems of merchandising have made wonderful progress and the rise in the cost of living during the war was said to have enormously increased their grocery business on account of their fair prices.

Spaghetti Timbales. — Butter small cups well and sprinkle them with bread-crumbs. Now take some cold boiled spaghetti, and beginning in the center of the cup, coil it around and around till the cup is filled with the spaghetti. Break an egg into the hollow formed, add salt, and set the cups into a pan of hot water. Put the pan into the oven for a few minutes until the eggs are set. Turn out on a hot plate. Many like a drawn butter sauce served with the timbale.

Vegetable Fish with Tomato Sauce. Soak a half pound of lentils over night. Next morning put to boil until very tender with just enough water to cover them. When water boils away add more a little at a time, so that there will be but little liquid left when done. Strain off all the liquid, then rub the lentils through a sieve; spread the pulp on flat plate to cool and harden. When firm add one beaten egg, seasoning to taste and enough bread crumbs to enable you to mold the mixture. Shape as nearly as possible like a fish (see illustration) using a large raisin for eye. Brush with beaten egg and bake in moderate oven from twenty minutes to half hour, basting frequently with melted butter. Serve hot with tomato sauce.

Almond Cutlets. One-half pound lima beans, two ounces almonds, two eggs, one teaspoonful of butter. Rub the cooked beans through a sieve and add to them the almonds which have been blanched and run through a food chopper. Beat one of the eggs and add to the mixture with a pinch of salt, mix thoroughly. Now add the butter (melted) and enough bread crumbs to enable you to mold the mixture into desired shapes. Divide into about six portions, shape each one like a cutlet, dip into egg, then crumbs, and fry in butter or bake in the oven. A stalk of celery or parsley may be stuck in each one for the bone in the cutlet. Serve with sauce.

Stuffed Eggs. Hard-boil as many eggs as needed. Cut in half carefully and take out the yolks without breaking the whites. Mash the yolks very fine and add to them one small onion grated, salt to taste, some chopped parsley and enough melted butter to make a consistency soft but firm enough to permit molding into tiny balls. Replace into the whites and serve.

If you are inexperienced in mail-order buying you should be cautioned against selecting the very cheapest grade of goods offered, for that may cause you to become disgusted and repudiate the whole system. Sugar is sugar, but when it comes to syrup or herring, the lower grades are inferior in quality, and even for economy it pays to select your stock from the better priced grades in the mail-order catalog.

Even if you are to purchase most of your foods locally, it will pay you to keep an up-to-date mail-order grocery price list in the house. Then you are in position to see to it that the local grocer does not overcharge you. An instance in point, and not at a cross-roads grocery either, was noted in purchasing foods for the Physical Culture food laboratory. These supplies were bought from a large New York department store. For the most part, the prices seemed reasonable enough, but a half pound of walnut meats were charged at 49 cents. Comparison with a Chicago mail-order catalog showed walnut meats at 59 cents a pound. One of the tricks of the local department store is to sell certain staples at a low price and add ridiculous profits on the items that are less frequently purchased. The mail-order companies have a more sensible system of trading, as they make no claim of offering goods at "less than cost," and yet can be depended on to sell all goods at a moderate profit.

A further advantage of possessing such a food price list is that it will enable you to make out a list of current food prices at their real *cost per wheat pound.* Take your catalog and copy down a list of the staple foods you use most. Where prices are stated in other quantities, reduce them to the pound basis, which is feasible as the net weights of the food packages are always stated. Now consult the wheat-pound table on page 357 and set after each food the wheat-pound factor. In a third column multiply the prices by the factors, and thus get your price per wheat-pound.

Package foods are rarely sold as cheaply as the same foods in bulk. But packages are convenient, and, with the present law requiring the printing on the package of the net weight of the contents, there is no occasion for your being cheated by the package system. But the government cannot prevent you being cheated if you do not use the information which the law insists on being put there for your protection.

When you buy package foods note the net weights. If you purchase a package of oatmeal for fifteen cents, and the net weight be one pound, ten ounces, figure it out and find that you are paying nine and a half cents a pound. If the bulk price is eight cents per pound and you use ten pounds of oatmeal a month, you can figure your month's saving from bulk purchase at fifteen cents and can judge whether the saving is worth the difference in quality or convenience which the package purchasing will give you.

There is nothing fundamentally wrong with the package system of selling foods. If the packages are not too small and not too expensive, the system may represent the most economical way to sell the food. The sugar trust has adopted the package system, and the small cloth sacks which they put up probably represent no more expense, considering the wholesale process of weighing and sacking, than does the worth of the paper sack, the grocer's time and your time, and perhaps the time of a line of waiting customers. The sugar sacked at the factory is honest weight and is sold at a price that varies but little from the bulk retail price. The sugar trust did not dare use the package system as a means of boosting the price because the public had so long purchased sugar by bulk that they would not have stood for such price boosting. It is the abuse and not the legitimate use of the package system that has called forth the criticism of the food economists. It is the small package and the fancy package and the much advertised package that are chiefly at fault. If you want to get some idea of the legitimate advance in the price per pound for the small package of food, consult again the grocery catalog from one of the large mail-order houses which list foods in packages of all sizes from the small fancy cans and bottles up to hundred-pound sacks.

Lower Cost in Quantities.—You will find this principle running through all food selling as through trading everywhere, that the greater the quantity purchased at one time the lower the cost per pound. Foods that keep well may then be purchased in fairly large quantities. So far as possible, these foods should be bought in the wholesale packages. Sugar, for example, may be purchased by the hundred-pound sack, and apples by the bushel instead of by the dozen. Farmers may save in this fashion more easily than city buyers. People in crowded city apartments claim they do not have room to store food, yet a thousand pounds of dry, non-perishable food would only take up a space of twenty cubic feet, a space two by two by five feet, no more than the size of a couple of trunks, and buying foods in large units will work a saving of from ten to fifty per cent and pay enormous dividends on the value of the space required to store them.

By a little thinking and planning, a little shifting about of the furniture, and placing of some boxes or shelves or mouse-proof bins under a table or behind a cupboard, you can find room for storing sufficient non-perishable foods to enable you to purchase them in the larger and more economical sized packages. Your grocer around the corner may be astonished at your change of habit; he has so long been weighing out that pound of sugar, and getting down that small size carton of corn meal, that he will argue gravely against your seeming desire to hoard food. Yet he has been charging you for this foolish service, and the wasted labor of a delivery boy trotting endlessly to your door with a few days' allowance of non-perishable foods that you might just as well purchase in the size package in which he buys it. If he will not accommodate you and insists on charging small quantity rates for large-sized orders, then go to a large grocer, a wholesale or mail-order house, that will sell you at large quantity prices. Even package foods, as package cereals, and canned goods may be purchased by the dozen or by the case.

The package-food industry has grown up because of this improvident habit of wasteful small purchases. The arguments for the small package's greater purity are largely advertising talk and used to cover up the enormous profits made possible by such a system. During the war, when corn meal was worth five cents a pound in quantities, it sold for seven cents a pound in bulk, and at fifteen cents for a neat paper carton, containing a pound and a half. Fifteen cents is such a small amount that most of us pay it uncomplainingly—yet it was ten cents a pound, just double what the meal was really worth. Cotton-seed oil likewise was worth a dollar and a quarter a gallon, yet when purchased in ten-cent bottles sold at the rate of over two dollars a gallon. Such are the prices we pay for the small package, the endless running to the store, and the grocery boy's forever knocking at the door with endless little glass and pasteboard packets for which we are paying handsome profits under the guise of convenience, which isn't convenience at all, but merely stupid, expensive trouble, all because we are too lazy to think and plan for our future needs.

Here are a few of the foods that one may purchase in quantities and which will keep for many weeks or months, if need be, and these foods should make up from fifty to ninety per cent of an economical dietary.

1. Cereals, if kept sealed.
2. All oils and cooking fats.
3. All nuts.
4. All dried fruits.
5. Sugar, syrup, and honey.
6. Cured meats, like dried beef or bacon.
7. All canned goods.
8. Dry beans and peas.
9. Eggs in the cheap season, to be put down in water glass.
10. Smoked, dried, and canned fish.
11. If one has a cellar—potatoes, apples, and many other vegetables.

Speaking from a fairly large experience in handling problems of food economy, I advise the calculating of the economy of the diet by totaling the foods as purchased in a week or month, rather than by keeping track of foods as cooked or served. From the financial standpoint it is the food we pay for, and not the food we eat, that counts. The eliminating of waste between the grocery bill and what cleaves to the ribs is quite a different problem. If one buys carefully and avoids waste, the inaccuracy in figuring one's diet from the grocery bill will be less than the inaccuracy that would occur if one attempted to estimate it by weighing ready-to-eat dishes, and the latter method would involve immeasurably greater labor. Foods, as purchased, vary widely in composition, especially meats, but calculating foods as served is still less accurate for the reason that every cook has a different twist for the recipe and the process of cooking greatly influences the percentage of water.

Do not attempt any elaborate system of bookkeeping, but have a hook on which to hang from day to day your grocery bills or other slips recording food purchases. See to it that you buy everything by the pound and that the number of pounds as well as the price are recorded on these slips. Milk may be recorded by the quart and eggs by the dozen, as these quantities are easily figured in pounds when you make your monthly total.

If you buy other foods by the dozen, the piece or the bushel, find out what the items weigh. A kitchen scales is highly desirable both to check the honesty of your grocer and to weigh up foods that you cannot buy by the pound. But if you have no such scales, make the grocer weigh up such foods until you learn how to translate his quantities into pounds.

On your food slips record, whenever possible, the net food weights—the portions you will actually eat. All tables in this work are based on the edible portion of the food. In the following section are given the percentage of refuse in the principal foods that of necessity are purchased with refuse or waste portions. Thus, if your monthly purchases show ten pounds of bananas you must subtract thirty-five per cent for waste, giving you 6.5 pounds net. All food economy figures should be based on such net weights.

Percentage of Food Waste Purchased.—Meat waste includes bone and often surplus and inedible fat. The refuse from bones runs about 20 per cent in chops. The waste in poultry is large, running from 25 per cent in old fowls to 45 per cent in broilers. Fish waste is considerable, varying from 30 to 60 per cent on the whole fish as purchased. The fact that fish as shown in the shop have a cheaper price tag than meat does not indicate that the real price is lower. The waste of fruits and vegetables run from nothing for berries up to 50 per cent for cantaloupe. Orange peels are about 30 per cent of the weight as purchased. Bananas have a waste of 35 per cent. In these cases the peels are thick and quite unedible, but in the case of fruits like apples and pears or vegetables like potatoes, the peel is very thin, and becomes a source of consequential waste only when we employ the clumsy system of removing the skin by cutting off part of the substance. A large amount of good food is thus wasted, including most of the valuable mineral elements. Baking potatoes "in the jackets" also means a loss (if the jackets are not eaten), since much of the meat of the potato sticks to the stiffened skin and is discarded.

Potato skins are not bad eating, and serve the same dietetic purpose as wheat bran, the mineral elements being digested and the cellulose serving to give the bulk to the intestinal residue and preventing constipation. If you cannot accept this idea of eating the skins, you may adopt the plan of dropping the washed potatoes into a vessel of boiling water and allow them to remain ten minutes. Remove, rinse in cold water, and strip the thin skin as when potatoes are peeled after thorough cooking by boiling. The potatoes will still be practically raw and may be handled like raw peeled potatoes in further cooking. Best of all, such potatoes may be baked when they will crust over with a delicious golden brown skin. Such baked potatoes are entirely eaten, avoiding the unsightly waste of baked potatoes as usually served.

Buy a fireless cooker and use it. The fireless cooker saves fuel, it prevents heating up the kitchen, and it eliminates the worry from fear of food sticking and burning. The fireless cooker may be used for any food that is to be stewed, steamed or boiled.

CHAPTER XXIII.

ADAPTING THE DIET TO VARIOUS CONDITIONS.

THERE is no ideal or perfect diet for all people at all times. The fundamental laws of nutrition must be adapted to the varying conditions of life. In this chapter I will discuss these varying conditions, which may be considered as normal variations, as distinct from the application of dietetic laws to actual ill-health and disease, which is considered at length in Volumes III and IV.

These normal conditions are: season and climate, growth and age, sex, pregnancy and nursing, occupation and activity, stature and weight, the influence of diet on the activity of the bowels. Between some of the above-mentioned conditions there are certain interrelations. Thus the chief distinction between the ideal diet for man and woman is merely one of adapting the quantity to the difference in size and weight of the body. The chief reason for the modification of the diet with advancing age is that of decreasing muscular activity. The mother's diet during pregnancy and nursing is a matter of adding to the normal diet of woman the essential dietary elements required for the rapid growth of the child that is being nourished from the mother.

In the adaptation of the diet for these various conditions we will have to consider both quantity and quality. Obviously, the adaptation of the diet for variations in bodily size should be a quantitative one, while the distinction in the diet required for growth compared with that of adulthood is largely qualitative. The adaptation of the diet to muscular activity, and also to old age, is a matter of the quantitative change in the energy-producing content of the food and also a qualitative change in the diet due to the change in proportions of the energy yielding food and the other dietetic essentials.

ACCORDING TO SEASON AND CLIMATE.—Many erroneous ideas commonly exist concerning the effect of climate and season upon diet. The heat radiated from the body must be furnished by food, and this would indicate that there should be an increase in the total food intake in cold weather. But in practice, cold weather results in our wearing more clothing, staying indoors, and decreasing our exercise. Hence, we often require practically no more food in winter, and sometimes less, than in summer.

People who eat all they can in winter but worry over their summer diet have this justification for their pains—the summer diet, because of the greater danger of food contamination and decay, results in more frequent cases of ptomaine poisoning, indigestion and bowel troubles, and the death rate of children who are more subject to such troubles is greater in summer. The man who lightens his summer diet only is usually overeating in winter, and it may not be without significance that the greatest death rate of adults is toward the end of the winter season, after people have been sitting indoors and eating "heavy foods."

There is some justification for cutting down the meat consumption in summer, as the excessive eating of protein (lean meats) results in an increase in body temperature. There is no reason for cutting down on the so-called heating foods—fats, starches and sugars—merely because it is summer. These foods eaten in excess result not so much in an increase of body temperature, but an increase of body fatness. If a man is overfat at any time of the year he is uncomfortable and inefficient. The fat is more uncomfortable in the summer, and there is more reason for him to reduce, but that is no excuse for his being fat in the winter—it is both cheaper and more comfortable to buy an overcoat than to grow one of blubber like a walrus.

The common, and in general the correct, belief is that the diet for growth must contain a high proportion of the protein foods. This belief originated from the chemical knowledge that the living body, with the exception of fatty tissue, is chiefly composed of protein, and hence, if rapid growth is to be expected, ample protein-building material should be supplied. This chemical reasoning had long been substantiated by the observations that when young animals were supplied high protein diet growth was stimulated thereby.

The general truth of the necessity of protein for growth cannot be disputed either from the theoretical reasoning or practical observation. There are, however, certain dangers in the application of this general principle to the feeding of the children. In the first place, the old school of dietetic teachings laid undue emphasis on the fact that meat was the protein food par excellence. In all old-fashioned food classifications the protein foods were designated as "tissue forming" or "growing" food, and lean meat, containing little else than protein and water, was therefore ranked highest in such classification. Common-sense observations led to the recognition of milk and eggs as more wholesome and digestible protein food for children, and hence these more desirable articles of diet have generally held a high and worthy place in the feeding of children.

But even with this consideration, the danger of the old teaching lay in the fact that the typical diet of meat-eating people was unduly rich in protein, and if special efforts were made to increase the protein in the children's diet above that of the parents, the result would be a far greater proportion of protein than the actual needs of growth demanded.

The danger of error here may readily be understood by the consideration of the slower growth of the human young compared with that of the young of domestic animals. The calf reaches its full growth in two or three years, pigs and chickens in less than a year, while the child requires nearly twenty years for its growing period. Nor do we need to depend upon theoretical reasoning from the fact of the slower rate of growth to reach the conclusion that the child requires less protein than the rapidly growing young animal. The lesson is prepared for us in unmistakable form in the fact that the milk of the human mother contains but about one-half the proportion of protein that is present in the milk of a cow. This fact is well recognized in the custom of modifying cow's milk for human infants. Such modification is accomplished by taking the top portion of a bottle of milk, adding water and milk sugar. In this manner the percentage of protein from the cow's milk is diluted, whereas the sugar content is increased, and the fat content, because the creamier portion of the milk is taken, remains about the same.

Composition of Mother's Milk.—The composition of mother's milk is indeed the best standard for the diet of early childhood; it is less rich in protein than is cow's milk, and is decidedly less rich in protein than would be a diet of cow's milk to which was added meat and eggs. On the other hand, it would not be safe to attempt to prescribe a diet for children merely by taking a proportion of protein as shown in mother's milk and using this as a standard to select an ordinary diet of vegetables or a diet of vegetables and meat which would yield the same quantity of protein foods. A proportion of protein derived from vegetables and meat that was no greater than the proportion of highly efficient protein in mother's milk, would most likely prove inadequate because of its lower availability.

The body is able to rid itself of food elements taken in excess of its needs, but it is wholly incapable of supplying elements that are deficient. Hence in childhood as in adult life when a mixed diet is used, the exact chemical content of which is unknown, it is essential that the food contain something in excess of the theoretical minimum needs of the body. The diet for childhood should therefore be moderately rich in protein food, and these should be selected from those food groups which most nearly approach the highly efficient body-building protein supplied in the mother's milk. As a source of protein for childhood we must therefore rank cow's milk as that of first quality, and eggs as a second best choice. Beyond this we have little reason to consider the problem, because when these foods are used in moderate quantities the foods added to secure other elements of the diet will contribute such further protein as is required.

But in the problem of feeding for growth protein is not the only essential consideration. The recent discoveries of science have thoroughly established the fact that deficient diets, which have too often resulted in stunted and weakly children, are not to be explained so much by a lack of protein as by deficiencies in mineral salts and the vitamines. The highly beneficial results of the use of milk in feeding children are to be explained by the presence in a highly assimilable form of these dietetic essentials. Calcium (lime) and phosphorus are the mineral elements most likely to be deficient. These are supplied most abundantly by milk. Eggs alone are not so complete a diet for growth because of the fact that we do not eat the egg shell from which the growing chick secures a large portion of its calcium. Eggs cannot therefore be considered so complete a growing food as milk, although they are far superior to meat or vegetables as a source of protein.

By the supplying of a liberal proportion of milk to the diet of childhood the chief danger of mal-nutrition is avoided. As the quantity of milk is decreased and the proportion of energy derived from other food is increased, care should be taken that mineral salts and vitamines are supplied in like proportions. This factor of safety can be assured by the free use of green vegetables, fruits and entire grain products.

The chief dietetic danger of childhood comes from the child's fondness for confections, cakes and pastries made of white flour, sugar, starch, glucose and fats. Such denatured or super-refined foods are practically useless for supplying the elements of growth. Theoretically they are not harmful in small quantities, but in practice their use cloys the child's appetite so that he under-eats in foods containing mineral salts and vitamine, and there is grave danger that the proportion of these highly important dietetic essentials will therefore be decreased below the line of safety.

The first essential of the growing-diet of childhood is the inclusion of milk and eggs for the supply of the most efficient growing protein and for the certainty of a supply of minerals and vitamines in their safest and most utilizable form. The second most essential consideration is to include green vegetables and fruits so that as the proportion of milk is decreased dietetic habits may be formed which will continue the supply of these essentials. Third, the inclusion of whole-wheat bread and whole grain cereal products, such as oatmeal and unpolished rice, in preference to white flour, polished rice and denatured patent cereal foods. Fourth, if the child is raised at a meat-eating table it should be taught to eat meat in very moderate quantities and not be allowed to make it the main dish of the meal. Fifth, the use of sugar and confections should be discouraged and the natural taste for sweets should be given a proper expression by permitting a free use of raisins, dates, oranges and other fruits that yield natural sugar in combination with mineral elements in an undenatured form.

DIET ACCORDING TO AGE.—Taking first the question of quantity, we find that the amount of food should be greater, considering the size of the body, in youth and slowly decrease with age. The new-born infant eats far more per pound of body weight than the full-grown man. This is true, first, because of the more rapid growth, second because of the radiation of heat relatively greater from the smaller body, and third because the general rate of organic activity is greater. The heart-beat and the breathing is faster in the child, and its activities are more constant. Small animals eat more per pound body weight than do the larger species.

The following table gives for boys a diet standard estimated on the basis of a proper amount of healthful exercise, but no constant heavy labor. The standard should be the same for girls until about the tenth year, reaching that of the mature woman (1.2 wheat pounds) at the age of 15.

Dietary Standard For Boys

AGE	WHEAT POUNDS DAILY	AGE	WHEAT POUNDS DAILY
1	.5	12	1.1
2	.6	13	1.2
4	.7	14	1.3
6	.8	15	1.4
8	.9	16	1.5
10	1.0		

After physical maturity the quantity of food needed is fairly constant throughout adult life and is much more influenced by activity than by age. As old age approaches the quantity of food required gradually decreases, due chiefly to cessation of activity and also in part due to the shrinkage of the quantity of muscular tissue. Of all the known rules for attaining long life that of an abstemious diet is conceded to be the most important. As age increases the dangers attending overeating become greater. The old man not only fails to take the vigorous exercises of the younger, but he moves slowly, and all his bodily actions are slowed down and require less energy for their continuance. At from fifty to sixty—according to the degree of activity—the diet may be cut down one-tenth of a wheat-pound. Further age and increasing feebleness should result in further cuts to 1.2, which is about as low as the diet should go for a man who is up and about. 1.0 wheat-pounds is about right for the bed-ridden invalid.

Diet According to Occupation and Activity.—Muscular activity, whether of work or of play, is the greatest factor in altering the food requirement. A man doing no active muscular work and taking only light exercises, requires less than one-half the amount of food that he would need if he were working to the limit of his muscular capacity. But such extreme muscular work is comparatively rare and called for in but few occupations.

A man at heavy labor can, without apparent harm, eat foods which would wreck the digestion of a man at light labor. If the lumber-jack eats from one to two pounds of meat per day, it is his work that makes possible such eating and not the eating of the meat that makes possible his work. What is good for a man at moderate labor is still good for a man at heavy labor, but there are food elements that extra labor need not increase. The body requires practically no more protein, salts or vitamines, for heavy labor than for mere existence. Because cereal foods are cheaper, the manual laborer is fortunate in that the demands of his work do not require an increase of protein as was formerly thought to be necessary.

Extra muscular activity requires extra food for energy only, hence, cereals, sugar and fats are all that need to be added to a diet that already has enough of the other food elements to support normal life. In practice, in the poor man's home, this means a heavier consumption of the cheapest dishes. But it is well to note that the laborer's wife and children will need the same food proportions as other people, and hence the heavy worker with his workman's appetite, should partake of the low cost dishes and indulge himself in the daintier dishes only with such appetite as is expected of a man at light labor. This withholding from the head of the household the better tasting food may seem a difficult business in some instances, yet if we will stop to think it is what is commonly done in every household where bread and potatoes are piled on the table unlimited, and desserts served in limited and equal portions to all. The foods that are most needed to round out the diet made of the low cost cereal and fat dishes will be fruits, milk, eggs, and vegetables, especially the green salads. If the family is hard pressed for cash it may be well if more of these dishes are served to wife and children at the noon or afternoon lunch when the father is at work. Usually father won't mind it a bit, for he wants something "filling."

Because muscular activity stimulates the appetite there is often a tendency to allow a small increase in muscular work to result in too large an increase in food consumption. There are very few occupations in which the food intake should exceed 2 wheat-pounds. The following estimates will serve as a guide for the increasing of the diet with labor. It is, of course, only approximate, as the amount of muscular labor in any occupation varies widely.

A man of average size and weight when resting in bed (as from a broken leg) will require 1.0 wheat-pounds.

When on his feet and up and about the house taking absolutely no other exercise, 1.3 wheat-pounds.

When engaged in office work taking exercise equivalent to walking two miles a day, 1.5 wheat-pounds.

Indoor clerks on feet all day, 1.6 wheat-pounds.

Light muscular labor, as feeding printing press, 1.7 wheat-pounds.

Chauffeurs, teamsters, 1.8 wheat-pounds.

Carpenters, plumbers, expressmen, 2.0 wheat-pounds.

Walking all day as in following a plow, 2.2.

When engaged in harvest work, as shocking grain or pitching hay, including both continual working together with constant stooping or lifting for long hours, 2.5 wheat-pounds.

When lumbering, ice harvesting or engaged in similar excessively hard labor outdoors in cold weather, 2.8 wheat-pounds.

Six-day bicycle races and other deliberate efforts to utilize man's muscular abilities to the limit, 3 to 3.5 wheat-pounds.

It is to be borne in mind that such feats as six-day bicycle races usually result in the consumption of stored bodily fat. It is very difficult for the body to digest and assimilate such quantities of food even though the muscular consumption for the time demands it. In England, an experiment was once made to see how much men could eat and what would be the result of such deliberate over-eating. Healthy men taking out-door exercise were used as subjects and were able to stuff themselves with from 3 to 3.6 wheat-pounds per day. In every case they broke down in a few weeks with digestive disorders, and usually lost heavily in weight before recovery.

Food for Mental Activity.—To find a special diet for brain workers has long been one of the aims of science. This search has reached no definite goal. It has long been known that the brain cannot work efficiently if the general health is in any way depleted. But scientists have not been able to find any particular food that would make a man think.

A proper understanding of the physiology of thinking indicates the futility of a search for brain food. Muscular work converts matter into energy, but mental work consumes no appreciable quantity of matter. As thinking consumes nothing, there is no food that can create thought. This brain tissue is removed but slowly and its composition cannot be materially changed by particular foods.

Experiments in fasting seem to show that the physiological chemists have yet much to learn, for fasting thoroughly demonstrates that the power to perform intellectual labor not only does not depend upon the amount of food eaten, but within certain bounds, *is dependent upon the ability of man to do without food.* In other words, the longer he fasts within certain bounds, the greater becomes his intellectual power and the clearer his intellectual vision. Yet it is self-evident that if this idea is carried to the extreme and the man fasts to the point of physical exhaustion he is then unable to utilize his power of thought to any practical purpose. Hence, the "golden mean" must be observed. A sufficient quantity of food should be taken to maintain physical vigor at its highest degree of efficiency without over-loading the body in the slightest, and at the same time to get rid of unnecessary and undigested foods. Experience, then, demonstrates that the brain and nerves, when the proper degree of rest is given them, will recuperate themselves from the stores found in abundance in a healthy body, and will thus keep the organs of the mind in a condition fit for the highest intellectual manifestations.

While there is no particular food that can be eaten to aid the working of the brain, there are very many non-food materials that may be taken to injure its functions. Alcohol is a brain poison, the action of which is obvious. Nicotine, caffeine, and the various habit forming drugs also affect the brain. Any dietetic error that results in auto-intoxication destroys mental efficiency. The mere eating of excessive food produces a condition of the blood which results in dullness and drowsiness. Very many ways of eating will prevent us from thinking, and chief among these is plain gluttony.

Comparative Dietetic Needs of Men and Women.—Except in child-bearing or nursing periods the chief distinction of woman's diet compared with man's is merely that one due to her lesser physical stature. Hence the proportionate differences would only apply in comparing a particular man and woman whose difference in size are relatively the same as the average differences of the sexes.

The dietetic requirements of women are usually placed at four-fifths those of men. If woman was engaged in as great a physical activity as man this would be a correct estimate. However, woman's smaller size and her quieter ways, together combine to make her food requirements relatively small, and in many families where the husband works in active labor the wife might overeat and the husband undereat, when she was not consuming more than half as much food as he. This is no argument to deprive woman of her fair share of food, for in practice, its application will result usually in restoring her to health, as woman suffers more frequently than man from indigestion or overweight, due to a combination of heavy eating with light muscular activities.

Woman's work may be very wearisome, literally the back-breaking sort, but the maintenance of an uncomfortable position or exhaustion from working in a hot and humid kitchen is not the sort of work that requires a heavy intake of food.

Woman's weight averages 83 per cent. of that of man, but her food requirements are not as much in comparison, because of the fact that woman's muscular system is not 83 percent that of man's. If it were, she would truly be more muscular for her size than man. The average woman carries more fatty tissue than man as shown by comparison of their statures. The weight of a body is as the cube of the dimensions and so figured woman's ideal weight should be only 77 per cent. of man's.

Under average conditions there is also a qualitative dietetic difference indicated for the sexes due to the fact that the average woman *does* carry more fatty tissue and that she does exercise relatively less, hence she will need a somewhat larger portion of the body-building and vitality-yielding elements of food and a comparatively smaller portion of the heat and energy supplying food elements. Her diet should therefore be more like that of the child when this is contrasted with that of the adult and particularly that of the hard-working man. If a woman is over-weight or especially inactive this difference should be increased, but where the weight is excessive the diet should conform more nearly to that recommended for the reduction of obesity, which is distinguished from that of the best growing diet of childhood by a lesser proportion of the growing protein derived from milk and eggs.

Although truly gluttonous appetites are more common among men than among women, there is probably a larger proportion of women who overeat than of men. This fact can be explained by the corresponding fact that a larger proportion of women are under-exercised. It may also be due to habits of serving food in uniform portions which particularly applies in case of dining in public restaurants. A woman of average size and activity who eats the same quantity of foods as the average man will in nine cases out of ten be over-eating. As it is often impractical, particularly in dining out, to have food portions served to individual needs, a woman will do well to omit some items from a dinner as served to the heartier eating man. Certainly such a course is in better taste than the habit of ordering the full service of food and leaving a portion uneaten. The plan of omitting some dishes from a full dinner also gives the intelligent woman a chance to exercise some selection in her food without the necessity of appearing unduly finicky or cranky. The items which she should omit from the conventional meal would ordinarily be those dishes richest in carbohydrates and fats, and this first would apply particularly in the case of the woman who is inclined to carry more weight than the laws of health and beauty demand. It should be noted here that all cases of over-eating do not result in overweight but with some individuals may cause indigestion and actually result in underweight. In either case the thing to do is to eliminate the heavy starches, meats and rich sweets and pastries.

For the Pregnant or Nursing Mother.—The diet for the mother who must eat for her child as well as for herself is essentially a diet for growth. The ideal diet for the woman not doing heavy physical labor is closely akin to the ideal diet for the child, hence the primary need for the mother and the secondary needs for the growth of the child may be combined harmoniously. The additional amount of food that must be eaten to provide for the growth of the child is relatively small as the child's growth is comparatively slow. During the nursing period the total demands will be somewhat greater than during pregnancy.

But while the additional amount of food which the child carrying or child nursing mother will require is not great, it is highly important that the diet be of the finest growing quality and amply and richly supplied with high growth protein and with mineral salts and vitamines. Milk, butter and eggs should enter in reasonable proportions into the mother's diet. Fruits and leafy vegetables are highly desirable. Sweets, preferably in the form of fruits and honey, are a desirable source, not only for supplying energy to the mother during pregnancy and nursing, but as a source of milk sugar.

The healthy and well-fleshed adult carries a reserve store of many of the food elements which will bridge over periods of dietetic deficiencies. But if the mother's diet is deficient the growth of the child will make the first demands on the lacking elements and the mother's vitality will suffer accordingly. If the deficiency is not remedied, both the mother and child will suffer, but the mother will have more opportunity to recover, whereas the child's growth may be stunted or a weakness may result in the rapidly developing young life which cannot be so easily remedied at a later date.

Starches may enter into the mother's diet more largely than they would in the diet of the young child, as her digestive powers are better able to cope with them. The same is true of meat, although there is positively no advantage of meats over milk and eggs and if the latter are available in abundance there is no occasion for the mother's becoming a heavy meat eater at this period, though less harm would result than from the feeding of meat to young children.

After childbirth, if the mother is thin, and especially if she is doing heavy housework, her diet may approach that of the male standard in quantity, but if she has retained her plumpness, or when she regains it, there would be no occasion for a heavier diet than that maintaining normal bodily weight.

Appetite may be more safely relied upon to indicate the quantity of food needed than to indicate the quality. This particularly applies to the modern civilized diet in which such natural instincts as man possesses are more or less baffled by habits of eating artificial food forms and mixtures. Scientific knowledge and intelligence are absolutely essential if modern civilized man would reach the maximum of efficiency in diet and this principle applies to the pregnant or nursing mother more especially than to other people at other times, because a deficient diet at this time is a source of greater danger.

The young child, whether in the mother's womb or nursing at her breast, is living its small life at a relatively more rapid rate than is the adult, and dietetic deficiency will therefore more quickly result in impairment of growth and vitality.

Gaining Weight.—With this purpose in mind, the first thing to do is to determine whether one wants to gain muscular or fatty tissue. If the gain desired be muscular tissue, the only way to secure it is by exercising. Appetite will then usually urge one to eat sufficiently to supply all the energy this exercise involves, and the muscular tissue will be slowly built up by such exercise.

The foods required for the increase of muscular tissue are the proteins, but the actual amount needed is small and will be supplied by any normal diet. There must also be a slight surplus of wheat pounds or the heavy exercise will result in a depletion of that small, but desirable, portion of body fat which every normal individual should carry.

There may be a few instances, most notable in the case of thin women, where it is desirous, as a matter of appearance, to add a considerable amount of fatty tissue to the body. In these cases a reasonable surplus of food should be encouraged. Even to gain fat, it is often necessary to take exercise to stimulate appetite and increase the digestive and assimilative powers of the body. To gain weight, a proper balance must be struck between the exercise which will increase appetite and that which will burn up the material which might otherwise be deposited as fat.

In case of weakened digestion or poor appetite, it frequently happens that those foods which the appetite most readily accepts are low in nutritive value. Personal experiments should then be tried with foods that are high in wheat-pounds, but which also seem acceptable to the appetite and the digestion. Fat meats are frequently indigestible and are rarely advisable in large quantities. In such cases, the substitutes may be found in the form of vegetable oils, milk, cream, butter and nuts.

In case it is the starchy foods that are indigestible, the remedy may be in the larger use of fats, but this cannot be carried beyond a reasonable proportion, as fat should rarely form more than one-fourth of the total food intake. Starches may be logically replaced by the natural sweets of fruit. Likewise, the heavy cereal starches. breads, porridges, etc., may be replaced by the more diversified and usually more appetizing forms of carbohydrates found in vegetables.

How to Reduce Weight.--The only scientific method of reducing the bodily weight is by lowering the food intake below the point of actual consumption in the muscle cells. A misleading notion in dietetics in the past has been the notion that some foods were fattening and others were not.

Fat people will frequently go to any trouble to avoid eating potatoes, or go without sugar in coffee, or avoid butter or some other few particular tabooed foods without making any effort to control the quantity of food as a whole. While it is true that the foods commonly avoided by those who wish to reduce are foods that yield heavily in nutriment and do make people fat, yet it gets one nowhere to avoid particular foods, if other foods are consumed that keep the total wheat-pounds up to the former figure.

The use of exercise for the reduction of fat is valuable, but its direct effect is not as great as that of food reduction. Usually a fat man who has utterly neglected the care of the body is a man half-sick and generally run-down in all bodily activities. Exercise for him is exceedingly valuable, but not alone for the reduction of fat. Fat can be reduced by exercise alone and by food alone. By far the best program is that which involves both methods, but the main reliance should be in the reduction of the food intake as measured in wheat-pounds.

One great difficulty experienced in reduction of body weight comes from the sudden determination to reduce on the part of the person who previously made no effort to restrict the food or to take any systematic exercise. He then starts out taking a ten-mile walk, and at the same time resolves to "diet." As he has always been in the habit of eating all his appetite demanded, and as he comes home from his jaunt with the greatest appetite he ever had in his life, and the first honest one, there is an immediate conflict of purposes, and his resolutions frequently go to smash.

This discouraging result may be avoided if a little common sense is used in planning. If one has been in the habit of taking any exercise at all, he will find it advisable to increase that exercise gradually without such strenuous efforts as will stimulate his appetite. If exercise has not been among his habits, it will be better to first cut the diet, and wait until he has become accustomed to dietetic restriction, and to leaving the table a bit hungry, before he imposes upon himself the greater temptation that will come from the increased appetite due to exercise. Indeed, he will find that after a few weeks of abstemious eating he will not consider the honest appetite earned by exercise as a behest which he must obey or perish. Having accustomed himself to allowing his brain and not his palate to dictate his bill-of-fare, the appetite from exercise may be mastered without its overwhelming him.

Many books written on the reduction of fat have been innocently or intentionally deceptive. The authors have inferred that bodily weight could be reduced while still enjoying all the pleasures of eating. This is true if we confine the pleasures of eating to the genuine pleasures that come from the true epicurean test that is a part of the physical culture system of health building. But if the inference is that the fat man can continue to indulge his gluttonous appetite for conventional cookery, washed down with conventional liquors, then he is doomed to disappointment, and selling him a book on fat reduction is taking money under false pretenses. If the fat man will not give up his pleasures of gourmandizing, let him be fat. It is Nature's penalty, and there is no way to remove the effect without removing the cause.

The practical problem of the selection of the diet for reduction is in finding a diet that will not make the subject suffer too severely from the pangs of hunger. A little hunger is a good and wholesome thing, but the fat man is of an indulgent type, and rarely has the courage, at least in the first stages of his experiment, to severely deny himself. He should not be judged too harshly for this weakness, as the very fact that he is fat would indicate that he has been long in the habit of indulging in food and there may be an abnormal craving in the stomach that will make the partial fast of the reducing diet more severe upon him than it would be upon a man whose appetite had been trained to restraint.

The foods selected for reduction should therefore be those which supply all possible elements without a high wheat-pound value. Thus, if one attempted to consume lettuce to the extent required to supply 1.5 wheat-pounds, it would take 22 pounds of that excellent food to supply the nutrition. The very idea of eating 22 pounds of lettuce would stagger even a fat man's appetite, and there would therefore be little danger of remaining fat on such a diet. Of course, it is not practical to recommend a diet of any single one of these low nutrition foods, but the diet can partake more largely of foods of this sort. Bulky vegetables of all sorts are excellent to give a sense of fullness. This includes the salad vegetables, which are taken raw, as well as all cooked vegetables, and does not need to exclude potatoes, which are composed of starch in about the same proportion as are most boiled cereals. In serving green vegetables, either raw or cooked, they should be dressed with lemon juice, not oil. One may destroy the reducing tendency of the diet by addition of oil. A green salad dressed with oil may be more fattening than a similar sized dish of potatoes. Fresh fruits have an effect similar to that of bulky vegetables.

Mastication Relieves Hunger.—The act of mastication and the actual presence of a residue in the intestines, both serve to alleviate hunger. The usefulness of fruits for this purpose may be lost entirely if sugar is used. Excessively sour fruits like rhubarb and cranberries, require so much sugar that they become nearly as fattening as porridges. Sugar is considered to be a fat producer, and while it is no more so than starches, and decidedly less than fat, it is to be guarded against for the reason that it requires absolutely no mastication, is absorbed quickly, and leaves no bulk in the intestines, and hence it is very easy to add quantities of it to the diet without becoming aware that the diet has increased.

The third group of foods which should be called upon for reducing the diet are those which from habit are taken in small quantities. For this reason, bacon might well be put on the list of fat reducing foods. If by habit one eats a pound of fish at a meal, and this is fried in oil, he will consume a larger number of wheat-pounds than if the meat of the meal be bacon, which is usually served and eaten in small quantities. When the cook or housewife is planning a diet for one who wishes to reduce, a great deal of cleverness can be exercised in cooking and serving. Small portions should be served; bread may be cut in extra thin slices, and other means used to make a man feel that he has had his dinner without his really having consumed a large quantity of food.

The last, and perhaps the best method of all for aiding in this general effect of satisfying the appetite with less food, is increased mastication. The beneficial results achieved by Fletcherism have been largely due to the lessening quantity of food eaten. Less food was eaten because from habit the appetite became satisfied after a given amount of mastication. A similar effect is gained, both from an increased time required to eat and from the restoration of normal or true appetite as against that artificial appetite acquired from the high flavors and the mushy conditions of most conventional foods.

To summarize the general plan for the diet for reduction, we should first select bulky foods, as green vegetables and fresh fruits; second, if meat is taken, use those meats that are habitually taken in small quantities; third, use foods that require chewing, such as very hard crackers and breads. All these foods should be eaten slowly and swallowed without the aid of liquids.

The rate of weight reduction will depend upon the number of wheat-pounds burned in the body and those taken in the diet. If the amount of exercise is sufficient to consume 1.5 wheat-pounds and if but 1 wheat-pound is eaten, the subject will obviously lose weight at the rate of .5 wheat-pounds of nutrition per day. If this loss is to come from actual body fat, it means a loss of about one-fourth of a pound per day.

If one fasts completely, the loss will be about three-fourths of a pound per day. When one begins to reduce his diet, there will be a much greater loss for the first few days, due to the emptying out of the digestive tract and the reduction of the body fluids which excessive eating increases. The rate of reduction aimed at is a matter of individual choice. From one-quarter to one-half a pound per day is entirely practical and means that the diet consumed should be from one-half to three-fourths of a normal diet.

Those who are reducing, or for any other purpose make a definite effort to decrease the diet, should guard against accessory food items, the chief of which are candy, nuts, ice cream, and soda fountain concoctions. The chief harm of eating between meals is that it usually leads to overeating. Especially in the case of candy, the number of wheat-pounds adds up quite rapidly. Candy is practically pure sugar with very little water, and is from three to ten times more filling, pound for pound, than porridges, vegetables and fruits.

The use of alcoholic liquors involves a very different question. Many serious arguments have been waged over the food value of alcohol. Beer does contain considerable non-alcoholic food material. It has been assumed that the fact that beer had a food value should be universally interpreted as a reason for the approval of beer. In reality, it is a reason for its condemnation. In the use of beer, the nutriment added to a diet already ample may prove a source of evil only secondary to the harm done by the alcohol itself. The same thing may be said of certain sugary soda fountain drinks. Many of these are directly injurious because of harmful ingredients, but as they are taken in addition to the regular meals, they add fuel to the flames, though we rarely think of these food accessories as being the cause of our trouble.

The best way to fatten a chicken or pig is to get it to nibble and eat continuously. Beer saloons, candy stores and soda fountains will be beneficent institutions only when human efficiency is to be determined along the same lines as the hog farm.

In the problem of dieting for reduction, valuable suggestion may be derived from the teachings of modern efficiency. Whether it is a question of a workman in a machine shop or a man thinking out a big deal on the stock exchange, a fundamental rule of personal efficiency is to plan out and decide exactly what you are going to do in advance of the actual doing. A man who has planned to do a definite thing in a definite way and to quit when he is finished will invariably make a cleaner job of it than a man who goes at it blindly.

To apply this principle to dieting, one should discard the old idea of eating till one is filled, and decide either before one sits down to dinner or after one sees the bill-of-fare, just what and how much he is going to eat. This definite planning in advance of a fixed program of action always aids in the carrying out of that action. It develops will power and will power is nothing more than the ability to think out a line of action and then do it without hesitation and wavering.

A prominent New York business man who succeeded in reducing his own waist line very materially, advocates standing up to eat. Inasmuch as it makes the meal less a matter of leisure and rest, it discourages the habit of eating until satisfied. This should be well worth trying by those who find difficulty in limiting their food intake. So great is the belief of the gentleman in question in the efficiency of a restricted diet that he made a rule in his business that his buyers should not close any deal after one o'clock. He made a second rule that they should not lunch before one. This plan effectively side-stepped the usual custom of the salesman inviting the buyer out to dinner and filling him up with good things and good cheer until, with a full belly and a sleepy head, he became exceedingly acquiescent to his host and agreed to take the goods at the other man's price.

"A full round belly with capon lined" means weakness, dullness, inefficiency and failure.

OVERWEIGHT CAUSES DISEASE AND DEATH.—One of the most striking recent changes of opinion among medical men has been due to the discovery that the statistics of life insurance companies show that fat policy holders are very much poorer insurance risks than thin ones. The overweight policy holder is shorter lived and has a higher death rate at all ages than does the normal man, whereas at all ages after 30, the overweight man has a higher death rate than the underweight man. In old age, the underweight man actually has a lower death rate than the average so-called normal man, evidently due to the fact that a large proportion of old men are so fat as to bring up the average weight to a point that is greater than the ideal weight. Hence, among old men, those who have been classed as normal are really too fat.

The diseases on next page seem to be fat man's diseases. It is more logical to say that both the disease and the fatness are caused by the same error of over-eating and under-exercise. These figures are too striking to be ignored. That four times as many middle-aged fat men should die of heart disease as thin men is a pretty obvious indication that "fat, hale and hearty" is a lying phrase.

Evidently, people who are fat are not hale and hearty, and people who are hale and hearty are not fat. This great fallacy which such popular phrases express is based upon two lines of false reasoning: First, the notion that because food is essential to life and because it is good for man to eat, that it is good to overeat and gain the resulting fat; second, because a man who is actually sick and nigh unto death is reduced to skin and bones, the suggested remedy, to the simple mind, is to go to the other extreme and be fat.

RATIO OF DEATHS OF MEN 50 POUNDS OR MORE OVER WEIGHT AND 25 POUNDS OR MORE UNDER WEIGHT, THE NORMAL DEATH RATE IN EACH CASE BEING EXPRESSED AS 100.

Age when insured	15 to 29		30 to 44		45 and up	
	Over weight	Under weight	Over weight	Under weight	Over weight	Under weight
Typhoid	233	79	129	89	121	108
Diabetis	250	117	492	42	485	21
Apoplexy	260	70	279	58	188	53
Heart disease	350	107	295	72	197	64
Appendicitis	56	81	157	93	195	63
Cirrhosis of liver	433	33	380	30	203	36
Bright's disease	331	84	330	61	209	54
Total deaths from all causes	115	121	163	104	133	88

In some instances, there seems to be a bit of truth in this last reasoning, so false in the main. Thus in the case of tuberculosis, fat men do not die, but this does not prove that a person with a tendency to tuberculosis may prevent the disease by fattening himself like a corn-fed hog. A more likely explanation of the low death rate from tuberculosis among fat men is that the possession of fat is an indication of ample digestive and assimilative powers, whereas tuberculosis gets a foothold only where the digestive and assimilative powers are deficient. Thus fatness and freedom from tuberculosis may come from the same cause—good digestion; but long life is due to a good digestion used and not abused.

WHY BRAN IS NEEDED.—Constipation as a disease is fully discussed in Volume IV. The foods recommended for the cure are those that have the largest proportion of cellulose of indigestible fiber. Chief among these is wheat bran. The effect of bran is similar whether it be eaten as whole wheat, whole wheat bread or taken separately as bran. The folly of separating the bran from the flour and again recombining them in the diet is obvious. Neither the flour nor the bran is as palatable when eaten alone as when eaten in the natural form of the entire grain.

If the diet contains a normal proportion of wheat and all of this is eaten in its entirety as perhaps a cereal food or bread, the activity of the bowels will usually be well regulated. But where one is forced to eat white bread products, the error can be remedied by the separate use of bran. In such cases the bran may be mixed with other cereal dishes as oatmeal or it may simply be boiled and eaten with cream and sugar like other cereals. About three rounded tablespoonfuls a day will return to the diet the proportion of bran removed from the white bread ordinarily eaten.

While the chief reason for using bran is that of increasing the bowel activity by the presence of the indigestible cellulose, the conclusion should not be reached that bran is all waste. It is rich in salts, vitamines and protein and also contains some digestible carbohydrate, in addition to the indigestible cellulose. In its composition bran resembles leafy foods which are also excellent for increasing the food bulk and intestinal activity.

The word "indigestible" has two meanings, the one as applied to the failure to digest foods that should be digested, the other is the failure to digest inert substances that add bulk to the diet, but are not affected by the digestive juices. Indigestion of fats or carbohydrates and particularly of proteins is harmful because when not digested such material decomposes and poisons the system. Cellulose, on the contrary, though it fails to digest, does not decompose, and its presence is a benefit as the increased bulk stimulates the peristaltic action of the bowels and so hastens the removal of all food residue or bodily waste excreted by way of the bowels, the retention of which is harmful.

A general misconception is prevalent as to the source of the material passed from the bowel. With the exception of cellulose, very little of the feces, in the case of a healthy organism, is actual undigested food, but is composed of the residue of digestive juices and of material excreted from the body by way of the bowel. Man naturally lived on vegetable foods containing considerable cellulose. His intestines are made of sufficient size to accommodate this residue. If it be lacking they fail to function as rapidly as nature intended and the wastes are therefore retained over long. This same principle applies to all animals, in a varying degree, according to their diet.

The conventional foods of civilization have been denatured by the removal of the cellular outer structures. This is harmful, both for chemical and mechanical reasons. A properly balanced diet of whole grains, vegetables, fruits, nuts, milk and eggs would never cause constipation, although when the condition has become chronic some special cases will require more than a normal diet to effect a cure. On the other hand, after the system has, in a measure, become accustomed to functioning on a diet deficient in cellulose, the use of the quantity nature intended may, in some cases, bring about too rapid movement of the food through the intestine and therefore result in incomplete digestion, even of the digestible food ingredients. In extreme cases, this becomes diarrhoea.

Because of unnatural living habits in the past, certain individuals will therefore find that special care is required to regulate the bowel activity. Personal trial is the only way to solve the individual problem. In most cases varying the amount of whole wheat bread used will prove a sufficient means of regulation. If the bread alone is not sufficient, bran may be used in addition. When ample leafy greens and fibrous fruits are eaten, less whole wheat or bran may suffice. If the use of all these products results in too rapid passage of the bowel content, then the more fibrous portions should be eliminated and a larger share of the salts and vitamines secured from dairy products. While the natural foods that are rich in salts and vitamines are usually also rich in fiber, there is enough distinction in the fiber content to permit of personal adaptation of the diet in regard to the cellulose without a return to the white flour and meat diet which is deficient in all of these essentials.

Although the chief element in the regulation of bowel movement is the amount of cellulose or fiber, there is also some difference of effect in non-fibrous foods. Starches are more constipating than sugars, and proteids more constipating than fats. Milk when used in small quantities is constipating, but a full diet of milk is laxative. Sweet fruits are mild laxatives, both because of their cellulose content and because of the sugars.

Food oils are laxative if taken in excess because that portion not digested acts as a lubricant. Purified mineral oil is in no sense a food as it is wholly indigestible. Its action in preventing constipation is like that of cellulose, in that it passes through the bowels without being digested. In addition it acts as a lubricant. Its use is to be recommended only in cases that fail to yield to food treatment. It is certainly to be chosen in preference to laxative drugs, the effect of which is to cause an artificial diarrhoea.

Agar is a gelatinous form of cellulose made from seaweed. It is indigestible and acts like bran, but is smoother in texture. Where bran is found to be irritating, agar may be substituted, but it is more expensive and less easy to obtain.

CHAPTER XXIV.

COOKING AND SERVING FOOD.

THE question, whether cooking has been an advantage to the world or not, is one upon which strong points may be made on both sides.

The claim is made by the natural food dietarians that natural foods possess special virtues because their vital principle and life-force are not destroyed by cooking. The scientists of the Department of Agriculture contend that biological experiment and physiological chemistry offer no data that warrant this belief. They contend that experiments demonstrate that men fed on cooked cereals exhibit as good physiological condition as those who live upon the natural foods. On the other hand, they state that there is no reason to suppose that uncooked cereal foods are unwholesome if they are properly cleaned and free from bacteria. They also seem to accept without cavil the statement that they are especially useful in counteracting constipation on account of the large amount of indigestible crude fiber which they supply.

DIGESTIBILITY OF COOKED AND UNCOOKED FOODS.—The following is a statement prepared by Milo Hastings on his investigations at the Kansas State Agricultural College in 1905-6 for the purpose of determining the digestibility of uncooked vs. cooked foods, which investigations were the first of their kind ever undertaken in accordance with accepted scientific methods.

"The common statement is that the walls of the cells containing the starch granules (in wheat, oats, corn, etc.) are composed of indigestible cellulose, and that in the process of cooking in hot water or steam the starch cells absorb water, expand, and rupture the cellulose envelopes, thus permitting the digestive juices to reach and act upon starch grains. As a matter of fact, the belief that there are cellulose walls around starch granules is a deduction from the general botanical fact that plant cells have cellulose walls. Now it happens that the cells of the interior of the grain being protected by the heavy outer covering of the kernel, have, in the process of evolution, lcst their individual cell walls, so that the interior of the ripened grain kernel is simply a mass of starch granules.

"The heat of moist cooking has no effect upon grain fats. The proteids are coagulated. The starch grains, where moisture is present, swell up and form a pasty or gelatinous mass. Between the digestion of raw and cooked grain, the following differences are readily noted: Raw grains, because of greater hardness and dryness, are naturally more thoroughly masticated. Cooked grain products may be masticated by force of will power or cultivated habit, as is the case with the followers of Fletcher, but the soft, mushy condition of cooked starch products does not readily call forth mastication, as natural foods which are in a similar condition do not require either grinding by the teeth or the influence of saliva in their digestion, and hence man has no instinct which leads him to masticate such pulpy foods."

The following experiments were carried out by the same writer on nutrition with a view of determining the digestive effects of the entire alimentary canal upon various cereals. The investigation was conducted along two lines. The first experiment was for the determination of the digestive effects upon individual grains by observing the remnants that passed from the alimentary canal. The second was a comparison of the dry weight and starch content of the excreta from diets which were identical, except that the grains in one case were cooked and in the other case taken raw.

The subject, at the time of the experiment, was twenty-two years of age, weighed 140 pounds and was actively engaged in distance running. For eighteen months previous to this experiment, his diet had been chiefly of grains, fruits, and milk, eaten both cooked and uncooked. In the first experiment the method pursued was as follows:

A full dinner was eaten at noon, consisting of milk, eggs and such fruits and ground grains as are readily and completely digested. At 7 p. m., a meal of boiled rice and milk was taken, during which the grains to be experimented upon were swallowed whole.

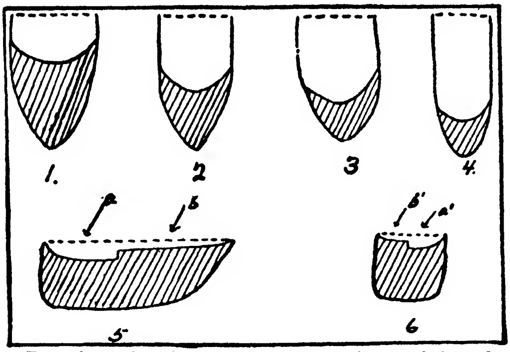
FINDINGS IN EXPERIMENTS.—The examination of the digestive remnants was conducted according to the usual laboratory methods and the findings were as follows: Commercial rice grains, pieces of raw potato and of almond kernels, and the halves of split beans and peas were all entirely digested. Pieces of walnut and hazelnut kernels, and of soy beans, were almost entirely digested. Whole wheat, Kaffir-corn, hulled barley, rye, beans, soy beans and corn were recovered in their entirety. In other words, when such seeds are not broken up by mastication, the indigestible hull protects the interior of the seed from the action of digestive juices.

Far more interesting and significant results were achieved by sectioning, or cutting wheat and other grains in such a fashion as to expose the cut surface to the action of the digestive juices, showing the comparative digestion of various grains, and of the component parts of the grain.

The cooking experiment was conducted by comparing the right and left side of split grains. The cooked halves were boiled for one hour, which softened the starch as much as would soaking several hours in the digestive juices of the body, yet the two sets of grains when compared, showed that about the same portion of starch had been eaten out by digestive juices.

In all corn grains, whether raw or cooked, the starch portion, as is shown in the accompanying drawings, is much more rapidly digested than the germs or proteid in fatty portion of the grain. This is rather an amusing finding, considering the fact that the learned dietetists of the past have told us starch was the particular element of food which needed the application of heat to make it digestible.

The study of the accompanying drawings, which show the average portion of starch digested out of the grain hulls, indicates, beyond all possibility of doubt, that, by this subject, raw starch is digested with rapidity and thoroughness.



Drawing showing the relative digestibility of uncooked grains—Grains were cut on dotted line; unshaded portion was digested. 1—Barley; 2, —Rye; 3—Wheat; 4—Oats; 5-6—Corn. Points marked a in 5 and 6 show starchy portion, points marked b show germ.

The fact that unbroken raw grains are indigestible because of the actual cellulose covering, should not be confused with the claim that the starchy grains are indigestible when raw, because of the supposed cellulose covering of the single botanical cell, which is scarcely visible without a microscope. The digestion of the hulled rice grains, and the amount of starch eaten out of the grain hulls where the digestive juices could only attack from one side, clearly indicate that the grain particles, where mastication has been at all thorough, would be digested very readily indeed when they reach the proper division of the alimentary tract.

The second experiment consisted of living during two separate periods on diets exactly alike, save that the grains of the first week were boiled for two hours, while during the second week they were taken raw, with only such soaking, as was necessary to render mastication agreeable. The following is the weekly bill of fare for both periods:

800 grams	wheat	700 grams	sugar
700 "	rice	550 "	raisins
200 "	Kaffir-corn	150 "	dried apples
200 "	rolled oats	7	lemons
100 "	rye	7	pints milk
100 "	corn	14	eggs

The dried weights of the undigested residue were as follows:

Cooked grain ....298.6 grams
Raw grain ....256.5 "

Chemical analysis of the two samples showed that the starch had been completely digested in either case, thus indicating that the lessened digestibility of the cooked diet was due to the indigestibility of cooked proteids.

The complete digestion of all starch, in both the cooked and uncooked diets may seem to the reader not to be a conclusive argument upon either side of the question. These experiments do not indicate that cooking renders starch indigestible, but they do show that cooking is wholly unnecessary for starch digestion, and that the process of cooking only disturbs Nature's plan without any corresponding benefits. The cooking of starch discourages mastication, increases fermentation (raw starch being practically unfermentable), and needlessly increases the bulk of the meal.

As an explanation of the complete digestion of the two diets, it might be stated that the rations which represented in quantity the customary diet, contained but two-fifths of the proteid and three-fifths of the energy required by the Atwater, or government, dietary standards. Lest some think this diet be insufficient, it might be stated that the subject, during the period of the experiments, was entered in two distance runs, and finished a two mile road race in the time of eleven minutes and nine seconds.

There can be no doubt that the great deterioration in the teeth of civilized races is largely attributable to the use of cooked food. We do not have enough hard substances to masticate. It seems to be the desire of the modern cook to eliminate everything from the dietary that must be masticated. Even the healthful crusts of bread are cut off, and if you try to get them at a first-class hotel you are looked upon as a "crank."

Predigested Food.—In the vain desire to discover a short cut to health, while continuing dietetic habits which are in direct opposition to natural laws, the predigested food idea had its birth. Its principle is altogether bad. Man should thoroughly masticate his food by chewing and thus develop by and in himself the strength he needs. This is the natural and normal process; any deviation from it is attended with danger. As one authority states: "The predigestion fad has been one of the greatest fallacies that has ever been forced upon the public mind. That the juices of some fruits are already in the form of glucose, and can be immediately absorbed without any digestive process, does not prove that the mushy cooking and other forms of so-called predigestion are beneficial. As a matter of fact, the 'predigested foods' are not changed into the final products of digestion, but are composed of semi-soluble starch, gummy dextrine, and perhaps a little maltose. These substances only interfere with and disturb the normal process of digestion."

At variance with these statements we have the claims of some government food experts that the nutrients of the grain are found inside the starch-bearing and other cells, and the walls of these cells are made of crude fiber, on which the digestive juices have little effect. They say that unless the cell walls are broken down the nutrients cannot come under the influence of the digestive juices until the digestive organs have expended material and energy in trying to get at them. Crushing the grain in mills, and making it still finer by mastication, breaks many of the cell walls, and the action of the saliva and other digestive juices also disintegrates them more or less, but the heat of cooking accomplishes the object much more thoroughly. The invisible moisture in the cells expands under the action of heat and the cell walls burst. The water added in cooking also plays an important part in softening and rupturing the cells. Then, too, the cellulose itself may be changed by heat to more soluble forms. Heat also makes the starch in the cells at least partially soluble, especially when water is present. The solubility of the protein is probably, as a rule, somewhat lessened by cooking, especially at higher temperatures. Long, slow cooking at a moderate heat is therefore better, as it breaks down the crude fiber and changes the starch to soluble forms without materially decreasing the solubility of the protein.

The experts contend that cereals differ considerably in the amount of cooking required to make them thoroughly digestible, but not enough is definitely known on the subject to say exactly how long each kind should be cooked. In general, it is true that the more abundant and coarse the crude fiber the longer should be the cooking period. For this reason whole grains require longer cooking than partially crushed ones, and those containing the skin of the seed more than those from which it has been removed. For instance, whole corn kernels require longer cooking than fine hominy, and whole-wheat preparations more than flour gruel. Rice, which is remarkably free from crude fiber, can be thoroughly cooked in a comparatively short time.

In the case of the partially cooked cereals it is difficult to know how much of the necessary cooking has been done at the factory. It is safe to assume that they still require at least all the cooking suggested in the directions usually accompanying the package. Physicians sometimes complain that these preparations are indigestible and prefer old-fashioned home-cooked grains. Yet it is hard to see why the partially-cooked cereals, if they are properly re-cooked before serving, should not be just as digestible as those cooked at home, and they certainly permit some economy in fuel and time. With all cereals it should be remembered that over-cooking is unusual and harmless, while under-cooking is common and undesirable.

Principles in Cooking.—The general principles underlying the cooking of vegetables have been well stated by the late Miss Maria Parloa in one of the government bulletins:

"Vegetables are baked, roasted, fried, or boiled, are used for making a great variety of dishes, and are prepared for the table in other ways; but the most common method of cooking them is in boiling water. Steaming is not infrequently resorted to as a method of cooking vegetables and is, of course, similar in principle to boiling in water.

"The simpler the methods of cooking and serving vegetables the better. A properly grown and well-cooked vegetable will be palatable and readily digestible. Badly cooked, water-soaked vegetables very generally cause digestive disturbances, which are often serious. Nearly every vegetable may be cooked so that with plain bread it may form a palatable course by itself, if it is desired to serve it in this manner.

"All green vegetables, roots and tubers should be crisp and firm when put on to cook. If for any reason a vegetable has lost its firmness and crispness, it should be soaked in very cold water until it becomes plump and crisp. With new vegetables this will be only a matter of minutes, while old roots and tubers often require many hours. All vegetables should be thoroughly cleaned just before being put on to cook. Vegetables that form in heads, such as cabbage, cauliflower, and Brussels sprouts, should be soaked, heads turned

Spaghetti and Mushrooms Boil a pound of spaghetti in slightly salted water for fifteen minutes. Now put into a saucepan one quarter pound of butter and two onions cut very fine or better still chopped, one pound of mushrooms sliced and simmer for five minutes. Meanwhile peel and cut into small pieces four fair sized tomatoes, add, and let the mixture cook for fifteen minutes, pepper and salt to taste. Serve hot with grated Parmesan cheese.

Rice in Cabbage Rolls. Scald some large cabbage leaves till they are limp and pliable. Boil some rice, add to it a few raisins, blanched almonds and sugar to taste. Now take the leaves and put about a spoonful of the rice in each and roll up (see illustration), tucking the ends in carefully so none of the rice can get out. Then take the little rolls and put into a saucepan with a lump of butter or some good olive oil and let simmer gently about twenty minutes till cabbage is done.

down, in salted cold water, to which a few spoonfuls of vinegar may be added. If there are any worms, or other forms of animal life in these vegetables they will crawl out. To secure the best results all vegetables except the dried legumes must be put in boiling water, and the water must be made to boil again as soon as possible after the vegetables have been added, and must be kept boiling until the cooking is finished. Herbaceous vegetables should boil rapidly all the time. With tubers, roots, cauliflower, etc., the ebullition should not be so violent as to break the vegetables. Green beans and peas when removed from the pod must also be cooked gently, i. e., just simmer. When the pods and all are used they are to be cooked rapidly, like the herbaceous vegetables.

"To secure the most appetizing and palatable dishes, only fresh, tender vegetables should be cooked. If, however, green beans, peas, etc., have grown until a little too old and it still seems best to gather them, a very small piece of baking soda added to the water in which they are boiled makes them more tender, it is commonly believed, and helps to retain the color. Too much soda injures the flavor and an excess must be carefully avoided. A little soda may also be used to advantage if the water is quite hard. Peas may be boiled for fifteen or twenty minutes in the water to which the soda has been added. Then add enough boiling water to cover them generously. Place over a hot fire and when they begin to boil draw back where the water will bubble gently.

"During the cooking of all vegetables the cover must be drawn to one side of the stewpan to allow the volatile bodies liberated by the heat to pass off in the steam. All vegetables should be thoroughly cooked, but the cooking should stop while the vegetable is still firm. This, of course, does not apply to vegetables that are cooked in soups, purees (thick strained soups), etc. The best seasoning for most vegetables is salt and good butter. Vegetables that are blanched and then cooked with butter and other seasonings and very little moisture are more savory and nutritious than when all the cooking is done in a good deal of clear water."

To those who study the question of economy down to its smallest detail it is well to understand the losses that occur in cooking vegetables by different methods. In baking vegetables there is little loss of material, except the water which is driven off by the heat. When vegetables are immersed in water, as in boiling, a greater or less loss of material is almost inevitable, the kind and amount of material extracted by the water depending upon such factors as the sort of water used, its temperature at the beginning and during the cooking period, the length of time the cooking is continued, and the condition of the vegetable, that is, whether pared, whole, or cut into small pieces.

When potatoes are boiled in the jackets the loss of material is very trifling. When peeled and soaked for several hours before boiling the loss amounts to about fifty per cent of the nitrogenous matter, and forty per cent of the mineral matter present. When potatoes are peeled and placed at once in boiling water only about eight per cent of the proteid matter, and nineteen per cent of the mineral matter are extracted by the water. But little starch is removed from potatoes by the solvent action of water. But when peeled potatoes are boiled the amount of starch removed by abrasion is considerable—at times nearly thirty per cent of the total value of the potato. When carrots are cut into small pieces nearly thirty per cent of the total food material is lost. The sugar extracted is equivalent to nearly a pound to the bushel. There is a corresponding loss also when cabbage is boiled, amounting to about one-third the total food material present.

Another grave fault in cooking is the habit of boiling out all the flavor of vegetables in the process. When cooking vegetables use only sufficient water to avoid burning; never so much that it will be necessary to pour off a quantity when the food is ready to serve. With this water that is poured off, usually goes not only the best flavor of the food, but the vegetable salts also. These saline elements that are a part of all vegetable life, are usually absorbed by, or dissolved in this liquid, which is generally poured off. The result is that a quantity of inorganic mineral salt must be added in a form which many hygienists believe cannot become a part of the body.

A table on page 577 gives the proper time for cooking the vegetables commonly in use.

What Overcooking Does.—Most foods are over-cooked. Too much heat deorganizes and destroys the nourishing, life-giving qualities of the food. No deorganized element is fit for use as food. This is a fact that cannot be learned too soon. Mineral substances cannot sustain life because they are unorganized. The minerals needed by the body must be obtained from organized living substances. Only vegetable or animal life can sustain the life of man, because they only are organized. A chemist may mix the exact chemical elements in the same proportions contained in a grain of wheat, but it will be useless for food, although the wheat itself is a perfect food. In the one case it is organized and therefore the proper material for food; in the other case, unorganized and useless.

Another objection to excessive cooking is that it so softens the food as to tempt the eater to swallow it without mastication, and the injurious effects of this habit cannot be overestimated. Any food that is bolted without being masticated will pass through the body without yielding the best of its nutrient elements for the benefit of the body, besides fermenting in the upper intestines and causing the many and serious troubles which have been already explained.

When the abnormally trained appetite calls for those foods that "melt in the mouth," the man and woman who eat such foods will find that they are apt to tempt into the habit of bolting. Teeth were made for use, and not only does the health of the teeth depend upon their proper use in the mastication of hard foods, but the health of the body depends upon their discharging their functions in a proper and satisfactory manner.

On the other hand, there is very little danger that one will be tempted to "bolt" uncooked foods. Such foods must be masticated, and will supply far more nutriment than will cooked foods swallowed without mastication.

Many physical culturists are puzzled as to cooking without lard. Butter, cream or olive oil are all perfect substitutes for lard. There are thousands of people in the United States who have never used lard for cooking purposes, and they are as much surprised when informed that a large number of people do not know how to cook without it, as the latter class is to learn that there are those who never use it.

Cotton-seed oil is often used, as it is cheaper than olive oil, and is certainly to be preferred to lard. A great deal is sold as olive oil.

Fried foods are almost universally condemned by hygienic experts, yet *wholesome* foods, when properly fried, are as digestible as when cooked in other ways. Of course, batter-cakes and foods of that character are not fit for food, and even a dog would not eat them if made with white flour, as is usual. Batter-cakes can, however, be made from graham or whole wheat flour, and such are quite satisfactory as food.

High seasoning and elaborate combinations of foods in cooking are to be condemned. Every means should be adopted to bring out the natural flavor of the food, but it is not at all infrequent to find different articles of food so disguised by seasoning that their character is difficult to determine. Such a practice is, of course, injurious; for the appetite cannot be depended upon to indicate the proper quantity when benumbed by pepper and other stimulating seasoning.

The importance of good cooking can hardly be over-estimated, yet it is usually considered of about the least importance of anything in life; for it is often left to the ignorant and unskilled servants, who no doubt swell the income of medical men quite materially by the influence of their dishes upon the household. Therefore, no girl should be allowed to marry until she thoroughly understands the art in all its branches, so that, whether she has to do the cooking in her own home or not, she will at least be able to direct all the operations of the kitchen in an intelligent manner. So long as people will eat cooked foods, these should be cooked according to the highest dietetic and practical knowledge, so that the maximum of palatability and digestible efficiency can be gained from them, with the minimum loss of food value.

In the following pages a number of menus are given suited to diet, with recipes for the dishes named in them. There are three lists: One of Cooked Vegetarian Foods, one of Uncooked Vegetarian Foods, and one of Mixed Foods, including Meats.

The menus are primarily intended for the two-meals-a-day plan, but some of the dishes given for the two meals can be reserved or repeated for the third meal when three meals a day are eaten. Quantity per portion is optional.

TIME FOR COOKING VEGETABLES.

Boiling.

Asparagus—Fifteen to twenty minutes.
Beans (Lima)—One-half hour, slowly.
Beans (string)—Two hours.
Beans (dried)—Four to six hours, slowly.
Beets (young)—Forty-five to sixty minutes.
Beets (old)—Three to four hours.
Cabbage—Thirty to forty-five minutes.
Carrots (young)—Forty-five to sixty minutes.
Carrots (old)—Two to four hours, slowly.
Cauliflower—Thirty to forty-five minutes.
Celery—Thirty minutes.
Corn (green, fresh)—Eight to ten minutes.
Macaroni—From twenty to forty minutes.
Onions—Thirty to forty-five minutes.
Oyster Plant—Thirty to sixty minutes.
Parsnips (according to size and age)—One-half to one and one-half hours.
Peas—Fifteen to twenty-five minutes.
Split, dried peas—Four to six hours.
Potatoes—Twenty to thirty minutes.
Spinach—Twenty to thirty minutes.
Squash—Twenty to thirty minutes.
Tomatoes—Fifteen to twenty minutes.
Turnips—One hour, boiled hard; four to five hours, if steamed slowly.

Baking.

Beans—Six to ten hours.
Potatoes—Forty-five to sixty minutes.
Macaroni—One-half to one hour.

Menus and Recipes—Cooked Vegetarian Foods.

SUNDAY.

Breakfast.	*Dinner.*
Grape Fruit Figs	Nutmeato Roast with Egg Gravy
Shredded Wheat with Cream	Fruit Salad with French Dressing
Cream of Celery	Baked Irish Potatoes
Graham Bread Creamery Butter	Apple and Banana Sauce
Cocoa	Postum

Cream of Celery.—Two stalks celery; two tablespoonfuls butter; two tablespoonfuls flour; one cup milk; a little parsley; salt to taste. Boil celery in water until tender. Drain off water and rub celery through sieve. Add milk. Stir butter and flour to a paste, and add this slowly to the heated milk and celery. Add the minced parsley and season with salt to taste. Cook until thick. Serve hot, with salted wafers.

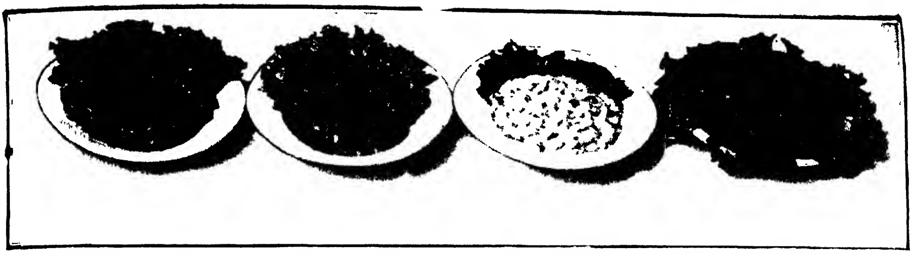
Fruit Salad.—One grape fruit; one orange; one bunch red California grapes; a few English walnuts. Cube the grape fruit and orange, being very careful to separate the pulp of the grape fruit from the skin, which is bitter. Cut the grapes in halves and take out the seeds. Chop the nuts quite fine. Add all together and serve with French dressing.

Nutmeato Roast with Gravy.—(1) Nutmeatose. One cup nut butter; one cup sifted kidney beans; one and one-half cups water; two spoonfuls cornstarch; one spoonful salt. Cook beans until tender and rub through sieve. To one cup of this sifted pulp add the other ingredients and mix well. Cook in sealed cans three to five hours.

(2) Nutmeato Roast. One pint of toasted bread crumbs; one pint water; one-half pint strained tomatoes; one-half pound nutmeatose chopped fine; flavor with finely sifted sage. Mix well, and salt to taste. Bake in buttered, shallow pans until brown. Serve with egg gravy.

(3) Egg Gravy. In one pint of water dissolve one level spoonful nut butter. Thicken with flour until thin gravy. Just before removing from stove, add one egg, well beaten. The white of egg may be used or omitted, as desired.

Apple and Banana Sauce.—Cook apples as you would for ordinary applesauce. When just about tender, add one or two sliced bananas (according to the amount of apples you use). Finish cooking until both are tender. Remove from heat and add sugar to taste. If apples are not too sour, you will not need to add sugar.



CARROTS AND PEAS. CHEESE RELISH. COLD SLAW. VEGETABLE STEW WITH GRAVY.

Carrots and Peas.

Take a carrot and run through a chopper. Pour a few green peas over top.

Cheese Relish.

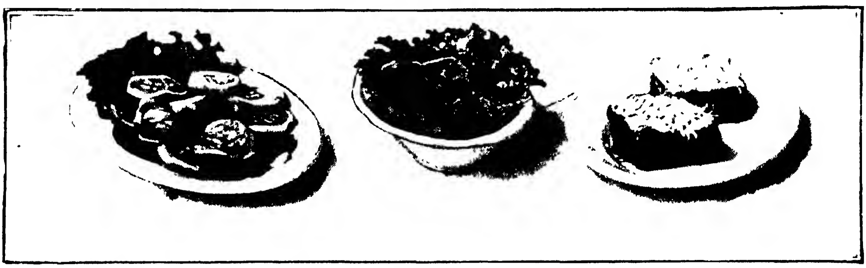
Take ¼ lb. cheese and run it through a grinder; chop one small stalk of celery finely; mix two together and add one small green pepper and if too thick mix in a little cheese. Take two tablespoonsful of butter and melt in a small dish; add one teaspoonful of whole wheat flour and stir to a paste; now add a little grated onion and enough hot milk to make a thick cream sauce; then to the whole add a small amount of burnt sugar, prepared by putting a teaspoonful in a dish and letting it burn until brown.

Cold Slaw.

Chop one small cabbage finely. Dress with sour cream and lemon; if necessary, add a little salt.

Vegetable Stew with Gravy.

Take one onion, one potato, one carrot and one small turnip; pare all and cut into small cubes or dice shape. Put onion in boiling pan and let boil for fifteen minutes (as it takes longer to cook them); then add the rest and let boil for fifteen minutes longer. Be sure not to let boil too much, or vegetables will become mushy. When done strain off water and set aside to steam with cover part way off pan.



TOMATO AND CUCUMBER SALAD. ESCALLOPED CORN. FIG PUDDING.

Tomato and Cucumber Salad.

Slice two medium sized tomatoes into small pieces. Do likewise with one medium sized cucumber; add together and dress with olive oil and lemon juice. If necessary salt to taste.

Escalloped Corn.

Cook until done, two ears of corn (canned corn may be used if fresh is not obtainable). Have ready a small baking dish well buttered; then place in corn to depth of one half inch, salt and grate a little onion over it; then place over this whole wheat bread crumbs to the depth of one inch; then another layer of corn and onion, salt and a small piece of butter; and last of all, on top another layer of bread crumbs; pour over the whole a cup of milk; place in oven and bake for fifteen minutes; before baking grate a little cheese over the top.

Fig Pudding.

Stone six dates and put through chopper. Take six figs and do likewise. Grind ¼ lb. mixed nuts; also half a loaf whole wheat bread. Mix all together and moisten with cream. A few raisins can be added with advantage. Spread in a flat pan and cover pudding with sugar, and then on top of that shredded cocoanut.

CREAMED SPINACH. GRAPENUT PUDDING. TOMATO AND PINEAPPLE.

Creamed Spinach.

Boil in salt water two quarts of spinach for twenty minutes. When done squeeze out water and chop fine, put back in saucepan and add a small piece of butter, ½ cup of cream and the yolk of a hard boiled egg cut fine; season with salt and a dash of pepper. When serving use the white of the egg as a garnish.

Grapenut Pudding.

Let boil one cup of milk; pour into it ¼ cup of Grape Nuts. When cool stir into it the yolk of one egg, and a tablespoonful of sugar and two drops of vanilla extract; put all in a small baking dish, and stir in the white of egg, well whipped; bake for fifteen minutes. Just before ready to serve pour over a sauce of one teaspoonful of melted butter, a tablespoonful of sugar, and half a teaspoonful of flour. Stir these to a creamy substance; pour over a little boiling water and flavor with a little lemon extract.

Tomato and Pineapple.

Take three tomatoes and slice into small pieces; also one small pineapple and do likewise. Add together and make a dressing of equal parts of honey and lemon.

MONDAY.

Breakfast.	*Dinner.*
California Grapes	Egg and Beet Salad with Oatmeal Wafers
Bananas Corn Flakes	Baked Squash Creamed Potatoes
Cream of Tomato Soup	Ripe Olives
Corn Bread Mixed Nuts	Prune Whip Cake
Milk	Grape Juice

CREAM OF TOMATO SOUP.—One can tomatoes; one and one-half pints milk; three tablespoonfuls butter; five tablespoonfuls (level) flour; celery salt; one onion; salt to taste. Heat tomatoes and run through sieve. Add the heated milk and minced onion to tomatoes and cook until onion is tender. Rub the flour and butter to a paste, and add slowly to the tomato mixture. Season with celery salt and salt to taste. Serve hot.

EGG AND BEET SALAD.—Take three or four large beets, and cube them. Add three hard-cooked eggs, cubed. Add a cooked salad dressing, and serve very cold on little, yellow cabbage leaves.

CREAMED POTATOES.—Five large cooked potatoes; one cup milk; two tablespoonfuls butter; two tablespoonfuls flour; small quantity of parsley; salt to taste. Cube potatoes. Pour over them hot white sauce, which has been made from the milk, butter, and flour, as given above. Add minced parsley and salt to taste. Cook a few minutes and serve.

TUESDAY.

Breakfast.	*Dinner.*
Stewed Apricots	Purée of Navy Beans
	Celery and Apple Salad
Cream of Wheat Dates	Creamed Turnips
Whole Wheat Gems Honey	Macaroni with Cheese
	Sliced Oranges and Pineapple
Cocoa	Postum

WHOLE-WHEAT GEMS.—One quart whole-wheat flour; one quart water; one tablespoonful melted shortening; two tablespoonfuls sugar; two tablespoonfuls baking powder; pinch of salt. Beat thoroughly and put into hot, greased gem pans. Bake twenty minutes in hot oven.

PUREE OF NAVY BEANS.—Three cups of cooked beans; one minced onion; two cups milk; three tablespoonfuls butter; one tablespoonful flour; pinch of red pepper; a little parsley; salt to taste. Proceed same as in making cream of tomato soup.

WEDNESDAY.	
Breakfast.	*Dinner.*
Stewed Prunes Oranges	Banana and Nut Salad
Cracked Wheat with Cream	Buttered Parsnips
Poached Eggs on Toast	Baked Sweet Potatoes
Postum	Creamed Onions Corn Gems
	Apple Snow Date Coffee

CORN GEMS.—One egg; one and one-half cups milk; one-fourth cup sugar; one-half cup flour; one cup corn meal; two level teaspoonfuls baking powder. Beat first three ingredients together. Then mix corn meal and flour and add a little at a time, beating well for at least five minutes. Then add the stiffly beaten white of egg, and bake in gem pans in moderate oven.

APPLE SNOW.—Cook four apples until very fine. Beat the white of one egg. Add apple sauce slowly, beating all the while. Add one tablespoonful grape jelly to this and beat until it is thoroughly mixed. Serve in little dishes, with chopped nuts sprinkled over the top.

THURSDAY.	
Breakfast.	*Dinner.*
Figs Oranges	Cabbage Salad Nut Sandwiches
Corn Flakes with Cream	Baked Asparagus with Cheese
Cream of Lima Beans	Creamed Cauliflower
Graham Bread Butter	Stuffed Peppers
Cocoa	Mixed Nuts Mock Cherries
	Lemonade

CABBAGE SALAD.—Chop cabbage very fine. Add a few fresh grapes, and mix thoroughly with salad dressing. Serve on lettuce leaves, and garnish the top with nuts.

STUFFED PEPPERS.—Mix two cups of sifted tomatoes with two-thirds cup of bread crumbs. Season with salt, minced onion, and minced parsley. Stuff the peppers and place in pan with a little water and butter. Bake until tender in medium oven.

MOCK CHERRIES.—Take equal parts of cranberries and raisins. Cover with water and cook until tender. Add sugar to taste. On account of the large quantity of natural sugar in the raisins, very little additional suger will be required.

FRIDAY.

Breakfast.

Grape Fruit Raisins
Rice with Dates and Cream
Sandwich Cream Toast
Creamery Butter Cocoa

Dinner.

Tomato Soup
Egg Salad Escalloped Corn
Baked Rice or Macaroni with Cheese
Grape-Nuts Pudding
Welch Grape Juice

RICE WITH DATES.—Wash one-half cup rice. Cook in large quantity of salted water until nearly tender. Drain thoroughly and put into double boiler with one-half cup pitted dates. Finish cooking until tender. Serve with cream.

SANDWICH CREAM TOAST.—Select some well-browned triscuit, and if not crisp enough, toast slightly to a delicate brown. Spread thickly with butter and add a generous layer of grated cheese. Place three or four of these in a cereal bowl in sandwich form, one on top of the other, with the buttered side up. When ready to serve, pour over this a cup of hot milk. Part cream may be used if desired, but the butter and cheese make it very nourishing and appetizing.

EGG SALAD.—Cook six eggs until hard. Carefully remove whites from yolks. Mash the yolk, and mix with one minced onion and a little parsley, salt, and red pepper. Add salad dressing until of the right consistency. Cut the whites into small pieces. Place a spoonful of the salad mixture upon a plate, sprinkle the white over the top, and serve.

BAKED RICE WITH CHEESE.—Add alternately cooked rice, cheese, and a little salt and red pepper, until the baking dish is full. Pour a little milk over the top, and cover with buttered bread crumbs. Bake until a delicate brown.

GRAPE NUTS PUDDING.—Allow about four tablespoonfuls of grape nuts to each person served. Put to soak for two or three hours, in milk enough to cover them. Chop up some dates, figs and raisins, using about the same amount of fruit as you do cereal. Mix thoroughly together, then add several spoonfuls of nuts, chopped or ground. Make into squares or round shapes and serve in dessert dishes with whipped cream or the white of egg beaten stiff and sweetened with honey or powdered sugar.

MACARONI WITH CHEESE.—Break macaroni into small pieces. Cook until it has doubled its size, and then drain off water. Prepare a white sauce, and add alternately into a bake pan, white sauce, macaroni, and grated cheese, until the pan is full. Cover top with buttered bread crumbs and place in oven. Bake until a delicate brown. Serve in baking dish.

SATURDAY.

Breakfast.	*Dinner.*
Stewed Dried Peaches Figs	Lettuce Salad, served with Peanut Sandwiches
Oatmeal with Cream	Baked Cabbage with Cheese
Creamed Asparagus on Toast	Potatoes Served on Half Shell
Rye Bread Butter	Graham Muffins
Postum	New Maple Syrup
	French Apple Sauce Nuts

Creamed Asparagus on Toast.—Use one can of asparagus. Drain off juice, and cut into small pieces. Put the asparagus into a white sauce, and serve all on toast. Garnish with parsley. This makes a very good breakfast or luncheon dish.

Baked Cabbage with Cheese.—Cut the cabbage the same as for cold-slaw. Parboil until tender, and then drain off water. Put into a bake dish alternate layers of cabbage, white sauce, and grated cheese, seasoning to taste. Continue until dish is full, having cheese for the last layer. Cover with bread crumbs and bake until brown. Serve in bake dish.

Baked Potatoes on Half Shell.—Bake potatoes, and when done cut in two lengthwise halves, with sharp knife. Scrape out contents into hot bowl, and then mash. To every six potatoes, add two tablespoonfuls butter, three tablespoonfuls hot milk, and one-half teaspoonful salt. Mix thoroughly, beating with fork or Dover egg beater. Then add beaten whites of two eggs. Do not stir, but *beat.* Refill skins very lightly, heaping high on top and keeping the surface ragged. Put these skins upon shallow pan, and place in oven until well browned. Garnish with parsley, and serve hot on hot platter.

Graham Muffins.—Two cups Graham flour; one-half teaspoonful salt; three and one-half level teaspoonfuls baking powder; one-third cup sugar; one egg, beaten; one tablespoonful melted butter. Bake twenty-five minutes in greased muffin pans, in moderate oven.

French Apple Sauce.—Wash and core several red apples. Butter deep, earthen dish, and into this slice in rings not more than one-fourth of an inch thick, the prepared apples. Dot with a few bits of butter, and sprinkle with brown or white sugar mixed with a little flour. End with sugar and flour on top. Cover dish lightly with paste, and bake in moderate oven one hour. The sauce should be deep red in color, and thick and juicy.

Uncooked Vegetarian Foods.

SUNDAY.

Breakfast.	*Dinner.*
Grape Fruit	Vegetable Medley with Dressing
Banana and Nut Cereal	Sandwiches of Bran Biscuit and Peanut Butter
Dates Stuffed with Cheese	Fancy Fruit Salad in Orange
Sumik	Grape Juice

BANANA AND NUT CEREAL.—As this constitutes the principal part of a meal, serve a generous quantity. Take a large cereal bowl and first put in it a layer of Post Toasties; then add another layer of wheat, or oat flakes, according to dictation of appetite; next slice a banana and arrange daintily on top. Between the banana slices place the half meats of either walnuts, pecans, or any favorite nut. Do not add the cream until served, as this tends to soak the cereals, thereby removing their delicious crispness.

MINCED ONION AND CABBAGE SALAD.—Chop rather finely the desired amount of cabbage and onions. Some like only a small quantity of onions to merely give the salad a slight flavor, while others prefer half of each. Daintily garnish a salad dish with lettuce or parsley; then put on several spoonfuls of the minced vegetables. Pour a liberal amount of the mayonnaise dressing over this and serve.

MAYONNAISE DRESSING.—Allow the yolk of one egg for each person, or if you have no use for the whites of egg, use one egg for every two salads served. Whip the egg lightly; then add two tablespoonfuls of olive oil, and lemon juice enough to suit the taste. If still accustomed to the use of salt, a slight pinch may be added to the above mixture; then beat well. This dressing makes a very appetizing addition to any vegetable salad.

VEGETABLE MEDLEY.—This can be made of as many vegetables as one desires, having them chopped rather fine and mixed well together. Serve on a garnished salad dish with mayonnaise dressing.

FANCY FRUIT SALAD IN ORANGE.—Use the following fruit salad recipe with the addition of nuts. Cut the top off an orange; remove all the inside; use this in the salad. Fill the orange with the salad mixture, cover with whipped cream, place a walnut-meat in center, and sprinkle with ground nuts.

MONDAY.

Breakfast.	*Dinner.*
Triscuit and Cheese Sandwiches	Date Marmalade Sandwiches
Fruit and Cereal Medley with Cream	Cream Slaw
Grape Lemonade	Sliced Onions with Dressing
Prune Whip	Apple, Date and Nut Dessert
	Sumik

Fruit and Cereal Medley.—Mince some figs, oranges, bananas and dates, mixing well together. Put a few grape nuts in a cereal bowl, then a layer of the fruit mixture; sprinkle a little more of the cereal on this and add about five spoonfuls of the fruit dropped separately; one in the center and four evenly distanced around the outside. Serve with cream.

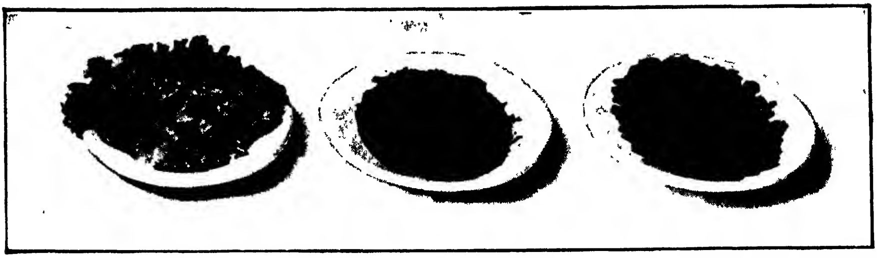
Prune Whip.—Soak some prunes over night, in cold water If a good grade of prunes is used, this should make them as soft as when cooked. Some require longer soaking to be soft enough. Remove the seeds and mash to a jelly. Serve in a dessert dish, and drop three teaspoonfuls of whipped cream, separately and evenly distanced on top. Place the half meat of a walnut or pecan in center of each spoonful of whipped cream. If daintily served this makes a very pretty dish.

Grape Lemonade.—Fill a glass two-thirds full of water; add the juice of half a lemon; then fill with grape juice.

Date Marmalade Sandwiches.—Pit the dates and soak in just enough lukewarm water to cover them, for several hours. Mash, or run them through a colander. Serve between buttered triscuit, bran biscuit, or whole-wheat bread.

Apple, Date and Nut Dessert.—Slice some apples in dessert dishes and sprinkle them with chopped or ground nuts. Tastily arrange the halves of dates on top; sprinkle again with nuts and grated cocoanut. Serve with cream or olive oil. This is also very nice with the juice of an orange poured over it.

Dried Apple Sauce.—Soak the dried fruit, in just enough lukewarm water to cover it, until it is in a soft state to be easily mashed with a fork, or run through a colander. Sweeten to taste and serve plain or with cream.



APPLE AND CELERY SALAD. SPAGHETTI, CREOLE STYLE. ONIONS AND POTATOES WITH CHEESE.

Apple and Celery Salad.

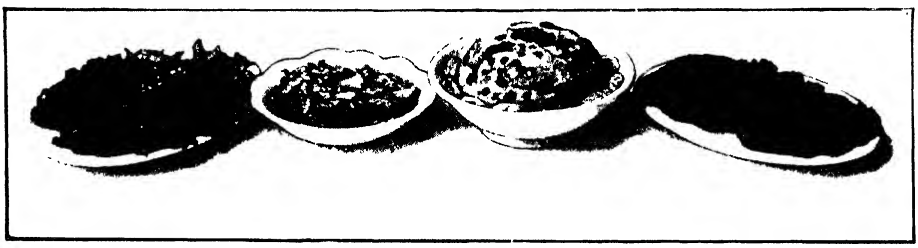
Peel one apple, cut into small pieces; take one small stalk of celery and chop it finely; add the two together and make a dressing of sour cream and lemon.

Spaghetti, Creole Style.

Cut up three or four long pieces of sphaghetti. Place in boiling water and boil fifteen minutes; then set aside to swell for ten minutes. Add to a finely chopped onion, two tablespoonfuls of butter and a teaspoonful of finely chopped green pepper; then allow to fry for four minutes. Then heat a cupful of canned tomatoes, and add fried onion and pepper. Now take spaghetti and strain off water, add to the tomatoes, etc., and salt to taste. When ready to serve sprinkle a little grated cheese over the whole.

Onions and Potatoes with Cheese.

Peel two onions, and wash three unpared potatoes; cut in fine slices and place in small baking pan with two ounces of butter and a quarter cup olive oil; salt to taste; cover and place in hot oven until done. While cooking stir two or three times. When done sprinkle grated cheese over top and replace in oven for a minute. Serve hot, turned out on platter.



SCALLOPED POTATOES. FRUIT SALAD. FRUITED RICE. EGG PLANT.

Scalloped Potatoes.

Pare two or three potatoes; boil and slice thin in a baking pan; season with a little salt, butter and ½ a grated onion and pour over the whole a white cream sauce made of a cup of boiling milk, added to a paste made of a tablespoonful of butter and one teaspoonful of whole wheat flour, stirred well together, seasoned with salt, pepper and a touch of grated onion. After sauce is poured over potatoes, spread over top a well-beaten egg, as this gives it a brown crust on top and looks very appetizing.

Fruit Salad.

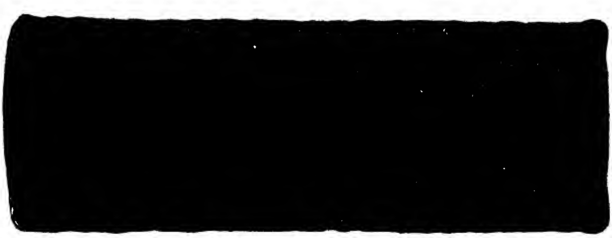
Take one small pineapple and slice into pieces; also two apples and three bananas and do likewise. Chop ¼ lb. almonds or pignolias or any other nut. Add all together and dress with equal quantities of honey and lemon.

Fruited Rice.

Take a half cup of rice and wash in cold water; put in sauce pan with a little water and let come to a boil; boil ten minutes and set aside for fifteen minutes to steam, with cover on sauce pan. Have ready one-half cup of raisins and one-half cup of currants, thoroughly washed, and also a cupful of cream; add this to rice; also raisins and currants; stir together and boil again for three minutes; serve hot with a sliced banana on top and sugar and milk to taste.

Egg Plant.

Slice a small sized egg plant in quarter inch pieces; soak for a half hour in cold water with a pinch of salt in it. Have ready some cracker meal, a little whole wheat flour and two well-beaten eggs, drain off water from slices; now cover slices, one at a time, in flour first; second, dip in egg, and third, cover with cracker crumbs, and last back into egg; have on the stove a small dripping pan with a part olive oil and a part butter, very hot; place slices in and fry until a light brown (about six minutes). Do not pare egg plant until ready to use, as exposure to air will cause them to turn black.



A type of the wholesome whole wheat bread sold by Physical Culture Restaurants.

TUESDAY.

Breakfast.

Fig and Triscuit Sandwiches
Apple, Celery and Nut Salad
Nutted Cottage Cheese
Milk

Dinner.

Nutted Fruit Corn Flakes with Cream
Celery Hearts Stuffed with Cheese
Garnished Pepper Salad
Banana Delicacy
Apple Juice

Apple Celery and Nut Salad.—Chop apples, celery and mixed nuts of any kind, very fine. Mix well together and serve with whipped sour cream, or mayonnaise dressing.

Nutted Cottage Cheese.—Take peanut butter or ground nuts cf any kind desired, and mix thoroughly with cottage cheese. Use enough nuts to merely give it a nice color.

Fruit Salad.—Cut into small pieces some figs, dates, bananas, oranges and pineapple; any fruit can be used. In regard to quantity of each, mix according to taste, and use enough oranges to make it very juicy. This is very nice if served plain, with whipped cream, or with the addition of a few nuts.

Nutted Fruit Corn Flakes.—Fill a cereal bowl two-thirds full of corn flakes. Remove the seeds from dates and nicely arrange the halves on top of the cereal. Sprinkle with ground nuts, and serve with cream or olive oil.

Garnished Pepper Salad.—Select some well-shaped green peppers or mangoes; cut off the top and remove the seeds; then place in a pan of cold water and let remain until water begins to boil. Take them out of water and let cool. In the meantime prepare a mixture of vegetables, cabbage, celery, onions and any vegetables that are preferred, chopped fine and thoroughly mixed with the mayonnaise dressing. Stuff the peppers with this mixture, place three olives on top, and serve on a salad dish garnished with lettuce.

Banana Delicacy.—Take thoroughly ripened bananas, and mash to a pulp with a fork. Serve in a dessert dish. Cover with whipped cream and arrange small chunks of orange and nut meats, alternately, on top.

WEDNESDAY.

Breakfast.	*Dinner.*
Shredded Wheat Biscuit with Fruit	Luncheon Sandwiches
Entire Wheat Bread	Rolled Wheat and Raisins with Cream
Butter	Combination Salad with Mayonnaise Dressing
Apple, Nut and Cheese Salad	Banana Whip Sumik
Grape Fruit	
Banana Coffee	

Shredded Wheat Biscuit with Fruit.—Select a good, ripe banana and mash to a pulp with a fork. Add a few chopped dates, or merely cut them in small pieces. This constitutes the fruit mixture. If handled rather carefully, the shredded wheat biscuit can be cut in halves, lengthwise. After so doing, take a large cereal bowl and crumble in it, very fine, one half of the biscuit; then evenly spread the fruit mixture over this. Take the top of the biscuit, as that always has such a delicate brown color, and place in the center of the dish. Serve with cream.

Apple, Nut and Cheese Salad.—In this salad, use the quantity of each according to the flavor desired to predominate. Cut the apple into small cubes, and grate the cheese rather fine. Any kind of nuts, either ground or in halves, can be added and all stirred well together. This is very nice served with olive oil or the mayonnaise dressing described in the Sunday menu of Uncooked Vegetarian Foods.

Luncheon Sandwiches.—Make a sandwich dressing of cottage cheese and chopped dates mixed thoroughly together. Place a generous quantity of this mixture between the buttered slices of whole-wheat bread, or well-buttered triscuits.

Combination Salad.—This salad can be made of as many different vegetables as one may happen to have on hand at this season of the year. They can be chopped or minced very fine, or if preferred cut in small cubes or chunks. If a tart salad is desired, serve with plain lemon juice; but a dressing consisting of olive oil and lemon juice beaten thoroughly together, makes it far more appetizing. Or serve with mayonnaise dressing.

Banana Whip.—Use only the real ripe bananas for this dessert. Mash them to a smooth jelly with a fork; then add, in quantity, about one half as much whipped cream as you have of the fruit, and stir well together. Serve in a dessert dish, and cover with a generous smooth layer of whipped cream. Sprinkle with ground nuts, and neatly arrange the halves of walnut meats on top. Make this dessert at the latest possible moment, for the mashed bananas grow very dark colored if allowed to stand any great length of time.

THURSDAY.

Breakfast.	*Dinner.*
Nutted Milk Flakes with Honey	Triscuit
Entire Wheat Bread	Butter Apricot Marmalade
Butter	Cottage Cheese and Vegetable Salad
Cheese and Onion Salad	Apple Dessert
Hawaiian Pineapple	Welch Grape Juice
Orangeade	

Nutted Milk Flakes with Honey.—For each person served, allow half a cup of rolled oat flakes. Allow them to soak an hour or more, in just milk enough to cover them and a quantity of honey to make them sufficiently sweet. Stir well together and place in a cereal bowl. Sprinkle with corn flakes and a generous amount of any kind of nuts desired. Serve with cream or olive oil.

Fruit Butter.—Use any kind of dried fruit desired. Put it in lukewarm water, enough to cover well, and let remain until the fruit is very soft, resembling the cooked state. Run through a colander; then mix thoroughly with the juice it has been soaking in. Sweeten to taste with either sugar or honey. Can be served plain or with whipped cream daintily dropped on top and garnished with nut meats.

Pineapple with Whipped Cream.—At some times of the year it is somewhat difficult to secure the fresh fruit, but the canned is easily obtained, either in chunks or circles. Place in a dessert dish, cover with whipped cream, and sprinkle with grated cocoanut or ground nuts.

Cottage Cheese and Vegetable Salad.—Select various kinds of vegetables, according to preference, and mince fine. Stir well together and place a generous flat layer on a garnished salad dish. Drop about three spoonfuls of cottage cheese, evenly distanced, on this layer, put a walnut meat in the center of each spoonful of cheese, and pour a liberal amount of mayonnaise dressing over it all.

Apple Dessert.—Select a large, rosy apple and cut in halves, not lengthwise. Remove the core and all the inside of the apple, leaving merely a shell thick enough to serve the salad in. The proportions may vary in this salad according to the individual's taste. Slice some apples very thin, cut dates in small pieces and break the nut meats in little chunks. Mix all together and fill the apple shell with this salad. Place on a dessert dish, cover the top with whipped cream, and sprinkle with ground nuts. Put a walnut meat in center.

FRIDAY.

Breakfast.	*Dinner.*
Fig and Triscuit Sandwich	Cheese and Onion Sandwich
Combination Salad with Mayonnaise Dressing	Fruit Jumble with Honey
Soaked Peaches and Cream	Minced Cabbage Salad
Malt Coffee	Grape Eggnog

Soaked Peaches and Cream.—Soak the dried peaches until softened; then put about three pieces of the fruit in a dessert dish. Pour some honey over these, and drop a spoonful of whipped cream on each peach.

Cheese and Onion Sandwiches.—Grate the cheese and mince the onions very fine. Use in proportion, as desired. Mix well with enough of the mayonnaise dressing to make it a proper consistency for spreading. Use between well-buttered slices of whole-wheat bread or triscuit.

Fruit Jumble with Honey.—Sprinkle a light layer of corn flakes or any favorite cereal, in a large cereal bowl. Next add a layer of sliced apples. Pour some honey over this and sprinkle again with the cereal. Then arrange a generous layer of sliced oranges and nuts. More honey can then be added. It is very nice if served in the plain way, or it can be eaten with cream.

Shredded Wheat Dessert.—With a sharp knife, cut a good sized square in the top of a shredded wheat biscuit. Remove all the shreds possible to make the place as large as can be for the fruit. Mash bananas to a pulp, and fill the biscuit with this. Cover with whipped cream and daintily arrange a few nut meats on top. Any fruit desired can be used in the biscuit.

Grape Eggnog.—Allow one egg for each person. Beat the yolks and whites separately. To the yolk of the egg, add enough grape juice to give it a fine color. Sweeten with honey. Then pour in a glass. If desired, the white can be sweetened with either honey or sugar. Put in the glass on top of the yolk, and serve.

SATURDAY.

Breakfast.

Shredded Wheat Medley
Nutted Eggnog
American Cheese
Figs Apples
Marble Dessert

Dinner.

Whole-Wheat Bread
Butter Dried Apple Sauce
Cottage Cheese and Cabbage Salad
Mixed Nuts
Grape Juice

Shredded Wheat Medley.—Crumble a shredded wheat biscuit in a cereal bowl. Select a dozen good Persian dates, cut in small pieces and place over the top of biscuit layer. Next sprinkle a generous quantity of raw peanuts over this mixture and serve with cream.

Apple and Nut Salad.—Take equal quantities of walnuts, pecans and almonds chopped rather fine. Use the same amount of apple (also finely minced), as the nut mixture, and stir well together. Then pour a generous quantity of mayonnaise dressing over this and serve on a garnished salad dish, tastily arranging a few olives on top.

Marble Dessert.—Use an equal quantity of dates, figs, bananas and apples, minced very fine, thoroughly mixed together. This constitutes the fruit mixture. If obtainable, use the fresh cocoanut, grated. If not, the shredded cocoanut will answer the purpose, although it is not as desirable and nicely flavored as the fresh nut. Spread quite a generous layer of this fruit mixture in a dessert dish. Sprinkle a thick layer of the cocoanut over this and then drop three small spoonfuls, evenly distanced, on top of the last layer. Place an almond meat on each spoonful of the fruit and lay a large dark raisin between each spoonful. These make a fine contrast on the cocoanut.

Nutted Eggnog.—To the beaten yolk of an egg add several large spoonfuls of milk (according to size of glass used), enough honey or sugar to sweeten, and two spoonfuls of ground nuts; then beat well. Pour into a glass and add the beaten white of the egg, slightly sweetened. Sprinkle lightly with the ground nuts. This is a delicious drink if it is properly seasoned and if a favorite kind of nut is used.

Cottage Cheese and Cabbage Salad.—Mix thoroughly, equal proportions of shredded or chopped cabbage and cottage cheese. Then stir in a liberal quantity of mayonnaise dressing, or if preferred use the olive oil and lemon juice.

Mixed Foods (Including Meats).

THE following bills of fare have been selected for those who are engaged in heavy labor, and feel that they are not able to follow the light vegetarian menus.

Those who are accustomed to three meals per day at the usual hours for such meals should eat some light fruit either at the noon or the morning meal, and the two heavy meals at the other meal hours.

Salt is the only seasoning allowed.

Fruit always means bananas or apples or other common varieties. Especial care is necessary to see that all fruit is served at proper ripeness.

Whole-wheat bread should be served at every meal.

Strained honey should be used instead of sugar when practicable.

Milk and water may be served at all meals. Drinking, unless to satisfy thirst, should be avoided.

SUNDAY.

Dinner.

Chicken or Turkey Soup
Roast Beef
Mashed Potatoes
String or Butter Beans
Tomatoes (stewed)
Fruit
Graham Flour Cake

Supper.

Fruit
Eggs Fried in Butter
Beet Salad
Hot Corn-Bread
Honey
Nuts and Dates

CHICKEN OR TURKEY SOUP.—Cover the bones, skin, etc., left from roast chickens or turkey with cold water, add one onion, a little celery, one-quarter of a bay leaf, bit of red pepper, and cook three or four hours. Strain, skim off the fat, add salt to taste and one cup of cooked rice, heat well and serve in cups with toast.

GERMAN CHICKEN SOUP.—Cut up the entire chicken at the joints. Put on in cold water and boil on a slow fire three hours, then take the meat out of the vessel and remove all the meat from the bones, chop it very fine, or better still, put it through a meat cutter and cut as fine as possible; then put the meat in a saucepan and strain the soup on it. Cut three onions and a small bunch of parsley leaves and add to the soup five minutes before serving.

SUMMER SQUASH.—Pare, cut up and simmer until tender. Mash with butter and salt.

WINTER SQUASH will need longer cooking than summer squash, and the seeds must be removed.

BAKED SQUASH.—Add to squash cut into small cubes one tablespoonful melted butter, two raw eggs, and three tablespoonfuls milk. Pepper and salt to taste. Put in buttered bake dish, sift dry crumbs over the top, and bake in a quick oven.

ROAST BEEF.—The best pieces for roasting are the sirloin rib and fillet. Rub the meat with salt, then dredge with flour; put a rack in the basting pan, set the roast on the rack and put in a hot oven for fifteen minutes; then cover the bottom of the pan with water; allow fifteen minutes to the pound if the meat is to be rare, twenty minutes if moderately well done. Baste often.

WHOLE WHEAT.—Put a quantity of this wheat in a vessel and soak it over night in water. In the morning salt to taste, pour milk over it and simmer—not boil—for from three to five hours. The longer it simmers the softer it will become and the more delicious it will taste when first placed in the mouth, though it would be well to remember that thorough chewing will bring out slowly but surely the full delicacy of the flavor even if not cooked until soft. This wheat can be eaten with butter, honey, cream or cream and sugar, though if the taste is not accustomed to "palate ticklers" of this character it will be found appetizing without any addition whatever. If it is desired to make the dish especially rich, it can be soaked in milk instead of water over night. If milk cannot be had, water can be used instead, though, of course, it will not taste so palatable.

This process can be applied to almost any of the whole grains, such as corn, barley, rye, etc., and they will be found very palatable and nourishing.

WHOLE OR ENTIRE WHEAT BREAD.—Three quarts of whole wheat flour, one quart lukewarm water or milk, one teaspoon salt, one tablespoon honey, molasses or brown sugar, and one compressed yeast cake dissolved in half cup of lukewarm water. To the lukewarm mixture of water, salt, sweetening and yeast, first add only enough of the flour to make a thin batter, and beat thoroughly for ten minutes. Cover and stand in a warm place for two or three hours, or until it raises. Then add the rest of the flour to make a soft dough. It should be said that the amount of flour may vary, because different manufacturers produce different qualities of whole wheat flour, some heavier, some lighter. There is as yet no standard. It may take more or less, but add enough to make a soft dough. Knead this quickly until it loses its stickiness. Divide into three or four loaves, put in greased pans, cover and let stand for an hour in a warm place, about 75 degrees Fahr., until it raises again; butter the top and put in a hot oven. As soon as brown reduce the heat and let it bake three-quarters of an hour.

MONDAY.

Dinner.	*Supper.*
Split Pea Soup	Fruit
Lentil Cutlets / Creamed Potates	Scrambled Eggs
Beets / Baked Custard	Lettuce or Watercress Salad
Fruit	Corn Muffins, hot / Nuts / Figs

SPLIT PEA SOUP.—This soup may be made with or without meat, as desired. If meat is used, bones from lamb or veal will do. Or simply the bacon will suffice. Put the bones, etc., in a pot, with two slices of bacon, salt to taste, one onion, a little celery, two and a half quarts of water, and one pint split peas which have soaked in cold water over night. Cook slowly four or five hours, press through a colander, heat, and serve. A ham bone may be used instead of other meat.

LENTIL CUTLETS.—Soak over night one cupful of dried lentils and one-third cupful of dried lima beans. Drain, add two quarts of water, half an onion, a stalk of celery. Cook until soft, remove the seasonings and rub through a sieve. Add one cupful of stale bread crumbs, one beaten egg, seasoning to taste, and the juice of half a lemon. Melt one tablespoonful and a half of butter, add one tablespoonful and a half of flour, and pour on gradually one-third cupful of sweet milk. Let cook until smooth and thick, and add to the lentil mixture. Set aside to cool. Then form into small cutlets, dip in beaten egg, then in powdered cracker crumbs and fry to a golden brown. Drain, and serve with tomato sauce.

Peas may be used for this dish.

BEETS.—Do not break the skins in washing or they will lose their color in cooking. Boil one hour. Rub off the skins, split in halves, dish, and pour on them a boiling mixture of one tablespoonful of melted butter and salt. Serve very hot.

BEETS WITH OLIVE OIL.—Boil the beets, peel, slice and serve cold with lemon juice and olive oil.

CREAMED POTATOES.—Put one tablespoonful butter in a frying pan and when it bubbles add one tablespoonful flour. Add one cup hot milk, with salt to taste. Add one pint cold boiled potatoes cut into small dice. Cook until thoroughly hot.

MASHED TURNIPS.—Select the large yellow turnips, as they are sweetest. Wash, pare and cut them into pieces. Boil them in salted boiling water until tender, two hours, pouring off the first water if they are old and strong. Drain, mash, season with butter and salt, and heap lightly in a vegetable dish.

Creamed Turnips.—Cut peeled turnips into half-inch dice, boil in a very small quantity of water. When cooked, pour over a cream sauce made of one cup hot milk poured gradually over one tablespoonful each butter and flour rubbed together. Season and serve. All vegetables made in this style should never be allowed to get cold before cream or sauce is added. When allowed to become cold they are not as easily digested and do not absorb the cream or sauce.

Boiled Turnips.—Pare and cut into quarters. Place into boiling water; boil till tender. Add butter, and a pinch of sugar. Stir and mix. Serve hot.

Baked Custard.—Beat five eggs, five tablespoonfuls sugar, one quart milk, one-half teaspoonful vanilla, and bake in a moderate oven until firm. If desired, pour the custard into cups, set in a pan of water and bake twenty minutes.

Scrambled Eggs.—Beat six eggs slightly and salt. Put a piece of butter in the frying pan, and when hot pour in the eggs. Stir constantly until done. To make this dish light and juicy beat two tablespoonfuls of milk with each egg.

Lettuce or Watercress Salad.—Wash and wipe carefully and serve with French dressing.

Hominy.—Into three and a half cups of boiling salted water stir one cupful fine hominy; steam or cook slowly four hours; slow, long cooking improves it, though hominy may be cooked by boiling one hour.

Corn Muffins (No. 1).—Two cups Indian meal, one cup flour, two cups milk, one tablespoonful sugar, two tablespoonfuls melted butter, two teaspoonfuls baking powder, three eggs, a pinch salt, beaten separately. Mix meal, milk, yolks of the eggs, sugar, butter, add the flour mixed with the baking powder, lastly the whites of the eggs. Beat well and bake in hot-greased pans in a hot oven. This makes twelve muffins.

Corn Muffins (No. 2).—Two cups corn meal, one and one-half cups flour, two and one-half cups sour milk, two eggs beaten separately, one teaspoonful shortening, one teaspoonful salt, one-half cup molasses, one-half teaspoonful baking soda, one teaspoonful baking powder. Beat well and quickly, put in hot gem pans, and bake one-half to three-quarters of an hour. This quantity makes twelve muffins.

The soda must be put into the sour milk, of course. Some cooks leave out the baking powder and use more soda, but I like the other way better. These muffins will be found nicer than those made with sweet milk. Buttermilk also may be used.

TUESDAY.

Dinner.	*Supper.*
Asparagus	Fruit
Carrots	Cheese Omelet
Baked Beans	Whole-Wheat Muffins (hot)
Fruit	Watercress Salad
Baked Rolled Oats (with butter)	Honey

BAKED POTATOES.—Select even-sized potatoes, wash carefully and wipe dry and put in a moderately hot oven. Bake until soft. Break the skin of each a little. They should be done in about 45 minutes.

Sweet Potatoes can be baked as above.

STEWED CARROTS.—Scrape young carrots, and cut in strips and boil in salted water one-half hour. Serve with drawn butter sauce or melted butter.

CARROTS AND PEAS.—Scrape and cut up six small carrots and boil. Mix with one cup of cooked peas (canned peas will serve), and one cup drawn butter sauce.

MASHED CARROTS.—Scrape, boil and mash the carrots and beat in one ablespoonful butter, salt and two tablespoonfuls cream.

BAKED BEANS.—Soak one quart small white beans over night, drain and simmer; then add one cup milk or cream, two tablespoonfuls butter, two chopped onions, one teaspoonful salt. Turn into a bean-pot or baking dish, and bake in a slow oven six hours, adding water occasionally if necessary.

ASPARAGUS.—Wash, cut off the ends and tie in bundles; cook in enough boiling salted water to cover for twenty to thirty minutes. Serve on toast with drawn butter sauce, using the water in which the asparagus was boiled, instead of milk, in making the sauce.

BAKED ROLLED OATS.—Steep rolled oats in sufficient sweet milk to cover it; season with salt and nutmeg to taste; put the mixture in a cool place or in an ice chest for about one and a half hours, to prevent the milk from curdling and to allow the oats to absorb the milk.

Butter a bread pan, pour the mixture into it, put small lumps of butter over the top of it, and bake in an oven of medium temperature for from 40 to 50 minutes. Cut it in slices, and serve hot on warm plates.

OAT-MEAL BREAD.—One cup of rolled oats soaked in two cups of boiling water. One-half cup molasses, one teaspoon salt, one tablespoon butter. When blood-warm, add one-half yeast cake, dissolve in warm water, and then four and one-half cups whole wheat flour. Mix with knife, and allow to remain all night. In morning cut down with knife and allow to rise again before putting in buttered tins. Cut down and pour into pans, raising once more before baking. Bake forty-five minutes. This quantity makes two loaves. A pinch of baking soda often helps to insure a good sweet bread.

To make omelets light and delicious, strictly fresh eggs must be used, and the skillet in which they are made should be used exclusively for that purpose.

In making savory omelets, the savory ingredients should always be beaten in with the yolks.

The savory ingredient may be grated cheese or raw apples; or finely chopped onions, one heaping teaspoonful to each egg; or the amount may be varied to suit.

CHEESE OMELET.—Proceed as for plain omelet, only add one tablespoonful grated cheese.

WHOLE-WHEAT MUFFINS (No. 1).—Tablespoonful of pure olive oil; tablespoonful of honey or sugar; one egg beaten with a cup of milk; one and one-half cups of whole-wheat flour; one teaspoonful baking powder; saltspoonful of salt.

Beat the olive oil, sugar and egg together, then add the cup of milk. Mix the flour, baking powder and salt well; then mix all well together.

Bake in a hot oven for twenty minutes.

This portion will make twelve muffins.

WHOLE-WHEAT MUFFINS (No. 2).—Two cups entire-wheat flour, two cups milk, one egg well beaten, two teaspoonfuls baking powder. Mix powder and flour, stir in egg and milk thoroughly and pour into hot gem pans. Bake in hot oven one-half hour, or until done.

WHOLE GRAINS OF CEREALS.—The variety of dishes made from grains prepared in this way is almost unlimited. For instance, eggs can be poached or prepared in almost any way, and served on boiled wheat or other grains, and it will be found a very palatable and nourishing dish. Grains prepared in this way can be added to a salad and will greatly increase its nourishing and appetizing qualities. It can also be served with steak and other meats. In fact, a well informed housekeeper can originate an unlimited variety of dishes in which boiled whole grains can be used to great advantage.

In case you should be caught without flour at any time, bread can be made of any one of these whole grains by the following process:

Soak the grains over night in water. In the morning salt and simmer until soft. When possible put in enough water to cook the grain to a proper degree of softness without adding more. When the water has all evaporated and the grains have become soft, remove from the stove and place a small quantity at a time in a jar, and put through the same process required in mashing potatoes. This will reduce it to a pulpy mass. Now, using gem pans, place in a hot oven and allow it to remain until baked through to a proper hardness. Serve with butter or as ordinary bread. In preparing this be careful to see that the grain has been cooked to a proper degree of softness, as otherwise it will not macerate sufficiently.

WEDNESDAY.

Dinner.	*Supper.*
Roast Turkey or Chicken	Fruit
Peas, au Gratin	Tomato Salad
Baked Sweet Potatoes (same as Irish potatoes)	Whole Wheat
Scalloped Tomatoes	Macaroni with Cheese
Dessert (Floating Island)	Rice Muffins
Fruit	Honey

Roast Turkey.—Wash the turkey inside and out, wipe and singe the pin feathers. Make a stuffing as follows: Crumb up one loaf of stale bread and (put the crusts in a bowl of water and wring out dry) moisten one tablespoonful butter, season with salt and one-half teaspoonful thyme; stuff the turkey and sew up; salt the turkey and put in baking pan, preferably a double baking pan, with a cup of hot water; roast, if good sized, three or four hours. (The time also depends on the age of the fowl.) Baste frequently unless a double pan is used. Be careful not to let the pan get dry and so burn the turkey. When done, place on a hot platter and make a gravy by pouring one and a half cups hot water into the pan and thickening it with flour.

Roast Chicken.—Same as turkey.

Peas au Gratin.—Soak one pint dried peas or split peas in cold water over night. Simmer five hours with half an onion and a little celery. Drain, put through a colander and add one cup bread crumbs, one and one-half tablespoonfuls butter, salt to taste, one cup of milk, and put in a baking dish. Grate a little cheese on top, and bake one hour.

Egg Plant.—Slice the egg plant at least half an inch thick, pare each slice, and fry brown. Don't soak in salted water or lay it in salt, as is often done, since this spoils the flavor.

Scalloped Tomatoes.—Take six large ripe tomatoes, skin and cut into small pieces. Spread a layer in the bottom of bake dish, season well, put a layer of coarse bread crumbs over the tomatoes with bits of butter. Continue this until the dish is full, having bread crumbs on top. Bake one hour.

Floating Island.—One quart milk, five eggs, pinch of salt, four tablespoonfuls granulated sugar, one-half teaspoonful vanilla. Put the milk in a double boiler to heat. Beat the yolks of the eggs and add the sugar.

When the milk is scalding hot, stir it slowly into the eggs and sugar. (This prevents curdling, which is hard to avoid if the eggs are poured into the milk.) Pour back into the double boiler, and stir until it thickens. Then add vanilla and set aside to cool. Just before serving, beat the whites of the eggs to a stiff froth with two tablespoonfuls of powdered sugar, and drop on the custard in little "islands." The addition of a little ring of currant jelly to the top of each "island" is an improvement in both the appearance and taste of the pudding.

BOILED EGGS.—The proper way to cook eggs, especially for invalids or persons of weak digestion, is to keep them in water at 160 degrees to 170 degrees F., rather than at 212 degrees, or boiling, since the white, or albumen, of this egg is rendered much less soluble by this high temperature. A simple way of cooking them properly is to let the water boil, then set it back off the stove and drop in the eggs, leaving them for four to six minutes. Serve with fruit, toast and chocolate and you will have a perfect breakfast. One can also put the eggs in a vessel and pour the hot water on them. If left in long enough they will become hard-boiled, but tender.

TOMATO SALAD (1).—Peel and slice fully ripe tomatoes; let them stand for five minutes to drain off the juice; then set them away on ice. When served, cut up the slices, and to each pint of tomatoes allow four tablespoonfuls of lemon juice, the yolk of one egg, and enough salt, and mustard, to season highly. Stir the dressing lightly through the tomatoes, and serve very cold.

TOMATO SALAD (2).—Wash thoroughly and dry carefully a head of lettuce. Pour scalding water over tomatoes a moment, and skin them. Put a whole tomato on a leaf or two of lettuce and pour a little mayonnaise dressing on each.

MACARONI WITH CHEESE.—The genuine Italian macaroni is the best. Boil one-half pound (or half a package of the French macaroni) for from fifteen to twenty minutes. Drain, and put half of it in a buttered baking dish, season with salt, grate cheese over it, add the other half of the macaroni, then more cheese and some bits of butter on top. Pour over it enough drawn butter sauce to fill the dish—about one cup, and bake three-quarters of an hour, or until properly cooked.

RICE MUFFINS (No. 1).—Take one cup cold boiled rice, two cups flour, two eggs, two cups milk, one tablespoonful butter and one teaspoonful salt. Beat very hard and bake quickly.

RICE MUFFINS (No. 2).—One cup boiled rice, one cup sweet milk, two eggs, two tablespoonfuls melted butter, one teaspoonful sugar, two of baking powder, and enough flour to make a batter; beat hard and add the baking powder the last thing. Bake in muffin rings.

THURSDAY.

Dinner.	*Supper.*
Thick Tomato Soup	Fruit
Cream Cheese Lima Beans	Nuts
Green Sugar-Corn Cauliflower	Rice with Grated Cheese
Fruit	Honey
	Barley Muffins Lettuce Salad

Tomato Soup.—Cover the bones, rim, etc., from a roast of beef or veal with cold water; add one onion, one carrot, celery, one-quarter of a bay leaf, small piece red pepper, and set on the back of the stove to simmer slowly five hours. Then add one can of tomatoes (or one quart fresh ones, peeled and cut up) and cook one and a half hours longer. Strain, thicken with flour, and serve with croutons made by spreading bread, cutting it into neat squares and browning in the oven.

Boiled Corn.—Husk the corn, leaving the last shuck on. Put into cold water, bringing this to boil; serve as soon as the water begins to boil.

Baked Corn.—Cut the grains of one dozen ears of corn down the middle and scrape. Add one cup boiling milk, salt to taste. Put in buttered baking dish, dot over small bits of butter and bake in moderate oven.

Stewed Corn.—Cut the kernels through the center, and scrape contents from the ear. Put into cold milk, bringing this to a boil, when remove from range. Add butter and salt, and serve.

Roast Corn.—Turn back husks and pick off the silk. Re-cover with the husks and roast in the hot ashes of a wood fire.

Cauliflower.—Cauliflower should be placed head down in well salted water for a while to remove insects; trim off outside leaves and boil for thirty or forty minutes. Serve with butter or pour a drawn butter sauce over it.

Cauliflower au Gratin.—If there is any cauliflower left over, it is very nice baked. Put the cauliflower is a baking dish, season, put on the top bread crumbs and grated cheese dotted with bits of butter, pour over all one cup drawn butter sauce, and bake fifteen minutes. If fresh cauliflower is used it should be baked longer.

Barley Muffins.—One cup barley flour, two tablespoonfuls sugar, one tablespoonful melted butter, one egg, one cup milk, one teaspoonful baking powder, a little salt. Mix well, beat up and bake in greased muffin pans about twenty to thirty minutes.

Boiled Rice.—Put one cup rice into three cups boiling water, and boil 20 minutes; then set in a pot of boiling water, and keep the water boiling for four hours. Rice cooked in this way is especially easy of digestion. Serve with grated cheese.

FRIDAY.

Dinner.	*Supper.*
Baked Fish	Fruit
Boiled Potatoes	Poached Eggs
Creamed Cabbage	Creamed Potatoes
Baked Onions	Honey
Fruit	Hot Corn-Muffins
Chocolate Pudding	Apple Salad
	Nuts and Dates

Baked Bluefish, or Shad.—Cut gashes across the fish, in which put narrow strips of salt pork; dredge the fish with flour, season with salt and pepper; put in a baking pan, cover the bottom of the pan with hot water, and bake one hour; baste often and add a little water if the pan gets dry. Serve with Hollandaise sauce.

Baked Onions.—Peel the onions and boil twenty minutes; drain, put in baking dish, cover with fresh boiling water and bake from one half to one hour. Take up and pour over them a sauce made of the water they were baked in, which should be about one cup; if there is not enough to fill a cup, add milk, let boil and add the yolk of one egg beaten and the hot milk poured on it, then return to the fire until it thickens.

Creamed Cabbage.—Slice half a good-sized cabbage and put in cold water; as soon as it comes to a boil put back on the stove to simmer for thirty minutes, when it will be tender; drain and cover with a sauce made of one cup of milk, one tablespoonful of flour and one tablespoonful of butter and a little salt; let it get hot in this and serve.

Chocolate Pudding.—One pint milk, one pint bread crumbs, yolks of three eggs, five tablespoonfuls grated chocolate. Scald the milk, add bread crumbs and chocolate. Take from fire and add one-half cup sugar, and the beaten yolks. Bake in pudding dish fifteen minutes.

Poached Eggs.—Have a pan of salted water boiling. Drop in the eggs carefully and set where they will keep hot but not boil, until the white sets. Serve on toast. It is a good plan to set muffin rings in this pan and drop an egg in each.

Apple Salad.—Chop one cup each tart apples (peeled and cored), and English walnuts or other nuts, one cup celery. Serve with dressing made as follows: Rub two slightly rounded tablespoonfuls of nut-butter smooth with two-thirds of a cupful of cold water and add half a teaspoonful of salt. Let all boil together for a moment, then remove from the fire, and add two tablespoonfuls of lemon juice. Set on ice to get very cold, then pour over the salad. Garnish with celery.

SATURDAY.

Dinner.	*Supper.*
Cauliflower Soup	Fruit
Parsnips Green Peas	Hot Graham Muffins
Baked Sweet Potatoes (same as Irish Potatoes)	Apple Omelet
Fruit	Macaroni à la Crême
Pumpkin Pie with Cream Crust	Honey Nuts and Dates

CAULIFLOWER SOUP.—Melt in a saucepan a tablespoonful of butter with three tablespoonfuls of flour. When these are thoroughly cooked but not browned—three minutes' stirring over the fire will suffice—add three pints of vegetable stock, and finally half a good-sized cauliflower which has been previously boiled. When the soup has cooked ten minutes strain it through a purée sieve, pressing through all the cauliflower. Return soup to fire and let simmer slowly for twenty minutes longer. Serve with bread croutons.

BOILED PARSNIPS.—If parsnips are young they require only to be scraped before boiling; old ones must be pared thin and cut into quarters. Put them into a stewpan of boiling water. Boil until tender. Serve with melted butter sauce.

BUTTERED PARSNIPS.—Boil tender and scrape; slice lengthwise. Put three tablespoonfuls butter in a saucepan, salt and a little chopped parsley. When heated put in the parsnips. Shake and turn until mixture boils, then lay the parsnips in order upon a dish, and pour the butter over them and serve.

CREAM CRUST.—Mix and sift one and a half teacupfuls of white flour with one and a half teacupfuls of Graham or whole-wheat flour. Moisten with one scant teacupful sweet cream, making a stiff dough. Roll not quite so thin as for white crust. For a fruit pie, brush over the bottom crust with white of egg to keep the juice from soaking in.

APPLE OMELET.—Stew apples as for apple sauce. Beat well with one tablespoonful butter, sugar to sweeten and a little cinnamon. When perfectly cold add five eggs, beaten well. Bake until brown. Eat warm, for tea, with whole-wheat bread. Grated raw apples are preferable to stewed.

GRAHAM MUFFINS.—One quart Graham flour, two teaspoonfuls baking powder, two tablespoonfuls sugar, a little salt, one tablespoonful butter, egg and two cups milk. Bake in small pans at once in a good oven, fifteen minutes.

MACARONI A LA CREME.—Boil the macaroni twenty minutes in milk; add a little salt. Pour on it drawn butter sauce, and serve with grated cheese.

CHAPTER XXV.

HOME METHODS OF FOOD PRESERVATION.

CANNING is more generally used in this country for preserving fruit and vegetables than drying. While one may purchase a large variety of canned foods, it is always well to be a little suspicious of those put up in tin or those in which pleasing coloring matters have been used to add attractiveness to the food in question.

While undoubtedly the pure food law has done much towards breaking up the practice of some dealers in adulterating canned goods and using harmful preservatives in them, it must not be forgotten that this law applies only to food shipped from one state to another and not in any way to foods made for sale in the state in which they are prepared. Hence, unless you are protected by a rigorous pure food law in your own state, you are as much as ever at the mercy of the wretches who adulterate and poison food under the false pretense of preserving it. Therefore it is just as well to avoid canned foods of unknown origin.

Dried foods, such as peas, beans and evaporated fruits, as a rule are better than similar foods preserved by canning, unless you are satisfied that these have been kept pure and clean during the canning process. At the same time there can be no question but that canned fruits and vegetables, if properly prepared, are a most useful addition to the everyday dietary. Those that are put up in glass are generally preferable to those put up in tin, though if, when the tin can is emptied its surface is smooth and bright, showing that no chemical nor acid has been eating away its substance, it is safe to assume that the contents are unharmed and harmless.

ADVICE TO CANNERS.—But by far the better plan, however is for the provident housewife to do the canning of the fruits and vegetables needed for her own household herself.

The process of canning is generally understood, but the government bulletins written by experts tell of improved methods and gives some excellent hints from which I extract the following:—

"In canning fruits it is well to remember that the product is more satisfactory if heated gradually to the boiling point and then cooked the given time.

"The selection of fruit is one of the first steps in obtaining successful results. The flavor of fruit is not developed until it is fully ripe, but the time at which the fruit is at its best for canning, jelly-making, etc., is just before it is perfectly ripe. In all soft fruits the fermentative stage follows closely upon the perfectly ripe stage; therefore it is better to use under-ripe rather than over-ripe fruit. This is especially important in jelly-making for another reason also: In over-ripe fruit the pectin begins to lose its jelly-making quality.

"All fruit should, if possible, be freshly picked for preserving, canning and jelly-making. No imperfect fruit should be canned or preserved. Gnarly fruit may be used for jellies and marmalades by cutting out defective portions. Bruised spots should be cut out of peaches and pears, etc.

"When fruit is brought into the house put it where it will keep cool and crisp until you are ready to use it.

"The preparation of fruit for the various processes of preserving is the second important step. Begin by having the kitchen swept and dusted thoroughly, so that there will not be a large number of mold spores floating about. Dust with a damp cloth. Have plenty of hot water and pans in which jars and utensils may be sterilized. Have at hand all necessary utensils, towels, sugar, etc.

"If practicable, pare fruit with a silver knife, so as not to stain or darken the product. The quickest and easiest way to peel peaches is to drop them into boiling water for a few minutes. Have a deep kettle a little more than half full of boiling water; fill a wire basket with peaches; put a long handled spoon under the handle of the basket and lower into the boiling water. At the end of three minutes lift the basket out by slipping the spoon under the handle. Plunge the basket for a moment into a pan of cold water.

Let the peaches drain a minute and then peel. Plums and tomatoes may be peeled in the same manner.

"If peaches are to be canned in sirup, put them at once into the sterilized jars. They may be canned whole or in halves. If in halves, remove nearly all the stones or pits. For the sake of flavor, a few stones should be put in each jar.

"When jelly is to be made from any of the large fruits, wash clean and remove stem and blossom end. Nearly all of the large fruits are better for having the skins left on. Apples and pears need not be cored, but there is so much gummy substance in the core of quinces that it is best not to use this portion in making fine jelly.

"Canning fruits is from all points the most desirable method of preserving them for home use. It is the easiest and commonly considered the most economical and the best, because the fruit is kept in a soft and juicy condition in which it is believed to be easily digested. The wise housekeeper will can her principal fruit supply, making only enough rich preserves to serve for variety and for special occasions.

"In canning, any proportion of sugar may be used, or fruit may be canned without the addition of any sugar. However, that which is designed to be served as a sauce should have the sugar cooked with it. Fruit intended for cooking purposes need not have the sugar added to it.

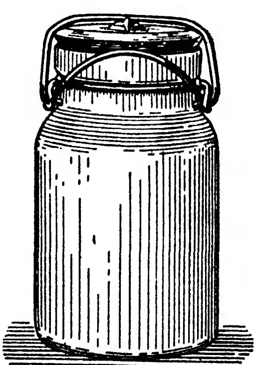
"Juicy fruits, such as berries and cherries, require little or no water. Strawberries are better not to have water added to them. The only exception to this is when they are cooked in heavy sirup."

Canning Vegetables.—In the canning of vegetables also Mr. J. F. Breazeale, an expert of the Department of Agriculture, makes some important suggestions and shows, what many housewives have not learned, that, when one knows how to go to work properly, it is just as easy to can vegetables as fruit. He says:

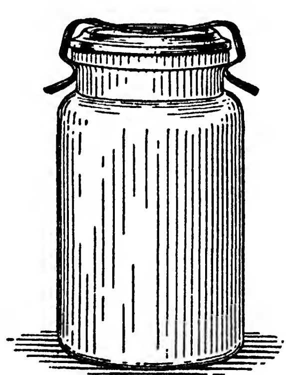
"Bacteria thrive in products like milk and in meats and vegetables rich in protein, such as peas, beans, etc. They are so small that they can only be seen with a microscope, and they reproduce themselves with amazing rapidity. One bacterium under favorable conditions will produce about twenty million in the course of twenty-four hours. Accordingly certain vegetables spoil more rapidly than others, because they furnish a better medium for bacterial growth.

"Certain species of bacteria will live and cause vegetables to decompose even when no air is present. Hence to guard against decay, the vegetable must first be thoroughly sterilized.

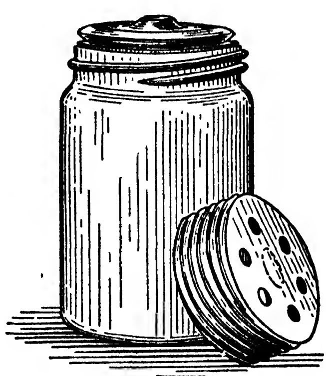
"Now the reproduction of bacteria is brought about by one of two processes. The germ either divides itself into two parts, making two bacteria where one existed before, or else reproduces itself by means of spores. These present the chief difficulty in canning vegetables. While the parent bacteria may be readily killed at the temperature of boiling water, the spores retain their vitality for a long time even at that temperature, and upon cooling will germinate, and the newly formed bacteria will begin their destructive work. Therefore it is necessary, in order completely to sterilize a vegetable, to heat it to the boiling point of water and keep it at that temperature for about one hour, upon two or three successive days, or else keep it at the temperature of boiling water for a long period of time—about five hours. The process of boiling upon successive days is the one that is always employed in scientific work and is much to be preferred. The boiling on the first



Type of jar used in canning. To open jar spring at side is first raised as shown.



Another type of jar with metal top and fastener.



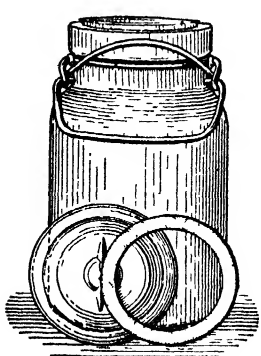
Type of improved screw-top jar, with glass top and metal screw cover.

day kills all the molds and practically all the bacteria, but does not kill the spores or seeds.

"As soon as the jar cools, these seeds germinate and a fresh crop of bacteria begin work upon the vegetables. The boiling point upon this second day kills this crop of bacteria before they have had time to develop spores. The boiling upon the third day is not always necessary, but is advisable in order to be sure that the sterilization is complete. Among scientists this is called fractional sterilization, and this principle constitutes the whole secret of canning. If the housewife will only bear this in mind she will be able with a little ingenuity to can any meat, fruit or vegetable.

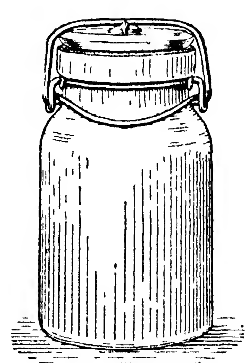
"Never attempt to can any vegetable that has matured and commenced to harden or one that has begun to decay. As a rule, young vegetables are superior in flavor and texture to the more mature ones. This is especially true of string beans, okra and asparagus. Vegetables are better if gathered in the morning while the dew is still on them."

DANGERS OF PRESERVING POWDERS.—For purposes of sterilization some people use "preserving powders." These powders should never be used. It may be true that some of them are not particularly harmful, but their use may be dangerous and had far better be avoided. The sure, safe and



Spring-top canning jar showing rubber ring and glass cover.

Jar with springs released ready for removing cover.

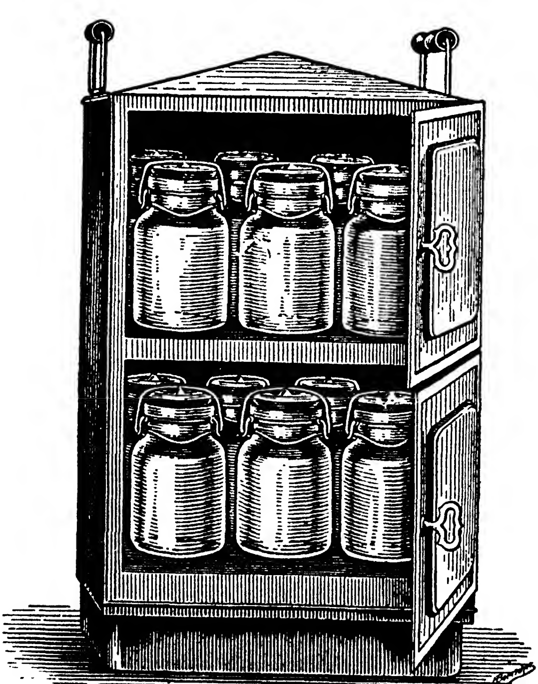


Jar at the conclusion of the canning, tightly sealed and ready for storing.

proper way to sterilize is by means of heat, and as this can be done very easily and cheaply, the use of all preservatives in canning should be rigorously excluded. In vegetables, as in fruits, glass jars should always be used, if possible, and the wider the top the better.

The best utensil for canning is the steam-cooker, as herewith pictured. It is ideal for canning, holding a dozen or more quart jars. At the same time it is somewhat expensive and can be dispensed with. If one has a common ham- or clothes-boiler with a tight-fitting cover, it will answer every purpose if it is fitted with a false bottom made of wire netting. This netting is made of medium sized No. 16 galvanized wire, with one-half inch mesh. Narrow strips of wood can be put across the bottom of the boiler and the wire-netting false bottom allowed to rest upon these.

As soon as the vegetables are prepared pack each jar full, add salt to taste, and then fill up the jar to the top with cold water. The rubber rings should always be placed on the top before the jars are filled. Then place the cover on top loosely so that the steam may have perfect opportunity of egress during the process of cooking.



Steam cooker with jars—a splendid device used in canning.

Now place the false bottom in the boiler and put in as many jars as the boiler will conveniently hold. Do not try to crowd them in. Leave space between them. Pour in about three inches of cold water or just enough to form steam and prevent the boiler from going dry during the cooking. It is not necessary to have the water up to the neck of the jars, as the steam will do the cooking. Put the cover on the boiler and set it on the stove. Bring the water to a boil and keep it boiling for one hour. At the end of that time remove the cover of the boiler and allow the steam to escape. Press down the spring at the side of the jar as shown in figure, or if screw-top jars are used, screw the top on. This will prevent any outside air from entering. The jars can now be removed and cooled or allowed to stand in the boiler till the next day.

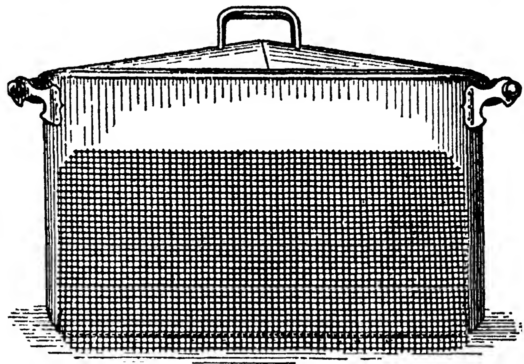


FIG. 5.—Sterilizer, showing false bottom.

Sterilizer consisting of ordinary wash boiler. In front is shown a false bottom made of wire netting.

On the second day raise the spring at the side of the jar as shown in figure, or unscrew the top, if screw-top jars are used. This will relieve any pressure from steam that might accumulate inside the jar during the second cooking. Place the jars again in the boiler and boil for one hour. Clamp or screw on the top as on the preceding day and allow them to cool. Repeat this operation on the third day. In removing the jars from the boiler be careful not to expose them to a draft of cold air while they are hot, as a sudden change in temperature is likely to crack them.

After the sterilization is complete the jars may be set aside for a day or two and then tested. This is done by releasing the spring at the side and picking up the jar by the top as shown in figure. (With screw top jars, no testing is possible.) If there has been the least bit of decomposition, or if sterilization has not been complete, the top will come off. This is because the pressure on the top has been relieved by the gas formed by the bacteria. In this case, it is always best to empty the jar and fill with fresh vegetables. If canning fruits or expensive vegetables, however, examine the contents of the jar and, if the decomposition has not gone far enough to injure the flavor, place it once more in the boiler and sterilize over again. If the top does not come off, you may feel sure that the vegetable is keeping.

DEHYDRATION OF FRUITS AND VEGETABLES.—Dehydration, or, in simpler language, drying, is an older method of preserving perishable foods than canning. That this custom, well known to our grandparents, was allowed to go out of use, is to be explained by the comparative cheapness of canning both at home and in commercial canneries. The war made canning more expensive and also made it imperative to save all food, which brought about a revival of the older method of preservation. Meanwhile the art of dehydration had been improved and the use of the method extended to a larger variety of foods, many of which are difficult to preserve by canning.

The chief practical advantage of dehydration is that it is applicable to vegetables, the lack of which in the early winter and spring diet is a serious fault from the viewpoint of either nutrition or economy. Certain fruits, notably apples, peaches, apricots, prunes, raisins, figs and dates have always been staples in the dried or dehydrated form. But until recently dried vegetables were a curiosity in the market. With the stimulation of interest in this important subject, we may now hope to see dried fruits and vegetables of all kinds in the general markets of our cities. The rural communities could preserve an ample stock of fruits and vegetables for the season of scarcity. With the general adoption of this efficient system there should be no excuse for the diet of even the poorer people being deficient in these important food groups at any season of the year.

With the first introduction of dehydrated vegetables it was natural that those firms which had developed expensive plants and equipments should represent the art of dehydration

A vine laden with luscious fruit.

to be expensive and difficult. While it is true that certain effects in color and flavor retention can be better secured with expensive equipment, there is no reason why practically all fresh fruits and vegetables cannot be dehydrated with simple apparatus available to every farmer and gardener. All that is necessary is to understand the general principles and to know the correct drying temperatures for the various foods.

In order to remove the water from fresh fruits or vegetables with the least possible change in the quality of the food, it is necessary that the drying be conducted speedily. This may be done by a suitable arrangement of the drying trays and by proper slicing and spreading of the material so that the air, which must be at a proper temperature, can circulate rapidly.

This combination of conditions may be achieved in several different fashions, and the one to be chosen will depend upon the local conditions and the amount of material to be dried. In the southern and western parts of the United States it is feasible to dry most fruits and some vegetables in the open by the heat of the sun. In cooler and damper regions, or in the later part of the season artificial heat is required or one may experience considerable losses from spoilage due to rainy weather.

Drying—Outdoors and Indoors.—For outdoor drying no special equipment is necessary, although there is more danger of spoilage by sudden showers. Greater cleanliness from dust and insects may be secured by drying under glass. Hot-bed sash may be advantageously used for this purpose. The sash need only to be set in frames that are provided at top and bottom with openings for air circulation. These may be screened to prevent the access of insects.

Where but a small quantity of material is to be dehydrated the drying may be done indoors by the heat of the stove. Open baking pans may be used, but a better plan is to make simple trays of heavy galvanized screen so that the air can pass through a number of them placed one above the other. Such a series of trays may be hung in the open above the stove. If a more convenient dryer is required, similar trays may be fitted into a sheet metal cabinet to be placed on top of the stove. The natural rising of the heated air will cause ample circulation through the cabinet if it has openings at top and bottom.

Home dryers of this description are in the market, but they can easily be made by any man or boy handy with tools. The entire cabinet need not be made of metal, but only the bottom parts that come near the stove. The tray frames and tray slides may be safely made of wood as the material in drying is to be kept at temperature considerably below the boiling point of water.

Where electric current and an electric fan are available dehydration may be conducted at room temperatures by means of the more rapid circulation of air. For work on a small scale one needs only to make a series of trays with closed sides and open ends and set them one on top of the other and blow the air through them with a fan. The most economical results are to be achieved by the combination of the fan and the artificial heat. Where the work warrants it a larger cabinet may be made with a fan in it so located as to circulate the air rapidly through the trays. In this case the cabinet may be so constructed that the same current of air returns to the fan. If comparatively small openings are allowed for the gradual exchange of air, fan drying is very rapid and results may be achieved with such a home-made apparatus that will quite equal the best product of the large plant.

Food material to be dehydrated should be selected, washed, inferior specimens discarded, and decayed portions removed, all with the same care that would be used if the food was being prepared immediately for the table. Many farm raised people who have relished home dried apples find it impossible to eat the commercial product because of the unpleasant evidence that wormy or rotton fruit was used. The dried food should in every case be so prepared that it will be ready for cooking without further examination.

The material to be dried must be cut into thin strips or slices. There is no advantage in making the slices too thin as they will mat together in the trays and dry unevenly. It is important that the slices be of uniform thickness, otherwise the drying will be uneven and the thin slices will be overdried before the thick ones are dry enough. As a general rule slices about one-quarter of an inch thick will give good results.

Fruits and vegetables to be dehydrated should be peeled only when those for whom they are intended insist on having the product without the peeling. Eating or refusing to eat the skins of most fruit and vegetables is a matter of habit. Many people who have been trained to eat all fruits and vegetables only after the peel has been removed object strenuously to the thought of eating fruit and vegetable skins, but if once induced to change their habit they wonder why they ever went to the trouble and waste of paring away what is often the best part of the food. If paring is insisted upon a method should be used, wherever possible, that will remove the thin outside peel only. In case of potatoes, tomatoes and beets this may be accomplished by dipping them in boiling water, the time depending on the particular product. Apples and peaches must be pared if one objects to the peel in the product. Mechanical apple parers are an improvement over the hand method, but there is no machine that will pare peaches and in commercial drying the skins are sometimes removed by a hot lye bath, which I certainly do not recommend. Potatoes if not pared should be scrubbed with a stiff brush which removes both the dirt and some of the outer layers of the skins.

As soon as fruit or vegetables are pared or sliced deteriorization begins, due to contact with the air and exposure to the attack of germs of decay. The chemical changes so caused will injure both the appearance and the flavor of the fruit. It is therefore essential that drying be begun as quickly as possible and completed at a rapid rate. There are certain methods in use to check this deterioration while the drying is in progress. One such method used commercially is to expose the freshly cut product to sulphur fumes which condense in the moisture as sulphurous acid and act as a poisonous sterilizing agent. A finer looking product can be secured in this manner, but only at the expense of wholesomeness. A more defensible plan of sterilizing the fruit or vegetables is to dip them for a few minutes into boiling water. This is not so objectionable as the sulphuring, but it results in the loss of valuable mineral salts by solution in the water. It also makes drying more difficult because of the added water that must then be evaporated.

STERILIZING WITH LIVE STEAM.—The best plan yet discovered for such sterilizing or blanching of material to be dehydrated is treatment with live steam. Where the quantity of food to be prepared is sufficient to warrant it a steaming cabinet may be constructed for the purpose. For smaller scale use a wire basket may be made to fit into a wash boiler. A little water in the bottom of the boiler will furnish the steam and strips may be placed to keep the basket out of the water. Have the material arranged loosely in the basket and expose to the steam for two or three minutes only. The steaming should be done as quickly as practical after slicing and the material should then be immediately placed in the dryer. Such treatment will check the changes that cause the darkening of the product in drying and may be used for whatever material is found to require it to prevent an inferior appearing product.

Drying must not be at too high a temperature because not only will the material be cooked, which is undesirable, but the outside will dry too quickly and the hard crust so formed will check the drying of the inner portion. Also in some cases too great heat will cause the juices to run out and be lost. The following table gives the correct temperatures for dehydrating various products, and also the yield of dried product per hundred pounds of fresh material.

	Initial temperature. Degrees Fahrenheit.	Finishing temperature. Degrees Fahrenheit.	Yield.
Apples	130	175	13
Apricots	130	160	17
Blackberries	130	145	18
Beans (string)	130	145	12
Beets	120	145	16
Cabbage	120	130	9
Carrots	120	145	11
Cauliflower	120	130	13
Celery	135	145	8
Cherries	120	150	20

	Initial temperature. Degrees Fahrenheit.	Finishing temperature. Degrees Fahrenheit.	Yield.
Corn (sweet)	130	140	28
Figs	120	140	22
Okra	120	135	10
Onions	140	140	10
Parsnips	120	145	20
Peaches	130	160	15
Pears	130	175	20
Peas	130	145	24
Potatoes (white)	125	150	24
Potatoes (sweet)	150	160	32
Prunes	130	175	30
Pumpkin	135	160	7
Raspberries	130	145	20
Spinach	130	130	9
Squash	135	160	8
Tomatoes	120	140	8
Turnips	140	165	9

None of these foods should be completely dried. The purpose is to reduce to about the state of dryness of cereals, that is, to about ten per cent of water. Sweet fruits do not need to be as dry as that, as the sugar acts as a preservative. In drying vegetables the process should be continued until no moisture can be squeezed from the dampest pieces with the fingers.

After the material is removed from the dryer it should be conditioned by being placed in an open bin and stirred occasionally. This will cause the moisture in the various portions to be evened up. The product should then be stored in paper or muslin bags or in paper or wooden boxes and should not be sealed in air-tight containers, which would cause it to "sweat" and spoil. The object in storing it is simply to keep out insects and dust. Material that has been dried in the open may be infected with insect eggs and therefore should be heated in the oven to a temperature of 180 degrees to kill all insect life before storing.

In preparing dehydrated foods for the table they may be either soaked in cold water in the case of foods that would be eaten raw in the fresh state, or they may be steamed, stewed or boiled. Proper methods of dehydrating cause little change in food value, and is on the whole less destructive to the nutritive properties than canning or other methods of preservation. Almost all dehydrated products undergo some alteration in flavor, and may not at first appeal to the taste, but this slight distinction in taste is not a sign of inferiority and many people, after getting accustomed to the dehydrated product, like it as well, at least by way of variety, as they do the fresh article.