CHAPTER V

THE PHYSIOLOGY OF NUTRITION

In the contemplation of a diet four factors must be taken into consideration, two intrinsic and two extrinsic. The two intrinsic factors are determined by the physiology of nutrition and the psychology of alimentation. The external factors are the supply of foodstuffs and the influence of trade. Under ordinary conditions in the life of a nation, with certain commodities the factors of supply and trade have as much influence on the selection of a diet as the factors of nutrition and psychology. At first sight it might appear that the factor of supply must necessarily predominate over the influence of trade, and this is of course true in the final analysis; but with a supply that is to be regarded as normal and sufficient, influence of trade operates so as to place certain foods in positions of predominance and others in positions of subordination that do not at all correspond to the essential values.

The influence of trade is a composite. It includes elements of production (including fertilizer, cost of labour, price of machinery, transportation and
climatic conditions); nationalities of consumers in different zones; trade policies; the influence of advertising and publicity; artificial manipulation of markets, beginning with the primary market and extending through the entire chain of distribution to the consumer; and includes finally a factor that may be termed "the psychology of trade," a definite tendency of commodities to move in certain directions that is not fully capable of analysis on the basis of known economic and commercial relations, but which is, in the final estimation, probably an expression of the efficiency of particular individuals.

In the diet of a people, all of these factors play a rôle in times of peace and prosperity. The greater the prosperity and the freer the choice of individual action, the less influential is the factor of the physiological nutrition of the body. With complete freedom of choice, divested of the influence of the four factors described, wide scope is afforded for the personal variable that extends from individualism to idiosyncrasy, an expression of the democratic viewpoint in relation to the personal habits of the individual.

Under conditions of stress the factors of physiology of nutrition and supply of foodstuffs assume more and more predominance over the factors of influence of trade and psychology of the diet. Efforts to influence the consumption of foodstuffs by
a people lie in the direction of giving greater predominance to the facts of nutrition from the purely physiological standpoint, under the existing conditions of supply. Uncontrolled, this is liable to result in harsh repression of the psychology of the diet on the one hand and in reckless elimination of the influence of trade on the other. Particularly the exclusion of the psychological relations of the diet is a mistake easily accomplished but difficult of repairment. The ideal adjustment is a composite of all factors; for a people as a whole it is better to secure a moderate degree of efficiency in the balancing of all factors than to secure a high degree of efficiency in one group, as that of physiological alimentation, viewed as animal nutrition.

In order that the average individual possessed of a general education and the cultured viewpoint of American citizenship, but devoid of technical training, may be able to understand the subject of nutrition from the standpoint of the four named factors, it is necessary that the principal facts known to hold in the nutrition of the animal body be understood.

From the standpoint of nutrition the body is a machine — a complicated machine — and, of course, something more than a machine. Viewed from the standpoint of energy relations (that is, the production of heat and the conversion of energy into work) the animal body presents a strict analogy to a ma-
machine. With a well-designed motor, one may perform work involving the use of gasoline possessing one hundred units of heat, as determined by analysis and measurement of the heat. In the working of this motor, it will be found on measurement that from 25 to 30 per cent of the energy of the fuel, according to circumstances in the design of the motor, will be converted into work; the remainder will be converted into heat and dissipated as such. When a labourer performs a similar act of work, it will be found that fuel has been burned in an entirely analogous manner, and that of the energy contained in the fuel consumed, between 25 and 30 per cent will be converted into work and the balance converted into heat and dissipated. The percentage of fuel converted as work is termed the mechanical efficiency of the machine, and the efficiency of a soldier on the march is about the same as that of the engine of the truck that is hauling the ammunition. When the man becomes tired his efficiency falls; when the engine departs from accurate adjustment, its efficiency falls. If for any reason in internal economy the burning of food-stuffs in the body is imperfect, as is the case in certain diseases, then the efficiency falls; if in the adjustment of the carburetor the burning of the gasoline is imperfect, the efficiency of the motor falls.

Viewed more closely, the animal body presents
striking differences from even the perfect machine. The machine must be repaired; the animal body is self-repairing. The machine must be lubricated in addition to having fuel supply; the animal body is self-lubricating in the sense that what might be compared to the lubricants of the machine are produced within the body. Lubrication, upkeep and replacement are all external in the motor, internal in the body. A machine must be built by external hands; the animal body possesses the power of multiplication of the species. The human body possesses finally the power of self-direction of its operations; the machine lacks entirely the power of self-direction except such as may be mechanically introduced and maintained.

A clear distinction must be made between the energy equivalents of heat and muscular work on the one hand and of other physiological functions and mental operations on the other hand. A man lying in perfect quiet, performing mental operations of prodigious intensity, will produce no more body heat, according to our present methods of measurement, than if his mind were not engaged. The movement of a nerve impulse down a nerve can be shown by extremely minute methods of measurement to be accompanied by evolution of heat; but applied to an entire body the amount of heat that must accompany mental operations is so small as to
fall within the range of error of measurement of heat involved in the maintenance of the body temperature. Practically, therefore, fuel is not required for mental work; and no more foodstuffs are required for a sedentary man engaged in mental operations than in idleness.

A number of other physiological functions, such as the influence of the ductless glands and the operation of the special senses, possess heat relations so minimal as to be of no importance when considered from the standpoint of the food requirements of the body. Therefore, for practical purposes we may say that the fuel needs of the body are represented solely by two requirements: requirement for heat to maintain the body temperature of the resting body and the requirement of energy for the maintenance of the muscular work of respiration, circulation, alimentation, and physical exertion. It is convenient to separate rather arbitrarily the factors of heat production and muscular work from those of repair and upkeep of the adult body and growth of the young body, both in the qualitative and quantitative sense.

The factors involved in these various relations of nutrition may be classified under six headings to which must be added two that are of importance in the act of digestion and therefore secondarily of importance to the state of nutrition. The first six
are protein, fat, carbohydrate, mineral salts, vitamins, and water; the two alimentary factors are bacteria and indigestible residue of the diet.

PROTEIN

Under the term protein we understand all substances allied to what is commonly termed albumin, — as the casein of milk, the white of egg, the plasma of muscles, gelatine, and the serum of blood. Protein is the substance of which flesh is primarily composed. Blood contains about 8 per cent of protein; the white of egg about 12 per cent; lean meat about 20 per cent; the common grains about 10 per cent; milk a little over 3 per cent; some of the beans as high as 30 per cent; potatoes a little over 1 per cent, etc. All living organisms, plant or animal, are, in the final analysis, composed of cells and structures derived from cells. The essential component of the cell is termed protoplasm and the chief constituent of protoplasm is protein.

Protein is not a unit substance. There are many kinds of protein and the variations are due to differences in composition. Proteins are organic substances of so large a molecular size that the individual molecules can be seen under a microscope when viewed with oblique illumination. Proteins are composed of aggregations of simpler substances known as amino-acids. About 20 amino-acids are
known and the different proteins contain variable numbers of these. It is the variation in components and in the amount of the several components that causes the physical and chemical differences in proteins. All proteins are, in their final analysis, of vegetable derivation; and animal proteins represent transfers to the animal body of amino-acids created in plant life. One gram of protein yields to the body 4.2 calories of heat.

The structure of proteins may be compared to the architecture of a house. A house contains brick, stone, concrete, plaster, glass, floors, roofing, doors, windows, iron pipes, etc. An architect could construct out of the same materials in the same amounts houses that would present entirely different external and internal appearances; and in a similar way proteins exist, consisting of the identical amino-acids in practically identical proportions, that have different chemical and physical properties depending upon the architecture, that is, the manner in which the different amino-acids are built together. It has thus become a common expression to term the amino-acids the “building stones of protein.”

Now the animal body must receive in the diet the amino-acids from which it builds its own proteins. Certain amino-acids can be formed in the body, but other amino-acids cannot be formed in the body and the diet must contain them. These amino-acids
we speak of as the indispensable amino-acids. When a protein contains all of the amino-acids or contains the indispensable ones and the others in such amounts as to enable the body to fill its requirements, we speak of this as a complete or balanced protein. If, however, the protein is deficient in certain of the essential amino-acids or contains a large preponderance of some one of the other amino-acids, we speak of the protein as incomplete or unbalanced. The balanced protein is able to fulfil all of the protein requirements of an animal body; the unbalanced protein is not. When an animal is fed a diet of unbalanced protein, growth cannot be maintained and if the defect be serious enough, the animal will waste.

The amount of protein required in the diet depends upon two variables: (1) Upon the intensity of wear and tear and upkeep in the particular animal concerned; and (2) upon the nature of the proteins of the diet, whether balanced or unbalanced. With a particular animal, if the diet contains balanced proteins a much smaller amount will be required than if the diet contained only unbalanced proteins. In general, less protein of animal origin is required to maintain equilibrium than with the use of plant protein.

Assuming that the proteins in the diet are balanced or within the range of adaptation, the amount
of protein required in the animal body is surprisingly small. Growth consists of dimensional and numerical increase. Certain cells, like the cells in the blood and the lining cells of the skin and mucous membranes, have a limited span of life; they die and must be replaced. Other cells, however, endure for the entire life of the individual. The number of cells in the biceps muscle of the newborn child is the same as will be present when that child has developed to maturity; the growth consists entirely in increase in the dimensions of the cells. Now the requirements of growth for a day are so small that they scarcely appear in comparison to the wear and tear needs of the day. In practical dietetics, a growing child of a certain weight requires very little more protein than an adult of that same weight. The chief concern in the diet of a growing child is not the amount of protein, but the presence of balanced protein. While the total amount of protein per unit of weight is very little less in the growing child than in the adult, the amount of essential amino-acids is distinctly larger. For this reason it is particularly important in the diet of the child to secure a large percentage of the intake of protein in the form of balanced protein, namely, that of milk. It is a safe rule that 40 per cent of the protein of the diet of growing children should be balanced protein obtained from animal
products. In the case of the adult, this may safely fall to less than 20 per cent.

This does not mean that vegetarianism in the strict sense is impossible. It is possible, but it is difficult. A person having at his disposal a wide variety of cereals and plants for selection could obtain a diet balanced in protein, although the amount of protein eaten to insure this would have to be larger than when animal products are used. Vegetarianism is much more difficult with the child than with the adult. It is difficult, although possible, to raise a child without milk, eggs, or meat; it is not in the least difficult, under conditions of modern markets, for an adult to practise strict vegetarianism with success. It will mean a large and bulky diet, and probably an expensive diet; but the balanced protein can be secured for the adult without much difficulty.

If the proteins be balanced a gram of protein a day per kilo weight is more than sufficient to cover all of the needs of the body, the wear and tear and upkeep. It is also sufficient to cover the needs of growth in the young. The mother's milk contains less than 10 per cent of its energy in the form of protein, but it maintains the highest intensity of growth in the life of the individual. Obviously, the amount of protein, if balanced, contained in mother's milk, would be sufficient for any later period.
Under upkeep and wear and tear we understand that cells in the act of functioning, like machinery in operation, undergo breakdowns. There must be replacements within cells; just as a particular piece of a gasoline motor, like a piston ring, may break and have to be replaced, so a small portion of living cells disintegrates and must be replaced. This wear and tear and upkeep is the largest fraction of the protein turn-over of the body.

If more protein is ingested than is required to maintain growth, wear and tear and upkeep, it is destroyed in the body. The body does not store in the sense that the body stores fat. No matter how great the excess of protein beyond the needs of the body, the needless protein is destroyed and end-products appear in the urine. Now, since protein is an expensive form of food to produce in nature and, therefore, expensive in the market, we ought to reduce the ingestion of protein to somewhere near the point of need. Protein consumed in excess of the tissue needs becomes a mere fuel, but a very expensive form of fuel and one that possesses in addition a residue to be eliminated in the urine. The difference between sugar and protein as fuel may be compared to the difference between crude oil and coal. Sugar burns completely and leaves no ash; protein burns incompletely and leaves an ash and this ash must be eliminated, imposing
upon the kidneys a useless labour, comparable to removing ashes from a grate. Certainly no engineer would use a coal with ashes if he could for the same price or a smaller price use an ashless fuel; and whenever protein is consumed in excess of the tissue needs, it amounts to selecting deliberately a fuel with a large ash instead of a fuel with no ash.

The consumption of protein is high in new countries where there is a large amount of land per capita, with many head of live stock per capita; it is low in countries of congested population where the per capita of domesticated animals is low. The consumption of protein is high with people of means and low in a nation of poverty. Thus the highest consumption of protein is seen in Australia and New Zealand; the lowest consumption is seen in India, Japan, and China. The consumption in the United States and England is high, as an expression of wealth. The consumption of protein in the form of meat varies largely in different nations; the ingestion of plant protein does not vary so widely.

Intense controversy has occurred during recent years as to whether meat possesses in the diet properties that are not yet measurable on the basis of either analysis or experience. It is contended that the strength and virility, in the physical and intel-
lectual senses, that together constitute the forces of civilization as seen in the Anglo-Saxon race, as distinguished from the Chinese or East Indian, are due to the greater consumption of meat. This argument is not valid. The consumption of meat is much higher in Australia and New Zealand than in England. The consumption of meat in this country was much higher 40 years ago than it has been in France for a long time—as long, indeed, as records exist there. Now, no one will contend that Americans possess attributes in any direction not possessed by the French that can be reasonably ascribed to our greater ingestion of meat. When one compares a sallow, anaemic East Indian with a rugged Englishman it is easy to be led astray and to ascribe the difference to the meat in the diet of the Englishman as against the cereal in the diet of the East Indian; but there are so many factors to be taken into account that no such conclusion is warranted. There are vegetarian peoples who are as rugged in comparison to the East Indian as is the Englishman. The Englishman is free of intestinal parasites, whereas practically all East Indians harbour one or many varieties of intestinal parasites. The hookworm campaign in our country has afforded to our people an illustration of the veritable transformation to be accomplished in a people without change of diet, simply by removal
of intestinal parasites. The diet of the East Indian is not merely a vegetable diet; it is a poor vegetable diet. For the growing child there is no question that protein of animal origin is very desirable and, indeed, from a practical point of view in the dieting of communities, indispensable; but after the fraction of protein known to be essential — for the adult, 20 per cent of one gram daily per kilo body weight — has been covered by the ingestion of protein of animal origin, it is immaterial with what protein the balance of the intake is covered, and there is no gain in an ingestion of protein in excess of the denominated amount. The average ingestion in America is at least 50 per cent in excess of need.

FAT

A certain amount of native fat is required in the diet. Fat exists in the protoplasm of every cell. The body forms fat from sugar easily; therefore, the necessary factor in native fat is not the chemical substance, fat. If the fat intake falls below a certain figure, especially with the child, disturbances of nutrition ensue. Now the amount of fat concerned is so small that the body could easily secure this amount from sugar. In this fat intake are two factors: one relating to the essential processes of growth, the other relating to less essential
relations in a diet. One gram of fat yields to the body 9.3 calories of heat.

A diet low in fat does not lend itself to our normal types of cooking. Foods prepared without fat are not naturally cooked and do not suit the taste. A diet low in fat is rapidly digested and inasmuch as the sense of satiation in alimentation is in part connected with the duration of the process of digestion, fat-free foods do not give the normal satisfaction. These two factors, the use of fat in cooked food and the acceleration of the process of digestion in the absence of fat, account for the dissatisfaction felt in Germany at present with the low fat intake. This is in part a matter of habit; the low fat intake in Germany today is as high as the normal fat intake, weight for weight, in Japan. Indigestion may ensue in any individual who continuously follows a diet that does not give digestive and physiological satisfaction.

Native fats of animal origin contain a special substance indispensable for growth. This is a fat-soluble vitamine and will be described with water-soluble vitamines under the discussion of these interesting bodies.

The desirable fat content of the diet of an adult may be stated to be not below 40 grams per day, but many individuals will find 50 or 60 grams much more compatible with their tastes. For the gen-
eral uses of fat in the preparation of food one fat is as good as another; vegetable fats are just as good as animal fats—oleomargarine, cottonseed oil, olive oil, corn oil, peanut oil just as good as butter, lard, tallow, or suet. The use of fats in the diet for the preparation of food is a matter of culinary art. For our entire population, daily ingestion of 50 grams of fat could not fail to satisfy the most extreme tastes. In the case of the child, the vegetable fats cannot be compared to the animal fats, especially to butter fat. Butter fat, in other words milk, contains a high concentration of the indispensable vitamine of growth, and for this reason in growing children a certain amount of the fat taken ought always to be milk fat. If the amount of milk that furnishes the balanced protein be present in the diet of the child, we may be sure that the essential amount of growth-producing substance is also present. The claims of one reinforce the claims of the other and make it a public duty to secure for every child in the slums of our cities that amount of milk daily that is necessary to maintain the normal processes of growth and development.

When the child is weaned it is transferred to cow’s milk, which for a time takes over the entire sustenance of the child. As the child grows older and other foods are added, the relative amount of its food derived from the daily milk falls gradually.
With the poor in our city slums children frequently are denied milk after the fifth year; with the classes of better means, milk is continued in the diet of the child until adolescence. With a well-selected diet, such as is possible to people of means, it is less necessary to continue milk in the diet up to the time of adolescence; but with the people of poorer means, where a proper diet is rarely selected, it is very important to continue the use of milk in the diet of the child as long as possible. For this reason, the maintenance of an adequate milk supply for cities at as low a price as possible becomes a matter of much more than mere nutritional importance.

CARBOHYDRATE

Under the head of carbohydrate are included all of the starches of cereals, tubers and vegetables of all kinds and the sugars. These carbohydrates all have the same ultimate meaning in nutrition, since in the act of digestion and resorption they are all converted into one chemical state, glucose. Carbohydrate is not absolutely necessary in the diet. Eskimos and other flesh-eating tribes subsist for years on animal products. Nevertheless the body requires a certain amount of sugar, since sugar is an essential component of cells and the circulating fluids of the body contain a quite constant percentage of sugar. When protein is utilized a certain
amount of sugar is formed, and when an individual subsists entirely upon meat and fat the sugar derived from the meat is sufficient to supply the body with the sugar that is required. The need of carbohydrate, in excess of the small amounts required by the cells, is as a fuel; and carbohydrate occupies its predominant position in the diet because it is the cheapest fuel. As a fuel sugar is more quickly utilized than fat. When the body has available for use both sugar and fat, and physical work is undertaken, the body always burns sugar first; it is only when the stores of sugar in the body have become depleted that the body burns fat to maintain work. We therefore speak of sugar as the primary fuel and fat as the secondary fuel, though they are entirely interchangeable; and in practical experience it is largely immaterial whether one supports body work and body heat by combustion of sugar or fat; it is a question of taste and economics. One gram of carbohydrate yields to the body 4 calories of heat.

The amount of carbohydrate required in the diet depends therefore upon climate and upon physical work. Given an adult resting man of 70 kilos body weight, the amount of protein required as previously stated may be set at 70 grams, equal to 300 calories—a food calorie is that amount of food which will produce heat enough to raise one litre of water one degree centigrade. The amount
of fat required for the maintenance of normal nutrition may be set at 40 grams, equal to 370 calories. The individual of 70 kilos, resting, fasting, in a room at tropical temperature, will produce let us say 1750 calories. Subtracting from this the sum of the heat values of protein and fat, will leave 1080 calories to be covered by carbohydrate, if the cheapest fuel is to be used, equal to 270 grams. One could maintain the body heat of this individual by the ingestion of a corresponding amount of fat (which would be 115 grams), or also by the ingestion of 270 grams of protein. A sedentary life requires 100 to possibly 200 additional grams of carbohydrate; active work, 400 or 500; hard work, up to or even exceeding 1000 grams. In actual practice, men who work hard do not cover all of their fuel needs with carbohydrate; they use both carbohydrate and fat in order to reduce the bulk of the diet. Sugar is a particularly available fuel for hard work; direct experiments indicate that sugar introduced into a working individual will be utilized in as short a time as fifteen minutes. The heat production of the new born babe is about 600 calories per day, that of the sedentary man about 2500, and the figure rises with physical work to as high as five thousand or more calories. The ration of our army provides 4400 calories. The heat production of women is less than that of men. The
per capita food need in terms of calories is between seventy-five and eighty per cent of the food need of the average adult male.

Now in the use of food in actual life we do not find protein, fats and carbohydrate separately, but find them commingled in different proportions in different foods. Thus, the cereals contain on an average of 70 per cent of carbohydrate and 10 per cent of protein. Milk contains all three; meat contains protein and fat; and many of the legumes, such as the soya bean, contain large amounts of protein, fat and carbohydrate. The green vegetables are poor in all, containing most carbohydrate and very little fat. With the diet so arranged as to contain the needed amounts of animal products in order to secure balanced protein and the fat-soluble vitamine, experience indicates that if the diet contains enough energy units to support the individual, it contains enough protein and fat to meet the needs of the body. One does not need to be concerned about the protein intake in a normal mixed diet, since it is practically impossible to secure the amount of carbohydrate necessary to maintain the work of the individual without at the same time securing the protein; and the same statement holds for fat. It is only when individuals in poor circumstances, in attempting to reduce the cost of living to the lowest level, subsist upon ver-
one-sided diets, consisting of few articles to the practical exclusion of animal products, that abnormalities in nutrition occur. A diet of potatoes alone has maintained individuals in apparent health over a period of several years. One can live on mixed cereals alone so far as protein, fat and carbohydrate are concerned. From the economic point of view it is important to calculate the components of a ration from the standpoint of protein, fat and carbohydrate; but from the nutritional point of view, this is less important in the normal mixed diet in a civilized community.

MINERAL SALTS

The body requires mineral salts for the skeleton and for the maintenance of the normal physical state of the body cells and circulating fluids. The chlorides, phosphates and carbonates of lime, sodium, potassium, calcium, magnesium and iron are the bodies most largely concerned. These mineral matters are obtained in the diet in cereals, fruits and vegetables. In a normal mixed diet it is rare to secure a deficiency in salts; it is only when the diet is extremely one-sided or repressed that a deficiency in mineral matters appears. This deficiency in mineral intake is more important in childhood than in adult life. A safeguard here lies in the abundant use of milk, which contains all of
the mineral matters needed for the body. A diet consisting of white patent flour alone would not contain the necessary mineral matters; a diet consisting of potato alone would contain the necessary mineral matters. The addition of fats to white patent flour would not furnish the necessary mineral matters. Much more mineral matter is contained in grain offal than in patent flour. Individuals who prefer bread made of patent flour must, therefore, secure their mineral salts from fruits and vegetables, and this is entirely practicable. If, however, it is not possible to secure fruits and vegetables, then the diet must contain flour made of the whole grain in order to obtain the necessary mineral matters.

VITAMINES

Under vitamines, we understand two kinds of substances whose presence in the body is essential to normal health and growth. These vitamines are designated in accordance with one of their pronounced properties, namely, that of solution, as water-soluble vitamine and fat-soluble vitamine.

The water-soluble vitamine is present in cereals, fruits, vegetables, meats, and in milk. If food-stuffs are consumed in a natural state, the water-soluble vitamine is abundantly available. It is, however, destroyed by prolonged heating and therefore in the preparation of foods some of the water-
soluble vitamine may be destroyed. The cereals contain the water-soluble vitamine in the outer layers, and it is, therefore, not present in patent flour, but is present in whole wheat flour. The vitamine of the cereals is not destroyed by the amount of heat used in the ordinary act of baking. On the other hand, the vitamines in vegetables may be destroyed in the ordinary act of canning where the heating is severe. Therefore, an individual subsisting upon bread made of a patent flour and canned vegetables and canned meat would be apt to exhibit after a length of time nutritional disturbances related to the absence of water-soluble vitamine. In the Orient, a diet of polished rice and fish leads to the disease termed “beri-beri,” which is cured by the administration of fruits, vegetables, or by the consumption of unpolished rice. A diet composed predominatingly of patent white flour and lard or other pork products is apt to lead to nutritional diseases, such as have been observed in Labrador; and it seems probable that pellagra is due largely to the absence of water-soluble vitamine. It is a common misconception that these vitamines reside only in the outer hull of grains and that, therefore, all individuals should use whole wheat flour. This is incorrect, for fruits and vegetables are, as already stated, rich in these vitamines.
The fat-soluble vitamine is not present in the cereals to any material extent. It is present in leaves and in many roots. If animals be fed wholly upon cereals they will exhibit after a space of time nutritional disturbances. If the diet contains leaves and roots, such disturbances will not appear. A balanced ration for domesticated animals consists therefore of cereals and leaves or roots. Now when these leaves and roots are consumed by animals, the fat-soluble vitamine passes into the tissues of the animal and passes also into the milk. The fat-soluble vitamine is present in milk to a higher concentration than in any other foodstuff. It is this that gives to milk its predominant influence over the process of growth, since absence of fat-soluble vitamine shows its most pronounced effect in cessation of growth. Since children cannot digest such leaves and roots, it is imperative that vitamine be offered to them in the form of milk. It is of importance to insist that the fat-soluble vitamine is not present in whole grains and is therefore not present in whole wheat bread. It is also important to know that fat-soluble vitamine is for us much more important than the water-soluble vitamine. The water-soluble vitamine is practically everywhere; but the fat-soluble vitamine is largely localized in a few foodstuffs, and these must be present in the diet in the
proper amounts. It is especially important that the diet of the woman in gestation should contain an abundance of fat-soluble vitamine in the form of milk or leaf vegetables.

WATER

No discussion of the need of water in the body is necessary beyond the mere statement that water is required in the act of digestion; that a certain water concentration is essential to the life of the cells; that water must be provided for renal elimination; and that the need for water depends beyond this upon the necessary elimination of water in the maintenance of body heat through the respiratory and cutaneous systems. There are many fads connected with the drinking of water. There is a common notion that water taken with meals is injurious. If mastication of the food be carefully carried out and water be consumed between the swallowing of food, the consumption of a moderate amount of water is advantageous. The idea that water with meals is conducive to obesity is only true if the use of the water is conducive to the ingestion of excessive amounts of food.

The normal diet should contain an indigestible residue in order to furnish a normal bulk to the stools. This is not a statement of animal physiology; it is a statement of the physiology of the
civilized individual. Experimental investigations in animals and X-ray observations on human beings indicate that the alimentary tract of the child normally reacts with an evacuation of the bowels following each ingestion of food. This is seen in the babe and would appear throughout normal life if it were not trained out of the individual in order to have his habits conform to the conventions of civilized existence. Investigations among savages in various sections of the world have indicated that savages evacuate the bowels after every act of eating, and there are in civilized communities considerable numbers of individuals who have retained or re-acquired the normal muscular habits of the primitive alimentary tract. With most individuals, however, the muscular tone of the intestine loses its normal response and depends for its reaction to a certain extent upon the mass of the intestinal content. The mass of the stools consists of the secretions of the alimentary tract, the unresorbed foodstuff that was digestible but not resorbed, and the indigestible components of the foodstuffs. Fruits and vegetables leave a large residue. The residue of cereals is heavy if the whole grain is consumed. The residue of meats, dairy products, patent flours and vegetable oils is very small since their digestion is practically complete and they contain little indigestible residue. It is quite imma-
aterial from what the indigestible residue is derived, whether from fruits, vegetables or the hulls of grains. This is a question of individual taste and of the reaction of the individual alimentary tract.

PSYCHOLOGY OF THE DIET

These factors described compose the physiology of digestion. They comprise the known facts of digestion in animals that hold for human beings so long as the human being can be compelled to act like an animal. They will hold strictly for savage tribes who have a physiology, but little psychology, of nutrition. As one ascends in the scale of civilization, the laws of the physiology of nutrition do not lose their validity, but the psychology of nutrition assumes constantly greater importance until finally, with the average individual of our day and country, the psychology of the diet, from the standpoint of the individual and of the community, is as important as the physiology of nutrition. It is not sufficient that the diet contains the denominated protein, fat, carbohydrate, vitamins, mineral matter, etc. It must contain them in certain ways; it must be prepared according to certain standards; it must be consumed under particular surroundings; it must be served in accordance with selected procedures. A thousand and one external influences determine whether or not a diet, correct
in itself from the standpoint of animal physiology, will be regarded as correct and proper by the consumer. The appearance of food, and its palatability, and the previous experience of the individual have a determining influence so profound that they may actually prevent the digestion and utilization of a particular foodstuff. It is thus true, not as a matter of notion but as a matter of fact, that a diet that would be entirely proper and comfortable for a Russian peasant would fail as nourishment for the highly specialized organism of a Russian artist. There is of course a great deal under cover of the term "psychology of nutrition" that is purely arbitrary idiosyncrasy, that will disappear under repression. There is, however, a great deal that is real and that bears directly not only upon the digestion of food and upon the sense of satiation but operates also to alter the normal processes of digestion.

In a period of stress, such as at present confronts the American people, it is incumbent upon every family to attempt a separation of the true psychology of the diet from false psychology, idiosyncrasy, and from the fads with which our ideas of diet have become infested. We have a maze of nonsense surrounding our ideas of food that must be removed if we are to face clearly and handle efficiently the food problem that confronts our
people. So long as people believe that corn meal is heating, that barley cannot be eaten in summer, that the quality of meat is determined by the size of the animal, that the digestibility of eggs varies with the colour of the hens, etc., etc., that long will it be impossible for such individuals to reconstruct their diet to conform to the correct physiology and psychology of alimentation. It is necessary to retain those features of the psychology of alimentation that make for refinement in life and satisfaction in nutrition; but also equally necessary to discard wasteful idiosyncrasies, vulgar superstitions and pseudo-scientific fads.

INFLUENCE OF TRADE

Trade influences our diet either essentially as a result of trade conditions or through manipulation. Commercial trade practices influence to a large extent the consumption of foodstuffs in the United States. It is a truism among the manufacturers of foodstuffs that a properly conducted, adequately financed campaign in advertising will create a market for any new foodstuff, irrespective of any question of superiority from the nutritive point of view. The history of breakfast foods is an illuminating illustration. There is no nutritive basis for the establishment of any one or for its replacement by another. The factors that count most in ad-
Vertising are method of preparation, saving of labour by the housewife, taste, attractiveness of the package, keeping qualities, in other words, secondary considerations. The prices are high compared with that of the original cereal from which they were derived; for the price covers the advertising, the cost of the special package, the marketing, the bulky freight tonnage, and the overhead charges of the retailer who has to carry many brands that occupy much space upon his shelves. None of these fancy breakfast foods have any nutritive superiority over the cereals out of which they are manufactured. They represent the desire of the American housewife to save work, to have something new and to serve an infinite variety of cereals.

Such an influence of trade is purely artificial and is based largely upon the restlessness of the consumer. There are, however, other trade influences of an entirely different nature. The trade pushes certain commodities because handling of them is profitable; conditions of transportation, portability, keeping qualities, evenness of production, ability to purchase by contract, financial responsibility of the producer, standardized quality of the wares, etc., all are involved. The grocer takes up each new breakfast food as an ephemeral trade, knowing that it will soon be supplanted. He takes up a certain line of bacon knowing that it will be always the
same; the firm manufacturing the article is responsible, the product is guaranteed, and it represents a staple in the mind of the consumer. In this sense, that which is staple in trade becomes a staple to the consumer. The flour of a certain section keeps better than the flour of another section; the sweet corn of a certain area is tenderer than that of another region. A large number of such trade factors will at once suggest themselves to the reader. They are essentially related to conditions in the supply and themselves really represent adaptations of the trade to conditions in the supply.

Now, in times of stress, trade conditions cannot be maintained, and particularly under conditions of war, with disorganization of labour and transportation, it becomes increasingly difficult for the trade to maintain its standards. This results in disorganization of trade values, depreciation of the worth of markets, and sophistication of foodstuffs, adulteration, and lowering of values. The standard article costs relatively and absolutely more to produce than the ordinary article, and with the differential between the two becoming increased, there is motive for sophistication and the consumer is tempted to leave the standard staple. A strict enforcement of pure food laws under these circumstances, though very much more difficult than in peace time, becomes the absolute duty of the gov-
ernment. Prior to the declaration of war against Germany by Italy, Italian exporters flooded Germany with sophisticated foodstuffs that were eagerly seized in the condition of stress in Germany because of the attractiveness in price distinction. It is difficult to enforce pure food laws under these circumstances because many of our pure food laws represent not factors of nutrition, but rather factors of trade. It is so easy for a manufacturer to allow his product to vary from his statement of contents if it is difficult in the markets to secure the substances necessary to maintain in the content the statement of contents.

In the United States at present, it is practically impossible to secure for purposes of manufacture the assortment of imported wares from the Orient, peppers, spices, etc., that were available in peace time, and it becomes very difficult for the manufacturer of a trade-mark brand to maintain the content under which his market was originally developed. Under conditions of stress it becomes much more difficult to grade grains and the manufacturers of flour find it increasingly difficult to select grains and blend them in order to produce the flour to which their trade has become accustomed. When cattle are rushed to market in poor condition and pigs at a very low weight, it is difficult for the packing houses to maintain the standard
of their products. Throughout the entire trade, the temptation to use fillers that are innocuous, but devoid of nutrient value, is difficult to resist. Freedom of action in the trade is much restricted under conditions of war, and such restriction in freedom of action often so operates to modify the influence of trade as to render it pernicious. On the other hand, the efficiency of governmental machinery in the maintenance of food laws is at the same time greatly reduced. When things are scarce and prices are high, even if speculation be eliminated, the very attitude of the consumer tempts to a modification of the normal factors of trade, and these modifications are usually in the direction of inefficiency in terms of final analysis in food units. It is the business of the government, when the available foodstuffs must be utilized to a more complete extent, to itself control this utilization in place of leaving it to the decisions of the interested traders. It is not merely the function of the government in war time to increase production, to eliminate speculation, to govern distribution, to make equitable division of foodstuffs to the consumer, to teach the consumer proper utilization of foodstuffs and the elimination of all waste; it is also the duty of the government to so control relations of trade that the diet of the consumer is not unduly modified and to his detriment. Any modification in the factors
of trade in war time will tend in the direction of reduction of efficiency in nutrition, never in the direction of improvement.

The question of trade brands represents one of the peculiar features of the situation that merits a moment’s discussion. If the established high-grade trade brands are maintained in war time this will usually be done at the expense of the quality of the remaining foodstuffs. The people of means will purchase the standard maintained brands, leaving to the poor the depreciated grades of foodstuffs. There is no reduction in price, however, that corresponds to the depreciation of foodstuffs to the poor classes. The prices of the standard high-grade brands are relatively the cheapest under such circumstances and yet they are beyond the purchasing power of the poorer classes. This leads to class resentment and to inefficiency in the nutrition of a people; and this has led the European governments practically to abolish such brands during the course of the war. There is, for example, in Germany, England and France today, only a war flour; the high-grade brands of the mills of those countries have been abolished for the period of the war. Germany used to produce particular varieties of foods that were widely exported—hams from Westphalia, sausages from Braunschweig, cakes from Württemberg, chocolates from Mannheim,
etc., etc. These have all been abolished; cakes have a uniform composition, hams and sausages are prepared in a uniform manner. The products of highest quality no longer exist, but the general average is above that which would have existed in the lowest grades had the products of highest grades been maintained.

To abolish the high-grade trade brands means of course an extremely radical step, one not to be taken without mature consideration, since it represents practically a revolution in the practices of the trades. In countries actively at war under stress of abnormal conditions this becomes absolutely necessary. It has not yet been necessary in the United States to abolish the high-grade brands as has been done abroad; but if here, as abroad, the quality of the ordinary goods becomes seriously depreciated, we may expect strong public clamour for similar action to be carried through here, because under such conditions the maintenance of a high-grade trade brand means not merely a commercial privilege to the particular producer; it means a direct favouritism to people of purchasing power, and this leads to class discrimination, bitterness of feeling and reduction in morale.