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.

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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 chem-

ical 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.