NUTRITION

Uses of Food

"A Classic of Science"

Although Mankind has been Eating Food a Long Time It is Less Than Forty Years Since We Found Out Why

METHODS AND RESULTS OF INVESTIGATIONS ON THE CHEMISTRY AND ECONOMY OF FOOD. By W. O. Atwater. U. S. Department of Agriculture, Office of Experiment Stations, Bulletin No. 21. Washington: Government Printing Office, 1895.

THE TWO chief uses of food of animals are: First, to form the materials of the body and repair its wastes; and, second, to yield energy in the form of (1) heat to keep the body warm and (2) muscular and other power for the work it has to do. In forming the tissues and fluids of the body the food serves for building and repair. In yielding energy it serves as fuel for yielding heat and power.

The different nutrients of food act in different ways in fulfilling these purposes. The principal tissue formers are the albuminoids. These form the framework of the body. They build and repair the nitrogenous materials, as those of muscle, tendon, and bone, and supply the albuminoids of blood, milk, and other fluids. The chief fuel ingredients of the food are the carbohydrates and fats. These are either consumed in the body or are stored as fat to be used as occasion demands.

Protein for Building and Repair

The albuminoids are the building material of the body. The bodily machine is made from them, but in the making of the machine the albuminoids remain partly albuminoids and are partly changed to gelatinoids, so that the machine, as built, consists of both albuminoids and gelatinoids. The gelatinoids can not, according to the best evidence now at hand, be transformed into albuminoids, but they do serve to protect the albuminoids from being consumed. Both albuminoids and gelatinoids, after they have served as building material, can be broken up and oxidixed within the body. In this cleavage and oxidation they serve as fuel.

Still another function of the protein is the formation of fats and carbohydrates. These latter are produced by the cleavage of the molecules of the proteid compounds. It is reasonably certain that the albuminoids, and probable, or at any rate possible, that the gelatinoids also, are thus transformed in the animal organism. Similar processes appear to take place in nonliving protein compounds (e.g., cheese) under the influence of ferments.

The nitrogenous extractives can neither build tissue nor serve as fuel, but they are useful otherwise. Just how they are useful is not yet fully explained, but they appear to exert some influence upon the nervous system, to act as stimulants, and thus to help the body to make use of other materials in its nourishment.

The amids do not appear to serve any purpose as building material in the animal body. Like the nitrogenous extractives, they are products of the cleavage of the more highly organized proteids. But while they do not appear to be used for either building or repair, they, or some of them at least, serve as fuel, and it is possible they may, like the gelatinoids, help to protect the albuminoids of the food and of the body tissues from being consumed.

The almuminoids are the most important of the protein compounds, both because they are the only ones that are actually used for building material and because they make up the bulk of the protein of the food and of the body. Gelatinoids and nitrogenous extractives occur only in such animal tissues as muscle, tendon, etc., and their quantity in these is small. The amids are found in considerable quantities in tubers, as potatoes; in roots, as turnips and beets, and in fruits; they are not found to any extent in other food materials. Since the quantities of gelatinoids, nitrogenous extractives, and amids in our food materials are so small, we do not go far astray in following the ordinary practice of using the term protein to denote the building material of the food.

Fats and Carbohydrates for Fuel

The machine needs fuel. Starch and sugar are burned in the body and yield heat and power, just as truly as does the coal which is burned in a stove to heat the house or under a boiler to drive an engine. The fats serve the same purpose, only they are more concentrated fuel than the carbohydrates. The body transforms the carbohydrates into fat, which it keeps as a reserve of fuel in the most concentrated form. While the fat of the body is consumed more or less directly, part of it is stored as fat in the body. At the same time the previously stored body fat is being drawn upon for use as fuel. The carbohydrates of the food are consumed more or less directly in the body. Small quantities are transformed into fat, as above stated, and other quantities, probably in most cases still smaller, appear to be transformed into the carbohydrates of the body. The quantity of carbohydrates in the body is at most quite small. The principal one is glycogen. Inosit, which was formerly reckoned with the carbohydrates, is found to have a different constitution, and to contain a benzene nucleus.

The fats and carbohydrates are not the only materials that can be used as fuel. The protein compounds can perform the same service. A dog can live on lean meat, which thus serves as both building material and fuel. We can likewise use the protein of our bodies to supply us with both heat and muscular strength. This last statement may be expressed in another form so as to emphasize an important difference between the protein and the other ingredients of food and between the animal machine and other machines. The protein compounds can do the work of the carbohydrates and fats in being consumed for fuel, but the carbohydrates and fats can not do the work of protein in building and repairing the tissues of the body.

The bodily machine is made of protein. That is to say, blood, muscle,

tendon, bone, and brain all consist of, or at least contain, protein compounds. These are formed from the myosin of meat and fish, the casein of milk, the albumen of eggs, the gluten of wheat, and other albuminoids of the food. As the muscles and other tissues are used up in bodily activity, the same materials of the food are used for their repair. Of course, the mineral matters have a good deal to do with the building up of the tissues. Thus, phosphate of lime is an essential ingredient of the bones.

The chief fuel materials of the bodily machine are carbohydrates and fats, but the protein of the food and the tissues also serves as fuel.

The animal machine differs from others in that it can use its own substance for fuel. . . .

How Food is Used in the Body

Food supplies the wants of the body in several ways. It either (1) is used to form the tissues and fluids of the body; (2) is used to repair the wastes of tissues; (3) is stored in the body for future consumption; (4) is consumed as fuel, its potential energy being transformed into heat or muscular energy or other forms of energy required by the body; or, (5) in being consumed protects tissues or other food from consumption.

Protein forms tissue (muscle, tendon, etc., and fat) and serves as fuel. Fats form fatty tissue (not muscle, etc.), and serve as fuel. Carbohydrates are transformed into fat and serve as fuel. All yield energy in form of heat and muscular strength.

In being themselves burned to yield energy, the nutrients protect each other from being consumed. The protein and fats of body tissue are used like those of food. An important use of the carbohydrates and fats is to protect protein (muscle, etc.) from consumption.

In this view food may be defined as material which, when taken into the body, serves to either form tissue or yield energy, or both. This definition includes all the ordinary food materials, since they both build tissue and yield energy. It includes sugar and starch, because they yield energy and form fatty tissue. It includes alcohol, because the latter is burned to yield energy, though it does not build tissue. It excludes creatin, creatinin, and other so-called nitrogenous extractives of meat, and likewise thein or caffein of tea and coffee, because they neither build tissue nor yield energy, although they may, at times, be useful aids to nutrition.

Science News Letter, August 5, 1933

MEDICINE

Isolated Faeroe Islands Aid Study of Whooping Cough

THE FAEROE Islands, tiny spots of land far north of Scotland, have helped to prove that vaccination against whooping cough is effective.

These islands, which are under the administrative control of Denmark, offer unique opportunities for epidemiological studies. Whooping cough spreads over the islands in great epidemic waves between each of which there is an interval of years. During an interval, all who have not had whooping cough catch it. Between epidemics there are no isolated, sporadic cases.

The action of whooping cough vaccines has been investigated during two epidemics on the islands by Prof. T. Madsen who is at the head of the State Serum Institute, Copenhagen, where whooping cough vaccines are made. Under his direction 3,926 persons on the islands were vaccinated, either as a preventive measure, or after the whooping cough had declared itself. There were also 1,073 persons who, though susceptible, were for various reasons not vaccinated. Among these persons there were as many as 26 deaths from whooping cough, whereas among the vaccinated persons there were only 6 deaths. In other words, the mortality from whooping cough was about 16 times higher among the controls than among the vaccinated persons.

But this was not all. For, on the whole, the whooping cough ran a much milder and shorter course among the vaccinated than it did among the controls. As the vaccinated and the controls lived under precisely similar conditions, the case for whooping cough vaccination is remarkably strong.

Science News Letter, August 5, 1933

RADIO

CHEMISTRY AND RECENT MEDICAL PROGRESS

an address by

Prof. Julius Stieglitz

Chairman of the Department of Chemistry, University of Chicago

To be given Friday, August 11, at 1:45 p. m. Eastern Standard Time over stations of the Columbia Broadcasting system. Each week a prominent scientist speaks over the Columbia System under the auspices of Science Service.

GENERAL SCIENCE

U. S. International Dues Paid From Private Funds

DUES OF THE United States in the International Council of Scientific Unions and six international unions upon which American science is represented are being paid from private money of the National Research Council because Congress omitted the usual appropriation of about $5,000 when it passed the State Department appropriation bill last session.

Rather than jeopardize friendly scientific relations with the international unions and with other governments, the National Research Council decided as an emergency matter to pay the 1932 quotas of this country from its funds although the present economic situation has increased the financial demands upon this coordinating organization.

Science News Letter, August 5, 1933

ARCHAEOLOGY

Safety Assured For Famous Indian Mounds

PERMANENT safety for the famed mysterious earthworks at Newark, Ohio, has been assured by action converting the land into a state park.

The plan of the earthworks, which in prehistoric times covered 12 miles, is an amazing design of circles, squares, octagons, and long avenues. How or why prehistoric Indians carried out so complex and extensive a project has puzzled visitors to the site from the time when the earliest white men reached the Middle West. It is now be-