sodium and potassium iodides were very soluble and were known to be entirely absorbed, whereas the amount of iodine actually absorbed from the so-called natural sources could not be so accurately estimated.

In reply to a question by Dr. Hubert Smith on the value of salt obtained from sea water, Sir Charles stated that the amount of natural iodides therein was extremely small, but the iodine concentration power of various plankton was very great, and thus the amount of iodine available from evaporating sea water would essentially depend upon the amount of contaminating plankton in the salt obtained therefrom.

PROTEIN AND AMINO ACID THERAPY IN MEDICAL AND SURGICAL CONDITIONS—A REVIEW

(*Joint Session of the Chemical and Medical Science Sections of the Congress.*)

By Muriel E. Bell, M.D., F.N.Z.I.C.

We may summarise the purposes of protein in the body as follows:—

For growth.

For repair, including that in current daily metabolic degradations and that in diseased processes.

For the formation of enzymes for digestion, muscular movement, secretion and excretion.

For the production of antibodies such as gamma globulin.

For the manufacture of hormones.

For enabling the liver to form plasma proteins, important in maintaining the water balance and the circulatory pressure.

For detoxifying certain poisons.

For forming the blood-pigment haemoglobin.

For chromosomes, and therefore for breeding and heredity.

It has been well expressed by Fox (1947) that proteins are not only the building material but also the workmen that do the building and the repairing.

Recent advances in the knowledge of the biochemistry of the proteins have established the fact that our body proteins are far from being static. We have previously imagined them to be stabilised in the structure of the muscle or the gland or other body tissue, or circulating as blood plasma in a closed system. Our only additional concept in the past has been that there is a certain amount of "wear and tear," terms of which we did not know the real meaning. We have known, too, that body protein is utilised for fuel when, during starvation, the stores of carbohydrate and fat have been exhausted. We have also said, with a hazy idea of its meaning, that protein is used for repair of the tissues.

But no one had any idea of the extent of the losses of body protein that were required for repair until, of recent years, measurements were made of the nitrogen excretion following burns or fractures or operations or of the volume of fluid and of protein lost from the blood when such an irritant as lewisite had been dropped on the skin and caused it to blister.

The use of plasma has been an effective form of protein therapy in burns, both thermal and chemical, and in a variety of acute medical and surgical conditions. This form of therapy is now familiar to all of us.

What is less familiar is the more gradual and less perceptible loss of protein that occurs with any form of injury, whether from the agency of bacterial toxins, or of an invading carcinoma, or of a mere break in the continuity of the tissue caused by a fracture or by the surgeon's scalpel. To understand the phenomenon of daily wear and tear of protein in the body, or of repair in injured tissues, we must get back to the modern concept of body protein as being in a constant state of change. This perpetual state of activity on the part of our body proteins has been revealed by Schoenheimer (1942), who used the method of marking or tagging with the isotope of nitrogen (N^{15}), preparing synthetic amino-acids with it to act as tracers of the amino group, while deuterium (H^2) was used for tagging the carbon chain. Recovery of the amino-acids from the various organs and from the urine disclosed the fact that there was active and rapid replacement of tagged leucine for tissue leucine, and so on for other amino-acids in the body protein, indicating that the proteins are rapidly and continually being opened and closed in the normal animal, even when there is no obvious need for that particular amino-acid. The proteins are therefore in a state of intense activity, and there is a "give and take" between body proteins and plasma proteins. In other words, we have the concept of a dynamic state of blood and organs. Some tissues are more active than others, but even such inert structures as tendons evince some activity. This shows how extensively the body constituents of living organisms are subject to regeneration. We are now better able to understand what we still refer to, for lack of a better word, as "repair."

Another concept fundamental to the understanding of some therapeutic findings is the biochemical transfer of methyl groups, in which the sulphur-containing amino-acid methionine (classified among the essential amino-acids), as well as two other substances, namely choline and creatine, are able to perform the function of transmethylation. Methionine is a particularly important amino-acid because its two component parts, the methyl group and homocysteine, both have to be available from the diet. By designating amino-acids as essential, we mean that though they can be formed by the body, their rate of formation is too slow for the body's total requirement of these amino-acids. The methyl group shifts continually from one compound to another, but there is a daily excretion of creatinine which accounts for continuous loss of the methyl group. Therefore, we need to put aside the idea that the body is similar to a combustion engine with fixed parts, or that exogenous and endogenous metabolism are unrelated.

The importance of the intake of protein lies in the fact that, if it is diminished, the body, having become adjusted to the previous intake, draws upon its tissues. There are no "stores" of protein in a strict sense; it is the body tissues that waste if demand exceeds supply.

Ideas that are still valid are that carbohydrate spares protein, but we have learnt of recent years that mixtures of proteins enhance the value of the protein fed. Therefore, the line drawn between first-class and second class proteins taken into the normal body is not as clear-cut as we formerly believed. A little milk protein will go a long way when combined with some protein from bread. However, the sick body cannot always deal with the quantities and variety of foods that are acceptable to the healthy body, and therefore we need to know what proteins contain the more valuable amino-acids for repair processes.

When a particular amino-acid is required for repair, and it is not available from the food, the degradation of a whole molecule of protein will occur, leading to increased nitrogen excretion. This happens in many disorders met with in medical practice.

Lack of appetite may arise in many acute illnesses as a result of toxaemia, but it may also be due to protein deficiency. One of the features of the clinical condition of the Belsen Camp victims was their loss of appetite as well as loss of the power of absorption. Experiments on rats have elicited the fact that the amino-acid methionine is specifically concerned with appetite, and appetite returns on the addition of a few milligrams of methionine, even when the total protein intake is still inadequate for other purposes.

In methionine, we have an amino-acid that is a key to several reparative processes. We have seen that it has a specific effect on appetite, in rats at any rate. It is also the urgent demand for methionine that causes protein loss in the repair of burns. It is the amino-acid which is particularly valuable in relation to certain diseases of the liver.

Interest has now begun to centre round the production of amino-acids for pharmaceutical purposes. Consequently, there is feverish activity on the part of chemists to devise means of producing them either by hydrolysis or by synthesis, at a price which permits of their therapeutic use. Those proteins which are by-products of industrial processes are being examined for their amino-acid potentialities. Arginine, for example, can be obtained from fish by-products. Breeding of plants is in progress to augment the yield of amino-acids, for example lysine and tryptophane in maize. There will now be a race between synthesis and hydrolysis, to see how each amino-acid can be produced most cheaply.

The use of oral and parenteral protein in aiding recovery from illnesses and surgical operations is gaining ground. For parenteral use, protein hydrolysates and amino-acid mixtures are being used. They must be in such a state of purity that they will not produce deleterious effects. For oral use, the taste must be acceptable. Certain commercial products are available which have attained these desired standards.

Protein as a therapeutic weapon implies for us that we can provide some of the raw materials from which the therapeutic mixtures can be made. Skim milk, for example, is a good source of valuable amino-acids, including methionine. Lactalbumin can produce a hydrolysate that has an acceptable flavour. The use of protein and amino-acid therapy is a challenge alike to the doctor to shorten the period of convalescence of the patient, and to the chemist to provide him with the materials for attaining this end.

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The above abbreviation covers the chemical side of Dr. Bell's address. The clinical section was published in the *N.Z. Medical Journal* of August, 1947. Unfortunately, after presentation of the paper, no time remained available for discussion.

FLUORINE AND DENTAL CARIES IN NEW ZEALAND.

By MARION F. HARRISON, M.H.Sc., Medical School, Dunedin.

A BRIEF review of the physiology and pathology of fluorine has been published in *N.Z. Dent. J.*, 43, 5, 1947. Dean *et al.* (1942) found an inverse relation between the fluorine content of the potable water supplies (where less than 1 ppm. F.) and the incidence of dental caries (*Pub. Health Rept.*, 57, 1177, 1942). In New Zealand, the fluorine content of the water supplies is less than 0.5 ppm. F., and is thus below the threshold value for protection against dental caries. (Chamberlain, G., *N.Z. J. Sc. Tech.*, 26, 90, 1944; *ibid.*, 28, 155, 1946; Denmead, C. F., *ibid.*, 28, 159.) Preliminary analyses of the enamel and dentine of New Zealand teeth indicate that the fluorine content is low compared with the results of overseas workers. From X-ray crystal analyses of enamel and dentine, it is seen that fluorine occupies an integral position in the main apatite lattice. These findings indicate that fluorine may be a factor in the high incidence of dental caries in New Zealand. It is therefore necessary to test this hypothesis. There are many ways that this may be attempted, as, for example, by the studies of the effect of the fluorination of the water supplies on the incidence of dental caries, of the effect of the daily ingestion of small amounts (e.g., 1 mg.) of fluorine during the calcification of the teeth, and of the effect of the topical application of fluoride solution on to the erupted surface of teeth.

So it is hoped, with the co-operation of dentists, of chemists, and of all those who are concerned with the high incidence of dental caries, on the above and other lines we may determine whether or not fluorine is a factor in the incidence of dental caries in New Zealand.

DISCUSSION.

Dr. R. M. S. Taylor opened the discussion, mentioning that H. B. Younger had recently written of Dental Caries as primarily a bacterial invasion of the "organic roads" of the enamel, the prism sheaths, spindles and lamellae. This offers an explanation for the partial immunity following development of permanent teeth where the drinking water contains optimum amounts of fluorine. He suggests that this "developmental or pre-eruptive immunity" does not affect