

The Antirachitic Vitamin D.

WHILE the chemical nature of the six known vitamins remains obscure, recent advances in knowledge have brought us very much nearer to understanding that of one of them, namely, the antirachitic vitamin D. This has been brought about through the work of Rosenheim, Webster, Drummond, Heilbron, Hess, and Windaus, some of whom have now shown conclusively that vitamin D may be produced in a highly concentrated form from a pure crystalline substance, ergosterol, merely by acting upon it with sunlight or the radiation from a mercury-vapour lamp. This discovery is of great practical as well as scientific importance.

Following the observations that the cure of infantile rickets was brought about by exposure of the body to ultra-violet light and by administration of cod-liver oil, it was found that a number of foodstuffs containing cholesterol, after exposure to ultra-violet light, were rendered effective as curative agents for rickets artificially induced in rats by previously feeding them on a diet devoid of vitamin D. From this the workers referred to were led to study cholesterol, ergosterol, fungisterol, and α -, β - and γ -sitosterols. At first it appeared that each of them developed activity under the influence of ultra-violet irradiation; but later it was shown that these compounds can only be purified with some difficulty, and it was proved that cholesterol and β - and γ -sitosterol when completely purified can no longer be activated by irradiation, and there is reason for supposing that the same will be found to be true of α -sitosterol and fungisterol. On the other hand, all the evidence goes to show that ergosterol is the sole antirachitic precursor.

If this be so, then ergosterol must be present in practically all fats of animal or vegetable origin, for all of these are capable of activation by irradiation, but it is found chiefly in fungi—in ergot of rye and in yeast.

When ergosterol is exposed to ultra-violet irradiation, it loses its crystalline character and becomes resinous. Oxygen does not appear necessary for this change, which can in fact best be effected *in vacuo* or in an atmosphere of nitrogen. The resinous substance thus formed is very highly active in curing rickets. The activity is, however, destroyed if the irradiation be long continued. Irradiated ergosterol has been found to possess remarkably powerful physiological activity; indeed, Miss K. H. Coward has shown that its calcifying effect can be demonstrated with so little as 1/100,000 mgm. administered to a rat in daily doses.

Of the vitamins, vitamin D is the one which pre-eminently needs to be artificially added to the diet, especially in sunless climates. The reason for this will be clear when it is considered that it is chiefly formed in animals rather than in plants, and results from exposure of the animal to sunlight or to a source of ultra-violet rays. It is well known that the sebaceous glands contain sterols and sterol esters, and there is good evidence for believing that it is from this source that the animal derives its

antirachitic vitamin. It has been shown, moreover, that the liver acts as a storehouse for this vitamin when produced, and that a reserve is set up in the animal during the summer months, by which it is enabled to maintain good health during the winter. It has been shown, too, that, as a consequence of the impoverishment of the store, the milk of a cow contains progressively less vitamin D as the winter months proceed. Milk and butter provide the most important dietetic sources of this vitamin; and for this reason, and because of the weakness of the sun's rays in winter, human kind suffer then impoverishment in respect of vitamin D, which is neither produced by the action of the sun's rays on their skins nor supplied in their diet in adequate amount.

Vitamin D appears to be necessary to the animal body for the proper control of the calcium balance, and a lack of it results in a depression of the phosphorus or calcium, or of both, in the blood. Moreover, the more cereal there is in the diet, especially oatmeal, the greater is the amount of vitamin D required. Its practical importance is by no means limited to the prevention or cure of rickets, but applies also to other conditions causing greater or less ill-health and suffering. It has, for example, already been shown by the admirable work of Prof. and Mrs. E. Mellanby that dental caries may be traced to a deficiency of vitamin D. From their work it would appear that, in a growing child, bone formation makes a first call on the calcium metabolism and may rob the teeth unless sufficient or an excess of vitamin D is provided. Indeed, dentists throughout England can point to innumerable examples of dental caries traceable to the substitution of margarine for butter during the War. In childbirth the drain on the mother is well known to result in dental caries, and there is strong reason for supposing that this could be prevented by the administration of more vitamin D.

The growth of population is such that the world production of butter is becoming insufficient to provide for all an adequate ration of vitamin D. Cod-liver oil provides another source of vitamin D, but irradiated ergosterol has the great advantage of being practically without taste. Moreover, it is less expensive, and being of standard purity the amount administered can be quantitatively adjusted with great accuracy.

The practical outcome is that the manufacture of ergosterol from yeast has been set up in Great Britain, and it is being irradiated commercially under proper scientific control with animal tests. Consequently vitamin D can be provided sufficient to meet the world's requirements. English manufacturers are issuing it in pellets or capsules and in oily solution, also in combination with vitamin A and malt extract, so that it is easy for all to make good the deficiency due to climatic influences during the winter months. Thus no time has been lost in applying this discovery of science to essentially practical ends.