rinted from British Medical Bulletin, Vol. 2 (1944),
10–11, pages 202–204.

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UTRITIONAL SCIENCE IN MEDICINE

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ritional research has now come to occupy a dominant tion in the study of problems both of health and of ogical science. In regard to disease, it began as a small e in 1897, when Eijkman correlated his observations on eri among Javanese prisoners with his experimental ts on polyneuritis gallinarum, finding that these con- ns in man and bird were both due to the consumption lished rice, and preventable by addition of the pericarp e grain. The flame was fanned by Holst and Frölich 07, when they studied scurvy in guinea-pigs and found t could be prevented and cured by something in fresh ables and fruits. As both beriberi and scurvy were seen in western countries, the average medical man not particularly interested in these clinical discoveries. s only in 1918, when it was shown by experiments on es that rickets, one of the most common diseases of e, was due to the absence from the diet of a fat-soluble nce associated with fish and animal fats, that the im- ce of diet in relation to human health and disease ppreciated.

ognition of Dietary Deficiency as a Cause of Disease

m 1920 onwards, the flame of dietetic and nutritional h became a fire extending over all countries of the In particular, the idea of " deficiency diseases "— diseases due to the absence from the body of specific al substances—was generally accepted. It was re- ed that, for the maintenance of health, certain vitamins her accessory factors must be present in the food in

sufficient quantities, as the animal body was either incapa of synthesizing them, or its power in this respect was limi

It is now known that this idea of " deficiency diseases not always so simple as when Grijns first formulated i 1901, and that there are other dietetic and nutritional fac which often determine the development of such illnes Thus, the amount of aneurin necessary to prevent beri and allied conditions is governed by the amount of ca hydrate or alcohol also consumed ; similarly the amoun vitamin D necessary to produce perfect calcification of b and teeth is conditioned by the amount of calcium phosphorus in the food and their relationship to one anc In other words, there are sometimes positive as we negative factors to be taken into account in such dise

It would be unfair, in recording the successes that followed the establishment of " deficiency disease " factor in animal and human life, to forget that the id such an ætiology had been advanced so long ago as by Chatin, following extensive estimations of iodi foodstuffs, when he related the development of simple to a deficient intake of iodine. This hypothesis was, ho formally suppressed by the French *Académie des Sc* in 1860. The recognition, as a result of the discove Pasteur, Lister and Koch, that a major cause of disea the invasion of the body by micro-organisms, was resp for an outlook which made it difficult, and at th apparently impossible, to imagine a deficiency or a of something from the body as being a cause of disea was only the discovery by Baumann in 1895 of io the thyroid gland that allowed the resuscitation of C original hypothesis of the cause of thyroid enlargeme research from that time has more and more confir views.

If this disregard of dietary deficiency as a factor in were the only suppressive effect that could be ascr Pasteur's remarkable work, it would probably not ficiently important to stress here, but it must also be bered that it had a similar influence on the attitude to Bernard's hypothesis that many diseases are due

abnormal working of bodily processes which, when physio-
logical or optimal, result in good health. It will be remem-
bered that Claude Bernard claimed, on this basis, that medical science was essentially experimental physiology. This again was an overstatement of the case, but the success of the *nateries morbi* hypothesis, as achieved by Pasteur, Lister nd Koch, again delayed, but did not prevent, the ultimate cceptance of Bernard's hypothesis. Indeed the develop-nent of research on " deficiency diseases " has tended only o emphasize the truth of the Bernard teaching.

Dangers of a Specialized Outlook

There is surely a lesson to be learnt from these historical cts—namely, that we must avoid allowing the very success f research on the relation of nutrition and disease to cloak nd possibly even to suppress, temporarily at least, other thological hypotheses and theories. The specialist is the ckbone of medical, as of all research, but the concentration at leads to discovery is apt to be associated with blindness other views, and this must be guarded against. Probably e danger is not so great nowadays, when many more men d women are engaged in medical research and when blication of results is so easy and widespread, but it would well if the danger were more widely recognized. What is re likely to happen now is, not the suppression of new nts of view and new lines of scientific investigation, but too rapid development, and adoption as a fetish by an vertisement-goaded public, of new discoveries in medicine. s undesirable reaction as regards vitamins has not been ent from some countries, and scientific men ought to nbat it. Except in infancy and childhood, there are but instances where good health cannot be maintained by ng properly chosen food without the constant adminis-on of vitamin preparations.

Biological Problems

rveying now the general field of nutritional science, do we find? We see that physiologists and bio-nists, mainly by means of experiments on the growth of

young rats, have detected a large and increasing number o chemical substances which must be present in the diet, ofter in minute quantities, either for the maintenance of life itself or for proper growth. The chemical constitution of mos of these vitamins is known. The chemists' success ha indeed been great. But what about the biological side can it be said why these substances are essential and/or i what way they work? From this angle the success has nc been so outstanding: a biological problem is usually muc more difficult than a chemical problem, for the living ce and animal body are not limited in their actions by th known rules and regulations of the chemist's laborator Besides, the physiological technique which led to the di covery of many of these substances, namely growth in youn animals, is so crude, and the factors involved are so ma and complicated, that little knowledge of biological functi can be deduced from them.

Thus, there is hardly any knowledge of how the vitam work in performing their functions. Even when the ultim action of a vitamin is known, as in the case of vitamin whose main function is certainly so to control calciu phosphorus metabolism as to bring about the calcificat of bones and teeth, there is still no knowledge of hov works. Does it simply bring about the absorption fr the intestine of sufficient calcium and phosphorus to m tain these elements at an optimum level in the blood, lea the calcifiable tissues to select their needs from the bl stream, or does it actually assist the calcification proces the bones and teeth? Even when there is sure evid that vitamin D acts in either or both these ways, there still remain the problem of how it performs these funct Does it, for instance, form part of an enzymic com analogous to the co-carboxylase in which vitamin I known to participate? In the case of vitamin D we ha least reached the stage of formulating the problem, an same applies to vitamin K, but with most other vitami have not even reached this stage. Clearly this is a challenge to all interested in experimental biology—ph logists, biochemists, pathologists, pharmacologists

linicians. To pathologists the appeal is specially strong, ven to those concerned with morbid anatomy, for one utstanding result of modern work on nutrition is that it is radually making that subject into an experimental science. ew things are more interesting than to see how, one by one, is becoming possible to reproduce under experimental etary conditions the long-known classical changes seen in orbid tissues, one of the most interesting in recent times ing the fatty infiltration, necrosis and cirrhosis of the liver duced by dietary defects of choline and the amino-acid ethionine.

Nutrition and Infection

Nothing seems to be more certain than that nutritional ect is at least part of the ætiological basis of many of the re common illnesses, and yet, in most of these cases, this nly conviction without satisfactory proof. For instance, vill probably be found that a dietetic or nutritional factor nvolved in the ætiology of enlarged tonsils and adenoids, tic ulcer, diabetes mellitus, pernicious anæmia, arterio-rosis and rheumatic disease. The relation of nutrition nfection remains an unsolved problem, but that there is a relationship is not to be doubted. Tuberculosis and r infective diseases increase when the nutritional con-n of a population is greatly lowered. What is even more in is that in badly-fed populations infective invasions by o-organisms are much more deadly than in the well-fed. the great field of investigations which lies before us, we keep a balanced view of the relative importance of the factors—infection and resistance to infection—as in-ed by nutrition. The bacteriologist and epidemiologist at times, be inclined to lay all stress on the infective s and the pathogenicity of the micro-organisms ; the onist, on the resistance of the body. The relative ance of these factors will no doubt vary greatly in articular infective process studied, but that both must arded as of major importance in many cases is un-d. We have recently seen how fruitful has been the of some chemotherapeutic agents, especially the

sulphonamides, when considered from the point of view the chemistry of the bacteria upon which they act, and it not to be doubted that knowledge of the chemical proces which underlie the toxic action of pathogenic micro-organis and the resistance of the tissues to them, and of how th are affected by nutrition, will shed great light on infect disease. In some cases it may even be found that pass of an infective agent through a series of people in g nutritional state will lower the pathogenicity of the invad micro-organisms.

In some types of infection it will probably be found diet, acting during the period of development of the affe tissues and after their formation, is the main contro factor as, for instance, in dental caries, gingivitis and p dontal disease. In other cases good nutritional condit may only modify the severity of the disease by increasing resistance of the body to the infective agent, as for inst in tuberculosis, while in some types of infection the and nutritional state may have little or no effect on incidence and severity of the condition.

To what extent, if any, dietary factors will be foun have a specific anti-infective action remains for futu vestigation. Some investigators on nutrition have al had experience in the search for this El Dorado, and in sequence regard the problem with more respect. No could have been more promising than the indications specific anti-infective action of vitamin A in young which die almost without exception with multiple inf foci when deprived of vitamin A, and recover rapidly vitamin or carotene is added to the diet within reas time. In endeavouring to extend these facts to ba infection in human beings two points were not realized first, that rats hold a special place among animals in susceptibility to infection when deprived of vitam because of their great liability to develop hyperplas metaplasia of epithelial surfaces under this condition second, that it seldom happens that human bein deprived of vitamin A to the extent produced experim in the rat experiments. Although it is undoubted

at a great deficiency of vitamin A in the body lowers man's sistance to bacterial infection, it is improbable that a degree deficiency of this vitamin, such as is met with in Britain nd comparable countries, is an ætiological factor in in-ctive disease of great significance, except possibly in infants. or is there any substantial evidence in the case of vitamin A at added resistance to infection results from giving more it than is physiologically needed. Indeed there is but le evidence that giving amounts of any vitamin larger than ose physiologically necessary makes the body functionally ore effective. An exception to this is nicotinamide which, larger doses than are necessary for health, appears to duce an effect on the neuro-muscular mechanism in man ich lowers the time needed to carry out strenuous exercises ociated with good co-ordination.

Nutritional Science and Food Policy

Var conditions in Britain have made it essential for the ntenance of health that modern knowledge of nutrition evealed by research should play an important part in ing food policy. War-time food policy in this country, arried out by the Ministry of Food, is described in a rate article below.* It might be of interest to say some-g from the point of view of the scientist on this question. an be said at once that during war-time nutritional rts in Britain have had an opportunity to express their s and to give their advice either through the *Medical arch Council* or through the Food Policy Committee of War Cabinet. Generally speaking, actions by the stry of Food have followed the lines of this advice, times on the basis of its nutritional advantages to the n, and occasionally because the shipping and economic tions enforced its adoption. As the scientists' advice od policy in war-time was based on both of these factors, ne to the same thing in the end, but this will not arily continue to be so when the time comes to adopt g-term policy for the days of peace. When that time

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* [*see BMB* **492**]

arrives, policies dependent on scientific and economic factors respectively will often be divergent and, unless the nutritional needs of the people are given precedence over economic claims, much of the progress in health standards of the population may be lost.

The war has emphasized the lesson that in industrialized countries two foodstuffs have pre-eminent claims to nationa control. The first is milk and the second cereals, especiall bread. So far as milk is concerned, the policy of Britai is satisfactory and will probably remain so in peace-tim In this case the Government policy to ensure that all pregnar and nursing mothers and all infants and children receiv if they so wish, a reasonable quantity of milk can only b commended. It is true that in war-time many adolescen and adults have had to go short of milk, especially in th winter months, and it is also true that too high a proportio of the milk is neither clean nor bacteriologically safe. Dete mined action is required both to increase the supplies and improve the quality, and the Government seems inclined press on with both of these policies.

The Bread Question

In the case of cereals and cereal products, the situatior not so satisfactory. Bread made from wheat has in the p formed, and undoubtedly will in the future, a substan part of the British diet. The bread eaten before the war made of a low-extraction flour (70 to 73 % of the ber and consisted entirely of the endosperm, while the bı aleurone layer, scutellum and embryo were extracted by millers and sold for cattle, pig, and poultry food. T most of the vitamin and mineral contents of the wheat b which are known to be essential for health went to anin while the residue formed a substantial part of human diet Nutritional scientists are agreed that this policy is wr but unfortunately there are two schools of thought as to best method of dealing with this important national prob One school, represented by British scientists, thinks bread for human consumption should be made of flour taining as much of the wheat berry as is physiolog

sorbable, i.e. the whole grain except for the outer coarse an. The second school, represented by some North- nerican scientists, thinks that flour should be of the old v-extraction, white type, with the addition of those vitamins pared by synthetic or other methods which are known to present in the original berry. This second method is sed on the assumption that the main vitamin contents of eals are known, and that their physiological importance the body is understood. These assumptions many physi- gists will find difficult to accept. It is probable that the icy of the British Ministry of Food in war-time as regards ad production, namely of producing 85%-extraction r with a minimum of fibre and with high vitamin-B_1 and content, has depended more upon shipping difficulties upon nutritional grounds. Consequently, when the ping situation is eased, there will be a powerful move to n to the meretricious attractions of the old white bread for an consumption, thus releasing to the farmer, poultry- er and manufacturer of proprietary food-products more e valuable offal for their own purposes. Possibly as a re to those with knowledge of nutrition there will be d to the bread aneurin, nicotinamide, riboflavin and as is now being done in North America.

is solution of the bread problem, which consists ially of depriving flour of most of the chemical entities eat which are necessary to life and then restoring a few ese substances, seems wrong in principle. In fact, ethod is also wrong, because the low-extraction white will undoubtedly be more and more eaten in tropical ther countries in which the addition of the vitamins t take place. There will be a repetition of the polished ory, only in this case it will be soulless bread.

Need for International Agreement

obvious that scientists of different countries cannot o differ on this important question of the best utiliza- available foodstuffs. In the case of cereals, and par- bread, it is very desirable that after the war they come together and see whether they cannot reach

agreement on the optimum composition, both from a nutr tional and from an æsthetic point of view, of those cere preparations which form such a large proportion of th normal diet. The path to such an agreement in policy ha already been blazed by the Health Section of the League Nations. This body achieved the outstanding feat, both setting up international standardization of vitamins, and al of determining standards of nutrition in terms of comm foodstuffs. Probably after the war either this body or successor will be able to bring about further internation co-operation in matters of diet and nutrition and, amo other things, agree on a common policy as regards optimal composition of bread and other cereal produ It may be that new milling techniques will have to be int duced to secure the production in peace-time of bread wh fully accords with the principles advocated by Bri scientists: namely, bread made from a flour which conta all the nutritionally important contents of the wheat b and is at the same time æsthetically excellent.

All that is demanded is that the factor controlling the stitution of bread should be primarily the health of the sumer, and that milling and other interests should be secon to this condition. Indeed, no nutritional policy adopte governments can be wrong if it places the health and needs of the community as its first and guiding princip

Printed by Spottiswoode, Ballantyne and Co. Ltd.,
Colchester, London and Eton