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FOOD STORAGE AND TRANSPORT

THE problems of storage and transport of food have troubled men ever since they began to crowd into cities and to attempt to live at any density in northern latitudes. A diet of the cereals that made these developments possible is obviously monotonous ; less obviously, but as inevitably, it is inadequate to maintain health. The three chief deficiency diseases that are recorded as causes of deaths—scurvy, beriberi and pellagra—are associated with diets consisting too exclusively of the three great cereals—wheat, rice and maize. In England scurvy was common until the introduction of potatoes and root crops, which supply vitamin C directly to human beings, or feed animals that will provide fresh meat and milk.

War brings back the old problem in an acute form. Armies are transported to places where they cannot get fresh food, and civil communities are cut off from their normal supplies. During the War of 1914–18, in spite of the relatively high standard of nutrition maintained and the recognition of the relation of these diseases to diet, British troops in Mesopotamia suffered from scurvy and beriberi, and small epidemics of scurvy appeared in Britain when potatoes were scarce in 1917. When the diet is uniform and monotonous the effects of any deficiency become cumulative ; hence the frequency of beriberi in prisons and asylums. Soldiers and others who live on fixed rations, if these are not soundly planned, are liable to deficiency diseases ; while civilians, though their food supply may be less well cared for, escape because they get a greater variety of diet and may protect their health by what may appear to be extravagances and indiscretions. The rations of British troops[1] in the Mediterranean in 1915, and even the diets of Armenian refugees at Port Said[2] in 1916, would have seemed luxurious to German civilians in 1917 ; but the soldiers got beriberi and the refugees pellagra, while the Germans suffered from neither.

The more the exigencies of war limit our food supply the more should we aim at maintaining a variety of foodstuffs and insist that these should keep their full nutritive value. We should not depend on supplements of vitamins. The diets given to British soldiers in the Mediterranean area during the 1914–18 period were planned on the basis of knowledge as it had stood a few years before ; but they proved deficient. It would be presumptuous to assume that we now know the whole range of our nutritive requirements and that a diet made up artificially, on the basis of knowledge as it stands now, would be complete. We must still depend on natural foodstuffs for our nourishment and use vitamin supplements only as a last resource.

Two vitamins, obviously, need to be considered—A and C ; for the supply of vitamin A is reduced by the loss of imports of butter (33 per cent of the supply in 1938 came from areas now in enemy hands) and that of vitamin C by the restriction of the imports of citrus fruits. We depend mainly on vegetables to make up the lack of these two vitamins. In the early

months of the year, when green vegetables are scarce, supplies of both fall below the amounts considered necessary. Preserved vegetables would help us to tide over this period. Soldiers who have to depend on food transported from a distance are liable to go short of vitamin C at all times of the year, and they may get little vitamin A from sources such as butter; preserved vegetables that retain their vitamins are therefore a necessary part of their rations. Apart from these more obvious examples, the supplies of nicotinic acid, riboflavin and animal protein are reduced by the shortage of meat. We should, therefore, aim at conserving these two vitamins and the biological value of proteins in any foods that are preserved.

The conditions of the present War modify the problem; they enhance the importance of transport as compared with storage. Owing to difficulties of shipping, weight and bulk must be kept to a minimum. So far as the supplies of the people of Great Britain are concerned, one solution is to limit imports to foods, such as wheat, that contain little water, and to produce the perishable foods at home. But this does not solve the problem of the soldier abroad, who depends on shipping for the whole of his rations. However, half or more of the weight of most of the perishable foods is made up of water. If this could be removed the tonnage required for their transport would be correspondingly reduced. We need, therefore, a method by which foodstuffs can be dried, without loss of their nutritive properties, rather than preserved in other ways such as canning.

Attempts have been made, from the earliest times, to preserve the perishable foods, more in order to provide variety than to safeguard health; but these attempts were not wholly successful; the products were not even palatable. In England the stored meat became high during the winter; strong spices were needed to mask the taste and prodigious quantities of beer to wash down the spices. The vicious tradition of strong sauces and pickles and the less noxious habit of copious beer drinking had once their justification. During those phases in the history of scurvy in which the relation of the disease to lack of fresh fruits and vegetables has been accepted, efforts have been made to prepare dried vegetables for use as antiscorbutics. During the War of 1914–18 the only vegetables in the rations of the Austrian army were dried by a process in which an influential personage had an interest. They were popularly known as "barbed wire"; the discontent caused by these bad rations contributed much to the collapse of the Austrian army. All attempts at the preservation of fresh vegetables failed for reasons that we now understand. The processes of canning fruits, by which some of the vitamin C is preserved, were developed in order to provide variety; the improvements of the commercial processes, which ensure that very little of the vitamin C is destroyed, have been dictated more by the desire to preserve the flavour than by any thought of nutritive value.

The present need to economize shipping has stimulated new efforts to preserve foods by drying without loss of palatability and nutritive value. The methods have made use of recent discoveries in connexion with the loss of vitamin C in cooking. Until a few years ago, it was thought that the vitamin C in vegetables is destroyed rapidly when these are heated in presence of air, in the same way as it is in simple solutions. It was therefore natural to suppose that the best way of drying vegetables would be to freeze them and then evaporate water under reduced pressure. The product obtained by this method is bulky, and owing to its open structure very susceptible to the water vapour of the atmosphere. It is now realized that the ascorbic acid is more stable when in plant tissues; but that an enzyme present in the cells destroys the ascorbic acid when the tissues are damaged by bruising or by heat. The main lossess in cooking are due to three processes: first, the action of the enzyme during the period that elapses after the heat damages the cells and before it destroys the enzyme itself; second, the extraction of the ascorbic acid by the water in which the vegetable is cooked; and third, and least important, destruction by heat and oxidation, without the assistance of the enzyme, as in simple solutions. Losses in cooking can be reduced to a minimum by heating up the vegetable rapidly to boiling point, in order to give the enzyme little time to act, and by using cooking water repeatedly so that the concentration of ascorbic acid in it approaches that in juices of vegetables. In the same way, the losses in drying are due to the action of the enzyme.

The extent to which modern knowledge has been foreshadowed in the past is remarkable. For not only had the essential role of fresh fruit and vegetables for the prevention of scurvy been demonstrated and forgotten repeatedly up to 1916, but so far back as 1757 Lind wrote that when the Lords of the Admiralty proposed that dried vegetables should be tried as antiscorbutics "it was objected by the very ingenious physician [Dr. Cockburn] that no moisture whatever could replace the natural juices of the plant lost by evaporation and, as he imagined *altered by a fermentation that they underwent in drying*". Change "fermentation" to "enzyme action" and the words of the very ingenious physician might be written to-day.

If vegetables are first scalded rapidly, the enzyme is destroyed and they can then be dried in a current of air, without special precautions save that the temperature should not rise above 80° C. Vegetables dried in this way and later cooked contain as much ascorbic acid as do cooked fresh vegetables. Loss of carotene (which is the precursor of vitamin A) can be avoided. Meat treated by preliminary short cooking loses none of its nicotinic acid and riboflavin. From the point of view of nutritive value the difficulties of drying have been overcome. Yet people will not eat foods, however great their nutritive value, if they are not as palatable and attractive in appearance as those with which they are familiar. Many families in Great Britain have gone short of animal protein this year, although they could get unlimited supplies of skim milk powder. Fortunately, palatability and appearance seem to run parallel with nutritive pro-

perties. The preserved vegetables are eaten as readily as fresh, and dehydrated meat will serve one of its most important functions in modern diets—that of providing flavour. As ascorbic acid can be estimated without difficulty, it should be possible to guarantee the general qualities of dried vegetables by insisting that they should contain specified amounts of ascorbic acid. The new method is commonly called dehydration to distinguish it from the old drying processes in which nutritive value was lost.

It is probable that the drying plant in Great Britain, in the immediate future, will be no more than sufficient to meet the needs of troops. It is to be hoped that, at some time in the future, it will be possible to use dried vegetables to add to the civilian supply of vitamins C and A during the early months of the year. The process seems so simple that it should be possible to make an efficient domestic dryer. Storage in air-tight receptacles should not be necessary, as the dried vegetables keep their ascorbic acid for some months when exposed to air.

After the armistice of 1918, the great shortage of shipping and the crippled state of the railway systems of Europe hampered and delayed the relief of the urgent scarcity of food east of the Rhine. When hostilities again cease, the available shipping will again be insufficient, the railway systems more severely damaged and the need for food will be even more serious. The difficulties of transport are recognized as one of the obstacles to the relief of famine. The diets recommended by the Health Organization of the League of Nations[3] for famine relief are made up of dry foods, cereals, milk powder and cod liver oil; they do not provide vitamin C. Dehydrated foods should be most valuable in supplying a more satisfactory diet.

When the urgent demands of famine relief have been met, a new problem will arise if our promises are taken seriously. We have guaranteed that no one in any part of the world shall suffer from want. It should be comparatively easy to ensure that no people go in want of food energy. In peace-time there is no gross shortage of food energy, when crops are normal, in any part of the world. An International Famine Prevention (not Relief) Organization could keep a watch on crops throughout the world and keep a stock of cereals that could be shipped to any area where a bad crop was anticipated. But it is perishable foods which are scarce. The best final solution would be that some of these perishable foods should be produced in countries which are specially suitable, and transported to other parts of the world, while a considerable proportion should be produced where consumed. This local production is both convenient and economical, as one-type agriculture is in the long run unsound. But it involves the reorganization of agriculture and a redistribution of the population of the most congested areas.

This will all take time, and in the interval these perishable foods must be imported from other countries in some form suitable for transport; again, dehydration should lessen the difficulties of the task. The production of the quantities of those foods that will be required will involve an enormous expansion of plant, and this expansion will raise problems of materials and labour, which will have to be apportioned between these and other projects. This process of reconstruction will involve a gigantic co-ordinated scheme, and it will come to nothing if it is not thought out beforehand. No speeches, declarations or charters will, by themselves, make the fruits of the earth fall into the lap of the Indian coolie or even of the peasant of south-eastern Europe.

[1] Med. Res. Council, Special Report, **167**, 248 (1932).
[2] Wilson, W. H., *J. Hyg.*, **20**, 1 (1920).
[3] *Bull. Health Org.*, 7, 677 (1938).

MAN'S RELATION TO THE LIVING WORLD

The Discipline of Peace

By K. E. Barlow. Pp. 214. (London: Faber and Faber, Ltd., 1942.) 8*s.* 6*d.* net.

THIS stimulating little volume makes an admirable complement to Lewis Mumford's "Technics and Civilization", which contains indeed the essence of Dr. Barlow's argument. Whereas Mumford is concerned primarily with the effect of the machine on man and how man is to regain control over mechanization, Dr. Barlow's approach is from the biological side, and he is concerned with the effect of man's interference with the balance of Nature. The importance of these ecological considerations, alike for our war effort and for post-war reconstruction, is slowly being realized, and Dr. Barlow's volume should materially assist that process of education.

The main argument of the book is that since man lives by the living balance of Nature—soil, plant and animal woven together in a vast balanced system—it is important that man should ascertain how his own character is related to the rest of life and how his machines link up with it. Only against this background can our essential social problems be understood. Justice and the association of man with his fellows in a commonwealth of peace are only possible when an attempt is made to administer the commonwealth of mankind for the benefit of mankind. If man is to enjoy the fruits of his estate, he must first recognize what is due to the natural world by which he lives, and become the responsible manager and administrator of Nature and no longer the mere exploiter.

It is one of the tragedies of the present situation that just when the ecological argument which Dr. Barlow ably sustains in his chapter on soil erosion is becoming more widely appreciated, the exigencies of total warfare are leading to further exploitation of natural resources and disturbances of the balance of Nature on a scale and in terms of a short-range policy, which it may take the work of generations to repair. On the other hand, as Dr. Barlow points out, the change back from war economy to peace economy fortunately involves an inevitable reorganization of industry which may well give us the opportunity to strike a new balance between industry and agriculture, though it would be rash to assume that the implications of the reactions of food, flood and agriculture are as yet fully or widely grasped. That is an essential preliminary to the development of the adequate organization, and the recognition in a