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Economic Advisory Council

Committee on Nutrition in the Colonial Empire

FIRST REPORT—PART I

NUTRITION IN THE COLONIAL EMPIRE

Presented to Parliament by Command of His Majesty
July, 1939

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FOREWORD BY THE SECRETARY OF STATE FOR THE COLONIES.

One of the most far-reaching of recent political developments has been the steady broadening of the foundations of social policy and the extension over an ever wider sphere of the responsibilities of Government. A significant example of this can be found in the subject of this report, the problem of nutrition. It is only within the last few years that the importance of this question has begun to be fully appreciated and that it has entered people's heads that Governments should seriously and actively concern themselves about it.

While Mr. J. H. Thomas was Secretary of State for the Colonies he sent a circular despatch to all Colonial Governors drawing their attention to the subject and asking them to submit reports upon the standards of nutrition in their territories. Their replies provided a mass of very interesting and valuable information. It was accordingly decided to appoint a Committee of the Economic Advisory Council which would first of all consider these replies and make recommendations, and would thereafter remain in being to advise on nutritional matters.

I feel sure that it will be generally agreed that the report which the Committee have now presented is a most useful document, of all the greater value because of the full summary of information which they have provided in Part II as the background against which the conclusions of Part I should be read and judged. The fact that Colonial Governments have already ordered over four thousand copies of the Report indicates impressively the importance which they attach to it, and the wide distribution which they contemplate. I hope that it will also be studied by employers of labour in the Colonial Empire, by missionaries and by all others interested in the welfare of its people.

The question of nutrition should affect a great many aspects of Colonial policy, and the Committee have attempted with a large degree of success to cover all these aspects and to reach conclusions which will assist Colonial Governments to take practical steps to improve nutrition. In a report which deals with such a large variety of Dependencies many of the conclusions are naturally of a general character. It will be for each Colonial Government to consider the particular application of the many ideas and recommendations in the report to its own territories, and I am requesting Colonial Governors to keep me informed of the action taken.

His Majesty's Government are deeply indebted to the members of the Committee for the preparation of a report which will, I am confident, do much to promote wise policies and improved standards of nutrition in the Colonial Empire.

MALCOLM MACDONALD.

COMMITTEE ON NUTRITION IN THE COLONIAL EMPIRE.

Terms of Reference and Composition.

On the 23rd October, 1936, the Prime Minister appointed a Committee of the Economic Advisory Council with the following terms of reference:—

(*a*) to survey the present state of knowledge in regard to nutrition in the Colonial Empire in the light of the replies received to the circular despatch addressed by the Secretary of State for the Colonies on the 18th April, 1936, to the Officers Administering the Governments of Colonial Dependencies;

(*b*) to advise from time to time as to the measures calculated to promote the discovery and application of knowledge in this field.

2. The Committee is constituted as follows:—

The Rt. Hon. Earl De La Warr, President of the Board of Education, *Chairman.*

Professor E. P. Cathcart, C.B.E., M.D., D.Sc., F.R.S., Regius Professor of Physiology, University of Glasgow.

Mr. G. L. M. Clauson, C.M.G., O.B.E., Assistant Secretary, Colonial Office.

Miss P. C. Esdaile, D.Sc., Reader in Biology, University of London.

Dr. Raymond Firth, Ph.D., Reader in Social Anthropology, London School of Economics.*

Professor N. F. Hall, Director, National Institute of Social and Economic Research.

Dr. J. M. Hamill, O.B.E., M.D., D.Sc., Senior Medical Officer, Ministry of Health.

Mr. Francis Hemming, C.M.G., C.B.E., Secretary, Economic Advisory Council.

Mr. E. M. H. Lloyd, Assistant Director, Food (Defence Plans) Department, Board of Trade.

Sir Edward Mellanby, K.C.B., M.D., F.R.C.P., F.R.S., Secretary, Medical Research Council.

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* Succeeded Miss Audrey Richards, D.Sc., on February 21, 1938.

Dr. A. J. R. O'Brien, C.M.G., M.C., M.R.C.P., D.P.H., Chief Medical Adviser to the Secretary of State for the Colonies.*

Sir John Orr, D.S.O., M.C., M.D., D.Sc., F.R.S., Director, Rowett Research Institute.

Mr. H. S. Scott, C.M.G., late Director of Education, Kenya Colony.

Sir Frank Stockdale, K.C.M.G., C.B.E., Agricultural Adviser to the Secretary of State for the Colonies.

Mr. Hanns Vischer, C.M.G., C.B.E., Secretary, Colonial Office Advisory Committee on Education.

Mr. D. H. F. Rickett, Assistant Secretary, Economic Advisory Council.

Mr. C. G. Eastwood, Colonial Office.

Joint Secretaries to the Committee.

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* Succeeded the late Sir Thomas Stanton, K.C.M.G., M.D., F.R.C.P., on February 21, 1938.

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CHAPTER I.

INTRODUCTORY.

As our terms of reference indicate, our work as a committee originated in the circular despatch which on the 18th April, 1936, was addressed by the then Secretary of State for the Colonies to the Officers Administering the Governments of all Colonial territories. The purpose of that despatch, which we print as Appendix 1 to our report, was to draw the attention of Colonial Governments to the increasingly important position occupied by the question of nutrition in public health work and in general administration policy in regard to agriculture and many other matters. It also asked for a comprehensive report from each territory upon every aspect of the question.

2. The replies received from Colonial Governments to this despatch formed the primary material on which we have based our study of the question of nutrition in the Colonial Empire. They represented in the aggregate a formidable mass of documents far too voluminous to be published in full. At the same time they seemed to us to contain material of unique value not hitherto generally available. In some cases the reports prepared by local nutrition committees have been published locally. A list of those so published will be found in Appendix 2 to this report. But it appeared to us desirable that some means should be found to present within a reasonable compass a general picture of the conditions prevailing in regard to the nutrition of the peoples of the Colonial Empire. Such a document would, we felt, serve a number of purposes. Not the least important of these would be to provide stimulus and guidance to Colonial administrations, by furnishing them with information regarding the similar problems met with, and the measures taken to deal with them in other territories. It should, furthermore, represent a valuable addition to the growing body of information which is now being assembled, notably through the agency of the League of Nations, on the problem of nutrition in many countries. A summary of the information contained in the material before us has accordingly been prepared and appears as Part II of this report. In arranging for this document to be prepared we were fortunate in securing the co-operation of the Imperial Bureau of Animal Nutrition, and we are indebted to Dr. F. C. Kelly, B.Sc., Ph.D., at that time Deputy Director of the Bureau for the work which he did for us.

3. During the preparation of this report there has occurred the death of one of our members, Sir Thomas Stanton, K.C.M.G., M.D., F.R.C.P., who, at the time of his death was Chief Medical Adviser to the Secretary of State for the Colonies. The subject of our report was one which he had very much at heart and we wish to take this opportunity of expressing our deep sense of the loss which we have sustained by his death.

4. The present volume falls into two sections. In the first, Chapters II to V, we lay down the general principles for correct nutrition and discuss how far existing Colonial diets differ from these principles and what the effect of these differences is. In the second and perhaps more important part of our report, Chapters VI to XV, we discuss the various means for effecting improvement.

5. In the preparation of this volume we have received assistance from many sources, too numerous to mention in detail. Our thanks are due to them all. Special gratitude is due to Dr. B. S. Platt, who besides giving assistance in the preparation of various sections of the report, has also contributed a Memorandum of great value on rice and its importance for human nutrition, embodying the results of several years' work in the Far East. This we attach as Appendix 6 to our report.

CHAPTER II.

THE IMPORTANCE OF THE PROBLEM.

6. It will be seen from the Summary of Information which we print as Part II of our report how extraordinarily diverse is the material which we have had to handle. It relates to no less than forty-eight different territories with an area of well over two million square miles. It concerns a population of rather more than fifty-five millions of people of the most diverse ethnological origin, widely separated from each other in space and character and divided into countless groups having the most different food habits and customs that it is possible to imagine. What contrast could, for example, be greater than that between Hong Kong, with its dense population, mostly Chinese by race, its reliance on shipping and entrepôt trade and its dependence on imported foodstuffs, and almost any of the African territories, vast in extent and for the most part thinly populated, where imports of foodstuffs per head are negligible in value and a large part of the people obtain their support from subsistence agriculture; or between either Hong Kong or an African territory and the Falkland Islands, with a small population, all of European origin, mostly living a rural life and engaged in sheep farming? Again, even within a single territory the sharpest contrast may exist between the manner and conditions of life of two communities living in close proximity. Leaving aside the contrast introduced by immigrant communities such as Europeans or Indians in Kenya, Chinese or Indians in Malaya, there are sufficiently strong contrasts among the indigenous peoples themselves. For instance, there is the well-known case of the Kikuyu and the Masai tribes in Kenya, close neighbours of one another, the one living on a vegetarian diet chiefly of cereals and sweet potatoes, the other on a diet chiefly of milk, meat and blood. Parallel examples might be quoted from almost all the other African territories and from several Dependencies outside Africa.

7. We have found this variety of conditions fascinating but bewildering. It is because of this diversity that in spite of the very considerable body of information which we have had before us, much remains to be added before we can lay claim to a complete understanding of the problem. Nevertheless the very variety of the material has increased the scientific interest, for it provides opportunity to study the interplay of race and

environment from which the nutrition worker may learn much of the connection between diet and health.

8. This diversity of conditions would have been more manageable if we had felt that we had a securer basis of scientific knowledge on which to work. The science of nutrition is still young. " Thirty years ago," as was pointed out in the circular despatch, " it was generally believed that the dietary requirements of human beings are satisfied so long as they have a large enough quantity of food to eat. It is now known that the adequacy of a dietary depends on the presence of a number of factors and that with quantitative sufficiency there may be qualitative defects producing the most serious physical consequences." So much is known but even in regard to European conditions more detailed conclusions are still liable to be upset by fresh discoveries. Far less is known of conditions in tropical countries. On the medical side we are at the stage where almost every generalisation must still be regarded as tentative. While it is possible to say that some diets are obviously inadequate and others are more nearly adequate, we do not know at all exactly what are the minimum requirements for satisfactory nutrition in tropical countries. While we know that an improper diet through its enfeebling effect contributes to the prevalence or at least to the severity of many tropical diseases, such as malaria and various forms of worm infection, we do not know at all precisely to what extent this is so. While we know broadly the chemical composition of the main foodstuffs we do not know to what extent this composition varies according to the locality in which they are grown and the treatment which they receive before consumption, nor do we know how far these chemical constituents are available to the person who consumes the article, nor how that availability is affected by ill-health and disease. In regard to the more obscure and sometimes picturesque foods which figure in many tropical diets, we know little or nothing except that they are probably of considerable dietary significance. In East Africa, for instance, several hundred different kinds of wild green leafy vegetables are used as relishes or side dishes at certain seasons of the year. Their importance in the dietary is almost entirely a matter of conjecture. Similarly the exact dietetic significance is still unknown of the grubs, wood lice, caterpillars, locusts and flying ants which are largely eaten in tropical Africa, of the eggs of megapod and turtle consumed in certain islands in the Western Pacific, and of many other articles of colonial diet.

9. It will be appreciated that in view of the astonishing variety of conditions and the absence of exact knowledge it is very difficult to draw any general conclusions. Certain broad conclusions seem to stand out and these will be found stated in later sections of our Report. Even these, it is obvious, may need revision when fuller knowledge is available.

10. Of one conclusion, however, we have no doubt and that is the great importance of the subject. The Secretary of State in his circular despatch expressed the view that there was no doubt that the potentialities of improved nutrition in affecting not only public health but also the economic and agricultural problems of the day were great. " On the public health aspect, there can be little doubt that every part of the Colonial Empire would benefit from an improved nutrition of its peoples. On the economic and agricultural aspect, while I doubt whether the Colonial Empire has at present any substantial contribution to offer, by way of increased consumption, to the solution of world problems (the monetary resources both of its Governments and of its peoples being too slender to enable them to increase more than slowly their purchases from abroad), I do feel that within its own borders increased attention to dietetic needs might well lead to an amelioration of some of its own economic problems. Not only will greater consumption of foodstuffs within each territory, small though it be in terms of world consumption, increase the local market for local food products, but also expenditure on improved nutrition may well be directly remunerative itself, leading as it should to a greater well-being, greater efficiency in production and less waste of human life and effort." The attention which we ourselves have devoted to the subject only confirms the remarks quoted above. We have no doubt that improved nutrition will bring very great benefit to the Colonial Empire. In saying this we do not have primarily in mind the eradication of deficiency diseases, though that is in itself an important enough field for work. More important than the effect of malnutrition in directly producing disease is its effect in producing general ill health and lowered resistance to other diseases, inefficiency of labour in industry and agriculture, maternal and infantile mortality and a general lack of well-being. There can for instance be no reasonable doubt that wrong feeding is one of the principal causes of the very high infantile mortality which prevails in most Colonial territories. On this subject alone, there is an immense field for improvement. The aim then of those concerned with nutritional policy should not be only the negative one of eradicating deficiency diseases but the wider and more positive aim of securing, so far as economic circumstances and medical knowledge permit, that the populations under their charge secure optimum nutrition.

11. We have found some difficulty in setting bounds to our report. The subject of " nutrition " is not clear-cut and it has no well-defined boundaries. On the contrary it has bearings on almost every aspect of Government activity. It affects the policy of Governments on economic matters generally, on health and medicine, agriculture, animal husbandry, customs and education; it affects not only the central Governments but also the district administrations, municipal and local authorities and

all employers of labour. On the health side, the question of nutrition is intimately related to the prevalence of disease and to many aspects of public health work. We have felt bound to deal at length with questions relating to maternity and infant welfare services. With agricultural questions also we have felt it necessary to deal at some length. We have also included what we hope is a comprehensive survey of the means of social welfare propaganda in primitive communities. We hope that in interpreting them thus widely we have interpreted our terms of reference aright.

12. A large part of our Report is taken up with a discussion of the causes of malnutrition and the possible remedies. In discussing these remedial measures we have endeavoured to insist on the necessity of a realistic and practical approach to the problem. In Colonial conditions it is not useful to say that the aim should be that every man, woman and child should consume four or five or six pints of milk a week and that until they do so they cannot be well nourished, for such a state of affairs is far beyond the realms of possibility. Sometimes it is not useful even to say that they should drink more milk than they do at present, for very often they drink none at all and it is hard to see how they can in any measurable period of time be brought to drink any. This indeed is one of the most striking things about our inquiry, namely the almost complete absence from tropical diets (with a few exceptions) of milk and indeed of animal products generally, and the impossibility at present of supplying them in anything like the quantities which are normally regarded as adequate in European conditions.

13. There may be those who say, " How then can anyone in the tropics ever be properly nourished? " We are not among those people. It *must* be possible for all except the very young to whom milk supplies are available from natural sources, to obtain adequate nutrition on little or no milk. Certainly it is possible to make the degree of nutrition much better than it is at present even though sufficient supplies of milk are not available. There is, however, no easy formula to be laid down. The kind of diet that will give the best result must be worked out on the spot for each territory, having regard to the conditions of local agriculture and the purchasing power of the community. It is only with a full knowledge of local conditions that it is possible to specify what supplementary foodstuffs should be introduced into the diet. We have made, however, in Chapter VIII a number of suggestions of a general nature which will, we hope, be of value.

14. There is no doubt in our minds that over a large part of the Colonial Empire one of the most important causes of malnutrition is the low standard of living of many of its inhabitants.

The foodstuffs which they themselves produce, supplemented by money obtained from the sale of produce, wages or some other source is very often insufficient to provide adequate nutrition in addition to all their other needs. Ignorance no doubt is also a very important factor in the problem, particularly in such matters as infant welfare, and much can be done at the present economic level to improve nutrition by education, welfare services, the introduction of new crops and so forth. Much too can be done to secure adequate nutrition at the present level by increasing the quantity and variety of foodstuffs that a man grows for his own consumption, for all our evidence goes to show the importance of this. But when all is said and done we cannot get away from the fact that the present economic level is, broadly speaking, not high enough. The problem is fundamentally an economic problem. Malnutrition will never be cured until the peoples of the Colonial Empire command far greater resources than they do at present. With a few unfortunate exceptions the wealth of Colonial Dependencies has increased and, with temporary fluctuations, is increasing, but it must increase much further before the nutrition problem can be solved. From a nutritional point of view, therefore, the constant aim should be so to increase the resources of the colonial peoples that they are able either to purchase or to grow the foodstuffs needed for satisfactory nutrition.

CHAPTER III.

THE PRINCIPLES OF CORRECT NUTRITION.

(*a*) The Food Requirements of the Body.

15. Although a proper supply of food is not the sole requirement for a state of good nutrition, nor an improper dietary the one and only cause of malnutrition, there is no doubt that normally the food a man consumes is the most important factor in his state of nutrition. Furthermore, although our knowledge of the fundamental processes, metabolic and otherwise, which underlie the state of nutrition is still very defective, it can at least be stated categorically that the food supplied must be adequate both in quantity and quality. This statement deserves emphasis since the tendency of more recent work has been to concentrate attention on the qualitative aspects of the diet and there is some risk that quantitative factors may be neglected.

16. The diet then must be sufficient in amount, i.e., it must contain enough materials of varying type to satisfy the energy demands of the body. This assessment is made in Calories. There is no subtle virtue in Calories as such; they are merely units of heat which are of use for calculation purposes. Calorie value is not synonymous either with food or biological value. Many organic substances possess Calorie values without being of any food value, e.g., coal. The energy requirements of the body are in the main dictated by the type and amount of muscular work carried out by the individual. The greater the expenditure of energy in the form of muscular work the greater the demand for an ample supply of energy-giving food. In estimating the amount of work done in a day it is essential that the method of performance the duration of muscular effort and the rest pauses, voluntary and involuntary, be carefully observed over the working day. It is useless to carry on observation say over one hour, afterwards multiplying the assessed effort over this period by say eight and recording the result as that of an actual eight-hour day.

17. Other factors which influence the extent of the demand for energy are naturally age, sex and size. Climate does not apparently exert any very marked influence, although generally speaking it may be said that the colder and the more inclement the atmospheric conditions the greater is the need for Calories. Formerly in the assessment of the individual energy needs body weight alone was utilised although it was realised that such a

standard might be far from accurate, as a result of the variation in the material which constitutes the bulk of the body weight. The weight might in the main be due to muscle, or it might be due to fat or to large bones. These materials differ in their metabolic activity, hence in their demand for energy supplies. Muscle is very active metabolically, bone is much below muscle and fat is inert. Recent work has shown that a much better measure is obtained when energy requirement is related to the surface area of the body.* When it is necessary to determine very accurately the needs of an individual it is customary to use as a basis the basal metabolic rate. This may be defined as the metabolic activity when the individual is lying at complete rest, warm, awake and in the post-absorptive state (i.e., about 12 to 15 hours after a meal). The general consensus of opinion supports the view that the metabolic rate of inhabitants of tropical and subtropical regions lies about 10 to 15 per cent. below that of inhabitants of the colder areas. Although the basal metabolic rate is of considerable interest from an academic standpoint, and in certain diseases is of considerable clinical importance, in practice it will be found that given the heights and weights of the people it is not essential to determine this rate when arriving at an estimate of the needs of a group of individuals.

18. As a broad approximation the Technical Commission on Nutrition of the League of Nations has stated the Calorie requirements as follows:—" An adult, male or female, living an ordinary life in a temperate climate and not engaged in manual work is taken as the basis on which the needs of other age groups are reckoned. An allowance of 2,400 Calories net (i.e., Calories available from food actually assimilated) per day is considered adequate to meet the requirements of such an individual." The Calories required by younger members of the family based on the foregoing figure are stated as " man values or coefficients." The values adopted by the Technical Commission on the basis of a total of 2,400 Calories are as follows:—

Male or Female	Adult	... ...	1·00
,, ,,	aged	12-19	1·00
,, ,,	,,	11-12	0·9
,, ,,	,,	9-11	0·8
,, ,,	,,	7-9	0·7
,, ,,	,,	5-7	0·6
,, ,,	,,	3-5	0·5
,, ,,	,,	2-3	0·4
,, ,,	,,	1-2	0·35

* The formula commonly employed for the determination of surface area is that of Du Bois :—

$$S.A. = W^{0.425} + H^{0.725} + 71.84.$$

in sq. cms. in kilos. in cms.

S.A. = Surface Area. W. = Weight. H. = Height. 71·84 = a constant.

The co-efficient for a man engaged in light work is 1·15; in moderate work 1·25; in hard work 1·50.

For children under one year the estimate should be made according to body weight, say 110 Cals. per kilo from 0-3 months, 100 Cals. from 3-6 months and 90 Cals. from 6-12 months. There is no special virtue attaching to these figures. They are simply arbitrary approximations which have been shown by experience to correspond on the whole satisfactorily with reality in temperate regions. They probably require some modification in tropical countries. They will, however, be found useful as general guides when comprehensive family studies are made.*

19. When we consider the actual food source of the required energy it will be found that foodstuffs may be divided into two classes, A and B. Class A contains the energy-yielding group of materials (proteins, fats, carbohydrates), Class B materials which, although they yield no energy, are essential for all metabolic processes (water, mineral salts, vitamins). Energy is derived by a process of oxidation from the three components of group A, namely, proteins (like lean meat, white of egg), fats (like butter, ghee or edible oils) and carbohydrates (starches and sugars). These substances are usually found in nature as mixtures in ordinary foodstuffs. Lean meat, for example, has always a small amount of " hidden " fat and a trace of carbohydrate in addition to the protein of which it is mainly composed; white flour, which is chiefly carbohydrate, contains 10 to 12 per cent. of protein and a trace of fat. The body and the food are frequently likened to a machine with its fuel. The analogy is a most imperfect one. In a boiler the fuel is merely burnt to liberate energy whilst in the body the food, it is true, is also burnt or oxidised to yield energy but it differs from the ordinary fuel in that it can repair the breakdown of tissue which is constantly taking place and give the essential material for growth in the young.

20. The protein component of the diet holds a unique position. It may be regarded for all practical purposes as the sole source of the essential nitrogen. Without a sufficiency of protein in the

* An earlier League of Nations scale of co-efficients (that adopted at the Rome Conference in 1932) has been much used in tropical countries. It is as follows :—

Age.	*Co-efficient.*
0 to 2	0·2
2 and 3	0·3
4 and 5	0·4
6 and 7	0·5
8 and 9	0·6
10 and 11	0·7
12 and 13	0·8
14 to 50 men	1·0
women	0·8
Over 50	0·8

food, life would be impossible. Although protein can and does yield energy to the body it is of greater importance for the growth, maintenance and repair of active tissues like muscle. It also possesses very marked heat-stimulating properties. How much then of this valuable material should the average diet contain? The Technical Commission on Nutrition of the League of Nations has suggested that the average requirements will be met by the ingestion of 1 gm. protein per kilo body weight. This requirement might, however, be stated in another, and probably better fashion, namely, that calories derived from protein should form some 10 per cent. of the total calories ingested. It is certainly true, however, that the protein needs of the growing organism per kilo body weight are greater than those of the adult.

21. Another question frequently asked is whether when hard muscular work is done there should be an increase in protein intake, particularly in the form of meat. Rightly or wrongly when hard muscular work has to be done man usually demands an increase in his supply of protein, often in the form of meat. There is also a certain amount of evidence which suggests that virile groups of peoples on the average consume more protein than the less virile. There is, too, evidence to suggest that proteins derived from animal sources exercise a greater stimulating effect than those from vegetable sources. Yet on the other hand there is no experimental evidence to show that there is an excessive or increased breakdown of protein containing body tissues when muscular work is done and hence there should be no need for an increased intake of protein.

22. Are all proteins which exist in the various food materials of equal value to the human organism? Certain proteins, generally referred to as " first class " proteins or proteins of high biological value, are given first place. These proteins are, in the main, derived from animal sources. They are found, for instance, in glandular organs, meat, milk and eggs. Milk proteins are of particular merit; if whole milk in sufficient quantity is not available its place may be taken by skimmed milk, whether liquid or condensed or dried, which contains the full complement of all proteins contained in whole milk. In the vegetable kingdom proteins derived from sources like whole cereals, peas, beans, lentils, etc., are good. There is a general belief, although there is little scientific evidence to back the belief, that in a mixed European diet at least one-third of the protein consumed should be in " first class " form. Whether or no this proportion be correct, there is good evidence to show that in a diet containing proteins from various sources, a supplementary action can take place as a result of the mixture, with the actual enhancement of the biological value of the combined proteins.

A combination, for instance, of animal and good vegetable proteins will have enhanced value, and so will a combination of maize, millet and soya beans, or a combination of cereals, legumes and leafy vegetables.

23. It is sometimes argued that a considerable proportion of the proteins ingested must be in the form of animal proteins. Others hold that proteins solely or almost solely of vegetable origin, if obtained from various sources, are adequate for good nutrition. We think that in the present state of knowledge it would be rash to be too dogmatic on the subject, but as a guiding principle we may take it that it is at least desirable, if not essential, especially in the diet of the young, to include a certain proportion of protein of animal origin such as that contained in milk.

24. Fats and carbohydrates are in some ways chemically similar; they are both compounds of the three elements carbon, hydrogen and oxygen. Fats can certainly be formed from carbohydrate but there is no irrefutable proof that the reverse change can take place. Fat is a valuable store of energy but it is not so readily available as is the energy from carbohydrate. There is no general agreement as to the optimal amount of fat which should be present in an average diet. The average diet in Great Britain contains about 100 gms. derived from all sources (butter, milk, meat, etc.). When hard work, particularly in the open air, has to be done, the natural consumption of fat tends to rise. It is usually assumed that the amount of fat required in the tropics is smaller than that in temperate countries, though some at least of the diets of well-to-do Indians are rich in fats. Some fats in addition to being a source of energy are the vehicle for the conveyance of certain of the indispensable vitamins, notably vitamins A and D. Fat, or at least certain of the unsaturated fatty acids, play some obscure part in growh. It is also of great use in reducing the bulk of diet. We know very little about the metabolism of fat in the body beyond the fact that for perfect oxidation there must be present and available a certain proportion of carbohydrate. As it has been said, fats only burn in a fire of carbohydrate.

25. When we turn to the consideration of the third group of energy-giving foodstuffs, the starchy foods, the mixture of carbohydrates which make up the bulk of the average diet, there is little to be said beyond stating that there is every reason to believe that they, of all foodstuffs, yield up most readily their energy to the body. These starchy foods are abundant and cheap sources of energy and thus we can readily and at small cost adjust our energy intake to the energy output by increasing or diminishing the proportion of carbohydrate in the diet. In contradistinction to a widely held belief, recently ingested carbohydrate, even in the form of glucose, although it causes a very

rapid rise in the level of the blood sugar is apparently not available as an immediate source of energy for the performance of muscle work and yet it has a marked restorative action after the work is done. The sugar must apparently be converted into some other form, presumably into its storage form of glycogen, before it can be utilised. Hence in the case of athletes the excess sugar should be consumed some two days before the effort is due to take place. Although sugar is an important member of the carbohydrate group, in its purified form as white sugar it can be regarded as nothing more than a mere source of energy whereas, when taken in the cruder or less purified forms as syrup or treacle (molasses), there is ingested at the same time quite substantial amounts of valuable mineral constituents. (See further Appendix 5.)

26. To turn now to the group of non-energy-yielding substances, water, mineral salts and vitamins. A plentiful supply of water is essential as about 70 per cent. of the body weight is water. All metabolic reactions take place in a liquid medium and are, for the most part, associated with the passage of water into or out of the various molecules. Quite apart from the actual loss of water from the organism there is a translocation of water, in the form of digestive juices, etc., within the body which amounts to about two gallons per day. The water excreted from the body, more particularly by the kidneys, plays an all important part in getting rid of soluble waste material.

27. The various mineral salts play an equally essential role as they participate in probably all the tissue activities. Unfortunately as yet our knowledge regarding the actual part they play as well as the amounts which are required for normal activity is very scanty. Excessive loss of a simple salt like sodium chloride during sweating is now known to account for the distressing symptoms of "firemen's cramp." This cramp is common to those whose employment necessitates their exposure to high temperatures with consequent loss of fluid in the form of sweat. This sweat carries along with it sodium chloride, the loss of which in time can evoke severe muscular pains. These cramps can be alleviated or prevented by drinking salted fluids. It has also of course long been known that an adequate supply of calcium and phosphorus is essential for proper bone formation, that iron and probably a trace of copper are required for the synthesis of the haemoglobin of blood, that iodine is essential for the proper functioning of the thyroid gland and so on. In Europe with its large and growing consumption of sophisticated and purified foodstuffs there is an increasing probability that there will be a shortage of minerals in the diet.

28. Quite as important as their synthetic activities, however, is the part played by the various mineral constituents in the

regulation of the acid-base balance or hydrogen concentration in the tissue fluids. The following are some of the common natural (European) sources of minerals in the diet:—

Calcium.—Cheese, milk, green vegetables, egg yolk.

Phosphorus.—Cheese, oatmeal, dried beans, egg yolk.

Iron.—Liver, oatmeal, egg yolk, green vegetables, dried beans, whole cereals.

Iodine.—Fish, watercress, onions.

The amounts required for normal maintenance are at the moment speculative. The Technical Commission on Nutrition have suggested that for an adult an intake of about 0·75 gm. of calcium (more for growing children say 1·0 gm. and for pregnant and lactating mothers 1·5 gms.), about 1·0 gm. phosphorus and about 10 mgms. of iron daily should be safe.

29. Finally we come to the vitamins of which five or six have definitely been identified. These various vitamins play essential, but as yet not definitely determined rôles, in the normal metabolic processes. Some of them have been isolated in pure form like ascorbic acid (C), calciferol (D) or in precursor form like carotene (A) and have actually been synthesized in the chemical laboratory. Although our present knowledge enables us to cure or alleviate certain diseases, which are now recognized as being due, in the main, to vitamin deficiency, e.g., scurvy, beri-beri, we are still very much in the dark about the amounts of the various vitamins which are required for the maintenance of health. Still more are we ignorant as to the unusual needs which arise when a person is suffering from disease. It is more or less generally agreed that except under medical supervision it is best to take the necessary vitamins in the form in which they are provided by nature, as ill results may follow the over-consumption of certain at least of these vitamins.

30. The vitamins about which most is known are A, B1, C and D. Vitamin A is important for health and growth and apparently particularly for the normal functioning of the epithelial cells. There also seems to be some intimate connection between this vitamin and the regeneration of the visual purple in the retina. The following are some of the chief sources of this vitamin: butter, milk, cheese, liver, most animal fats (not lard), yellow and red fruits and root vegetables, green vegetables, fish liver oils and red palm oil. The vitamin may be present either in the carotene (or precursor) form as in certain fruits and vegetables which can be converted in the body into the active vitamin or in free active form as in, for instance, butter and fish liver oils.*

* There are a number of carotenes only some of which are precursors of vitamin A. Foodstuffs which are rich in these precursors are yellow or red, although the colour by no means always implies their presence.

31. Vitamin B1 is the vitamin the absence of which is associated with the appearance of beri-beri. Vitamin B1 is widespread, being found with few exceptions in all the natural foodstuffs examined. Yeast, eggs, liver and green leaf vegetables and certain of the pulses are rich in it, whereas milk, meat and fish are poor sources. There is a certain amount of evidence to show that it exerts influence on the utilisation of the carbohydrate portion of the diet.

32. Vitamin C is the vitamin the absence of which is the causal factor in scurvy. As already noted the vitamin has been isolated in pure form, analysed and within recent years synthesized (ascorbic acid). It is found in fresh fruits and vegetables (oranges, lemons, mangoes, salads, tomatoes, etc.). It is readily destroyed on drying, cooking or exposure to sunlight.

33. Vitamin D is intimately related to the utilisation of calcium and phosphorus in the body and hence a deficiency of it is related to the disease rickets. One precursor of this vitamin is ergosterol, which on solar irradiation yields after a special process of purification a crystalline substance, calciferol, of very high antirachitic activity. It is now regarded as highly probable that this substance is one form of vitamin D in a state of purity. Vitamin D in addition to its antirachitic properties plays a part in the proper development of teeth. This vitamin is present in fat fish, fish roe, fish liver oils, egg yolk and, when the cows are exposed to sunlight, in milk and butter. It may also be supplied to the body in precursor form in green vegetables.

34. There may also be mentioned here vitamin B2 complex, which contains among other components riboflavin and nicotinic acid; this is the anti-pellagra or P-P vitamin. It is not affected by heat but it is soluble in water. It is found in, for example, yeast, liver, certain green vegetables, whole wheat and bran. The other vitamin is vitamin E, which is found in greatest amount in green leaves and in the embryos of cereals, wheat germ oil being a very rich source. This vitamin seems to play some part in the control of the reproductive processes.

35. So astonishing and interesting have been the results of the experimental studies of vitamin deficiencies that there has been a temptation, not unfortunately always resisted, to ascribe without any real justification a large and varied collection of clinical phenomena to a deficiency of vitamins. So much has this been the case that Sir Frederick Gowland Hopkins, the initial discoverer of vitamins, has been constrained to write:—
" We know that a fault in quality may be as deleterious as a failure in quantity. This fact the general public is now rapidly assimilating though not always to its profit. Indeed, a certain vocal section of the public is (as it has always been) so perverse

in its views concerning food that it is almost necessary to remind it that after all quantity still counts. We cannot live on vitamins alone."

(*b*) THE SPECIAL REQUIREMENTS OF CERTAIN CLASSES.

36. At certain periods of life—during pregnancy, lactation, infancy and childhood—an extra physiological strain is imposed upon the body. At such times the general principles of correct nutrition already stated in the preceding subsection apply with even greater force, and moreover the body requires certain additions to or departures from the normal diet, to help it to meet the special circumstances.

37. During the whole process of pregnancy the mother is caring and providing nourishment not only for herself but for another body also. This puts a special strain upon her, to meet which special additions to the diet are required. In general, the state of nutrition of the mother, provided she is free from disease, does not seem to play any marked role in the development of the child *in utero* so far as size is concerned; but there is nc doubt that if the supply of food to the mother be defective either in its quantitative or qualitative aspects, the growing foetus will deplete the maternal tissues of the essential material. Obviously in extreme conditions, where the state of nutrition of the mother is bad at the outset and if her supply of food be defective, the offspring must suffer. Under average conditions, however, if there be a shortage, it is the mother rather than the foetus which suffers during pregnancy.

38. The chief additional needs during pregnancy are for minerals and vitamins. The mineral requirements are considerably increased and if they are not supplied the mother will suffer. In a recent report issued by the League of Nations Mixed Committee on Nutrition it is pointed out that one of the commonest defects is a faulty mineral supply to the mother through which there is a deficiency of calcium salts for the skeleton and teeth of the growing offspring. This can be met from such sources as milk and vegetables or by the administration of additional calcium and of those substances which are a source of vitamin D, since this has a powerful influence in regulating the growth of bone.

39. The foetus also requires a large supply of iron and this has to be made good to the mother. Many women suffer from anaemia even in ordinary circumstances and under the stress of pregnancy the condition will probably increase with consequent bad results to both the mother and the child. This tendency to anaemia during pregnancy and the special needs of the foetal child make it very desirable that iron in good quantity should form a sufficient part of the nourishment of the expectant

mother: foodstuffs that are rich in iron are meat, egg yolk and certain vegetables, while there is evidence to show that the iron in whole cereals is specially well utilised.* Iodine is also specially needed by the pregnant mother. At this time too it is more than usually important that the diet should contain adequate vitamin elements.

40. The diet should be a balanced diet, sufficient in quantity, varied in character and preferably containing a supply of protein of animal origin, especially in the form of milk. The actual demands for protein by the mother are not greatly increased by pregnancy as the growth of the foetus is slow. Minerals and vitamins should be supplied by giving as much as possible of the protective foods like milk, green leafy vegetables, fresh fruit, potatoes if available, beans and bean products, etc.

41. As already stated, the pregnant woman has special needs, but the demands made during lactation are much greater. The extent of the demand is determined to a large extent by the amount of milk secreted. This is especially true as regards the supply of protein. Milk contains about 20 gms. total protein per litre. To cover the demand made by the mammary glands and the ordinary tissue needs it is calculated that about 2 gms. of protein per kilo body weight, i.e. twice the average adult requirement, is needed daily. Apart, too, from the increased supply of protein the nursing mother ought to receive a good mixed diet, rich in vitamins and minerals.

42. Milk is, of course, much the most valuable food both as a source of protein, and of vitamins and minerals, etc. When available, either in liquid, condensed or dried form—dried skim milk is excellent—and when the income is sufficient to permit of the purchase of it without unduly contracting the consumption of other forms of food, it should be used as much as possible. When milk in adequate quantities cannot be obtained, then other means, more suited to the local circumstances, must be devised for filling the needs of the nursing mother.

43. As regards the infant, certain principles may be laid down. Complete breast-feeding of the infant is of very great importance; its importance can indeed hardly be over-rated. But even breast-feeding may be inadequate if the nursing-mother in her turn is not provided with proper nourishment. When a baby is breast-fed, the need for supplementary dietetic substances is largely diminished but nevertheless it may be desirable to include some such substance as cod liver oil to supply additional vitamin A and especially vitamin D and iodine and some form of fruit juice say, orange or mango juice, to supply vitamin C. The need for including food with a high iron yield to mothers has already been indicated: this is mainly due to the need of

* Only about one-tenth of the iron content of meat is normally available for human nutrition.

the foetal child. When the infant is born it has an abundant supply of iron stored in the liver but this is gradually used up and should be supplied artificially before the haemoglobin rate in the blood becomes too low. Iron-yielding foods should as a rule be provided for the infant over six months of age: it has been shown that infants thus treated have a lower sickness rate from infection than those for whom these foods are not provided.

44. Where it is impossible to attain the ideal of breast-feeding, artificial feeding of the infant must be carefully thought out. In such cases the inclusion of the different specific protective substances in the diet assumes much greater importance because with artificial feeding the common illnesses of infants such as rickets, defective formation of teeth and anaemia are much more commonly found.

45. The nutritionally important period does not end when the child ceases to be an infant. The next few years are also of great importance. To help him meet the strain of growth, the growing child requires protein-rich foods in a proportion much greater than that required by an adult. He also requires an adequate supply of the various vitamins particularly the fat-soluble vitamins. Moreover as the child is more liable to attacks of infective and possibly debilitating disease it is highly important that the diet should be both quantitatively and qualitatively adequate. Faulty feeding, of whatever nature, during childhood may account for markedly defective growth or other physical deficiency. It must however be remembered that if the faulty feeding has neither been too grave nor too prolonged ultimate recovery up to the normal standard on the resumption of an adequate diet will probably take place. This is one of the potent factors of safety provided by Nature. In assessing growth and state of nutrition the standards common to the race examined should be used and not some arbitrary standard based upon European growth curves. Heredity is indeed a factor to be reckoned with.

(*c*) Other Factors Affecting Correct Nutrition.

46. We have set out above the main food requirements of the body as they are generally understood at the present time. Modern knowledge of nutrition has brought us to a point where we can lay down certain broad generalisations about the essentials both quantitative and qualitative of a satisfactory diet. But the test of a diet is its effect on individual health and well-being, and dietary standards must always be subject to qualification and revision in the light of actual observation of the effect of different habits of food-consumption upon physique and health. It is the inter-relation of diet and health which at the present stage of our knowledge is the most fruitful subject for study.

47. The analysis of this relationship between food and health is no simple matter. As our knowledge grows regarding the factors which affect the nutritional value of foodstuffs and the effects of food and other influences on the nutritional state of an individual, the complexity of the question becomes increasingly apparent, and it is evident that much fuller knowledge will be required before anything more than tentative conclusions can be reached. For instance, it used to be assumed that the nutritive value of a foodstuff could be determined once for all by analysis of its chemical composition in the laboratory. Recent investigations have shown clearly, however, that the biological value for the human subject may vary considerably. On the one hand the chemical composition of the foodstuff as actually consumed is by no means constant. On the other hand the power of the individual to benefit from the food he eats may vary greatly according to a number of different factors.

48. As regards the variations in chemical composition it is now common knowledge that the soil in which a foodstuff is grown, the method of manuring, the time and method of harvesting, the methods of storing, marketing, processing and cooking, have a very marked effect upon the value of the food as consumed so that if proper allowance is not made for these factors dietary calculations based even on accurate food consumption data may result in serious error. For example, striking differences may be found in the nutritional state of a group of workers fed in a communal kitchen by a food contractor and of similar individuals eating apparently the same foods in similar amounts, but in their home in a rural area. In the former case the food supplied may be a low grade of the staple cereal milled to an excessive degree, stale vegetables bought up cheaply and other similar foodstuffs, while in the latter case the cereal, having been milled at home, is not overmilled, the vegetables are eaten fresh and so forth. The result is that the nutritional state of the country dweller is generally considerably better than that of a similar individual living in the town.

49. As regards the power of the individual to benefit from the food he eats, many factors may react upon the state of nutrition by affecting the metabolic process in the body and so influencing the utilisation of foodstuffs. Among these factors are the mental state—unhappiness, worry and so forth—and many environmental factors, such as faulty hygiene, high humidity, overcrowding, noise and vermin, which all in one way or another interfere with proper rest and sleep. Other pathological states, traumatic and irritation factors, may be found occurring in a vicious circle together with food deficiency diseases. In diseases affecting the alimentary canal there is likely to be disturbance of absorption of food and increased

loss of nutritive values, as for example in diarrhoea. The requirements of particular food factors may be accentuated by disease or some phase of it, as in the case of fever or other diseases in which there is excessive blood destruction.

50. Again, while there is at present little precise knowledge on the subject, the nutritional requirements of an individual may, it seems, vary appreciably according to his race and the climate in which he lives. Thus in a tropical country where sunshine is abundant the requirements of vitamin D should be less than in a temperate country in winter where sunshine is comparatively rare.* In a hot country a smaller consumption of fats will be required than in a cold country. Possibly also through long custom one race may have adapted themselves to some special feature in the diet which economically is easiest to obtain. Most Colonial dietaries, for instance, being largely vegetarian are bulky relative to their nutritive value and it may be that people who for generations have been used to vegetarian diets can tolerate a greater bulk than others.

51. Another factor for which allowance must be made is the interaction of various foodstuffs on one another. Much attention is now being given to the effects upon one another of the various components of a diet. Thus, as already stated, when proteins from different sources are fed as a mixture, their biological value may be greater than their values when fed singly. Again the ratio of calcium to phosphorus in the diet is important; also, no doubt, the amount of calcium in the presence of limited amounts of vitamin D. The disposition of " fibre " in foods of vegetable origin is probably of more importance than the total amount as estimated by chemical means. A similar consideration holds for the nutritional value of different meats and " cuts " of meat in relation to the amount and distribution of connective tissue. Traces of inorganic elements in foods may also be of importance in determining their realisable value for the diet. The vitamin B1 requirements of the body seem to be determined to some extent by the Calorie value of the food or of the carbohydrate portion of it. The capacity of different foods for forming acids or bases in the tissues of the body is another factor of outstanding importance, and it seems that the contribution made by a foodstuff to oxidation and reduction processes in the body may also have to be taken into account in assessing its value.

52. Another aspect of dietary studies is the possible action of toxic substances in foods. In Western countries control has been

* It would, however, be rash to be too dogmatic on this subject. Rickets are known to exist even in the most sunny climates, e.g., in Iraq and Aden. The anti-rachitic quality of the sunshine may not be entirely dependent on the strength of the sun's rays. Moreover where purdah exists or the sun is too strong exposure to the sun may be avoided. Again, a summer's day in a temperate climate is much longer than a tropical day.

established of the effects on the body of bacterial and other contaminants including traces of poisonous elements introduced in manufacture. In the examination of dietaries such as those found in Colonial territories it may be well to remember that untoward results of certain dietaries may not always be sequelae of deficiencies and that cyanides, fluorides, products of parasitic growths and contaminants from storage are likely at times to occur in foodstuffs and to result in more or less insidious effects on the health of a community.

53. In all these ways it is becoming evident that the assessment of dietary deficiencies is a matter of considerable complexity. Some assistance may be derived from experiments on the nutrition of animals and from the experience of stock breeders and veterinarians. Even these observations however must be interpreted with caution. It is clear that the only satisfactory method of study is to make careful observations of all the relevant factors directly on the human subject. To this point we return in Chapter XIV.

54. Finally one of the important but too often overlooked criteria for the drawing up of dietaries is that the food prescribed, its cooking and its serving, should conform to the dietary habits of those to be fed. It does not matter how much better than the food to be supplanted is the substitute food whose introduction is sought; the initial trials must be carried out with care, and attention must be given to psychological factors. Appetite is a very subtle guide, tradition often salutary, but both can annoy and hamper the man who wishes to introduce other foods and other methods. Appetite may, it is true, be capricious but it may also be the manifestation of a very real need, as for instance the demand for certain mineral earths. It is not wise to ignore appetite until it can be proved to be wrong. There is a certain element of truth in the statement of Sir William Roberts many years ago that " the generalised food customs of mankind are not to be viewed as random practices adopted to please the palate or gratify an idle or vicious appetite. These customs must be regarded as the outcome of profound instincts which correspond to important wants of the human economy. They are the fruit of a colossal experience accumulated by countless millions of men through successive generations." If this be true of a community such as our own in Great Britain which for generations has been removed from close touch with nature and natural products, how much truer is it likely to be of a great number of those members of our Colonial Empire whose very existence, only too often, depends on their knowledge of these age old customs and dietary habits. This is not to say that these customs and habits are the best and only possible customs and habits but they should not ignorantly be cast aside until fully examined and tested.

CHAPTER IV.

GENERAL CHARACTER OF COLONIAL DIETARIES.

55. In this and the following chapter we shall attempt to give a brief indication of the general character of existing diets in Colonial territories, of the extent to which malnutrition exists and of the effect which it has on the health of the people. The task is not easy owing to the diversity of the material to which we have already referred and to the complications of other factors such as disease. In a survey such as this it is obvious that discussions must be confined to the salient points which are thrown into relief against the very varied background.

56. The first and most obvious feature of dietaries in Colonial territories is that, with some exceptions, they are predominantly vegetarian in nature and that relatively small quantities of animal products are consumed. Maize, rice, millets, coco-yams, ground nuts, beans, peas, cassava, yams, tannias, sweet potatoes, plantains, bananas, gourds, coconuts or other palm products and numerous green leafy vegetables are the main raw materials of vegetable origin from which dietaries are composed. Broadly speaking, some or other of these products are available everywhere, though the chief component of the diet varies from place to place.

57. It follows that one feature of these diets is that by Western standards an unusually high proportion of the energy value of the diet is derived from carbohydrates. This is at the expense of the amount of fat in the diets, which is usually low except in areas where coconuts or other palm products are largely consumed. Since it is necessary to consume two and a quarter times as much carbohydrate in weight to obtain the same amount of energy as from one unit of fat, it follows that the diets are also bulky relative to their nutritive value.

58. This is not to say, however, that too much food is consumed in the Colonial Empire. Far from it. There are few parts of the Colonial Empire where, except at feast times, people eat more than they ought to eat; much more often they eat a great deal less than they ought to eat. Though there is nowadays little or no actual famine, people frequently go short of food owing to bad harvests, locust invasions, or the absence of money to buy foodstuffs. If diets are sometimes bulky, the bulk is of foodstuffs which do not in themselves suffice for proper nutrition.

It is only in relation to the nutritive value that the diets are bulky.

59. Another characteristic of Colonial diets is that it is often chiefly by the consumption of one staple crop and one only that the necessary energy value is obtained. One of the most striking facts which emerge from our survey is the extent to which Colonial peoples are dependent upon a single crop for their main supply of food. In the majority of Eastern countries rice is the staple foodstuff and other elements in the diet are merely relishes or extras. What rice is in the East maize, millets, plantains or yams are in different parts of Africa. In the Pacific yams also form the staple food.

60. As regards animal products, it is true that the diet of certain pastoral tribes of Kenya and Tanganyika consists chiefly of meat, blood and milk, that in Northern Nigeria animal products predominate, and that to the nomad Somali camel's milk is the one essential to health and happiness. But the inclusion of animal foods in substantial quantity is the exception rather than the rule in the Colonial Empire. Meat, for example, enters but sparingly into the typical dietaries of Zanzibar, large parts of East Africa and the southern parts of the Gold Coast and Nigeria. Furthermore, when meat is available it is generally of poor quality, exceedingly deficient in fat and too expensive for the bulk of the population. In the West Indies the consumption of meat is perhaps a little more general.

61. As regards milk, the most important of all single foodstuffs, only one territory, the Virgin Islands, can boast " an unlimited supply of fresh non-tubercular cow's milk ". In Somaliland there is a high consumption of camel's milk and certain African tribes are also large consumers of milk. Almost everywhere else no milk is consumed, or the amounts are so low as to be of little account from the nutritional standpoint. In many territories the cattle population is and will probably remain insufficient to supply the necessary quantity of milk. This situation is frequently aggravated by the further difficulties of unsatisfactory quality due to adulteration and contamination, and of much ignorance and superstition. In Grenada, for example, there exists a deeply-rooted superstition that milk is the cause of worms in children, and in the New Hebrides both the indigenous and immigrant population dislike milk. The fact that they regard it as a dirty food is not surprising in view of the unhygienic conditions which so often surround its production.

62. Of all animal foods, fish is perhaps the one which is or could be most often included in Colonial diets. Not unnaturally it is most used by those to whom it is most easily available, namely by people living by sea or lake or river. It is commonly

eaten either fresh or dried, but, apart from one or two exceptional instances is as a rule eaten only in small quantities as a relish or side dish. The craving for fish is so acute among the Gilbertese that they will put out to sea in face of almost impossible weather conditions to get it. On the other hand in British Somaliland (which has abundant other sources of animal food) there is a genuine contempt for fish and also eggs. Although the latter are plentiful in some territories they are not largely consumed, and as a source of animal protein are without significance in many Colonial dietaries.

63. It follows from the absence of animal products from the diet that it is low in proteins derived from animal sources. Nor is the deficiency made good by an abundance of good quality proteins derived from other sources. There is a deficiency of all forms of proteins. The protein is usually highest when the staple cereal is wheat and lowest when it is rice. The greater part of the supply of protein will probably be derived from the cereal. The balance is made up of such foods as beans, peas and ground nuts, and in some instances from roots and leafy vegetables; but in general far too little of these commodities is consumed.

64. There is also as already stated a general deficiency of fats. Apart from their value as a concentrated source of energy and their use in connection with cooking, fats serve as a vehicle for vitamins A and D and their precursors. In Colonial diets the fats are almost exclusively drawn from vegetable sources. In vegetable fats vitamin A occurs always in the precursor form, the preformed vitamin being found chiefly if not entirely in fats and oils of animal origin, especially those obtained from fish and fish livers.

65. Again, there is in general too low a consumption of green leafy vegetables and fruits. In view of the extensive use of cereals and the scanty use of milk and fats these constituents are very desirable as a source of calcium, of the precursor of vitamin A and of vitamin C.

66. Specific peculiarities in the supplementary foods consumed distinguish particular geographical areas. Thus, for example, olives and olive oil are characteristic of the diets of the Mediterranean Colonies, and dates of the diet of British Somaliland. The inclusion of sugar cane is an important feature of the diet in the West Indian colonies and other sugar-producing dependencies. Curry stuffs are a valuable adjunct of the food consumed in Ceylon.

67. The more normal sources of food supply are supplemented in many cases by wild animals and insects. We have already mentioned the consumption of such things as grubs, caterpillars,

locusts and flying ants. Many kinds of wild animals are consumed, though not usually with any great frequency. In the more closely populated territories these sources of food are naturally rarest. In some of the more primitive or thinly populated countries they are of some significance.

68. As regards mineral deficiencies, it has long been known that an adequate supply of calcium and phosphorus is essential for proper bone formation. Most of the foodstuffs which are highest in these properties are lacking in Colonial diets. Moreover when the water drunk is rain water there is no possibility of the deficiency being made good by a high content in the water. The same applies to iron, the absence of which is one cause of anaemia. The intake of sodium must also, it seems, be extremely low in many parts of the Colonial Empire, since the diet is largely composed of vegetables the salts of which are chiefly potassium salts. The "salt" used is also in many instances of vegetable origin. Crude salts of mineral origin and edible earths are however often found in the dietaries of Colonial peoples. In some northern areas of the Gold Coast, for example, the people drink water impregnated to a milky colour with kaolin in preference to clear water, a habit apparently similar to the "pica" or depraved appetite described by many observers in parts of Kenya. In North Borneo a predilection for edible earths is commonly seen, especially among women and children, and the indigenous Mayan Indians of British Honduras regularly consume a drink made with maize steeped in a solution of lime water.

69. As we have pointed out in Chapter III, paragraph 26, an abundant supply of water is essential to proper nutrition. In many territories there is at present a scarcity of water supplies. Particularly is this so in some of the South African High Commission Territories, the Northern parts of Nigeria and the Gold Coast, parts of the East African territories, Somaliland, the Aden Protectorate and parts of Palestine. In some cases the inhabitants may have to travel long distances from their homes to obtain their water. In other cases the whole community is nomadic, wandering from water-hole to water-hole.

70. As regards the vitamins, the general character of Colonial diets as summarised above suggests that there is a widespread deficiency of vitamin A. This is confirmed, as we see in the next chapter, by the reports from many territories of the specific diseases known to be caused by vitamin A deficiency. In diets consisting so largely of cereals there is a considerable risk that insufficient amounts of vitamin B1 will be obtained whenever the cereals are taken in highly milled forms. The deficiency does in fact undoubtedly exist in many parts of the Colonial Empire, where it is the custom to consume polished or overwashed rice, as in Hong Kong and in the towns and some

country districts of Malaya and Ceylon.* In more primitive communities there is less risk of vitamin B1 deficiency, except perhaps when cassava is the staple.

71. The low consumption of green vegetables and fruits would suggest that there is a widespread deficiency of vitamin C. The low consumption of fats would in European conditions point to a deficiency of vitamin D. This is, however, normally counterbalanced in the Colonial Empire by the abundance of sunshine throughout the year, though there is evidence of rickets even in Aden. If there is a gross deficiency of calcium and phosphorus the sunshine will be ineffective.

72. It will be seen from this brief survey that there are few of the constituents considered necessary in Europe for a nutritionally adequate diet which are generally available in sufficient quantities in the Colonial Empire. After studying all the reports submitted by Colonial Governments and all the other available material, we have no doubt at all that there are few parts of the Colonial Empire (or indeed of any tropical country) where the diet of the majority of the population is at present anything like sufficient for optimum nutrition. Diets are frequently insufficient in quantity and still more frequently insufficient in quality. If they are bulky, the bulk is too often made up of foods that do not supply all the needs of a balanced diet. Judged by European standards they lack variety and they lack protective value.

73. We proceed in the next section to consider the effects of this state of affairs.

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* See the memorandum regarding rice which is attached as Appendix 6.

CHAPTER V.

EFFECTS OF MALNUTRITION IN THE COLONIAL EMPIRE.

74. Food deficiencies may cause well recognised deficiency diseases. They are certain also to lead to general illhealth, to increase greatly the susceptibility to many other diseases and to impair efficiency and wellbeing.

75. In determining how far the absence of certain specific food factors leads to disease, one of the difficulties is that it is seldom possible in man to observe the effects of one food deficiency in isolation. Food deficiencies are usually multiple and the interpretation of their effects is usually complicated by the presence also of various infections. Some symptoms, particularly those of a general nature occurring in the earlier stages of a deficiency disease, may not only be characteristic of the lack of a particular food factor but may well be the result of disease processes unrelated or only indirectly related to the dietary. For this reason the correct interpretation of the facts is a matter of much difficulty. It is not always helpful or justifiable to translate the results of experiments on animals directly to man. The only satisfactory approach to the subject is a careful compilation and analysis of a multitude of detailed observations on both men and animals.

76. Nevertheless, a considerable number of specific deficiency diseases are now generally recognised. Some of these, such as scurvy and beri-beri, have been known for a considerable time. Others have been diagnosed only comparatively recently. The subject is one on which much still remains uncertain. New relationships between food deficiency and disease are still no doubt to be discovered. It is very possible, for instance, that tropical ulcers are directly associated with food deficiencies. Again, there is still considerable difference of opinion regarding the early signs and symptoms of deficiency diseases. While the latest stages are comparatively well recognised the early stages, in which of course the disease is much more susceptible to treatment, are apt still to pass unnoticed. Again the effects of food deficiencies have so far only been considered in relation to the more obvious parts of the body, such as the skin, eyes, teeth, mouth, bones and blood, and little attention has been paid to their effect on tissues and organs more difficult of access and study.

77. There is therefore much that is at present unknown with regard to the occurrence of specific deficiency diseases. Most, however, of the known deficiency diseases are reported from one part of the Colonial Empire or another, and from the information given it appears probable that in a number of Dependencies there are a great many more cases of these deficiency diseases than have at present been recognised.

78. Diseases caused by deficiency of vitamin A are perhaps the most common of all in the Colonial Empire. There are reports from a wide selection of territories of affections of the eye, night-blindness, xerophthalmia, keratomalacia and well-characterised changes in the skin sometimes called follicular hyper-keratosis, sometimes phrynoderma. The prevalence of Bitot's spots and xerosis of skin and hair are probably also due to insufficiency of vitamin A. So also is impaired growth.

79. Beri-beri, which is recognised to be caused by a deficiency of vitamin B1, occurs with frequency in most countries where rice is the staple food and is found in various parts of the Colonial Empire. It is common in Hong Kong, and in the Straits Settlements causes on the average about 900 deaths every year. Apart from the well recognised beri-beri, the nervous system and blood circulatoin are affected by deficiencies of vitamin B1, and there may also be oedema and loss of appetite. Such cases are probably widely prevalent in parts of the Colonial Empire where the full disease has not been recognised.

80. Pellagra, due to the absence of the P-P. factor (another member of the B group of vitamins considered with good evidence to be nicotinic acid or nicotinamide) is reported fairly frequently. It is endemic among people living too exclusively on maize or maize products. Stomatitis, which sometimes at any rate appears to be the result of a less severe lack of the P-P. factor, is more frequently reported. Absence of this factor probably also accounts for a number of lesions of the skin.

81. Scurvy, caused by absence of vitamin C, is reported only very occasionally in its classical form, chiefly from those few territories in which there is periodically a famine period. Absence of vitamin C leads also to increased fragility of the capillaries in various parts of the body and causes lesions of the gums and various skin affections. These conditions are seen fairly often at certain seasons.

82. Vitamin D deficiency results in the well known signs of rickets in children and in changes in the mineral content of the bones of adults with subsequent deformities. The structure of the teeth and their resistance to decay are also largely bound up with adequacy of vitamin D. In each case, however, other considerations are involved, and as we have already said the deficiency of vitamin D in Colonial diets appears to be largely

compensated by the regular exposure of the body to sunshine, since diseases due to the absence of vitamin D are not very often reported.

83. In regard to diseases and disorders caused by absence of food factors other than the vitamins, there are some reports of the failure of proper bone formation, which would point to an inadequate supply of calcium and phosphorus. There are also many reports of anaemia, but it does not necessarily follow that this is due to a deficiency of iron, since analysis is complicated by the fact that there are a number of infective and parasitic diseases, especially such as are common in tropical countries, which cause destruction of the red blood cells. Nevertheless, in a proportion of these cases the anaemia may be due to a deficiency of iron in the diet and possibly also of other dietary factors which contribute to the formation of haemoglobin and the red cellular elements in the blood. As regards sodium, it is known that excessive loss of sodium chloride during sweating, such as may well occur in hot countries in the course of heavy work, accounts for " fireman's cramp." The occurrence of this condition is occasionally reported.

84. Apart from these well recognised diseases there are reports of a number of disorders possibly of dietary origin which have not yet been positively identified, although they have already earned for themselves a definite name locally. These include chalchaleh in Somaliland, chiufa and onyalai in Northern Rhodesia, decoque in the Seychelles, kwashiorkor in the Gold Coast and burning feet and butterfly wing in British Honduras.

85. Beyond the comparatively well established diseases there is now a general consensus of belief that there exist with great frequency, especially in the tropics, deficiency states which prevent the full enjoyment of health. Because these states are less well recognised, they are more insidious than the clearly defined deficiency diseases and are much more important factors in the lives of the people. The data available do not enable us to say with any accuracy, except where definite deficiency diseases are reported, that this or that deficiency exists in this or that territory; but we believe that almost everywhere health is impaired to a greater or less degree by malnutrition. We would go so far as to say that for every recorded case of a specific deficiency disease there are hundreds of cases of absence of full health due in part at least to malnutrition. This conclusion is supported by the observations of competent observers in every part of the world and by the evidence of the startling improvement of physique, wellbeing and efficiency which have been discovered to result from additions to the normal diet in areas so different as Malaya, Ceylon, East Africa, West Africa and the West Indies. Much of this evidence will appear in subsequent chapters where we discuss particular aspects of the problem.

86. Moreover the prevalence of malnutrition aggravates many other diseases. A person who is not properly fed will be much more liable to chronic infection with disease and much less able to offer natural resistance to such infection. Many persons in the tropics become infected with disease of one sort or another but show no noticeable symptoms so long as their natural resistance is maintained. It is only when this natural resistance is weakened that the disease appears. The effectiveness of the resistance, while partly depending upon other factors such as infestation with hook worm, is largely dependent on the state of nutrition of the individual. Moreover, the badly nourished subject will take longer to recover from any disease and is much more likely to relapse. This is amply proved by the experience of hospitals and dispensaries in districts where the people are known to be undernourished. Their wards are often crowded with cases in which healing or recovery cannot take place until the physical balance has been restored by an adequate dietary.

87. This is particularly the case with ulcers and a number of skin affections, leprosy, tuberculosis and malaria. Tropical ulcers, indeed, as we have already said, may even be a specific deficiency disease. The bearing of defective nutrition on leprosy is being increasingly recognised. We now know the importance of this factor in the cure of the surface affections of leprosy and in the prevention of the concurrent affections which used to prevail and to cause the high death rate. In the same way it is now recognised that there can be no effective treatment of tuberculosis without an adequate dietary and that an ill-nourished person is particularly liable to infection. Malnutrition is equally important in its effect upon the incidence of malaria. Malarial infection is widespread in most parts of the tropics, but the state of nutrition may determine whether an epidemic occurs or not. This was well seen in Ceylon in 1933-4 when the Colony suffered from a widespread malaria epidemic. This was preceded by a drought, and drought conditions continued during the greater part of the epidemic period. As a result food supplies ran short and considerable sections of the population were reduced to the borderline of starvation and could offer little or no resistance to the disease. Simultaneously the rivers and streams were largely reduced to stagnant pools forming breeding places for the anopheles mosquito. The report on the epidemic indicates clearly the part that malnutrition played in relation to this outbreak. " Even," it says, " if the masses had been well fed and prosperous there would have been an epidemic of malaria, but the vicious circle of malaria and destitution acting and reacting on one another would not have been established and the mortality rate would have been lower, convalescence would have been shorter and probably the infectivity and relapse rates would have been less."

88. To sum up, Colonial diets are very often far below what is necessary for optimum nutrition. This must result not only in the prevalence of specific deficiency diseases but in a great deal of ill-health, lowered resistance to other diseases, and a general impairment of well-being and efficiency. There is in our minds no doubt whatever that these conclusions are correct. They should, we venture to think, have great significance for Colonial Governments, and we feel that they should affect many aspects of Government policy. We do not doubt that if it were possible (as unfortunately it is not) to remove at one stroke all traces of malnutrition in the Colonial Empire there would be an immense gain in physical health, in mental alertness and in material welfare. Money spent on improving nutrition should be a sound investment, yielding its dividend in the increased welfare of the community as a whole.

89. This then is the position. We have now to consider how matters may be improved.

CHAPTER VI.

THE GENERAL CHARACTER OF THE PROBLEM.

90. The main causes of malnutrition in the Colonial Empire are in our view, first, that the standard of living is often too low; and secondly, that there exists widespread ignorance coupled with prejudice, both with regard to diet itself and with regard to the use of land.

91. Perhaps we ought to add also as a third main cause, disease. We have mentioned in an earlier section that, just as malnutrition reacts upon susceptibility to certain diseases, so those diseases react upon the state of nutrition of the individual. We shall not concern ourselves further with disease as a cause of malnutrition, since we may assume that Colonial Governments are doing all they can with the funds available to prevent and combat disease. It will be sufficient for our purpose to note in passing that many tropical diseases must necessarily affect very seriously the power of an individual to benefit by the food he consumes. This is particularly true of the various types of parasitic infestation which are widespread amongst the inhabitants of tropical countries.

92. The other two main causes of malnutrition, a low standard of living and ignorance, react to some extent on one another. If there were greater wealth in the Colonial Empire, Governments could spend more money on removing the ignorance, and if there were less ignorance, the available resources—be it lands, cattle or money—would be used to greater advantage than they are at present.

93. We shall have a good deal to say in later chapters about the ways and means of removing ignorance. We have no doubt, however, that a low standard of living is in most territories the fundamental cause of malnutrition, and we shall devote several chapters to a discussion of the many aspects of this question. In most parts of the Colonial Empire the problem, as we see it, is that its inhabitants—as indeed the inhabitants of many other parts of the world—have insufficient wealth either in food or money to supply their requirements.

94. A low standard of living does not normally mean in the Colonial Empire quite the same thing as in highly industrialized European countries. It would be a mistake to think of it as meaning, typically, that the individual has too little money.

Much more typically it means a shortage of the means of subsistence. In some parts of the Colonial Empire, particularly in parts of Africa, money has only been introduced comparatively recently and the economy is still to a large extent not a money economy but a subsistence economy. In such cases money is required chiefly for the purchase of clothing and for meeting tax payments for the services provided by the local authorities and the Central Government. In the provision of the essentials of life, such as food and housing, money plays little part; the bulk of the population are still agriculturalists producing their own food. From this almost pure subsistence economy, there is to be found every kind of gradation towards a money economy. In almost all Colonies cash crops have been developed to a considerable extent and every day money comes to play a more and more important part, while of course in the towns the economy is as much a money economy as in any other part of the world.

95. The pure money economy is however still the exception rather than the rule. For this reason it is difficult to measure the extent to which poverty is a factor in malnutrition. It would probably be easy to compute that the wages paid—say 10s. a month in East Africa, 15s. a month in West Africa or 1s. to 1s. 3d. a day in the West Indies—are not sufficient to provide a man and his family with the food that they ought to have.* But it only follows that the wage-earner must be undernourished when he has no other source of income. Fortunately he very often has another source of income in the food which he or his family grow for themselves. Similarly, if the money income of an African tribe from the sale of cash crops is only just sufficient to pay their taxes to Government and to provide those necessaries of life that cannot be produced locally, it does not automatically follow that the tribe is undernourished, for they may grow without difficulty all the food that they require.

96. But though exact measurement is usually impossible, we have no hesitation in saying that in almost every part of the Colonial Empire the total income of a very large proportion of the population is a long way below the minimum required for satisfactory nutrition. The reason for this is not necessarily that the available income is badly distributed, that some have

* For instance, it has been calculated that the minimum sum required to obtain a reasonably good diet (not an optimum diet) in Freetown (Sierra Leone) is between 6d. and 7d. per head per day, or say 15s. a month. That is just about the average wage received by the urban labourer, so that according to this computation if he is to feed himself decently there is nothing left at all for the food of his wife and family, let alone for his housing, clothing, etc., unless he has other sources of income. It would be a mistake to put too much reliance upon this or similar calculations, for the necessary statistical facts are hard to come by. Nevertheless, it does give a general indication of the position.

too much while the majority have too little, though this may be a contributing factor in some Dependencies. Much more fundamentally in our view it is due to the fact that the total income of the community is at present too low to provide optimum nourishment and at the same time to supply its other essential needs and all the services of local authorities and the Central Government.

97. In many parts of the Colonial Empire real wealth is increasing with increased development and, apart from the temporary effects of world-wide depressions, the increase is steady and continuous. In such territories it is possible to look forward with optimism to a gradual improvement in conditions, as economic circumstances permit. In some of the West Indies, such optimism will be more difficult. At present they are faced with an increasing population without any obvious prospect of an increase in wealth, whether from their export products or from any other source. We have no doubt that this is a problem which will receive the close attention of the Royal Commission at present investigating the position of the West Indies.

98. Increased development will inevitably lead to a great extension of the use of money. This change is bound to come; it is indeed essential for any substantial improvement in the standard of living. The change-over to a money economy will certainly bring difficulties and drawbacks. European history contains many instances of periods of political and social unrest which have accompanied the change-over from small-scale highly localised subsistence economies to wider monetary economies, and the task of adjustment in the Colonial Empire is not likely to be less difficult, for it is likely to be swifter than has usually been the case in Europe. The impact is upon something more than the traditional means of livelihood of the people, their method of raising and preparing their food, of cultivating their ground and storing their wealth; it is upon their whole social structure, because many of their economic activities have a social and cultural significance, and any change of them will make its impression upon their whole pattern of life and way of thought. It is not for us to concern ourselves with the social consequences of these economic changes. Governments are well aware of them and to be forewarned is to a large extent to be forearmed, for by many measures Governments should be able to soften the impact of the new forces and to assist society to adapt itself to them.

99. From the nutritional point of view the change-over is on a long view to be welcomed, for, as we have said, it is essential before any substantial increase in the standard of living is possible. Nevertheless there will be certain disadvantages even from the point of view of nutrition. For instance, as we show

later on, a tendency which may if unchecked lead to the formation of large urban proletariats in backward communities is nutritionally disastrous. Again among the rural population it is possible that the benefits of increased monetary wealth, which will enable them to vary their diet by purchase will, to some extent, be set off by the disadvantages of undue specialisation in production. Already in some parts of the Colonial Empire, where, for instance, rubber or sugar or cocoa are produced, the rural community tends to rely on the production of export crops to the partial exclusion of the production of food crops. With wise guidance and assistance from Government, however, these dangers can be guarded against. At present the farmer too often of necessity specialises in one crop because of the limitations imposed by conditions and his own ignorance. His diet could hardly with increased monetary wealth be more monotonous than it is now. On the whole there can be no doubt that the gradual disappearance of the old subsistence economy will be nutritionally to the good since without it there are narrow limits to the amount of development that is possible.

100. Our main concern at the moment is not however with the relative merits of a subsistence or a monetary economy. It is to emphasise the very large extent to which the problem of malnutrition is a problem of economic development. Whatever form that development may take, a primary need for the improvement of nutrition is to secure an expansion of the real income of the people of the Colonial Empire.

101. Primarily economic development in the Colonial Empire means improvements in agricultural production. There are, it is true, big towns in the Colonial Empire—such as Hong Kong, Singapore and Colombo—and they have their special problems, but the big towns are relatively few. Whatever the future may hold in store, the Colonial Empire at present is predominantly rural. Even Malaya, which has a larger urban population than any other part of the Colonial Empire, regards itself as primarily a rural country. Moreover, there are comparatively few territories in the Colonial Empire with large mining areas; Malaya, parts of West Africa, parts of East Africa and Trinidad are almost the only territories where mineral production is of importance. Predominantly the rural communities depend upon agriculture.

102. In most parts of the Colonial Empire the bulk of the foodstuffs consumed are produced within the territory of consumption. In some of the Eastern Colonies, Mauritius, some of the West Indies and in one or two other territories there are substantial imports of foodstuffs, but elsewhere, though there is plenty of room for increasing local supplies, imports form a negligible proportion of total consumption.

103. For all these reasons it follows that Departments of Agriculture and Veterinary Services have a most important part to play in promoting both the economic development and the nutritional welfare of the Colonial Empire. Our next chapter will deal with various general agricultural considerations, and the subsequent one with the desirable additions to colonial diets, most of which will be by way of locally produced foodstuffs.

104. But while the main problem is that of rural communities, the problem of the town-dweller where it arises is even more acute. If the state of nutrition in the country district is often bad, it is invariably far worse in the towns. The reasons for this are not far to seek. The dwellers in towns are entirely dependent for their livelihood on what they earn. Their wages are usually low and they are not able to supplement them by foodstuffs which they have produced themselves. The amounts which they must spend on other essentials, such as housing, are in comparison with the wages earned relatively high, and they find no lack of less essential ways of spending their money. They may also have developed a taste for European foodstuffs which are too seldom of nutritive value. Moreover they are as often as not country-folk by birth who do not find in the towns either the traditional foodstuffs and ways of cooking or the general social background to which they have been accustomed.

105. The precise nature of the urban problem varies in each territory, according to the state of civilization of its people and the type of social organization which is natural to them. Races for instance which habitually dwell in villages take more kindly to town life than those who are not habitually dwellers in villages or large communities. We think it safe however to accept the generalization that the poorest class of town-dwellers in the Colonial Empire as in most other countries is everywhere worse fed than their brothers in the country and that their state of nutrition is almost invariably bad.

106. The problem is not one of nutrition only. It is a social problem of great importance, full consideration of which would be outside our terms of reference. We would however emphasize how disastrous from a nutritional point of view (as well as from many others) is the formation of large urban proletariats in backward communities.

107. Another factor which is of great importance nutritionally in some Dependencies is the rapid increase in population that is at present occurring. In Malta, Ceylon, Basutoland, and some of the West Indian Colonies this problem is in varying degrees acute, for it is obvious that unless an increase in population is accompanied by a proportionate increase in the wealth of the community the result must be decreased wealth on the

average per head of population. The following table gives some striking figures:—

	1921.	1937. (Estimated).	Per cent. Increase.	Popn. per sq. mile 1937.	Birth Rate.	Death Rate.
Malta	212,000	265,000	25	2,175	33	17
Ceylon ...	4,505,000	5,780,000	28¼	224	34	21
Basutoland ...	499,000	562,000	12¾	48	—	—
Trinidad ...	366,000	456,000	24½	230	30	19
St. Vincent ...	44,400	57,500	29½	442	39	16
Barbados* ...	156,000	191,000	22½	1,151	29	20
Jamaica ...	858,000	1,152,000	34¼	254	32	17

* The population of Barbados in 1896 was put at 185,000, much the same level as in 1937. The fall between 1896 and 1921 was primarily due to emigration.

The problem is likely to become more serious as infantile and general mortality decrease.

108. It is often not easy to propound any solution. It would seem that it must be found in one of the following courses, (a) emigration, (b) an increase of visible exports, (c) an increase of invisible exports, (d) an increase of home production. Of these emigration is the remedy which has been to some extent effective in the past—e.g., in Malta and the West Indies—but it is no longer practicable on any large scale. An increase in visible exports may be equally difficult—for instance, sugar is almost the only possible export crop of some of the West Indies and the exports of it are regulated by the International Sugar Agreement. Industrial development may sometimes be possible but here again the finding of overseas markets will be the difficulty. An increase in invisible exports may be more practicable. In some of the West Indian Islands for instance there are considerable possibilities of developing the tourist trade. In some of the African Dependencies an important invisible export is to be found in the earnings of emigrant male labour. Another source of invisible exports is expenditure by the Imperial Government, either as in Malta for defence purposes, or, as by grants from the Colonial Development Fund, for the general development of the territory. There are, however, obvious limitations to this source of wealth.

109. In these circumstances the most important measure to offset increased population must often be increased development of local resources for local consumption. A certain amount of development of industries to supply the home market may sometimes be practicable, but generally the main task must be to increase the home production of foodstuffs of nutritive value. Clearly in such circumstances the employment of the available land should be so planned as to yield its maximum value to the community.

110. Once more therefore we are brought back to the importance of agriculture. We now proceed to the consideration of this question in more detail.

CHAPTER VII.

AGRICULTURE AND NUTRITION—GENERAL CONSIDERATIONS.*

111. The nutritional problem being largely an agricultural problem, it follows that in framing agricultural policy the nutritional needs of the community are of the first importance. In ascertaining what these requirements are, those responsible for agricultural policy will need assistance from the health authorities. It is for the health authorities to say what are the main deficiencies of the diet of a particular territory, and for the agricultural authorities to consider how the deficiencies may best be met.

112. There is therefore need for very close co-operation between the two Departments. Indeed there is really need for something more than co-operation. The knowledge of the doctor is apt to stop short at the analysis of deficiencies, and that of the agriculturalist to begin with the science of growing crops. Neither has the full knowledge to enable him to say authoritatively which foodstuffs are best able to remedy which deficiencies. For this purpose, if the co-operation between the two Departments is to be really fruitful the Medical Department must know something of the agricultural possibilities and limitations and the Agricultural Department something of nutritive requirements.

113. Naturally the nutritional factor cannot alone determine agricultural policy. That policy must be designed to safeguard soil fertility and to conserve the soil against erosion. Land should not be exploited for a short-term benefit. This is fundamental. Due place must also be given to the development of money crops. Climatic conditions, the nature of the soil, marketing possibilities: these too must also be taken into account. Clearly, however, to be fully effective agricultural policy must take account of nutritional needs as well as of these other factors.

114. If we may venture on a broad definition of the proper aims of agricultural policy, we would suggest that it should be somewhat as follows:—

Having regard to

(i) the nature of the soil and climate of each locality;

* *Note.*—In this chapter, and elsewhere in our report, we use the term "agriculture" and its derivatives to include also all forms of animal husbandry.

(ii) the traditions and practices of the people who use the land; and above all to

(iii) the paramount need for maintaining and where possible increasing soil fertility;

the aim should be the establishment of a balanced agriculture for the production of commodities (vegetable or animal products) to be used:

(*a*) as foodstuffs for direct consumption by the producer and his family, in which case they should be of the greatest nutritive value possible; or

(*b*) for sale or consumption elsewhere in the territory, in which case they should return the greatest cash value possible to the producer, while, in the case of foodstuffs, at the same time assisting in remedying the deficiencies of the diet of the people who buy them; or

(*c*) for sale in overseas markets, in which case they should return the greatest cash value possible.

115. Our chief concern in this and the following chapters will be with the production of commodities falling in categories (*a*) and (*b*) above. Commodities falling in category (*c*), namely products for export, concern nutrition only in that the greater the return from exports the greater will be the power of the producer to purchase the foodstuffs necessary for his welfare and the greater the available wealth upon which the local authorities or the Government can draw for purposes of social advancement, including education of the community on nutritional matters. In this sense any measure that increases the value of exports has a bearing on nutrition. We do not feel that we need interpret our terms of reference so widely as to necessitate a comprehensive review of the economics of colonial exports. It is, however, important to note that the yield of exports is apt to fluctuate very greatly. It is an unfortunate fact that the world prices of primary commodities are subject to more violent fluctuations than those of manufactured articles. The world prices of almost all the chief Colonial commodities have at one time or another in the last ten years been at double the lowest level reached during the same period. In some cases, for instance rubber and cocoa, the fluctuations are much greater. Moreover, since freight, insurance and middleman's costs fluctuate much less, the percentage fluctuations in the price on first sale are much greater. Something has been done by means of the international regulation schemes which apply to rubber, tea, sugar, tin and copper, to prevent the continuance of very low prices for a long period, but even these schemes cannot prevent (or at least have not prevented) considerable variations in price, and what the producer gains by the avoidance of extremely low prices he may lose (on the

short view) by the limitation of the quantity that he can export. The Colonial producer must, it appears, continue to expect to see a wide variation in his income from money crops.

116. In the case of the estate or mining company, the chief effect upon the producing territory of a fall in the price or quantity of exports is a smaller demand for labour and possibly a lowering of wages, but part at least of the drop may be met by drawing upon reserves and by reducing dividends paid to shareholders. This to some extent acts as a shock-absorber coming between the actual inhabitants of the Colonial Empire and the full effects of a depression. The small producer does not have this shock-absorber. At the same time, unless the whole of his land is devoted to production for export, which is fortunately not often the case, he can fall back upon the growing of foodstuffs, and this mitigates the hardship to him. For instance in Malaya during the years 1930 to 1933, when rubber could not be produced profitably, more vegetable products were grown and more home-milled rice was used, so that it sometimes happened that nutrition was actually better than in times of prosperity. Conversely when the price of cocoa in the Gold Coast rose after the war to over £100 a ton, the people did not bother to grow foodstuffs, so that there was at one time a real shortage of the primary necessities of life. Similarly it has recently been reported that the high prices of cocoa ruling in 1936-7 led to a shortage of foodstuffs in the subsequent season.

117. Family production of food to meet family needs is a great safeguard against some of the worst social and economic effects of fluctuations in the income from money crops. There are other reasons too, equally important, why it is most desirable that in every Colonial territory as many people as possible should themselves grow part at least of the foodstuffs that they consume.

118. In the first place the protective foods are usually more expensive to buy than others of less nutritive value. It is difficult to persuade a poor person to buy vegetables or fruit or animal products, for they seem to him to involve too large a disbursement of his scanty resources relative to their bulk. Unless therefore he has his own garden or his own animals, he will be likely to go short of the protective foods. Moreover, if he does buy them, they are often stale and have lost part of their nutritive value.

119. Secondly, as we shall show in a later chapter, we regard the general level of wages as usually much too low to provide by themselves the means of adequate nutrition, and an early increase in wages sufficient for this purpose will often only be practicable when the productive capacity of Colonial populations has been increased substantially above present levels. As

a long-term policy, increases in general productivity may provide the ultimate solution but in the meanwhile it is important that wherever possible the labourer should be able to supplement his wages by produce from his own garden or allotment.

120. Thirdly, it is generally accepted that an interest in the land stimulates a sense of self-reliance and responsibility and that there are many social advantages in the maintenance of as large a proportion of the community on the land as possible.

121. For all these reasons we make the following recommendations, the importance of which we desire to impress upon all concerned:—

(*a*) Colonial Governments should endeavour to ensure that as many people as possible should grow part at least of the foodstuffs that they themselves consume.

(*b*) Where a labourer for wages is more or less permanently employed on an estate, as in the West Indies, Mauritius, parts of East Africa and Malaya,* the estate-owner should normally provide him with land for a garden and perhaps even require him to make full use of it; in appropriate cases the owner should also permit or even require the maintenance of animals for the production of meat or milk products. The report received from Trinidad states that time after time it has been remarked that those labourers who have their own gardens are in a far better position than those who do not have this accessory means of balancing their budgets. This instance could be paralleled by many others. In some territories it may in fact be necessary to require by law that a certain proportion of estates should be given over to the production of foodstuffs either by the estates themselves or by co-operation with resident labourers. Satisfactory fencing should be provided for food gardens and allotments, wherever the prevalence of predial larceny, i.e. the stealing of food on farms, causes difficulties.

(*c*) Where there is a landless class, Colonial Governments should do all they can to provide them with at any rate some land. Attempts are now being made in the West Indies to develop peasant agriculture by settlement of families on whole-time holdings. This is very desirable under certain conditions and if adequate provision is made for supervisory and instructional services. At the same time cottage or food garden holdings which only require part-time attention may be no less valuable. Experience shows that it is not easy though by no means impossible

* See further paragraphs 282-295 below. In Malaya every estate is required by law to set aside one-sixteenth of an acre of land for each labourer who has dependents.

to make a success of land settlement schemes where the peasant is expected to make his entire living out of the produce of his holding. The settlers require careful selection and supervision, and progress on these lines must be slow and expensive. The part-time holding or allotment which is only intended to supplement the normal wage may bring increased well-being to a larger number of people at less cost to the community. Again adequate protection against predial larceny will be required.

122. A factor which is often of importance in relation to nutrition is land tenure. The growth of crops of nutritive value such as fruit may be hampered by the fact that the local system of land tenure is such that the individual has no inducement to plant crops of a permanent nature. Often where there is shifting cultivation or where land is held in common the individual may next year have no rights over the piece of land he holds this year. Naturally, in these circumstances he will not spend money or energy in maintaining the fertility of the land or in planting fruit trees which will only come into bearing some years later when someone else holds the land. The means of altering this state of affairs will vary in different territories. It is a difficult and technical question which we do not propose to discuss in detail. Sometimes it may be possible to modify the existing system so as to permit the individual to retain a right to the permanent trees he plants. Such is the system which seems to be developing in West Africa. Indeed the planting of palms and fruit trees near houses is, we understand, often the first step away from a system of shifting cultivation. Sometimes, where the recognition of anything in the nature of permanent rights of individuals over land is not regarded as appropriate, a form of communal development may be possible. For instance, the report received from Nyasaland suggests that villages might be encouraged to plant communal orchards under the control of the native authority.

123. This we regard as a most interesting suggestion, since it implies the possibility of development without sacrificing the advantages of the communal system. At the same time development will probably be quicker if, by judicious modification of existing customs, the progressive individual can be given some security of tenure and so be encouraged to make improvements on his own account. In any such modification however great care will be necessary to see that the community as a whole does not suffer for the benefit of the individual. Changes must be gradual and must meet with the consent and approval of the community. Before any change is carried into effect, careful study of the local system of land tenure should be made in order that the existing relation between communal control and individual rights may be taken into account. It will be

universally agreed that any very rapid change from communal tenure to anything like individual freehold ownership may well be disastrous. Nor should it by any means be taken for granted that unrestricted freehold tenure is the ultimate ideal. Even in territories such as the West Indies, where the land legislation has been imported wholesale from this country, it is held by many to be more than doubtful whether out-and-out freehold tenure is productive of the best results. It seems desirable that at least there should be some obligation on the part of the occupier of the land to comply with certain standards of cultivation and conservation. The whole subject of land tenure is, however, a technical one of which we have no special knowledge, and we do not feel competent to do more than indicate the bearing which it has on nutritional questions.

124. Another factor which sometimes prevents increased growth of food crops is the prevalence of predial larceny, that is to say the stealing of food from farms. This has been mentioned in the reports from several of the West Indies and from one or two other territories.

125. In many parts of the Colonial Empire the seasonal fluctuation of diet is a factor of importance. Happily the days of absolute famine are almost a thing of the past, but in many parts of Africa there is normally a period of acute shortage in the two or three months preceding harvest and this may at any time be aggravated by drought or the ravages of locusts. Apart from the pre-harvest shortage of the staple foodstuff there is often, in countries where there is a marked dry season, a shortage of the important protective foods in a fresh state just before the rains begin. At this time the staple foodstuff may still be holding out, but there may be few fresh fruits or vegetables, either wild or cultivated, and in consequence there may be serious dietary deficiencies. In West Africa, leaves of selected trees, shrubs and plants are dried and used in the dry season. How far they go to make up the deficiencies of fresh foods it is not possible to say. After the rains come there will be more extras—wild food plants, the leaves of trees, etc., as well as cultivated vegetables—and next year's supply of the staple foodstuff will be in the ground, but this year's supply of it may be running short. There may thus be two periods of shortage, one a shortage of extras just before the rains and the other a shortage of the staple foodstuffs some time after the rains but before the new staple crop is harvested.

126. The subject is one of considerable importance, especially in Africa. Shortages of extras will not lead to actual starvation but they may be nutritively very significant. Probably the most useful remedial measure is the encouragement of the drying of green foods by methods which preserve their nutritive value, a subject to which we return later. Shortages of the main staple

may be even more serious. Remedies for this must vary in each district. In some places there may be need for better storage facilities, though such facilities will fail of their purpose unless a greater spirit of foresight is shown by the people who at present improvidently consume too large a proportion of their staple crop soon after the harvest. The storage of food in tropical conditions is difficult and indifferent storage may lead to waste. We discuss this question later on. Much may also be done by developing early maturing or drought-resisting varieties of the normal staple crop. Elsewhere the remedy will be the planting of special famine reserve crops. Among these cassava is pre-eminent as it is highly drought-resistant and its tubers can be left under ground for a long time, sometimes for as much as two years or more, thus avoiding the necessity for extensive storage accommodation. It has been the salvation of large areas in the dry parts of Uganda, Northern Rhodesia and many parts of West Africa.*

127. In some territories an important factor is the absence for considerable periods of a large proportion of the adult male population who migrate in search of employment to other territories. On the one hand this tends to raise the level of nutrition amongst their own tribe since they often send home a considerable proportion of the wages they receive. On the other hand it may upset the system of cultivation in the villages from which migration takes place leaving an undue amount of work to be done by the women. This will affect adversely the amount of food available for consumption by the women and children.

128. One of the most potent means of increasing foodstuffs for the people is by increasing the yield per acre from their existing crops. Probably in every part of the Colonial Empire in which the inhabitants grow food for their own consumption the yield could be substantially increased on the one hand by the use of better seed and on the other hand by better methods of husbandry combined with the use of organic manures or composts. Many Colonial Departments of Agriculture have already done much valuable work on both these subjects.

129. As regards the use of better seed, there is still great scope before the plant breeders in the Colonial Empire in the improvement of food crops. There still remains much to be done in the improvement of crops by selecting high-yielding strains of local varieties, by plant-breeding, by introducing new varieties and by the further trial of crops not now generally grown. Many factors have to be taken into account, yields, nutritive values, ease of cultivation by the methods common in the locality, ability to tolerate mixed cultivation, date of

* As we shall show in the next chapter, however, cassava is low in protective value. It is therefore not satisfactory as the *sole* staple crop.

ripening, liability to destruction by pests in the field, keeping qualities in store and the prejudices of the local population. These factors naturally vary from place to place and there is therefore room for much experiment in almost every territory.

130. As regards the improvement of methods of cultivation, this is of even more importance in that unless it takes place the fertility of the soil may decrease from year to year. Soil deterioration is common throughout the Colonial Empire and the need for soil conservation and the prevention of erosion cannot be over-emphasised. The first and most fundamental objective of all agricultural policy must be to conserve the land and at the least to maintain if not increase its fertility, for the wealth of the soil is the capital of an agricultural country. With bad farming—such as now too often exists—this capital can be squandered very quickly and if it once disappears it demands great effort and a lengthy period to recreate it. A satisfactory system of land usage must include the maintenance of forest cover for the protection of water supplies, the maintenance of pasturage on lands suited for such a purpose, and the development of arable farming on other lands. We repeat: soil conservation and the maintenance of soil fertility must be the first aims of colonial agricultural policies and no agricultural system can be considered to be sound if it is not based on the correct usage of the land.

CHAPTER VIII.

THE DESIRABLE ADDITIONS TO COLONIAL DIETS.

(*a*) New Crops.

131. We shall consider in this chapter the foodstuffs which in the circumstances of the Colonial Empire seem to offer the best means of remedying the dietary deficiencies which we have described in Chapter IV. We have tried to be strictly practical. It is not enough to point out what is scientifically desirable. It is also necessary to take into account what is practicable. Ignorance, prejudice, local customs and habits, poverty, disease, climate: these and many other factors must all be taken into consideration. Always and at all times, the desirable must be conditioned by the practicable.

132. The objective as we see it is that the daily intake of foodstuffs at all seasons of the year should be sufficient to meet on the one hand the total energy requirements of the individual, and on the other hand his requirements of the various protective food factors. No amount of vitamins and minerals could ever make a man well-nourished if his energy requirements were not met. The first requisite therefore is that energy needs should be supplied. At the same time energy-giving foods are not sufficient by themselves unless the accessory food factors are also present. A good working rule for those who seek to improve Colonial dietaries would be to endeavour to increase the quantity of foodstuffs consumed by increasing the variety.

133. Very striking differences occur in the energy yield per acre of different forms of cultivation. Animal products for instance have a low energy yield per acre. Thus it is estimated that in the United States, although only about 40 per cent. of the energy value of the diet is derived from animal products (meat, milk, poultry and eggs), nearly three-quarters of the crop land is used for their production and almost all of the pasturage. A substantial part of the diet is thus made up of elements which, though of high nutritional value in other respects, are of low energy value in terms of energy yield per acre. Cereals on the other hand have a high energy value per acre, and of all cereals rice has the highest yield. It has been found that, taking in each case an average yield on soil suitable for the crop, a great deal more food measured by Calorie value can be produced from one acre of rice than from a similar area of any other cereal.*

* See further Appendix 6.

When a cereal or other food is converted into meat or milk, though there is an accession of other factors, there is an extensive loss of energy.

134. These considerations are of importance where population is high relative to the agricultural land available and where nevertheless imported foodstuffs can do little or nothing to supplement local production. At the same time energy by itself is not enough. Other things being equal, the crop which has the most protective food factors in addition to a high energy yield is to be preferred over that which gives little besides energy. An example will illustrate this point. In Travancore, in South India, the staple crop used to be rice. Rice is still grown on the low-lying lands and considerable quantities are imported, but with the increase of population in recent years, the state has had to find food crops which will grow on higher lands, and cassava now forms an important part of the food supply. The energy yield per head of population is probably no less than it used to be but there has been a marked deterioration in health, which it seems must be due to the fact that a large proportion of the population now live on cassava and not rice as their staple foodstuff. Cassava contains a much lower quantity of the protective factors than rice and therefore nutrition was bound to suffer if means were not found of replacing in the diet the various elements in the composition of rice which are not found in cassava.

135. Sometimes it may be desirable to sacrifice a little energy in order to obtain more of the accessories. For instance, it may be desirable to encourage the growing of a somewhat lower-yielding type of yellow maize in place of a higher yielding white variety simply because the greater value of the accessory factors in yellow maize more than makes up for the loss in the total yield of energy.

136. It should be a principle of policy that the energy requirements should be met out of the most varied possible supply of foodstuffs. On the one hand, as we have already stated, certain foodstuffs in conjunction have a supplementary action on one another, and on the other hand even apart from this factor the greater the variety of foodstuffs consumed the smaller the chance of there being a serious deficiency in any essential requirement.

137. The first and most obvious way of securing diversity is that additional staple food crops should be introduced. This practice is of value from the point of view of agricultural technique since it makes for diversified farming and provides to some extent an insurance against the failure of any one crop. Sometimes also it may make for a better distribution of labour throughout the year. The nutritional benefits are

important also. Thus, where ordinary potatoes or sweet potatoes (especially the coloured varieties) are used in place of some cereal, a valuable increase is obtained in the consumption of important mineral salts, vitamins and proteins. This increase while small in amount, may have a marked effect in improving the value of the diet.

138. The supplementary action of different elements of the diet in combination with one another is a consideration to which weight should be given. Thus as we have pointed out in Chapter III the proteins of mixed cereals and legumes when consumed together have been found to have a marked supplementary action. One of the best combinations from a nutritional point of view is maize, millet and soya bean. Peas and maize, wheat and maize, wheat and peas are other good nutritional combinations. Whether they are also practicable or desirable agriculturally must of course depend on local circumstances.

139. From the point of view of nutrition a combination of cereals and legumes is strongly to be recommended. There are a number of legumes, the addition of which to the diet will be of value in this way. In general while they will not completely make good the defects of a diet composed largely of cereals, they are good sources of protein and in some instances are richer in calcium than cereals. They are also good sources of vitamin B1 and are of particular value for this reason in combination with starchy foods.

140. Amongst the members of this group the soya bean and the groundnut may be mentioned as being worthy of special consideration. They both contain protein of good biological value and a high proportion of fat. The groundnut contains between 20 and 30 per cent. of good protein and as much as 40 to 50 per cent. of fat. The soya bean is particularly rich in calcium and the groundnut in vitamin B1. The soya bean in its fresh green state also contains vitamins of the B complex and the precursors of vitamin A and in this respect, as in its protein, fat and mineral content, compares favourably with most other vegetables. In the dried form, the bean serves as the basis for the preparation of a great variety of dishes.

141. Both crops are thus of outstanding food value and increased consumption of them would be valuable in almost all parts of the Colonial Empire. Groundnuts are already fairly widely grown but their use could be extended and they could be encouraged as an alternative staple crop. The soya bean is unfortunately not an easy crop to establish, and though in certain cases satisfactory crops have been raised, considerable experiment will generally be necessary before it can be successfully established over a wide field. Inoculation of the seed before planting will often be necessary and it is possible that

the system of growing soya beans for two or three successive seasons on the same land will result, as has already been found to be the case in some areas, in increasing crop yields year by year. When it is introduced, it is important that adequate instruction should be given in the methods of handling and cooking its products, for otherwise it will not be used to the best advantage and will fail to become popular*.

142. In addition to the soya bean there are other legumes which are of special value as foodstuffs. Mention need only be made of pigeon peas (*Cajanus cajan*) an important pulse crop in many parts of the tropics, cow peas (*Vigna unguiculata*) of which there is a great variety in Africa, black and green grams (*Phaseolus mungo* and *Phaseolus aureus*), tepary beans (*Phaseolus acutifolius*) lima beans (*Phaseolus lunatus*), dolichos beans (*Dolichos lablab*) and haricot-beans (*Phaseolus vulgaris*). In cooler climates, such as those of Mediterranean territories, wood beans (*Vicia faba*) are a pulse crop of importance. Many of these can be grown either as a garden vegetable crop for the sake of the tenderpods or "seeds" or as a field pulse crop. The leaves of some of them can also be used as a spinach. Thus in parts of Uganda the leaves of *Vigna unguiculata* are employed.

143. Besides the introduction of additional staple crops there are of course many others ways of introducing variety into the diet. Where a diet is and may have to remain predominantly vegetarian, the chief deficiency may well be in calcium, and amongst the plant products green leafy vegetables alone furnish a satisfactory means of repairing this deficiency. They have therefore a special importance in Colonial nutrition. Moreover, the green leaves introduce into the diet most of the other food factors of protective value; their protein, though small in amount, exercises a supplementary effect, and they help to make a diet more appetising. Green vegetables, it is true, have the disadvantage, at least for the feeding of young children, that they increase the bulk and hence decrease the digestibility, but

* The products of the soya bean include the sprouted bean and a preparation obtained by the process known as wet grinding called a "milk." This preparation is of use not so much for consumption in this form as in the manufacture of soya bean "curd." This curd, at least in the form obtained from one method of preparation, is rich in calcium derived from the gypsum or other calcium salt used in the curdling process. In skilled hands it can provide a basis for an extensive series of dishes of the most attractive kind. A range of "cheeses" and "jams" can be prepared by fermentation and by the growth of appropriate moulds on the curd. Another fermented product obtained from the soya bean is a sauce which is very popular in the Far East. Soya bean oil can be used for cooking. It is usually obtained by pressing. There is evidence, however, that when this method is used unsaponifiable matter, probably including accessory food factors of the vitamin A group, is left behind in the press cake.

this disadvantage is very small when compared with the many advantages that will result from increased consumption of them.

144. It is commonly held that green vegetables are of value as a source of iron in the diet. It is indeed true that they are found by chemical analysis to contain a considerable quantity of iron, but it is doubtful how much of this iron is normally absorbed from the alimentary canal. This is one example of the danger to which we have referred in an earlier section of assuming that the chemical analysis of a foodstuff necessarily gives an accurate index of its nutritive value.

145. An important point in regard to the value of green leafy vegetables as a source of food is their perishable nature. Experiment has confirmed that with wilting and injury such as occur in storage and transit there is a marked and fairly rapid loss of vitamin C and the precursor of vitamin A. It is therefore desirable that this class of vegetable should be eaten wherever possible shortly after removal from the ground. It is evident that from this point of view alone the value of home production is great. As we show elsewhere, there are many other reasons, social as well as nutritional, for which we regard it as important that as large a proportion as possible of foodstuffs should be grown by the people who consume them.

146. The range of the green leafy vegetables is wide and varied. There is much concerning their nutritive value which is still quite unexplored. In the case of wild plants used as relishes or side dishes even botanical identification is a matter of doubt and dispute. Lettuce takes first place as a salad plant. It can be grown at almost all altitudes in the tropics. If its use uncooked is considered undesirable, it may be boiled and used as a spinach. Attention may also be drawn particularly to the brassicas including cabbages, cauliflowers, Chinese cabbages and kales. Mention should be made also of amaranths, colocasias, the young shoots of cucurbits and numerous other spinaches. Lucerne, which is of great value in stock feeding can also be made into a very appetising human food if picked young and cooked rapidly in oil or fat. It is particularly rich in protein and has a good content of vitamins, calcium and iron.

147. Besides the legumes and green leafy vegetables there are a number of other vegetables which are also worthy of special mention on account of their nutritive value. These include various tubers such as yams and potatoes. The Irish potato is rich in mineral salts and protein; it contains also vitamin C. The red-fleshed and the yellow-fleshed sweet potatoes are good sources of the precursors of vitamin A and also contain some vitamin C.

148. Carrots, radishes (especially the summer or Eastern types), turnips, kohlrabi, beet, onions, tomatoes, egg-plants, cucurbits, ladies fingers, capsicums and many other vegetables have a nutritional importance which is out of proportion to their value regarded merely as sources of energy. Again, there are many vegetables, such as peppers, shallots and herbs which, besides having a high intrinsic food value, play a valuable part in stimulating appetite and may for this reason be important elements in the improvement of a dietary. In fact there is hardly a vegetable the addition of which to the diet would not greatly improve it.

149. Fruits are in many instances of outstanding importance as sources of vitamin C. There is indeed some evidence that an adequate intake of vitamin C can only be obtained in an ordinary diet of fruits are included in it. In addition they contain mineral salts and the precursors of vitamin A; it is worthy of notice that the skins of some fruits are often particularly rich in this last respect. In tomatoes, for example, the skin contains some twenty to thirty times as much of the precursors of vitamin A as the flesh. It is however indigestible and nothing like all this value is obtained by the consumer. Attention may be directed to citrus fruits (pomelos, grape fruit, oranges, tangerines, lemons and limes) and to papayas and pineapples as rich sources of vitamin C; to mangoes, papayas, dates, tangerines and peaches as sources of the carotenoid precursors of vitamin A and to cape gooseberries, oranges, raisins and figs as good sources of vitamin B1.

150. Edible fungi and seaweeds are valuable on account of their mineral content. They can be preserved by drying without sustaining any loss to their nutritional value. Some of them have the added virtue that they contribute to the flavour of dishes in which they are contained. There are also a number of nuts suitable for inclusion in the dietary which contain proteins of high biological value. These nuts are also useful sources of certain mineral salts and in some instances are quite rich in vitamin B1. We have already referred to the special value of groundnuts when dealing with legumes.

151. Oil seeds of all kinds are also important because of the bearing which they have on the supply of fats. In the circumstances of the Colonial Empire the special nutritive value of fats and oils lies largely in their content of vitamin A and its precursors. Amongst many Colonial peoples there is a great need for a vegetable oil rich in this respect. In West Africa a vegetable oil of outstanding value and a source of the precursor of vitamin A has long been in use and is now being developed in other parts of the Colonial Empire. This is red palm oil, obtained from the fleshy pericarp of the fruit of the oil palm,

Elaeis guineensis. The nutritive value of red palm oil so far as vitamin A is concerned is equal to that of a good cod liver oil. No serious loss of potency results from its use in cooking. A point of great importance however concerns the manner in which the oil is prepared. The nutritive value of the oil is associated with the pigments which give it its red colour, and if these are removed by bleaching as sometimes is the case the oil loses most of its special nutritive value.* From the point of view of nutrition the qualities of the unbleached red palm oil are unique and in our view the Governments of those territories where the soil and climate are suitable for the growth of the oil palm should do all they can to increase its use.

152. In the sugar-growing territories there is a considerable consumption of the sugar cane in its raw or semi-manufactured state. In recent reports it has been common to assume that beyond being a source of energy sugar has little nutritive value. This conclusion applies of course to sugar in the refined state and we have thought it might be useful to Colonial Governments if we examined in some detail the nutritive value of other forms of sugar products. Accordingly we attach as Appendix 5 a memorandum by Dr. F. C. Kelly on this subject. It will be seen that sugar-cane syrups and molasses may be useful sources of iron, but that otherwise apart from their carbohydrate value they appear to have little nutritional significance and when consumed to excess may be positively harmful.

(*b*) Animal Husbandry.

153. In those territories where it is at all practicable we are sure that great nutritional value is to be derived from increasing the consumption of animal products. Here, as in the case of many other commodities which we have mentioned above, the requirements of human nutrition and of improved agriculture go hand in hand, and increased attention to animal husbandry will often be as valuable agriculturally as it is nutritionally. Wherever it is at all practicable, the introduction of animal husbandry into a system of mixed farming is most desirable from an agricultural point of view if soil fertility is to be maintained. Even if the populations of Colonial territories were able to afford artificial manure in any quantity it would be futile to rely upon its use over any long period unless the rotation provided also for the incorporation of waste vegetable refuse into the soil. If soil structure and fertility is to be maintained, farmyard manure is essential where, as is normally the case in the Colonial Empire, vegetable refuse or compost is not available. Of the nutritional value of animal products, there can be no doubt, provided that the cost of obtaining them

* See further on this point Chapter IX, paragraph 226.

is not too great. It may often happen that it is easier to provide good class proteins from vegetable sources than from animal sources, but there can be no doubt that if animal products are available they are a most desirable addition to any diet, and of course animal products provide other constituents of dietary value besides protein. We therefore regard the increased consumption of them as very desirable in almost every part of the Colonial Empire, provided that purchasing power is not thereby unduly diverted from other forms of food and that the animals do not consume an undue quantity of cereals and other foodstuffs which would otherwise be available for human consumption. As we have pointed out earlier on, a considerable loss of energy value occurs in the conversion of cereals, etc., into animal products, and where the energy value of the average human diet is apt to be low this is a factor which must not be left out of account.

154. *Cattle.*—Increased use of cattle in a system of mixed farming is so desirable, both agriculturally and nutritionally, that it will, we feel sure, occur. At the same time there are plenty of difficulties to be overcome. Tsetse fly at present limit the possibility of development over large parts of Africa, though there are some kinds of local cattle which possess a degree of immunity to trypanosomiasis. Animal diseases, particularly rinderpest and bovine pleuro-pneumonia are often very prevalent and droughts may periodically cause the death of large numbers of cattle. There are few parts of the Colonial Empire which can be regarded as well suited for dairy farming according to Western standards. Kenya, Jamaica and Northern Rhodesia offer the most promising possibilities. and in one or two other Dependencies the production of milk for supply to urban areas is making some progress, but with these exceptions dairy farming as it is understood in Europe is unlikely to be profitable in the Colonial Empire.

155. Moreover, cattle are often not put at present to the fullest economic use. In Malaya and in parts of Ceylon they are usually kept not so much for consumption or to provide milk as for draught purposes and for cultivation work in connection with the rice industry. Where they can be kept in Africa they usually range at present over large areas of relatively sparsely populated grassland country and are not associated intimately with agricultural activities. They are regarded as valuable not primarily because they or their products can be consumed as food but because they are a mark of wealth and social status. More often than not the milk is not consumed nor is it converted into such products as curds or ghee, while the meat is consumed only at great feasts or when an animal dies. Quantity is prized more than quality, with the result that parts

of the country become overstocked with cattle which serve no economic purpose, except that they provide a reserve against famine. Overstocking not only with cattle but also with goats causes soil erosion and a vicious circle sets in, which it is very difficult to break.

156. This problem is one which has long exercised the minds of Colonial Governments in parts of Africa, and various remedies are being attempted. In Kenya it is hoped that the economic value of their animals will be brought home to some of the cattle owners by the meat factory which has recently been erected by private enterprise to manufacture various grades of meat products. Difficulty has been experienced in the initial stages in obtaining the cattle, but the hope is that this difficulty will be overcome. We trust that a market for the products of the factory may be found internally, for there are plenty of tribes in Kenya whose diet is greatly deficient in those constituents that meat products could supply. It is indeed often the case that a tribe may be rich in cattle but their diet very low in proteins. The meat factory may do something to reduce overstocking but it will not by itself touch the problem of under-consumption.

157. Equally important in our view is an increase in the number of butchers' shops in Kenya as in many other African territories since these will assist in the solution of both problems, overstocking and under-consumption of animal products. There has already been a considerable increase of meat consumption in Uganda largely through this means. The provision of stock routes to facilitate the movement of cattle on the hoof from areas where there is a surplus to areas where there is a shortage has also resulted in substantial increases of meat consumption in West Africa and elsewhere.

158. Hand in hand with attempts to develop the use of cattle for slaughter should go attempts to improve the trade in hides and skins. The curing of hides and skins has been greatly improved in recent years, but there is plenty of room for further improvement, which will result in a better return to the stock owner. The more lucrative it becomes to export hides and skins, the more cattle will be slaughtered and the more meat will become available for local consumption. It may also be possible to stimulate the economic use of cattle by increasing milk yields, by production of ghee and by encouraging in other ways the use of milk products; we return to this question in paragraphs 164-173. A more thorough study of pasture management is also required in some of the African dependencies.

159. *Buffaloes* can play in the wet tropics an important part in supplying milk, curds or butter. The people should be encouraged to keep good milch herds of buffaloes in those areas in which they will thrive.

160. *Sheep* exist in many Colonial Dependencies. In Cyprus the local cheese supplies are made from sheep's milk, while in several highland parts of Africa and in the Falkland Islands they are kept for the production of wool. Hairy sheep occur in other places but they are not so hardy nor do they increase so rapidly as do goats. Wherever the keeping of sheep is practicable it should be encouraged, but except in one or two territories it is not likely to contribute materially to a solution of the nutrition problem.

161. *Milch goats* may have greater possibilities. The goat is a most destructive animal where it has been allowed to increase in large numbers and to roam uncontrolled over the countryside. The damage which can be done by it is to be seen in many Colonial Dependencies. Milch breeds, however, if kept tethered, might prove to be most valuable from a nutritional point of view. The goat is hardy and is not particular as to its diet. While its milk may convey certain diseases such as undulant fever (as in Malta), it is not liable to be contaminated with tubercle bacilli. It is an animal which is well suited to the means of the peasant farmer, e.g., in the West Indies, and can be tethered to graze on any spare piece of land. We believe that the tethered milch goat may assist considerably in remedying the deficiencies in first class animal protein in certain areas.

162. *Pigs* are a considerable element in the economy of various parts of the Colonial Empire—the West Indies, parts of West Africa, Kenya (for European consumption) and Malta. The pig is chiefly valuable in that he consumes surplus or refuse which could be put to no other use. Among the Chinese in Malaya, for instance, the keeping of pigs is associated with market-gardening and the production of tapioca. The pigs are fed on the refuse from the tapioca factories and their manure is largely used by the market gardeners. From a nutritional point of view, the pig constitutes a valuable source of animal protein and fats and, though no meat is rich in vitamin B1, pork contains more of this vitamin than other meats. Where, therefore, there are products which are at present wasted, increased production of pigs may be very beneficial from a nutritional point of view. Where, however, products have to be specially grown for pig food, the advantage is more doubtful. From the point of view of the community as a whole we should regard it as very undesirable that any of the scanty supply of milk products—such as skimmed milk—should be fed to pigs. It should be possible to find more valuable uses for them.

163. *Poultry* may also be a very valuable source of proteins for much the same reason as pigs; they may be kept by anyone with a few square yards of land, they eat food that would otherwise be wasted and they require no great capital expenditure.

We suggest that Governments should do all they can to encourage the keeping and economic use of poultry. Considerable attention has been given to the subject recently in some territories. Unfortunately it often happens that according to local custom eggs are not regarded as a suitable form of food or that through poverty such eggs as are produced are sold in the nearest town. Government should, we suggest, do their best to overcome these prejudices and difficulties and to provide for the investigation and control of poultry diseases which not infrequently occur in epidemic form.

(c) Milk and Milk Products.

164. Milk is of such outstanding value for human nutrition, especially in infancy and childhood and during pregnancy and lactation, that it seems desirable to devote a special section to the subject.

165. As we have already said, the consumption of milk or milk products in any form is, in all but a few parts of the Colonial Empire, very small indeed, and in many cases no milk is consumed at all. We have recommended in the previous section that increased attention to animal husbandry is most desirable, and the improvement of the milk yield of native stock has been shown to be readily possible by selection and improved breeding. Nevertheless, the fact must be faced that consumption of milk and milk products in anything like the quantity normally regarded as adequate by European standards must remain impracticable for many years to come. We proceed to consider in this section the form in which the meagre resources available may best be utilised, whether those resources are derived from local production or from imports.

166. As has been seen milk and milk products may of course be derived not only from the cow but from other mammalian animals as well. In some parts of the Colonial Empire, for instance in Malta, the goat is a more important source of fresh milk than the cow, and elsewhere buffaloes are used. They give a milk very rich in fat. In some territories camel's milk is drunk and in others sheep's milk is used for making cheese.

167. Unfortunately fresh whole milk, besides being the most valuable of all foods, may also be one of the most dangerous. It is at all times a medium through which disease may be conveyed to man either through the transference of disease from the animal itself or through the introduction of impurities into the milk between the time it leaves the animal and the time it is consumed. Even in European conditions it is a matter of great difficulty to ensure purity of the milk supply, and in many primitive communities it would be almost impossible. It would be extremely difficult to supervise production and distribution

except with unwarranted cost, and in the tropics once milk has become contaminated the bacteria increase even more rapidly than in a temperate climate. Where fresh milk is of poor quality or much contaminated, it is certain that either condensed or dried milk of good market quality and protected from contamination in use is preferable.

168. It is of course conceivable that local milk supplies might be preserved by some form of heat treatment. Conditions have to be very favourable before a condensed milk factory has much prospect of success. A scheme for one is now, we understand, under consideration in Jamaica where conditions are as favourable as in any part of the Colonial Empire. The possibility of producing condensed milk in Kenya might be worth examining. Elsewhere it is possible that more simple arrangements for the heat treatment of milk suited to Colonial conditions could be devised. The subject is well worth investigation.

169. A certain amount of the local supply of milk may be turned into butter or ghee, that is, clarified melted butter; there has been a substantial development of ghee manufacture in recent years in many dependencies. This use of the liquid milk at least ensures the consumption of fats and some part of the other constituents of milk without danger to health, but from the point of view of the community as a whole it is wasteful of the scanty milk supplies unless the skimmed milk which remains is also used. In East Africa, however, where the production of ghee has been encouraged, it has been found that with the provision of an economic outlet for the cream the people to whom the skimmed milk has been returned have started to consume it, whereas previously they were disinclined to milk their animals at all. Contrary to a general belief butter is by no means the most valuable constituent of milk. It contains only the fats of whole milk, vitamin A and small quantities of vitamin D. Quite as valuable is skimmed milk, which stands next to whole milk in the order of the nutritive value of foods. Apart from the fat and its attendant vitamins A and D, it seems to contain all, or practically all, of the remaining materials required for the nutrition of the body, and if it is wasted there is a serious loss to the community.

170. Milk on turning sour clots and forms curds, the watery residue being known as whey. Curds play an important part in nutrition in several provinces of India, and there seems room for considerable development in the use of them in the Colonial Empire. They are already by no means unknown. Curds contain practically all the fat of whole milk with its attendant vitamins A and D, the bulk of the protein, much of the calcium and phosphorus and appreciable quantities of most of the other

constituents of whole milk. It possesses the important advantage over liquid milk that it can be kept for longer and is less liable to contamination.*

171. Cheese, which is manufactured out of the curds by pressing out such whey as remains in it, is also a foodstuff of great value which can be kept for considerable periods. It is particularly useful as a very rich source of first class protein. Usually, however, tropical peoples prefer liquid curds to hard cheese.

172. Whey, which contains the balance of the constituents of whole milk not in the curds, should by no means be wasted. Its protein and mineral elements and the B and C vitamins make it quite a valuable food which would add considerably to the nutritional value of a diet consisting largely of cereal products.

173. In general attention should be directed towards the production of those milk products which are suited to the tastes and requirements of the people and the conditions under which they live rather than to the development of a dairy industry on the lines familiar in this country. This point has been well brought out by a recent inquiry into the dairy industry of India.

174. We come now to the possibility of imports. Imports of milk and milk products are considerable per head of the population in Malaya and some of the West Indies, but are negligible in most other territories. We consider it very important that all Colonial Governments should remove all import duties on milk and milk products. This recommendation is subject only to two qualifications. In the first place there may be treaty obligations which preclude the total abolition of all duties. Secondly, the interests of a local dairying industry may have to be taken into account. We think, however, that it is very seldom that imports of dried or condensed milk would have any adverse effect upon a local dairying industry. They are not in general likely to compete with fresh milk, for such fresh milk as reaches the towns (where the majority of condensed milk is sold) is usually a luxury article meeting a different market. Nor are they likely to affect consumption of other milk products. While we do not wish to be too dogmatic on the subject, it seems to us likely that the only instance in which imported dried or condensed milk might be harmful to a local industry would occur if there were a question of setting up a local condensed milk factory.†

175. We feel, however, that even if all import duties are removed on milk and milk products (and in some cases there are

* See also Chapter IX, paragraph 228.

† See also on this subject Chapter X, paragraph 258.

none already) imports will still remain too expensive to provide a solution of the problem or, in most territories, to go far towards that end. Indeed, they may often be so expensive as to be positively harmful by diverting purchasing power from cheaper foodstuffs available locally. Although these local foodstuffs have not, weight for weight, the same nutritive value as imported milk products, the larger amount that can be purchased with the small cash resources of the average consumer may on balance give him better nutrition. It is important that nutritive value should always be assessed in conjunction with cost.

176. At the same time imports of milk products may be exceedingly useful. In some territories imports of condensed milk are already considerable, and it seems to us that there may be real use for bulk imports of dried skimmed milk for feeding to selected groups such as school children or labourers. Imports of dried skimmed milk might be practicable when fresh milk is not available or is far too expensive.

177. We attached as Appendix 3 to this report a memorandum in which it is sought to discover the most economical way, from a nutritional point of view, of spending a given sum on the purchase of manufactured milk, taking into account also the consideration of possible deterioration between manufacture and consumption. Prices vary so much from place to place and from time to time that exact conclusions are not possible, but the following broad general conclusions emerge:—

(1) Of the various types of manufactured milk, the real choice lies between condensed sweetened whole milk and dried skimmed milk. As regards keeping qualities, condensed sweetened whole milk is more convenient for household use, but dried skimmed milk is just as suitable, if not more so, for use in institutions or for the supplementary feeding of groups of the population, e.g. school children.

(2) £1 spent on condensed sweetened whole milk, or indeed on any form of whole milk, will purchase considerably more fats and vitamins A and D than £1 spent on any form of skimmed milk.

(3) But £1 spent on the purchase of dried skimmed milk will give a very much larger quantity of proteins, calcium, phosphorus, iron and the B vitamins than £1 spent on condensed sweetened whole milk or any other form of processed milk.

In other words, in everything except fats and vitamins A and D dried skimmed milk has very considerable economic advantages in the Colonial Empire over other forms of milk, at any rate for use in bulk. We recommend that its use should be greatly extended. It is true that no form of skimmed milk is suitable as a sole food for infants and if it were available

for general consumption the risk of its use for this purpose would have to be set off against the advantage to the general population of increased quantities of protein, calcium, etc. We think that the risk is one which might often be taken. Moreover it is also true that condensed whole sweetened milk is not by any means an ideal food for infants, because the large quantity of sugar it contains replaces Calories that should be obtained from more valuable foods containing fats, proteins, etc.

178. The conclusion that dried skimmed milk may be exceedingly valuable has already been reached in India, where steps have recently been taken to remove all duties on it and where it is now recommended for use for the supplementary feeding of schoolchildren and in other Government institutions. We would make the same recommendation as regards the Colonial Empire. We think that increased imports of dried skimmed milk for large-scale use might be of great significance in most parts of the Colonial Empire particularly in remedying protein deficiencies.

179. In a few territories it may not be possible to remedy the serious deficiency of fats without the use of some form of whole milk. Generally however it should be possible to supply the fats from other sources and the cost of so doing should not detract very materially from the advantages of dried skimmed milk in other respects.

(*d*) Fish.

180. Fish can contribute a number of constituents which are of importance to the dietary. In particular its proteins may be very valuable indeed. Fish oil, fish livers and " fat " fish such as herring and salmon are also rich in vitamin A and small fish entirely consumed give calcium and other inorganic elements. In addition sea fish are an important source of iodine. In short, they are a most valuable foodstuff and we regard it as most important that the supplies of fish in and around Colonial waters should be developed to the maximum possible extent. The river, sea and lake resources of fish in the Colonial Empire are still largely undetermined and we recommend that increased attention should be given to this matter.

181. In some Colonial territories a beginning has already been made. Ceylon, Malaya, Mauritius and some of the West Indies have for many years devoted attention to the subject. More recently Palestine, the Gold Cost and Zanzibar have been endeavouring to stimulate their sea fisheries, while surveys of the lake fisheries have taken place in Uganda and other parts of East Africa.

182. The possible types of fishery are three, (i) inland fisheries, both river and lake, (ii) inshore sea fisheries and (iii)

deep sea fisheries. In the first two cases development can probably best be carried out by the local inhabitant with little capital and equipment, but technical advice will be necessary both as to the fish resources which exist and as to the best means of exploiting them without depleting them. In the case of deep sea fisheries larger capital and equipment will normally be necessary, and it will not be attracted until it has been shown by expert survey and experiment that fish are available in paying quantities. We believe that much useful work might be done by some central organisation to advise and assist Colonial Governments on all these matters and we are very glad to learn that at the instance of the Secretary of State for the Colonies it has recently been decided to set up a Committee in London to assist in the development of colonial fishery resources.

183. It should be borne in mind that there are differences of great significance in the amounts of the various constituents present in different varieties of fish. This is particularly true in regard to the fat content which may vary from approximately 0·5 per cent. to more than 10 per cent. It is also important to appreciate that the offal of fish is particularly rich in accessory food factors and that these are lost where, as is usual, fish are eaten after having been gutted. With fish the problem of preservation and distribution must necessarily be an obstacle to more widespread consumption. We return to this question later.

(*e*) Concentrated Foodstuffs.

184. In the previous paragraphs we have made a number of suggestions as to the kind of crops and animal products which should be encouraged for the sake of improving nutrition. In general we consider that it should be the aim of nutrition policy to rely on natural foodstuffs for the improvement of diet. Circumstances may, however, arise in which certain groups (i.e. school children, hospital patients, labourers on estates and mines and in urban areas) may benefit from the distribution of highly protective foods in concentrated form, provided that these can be obtained cheaply in large quantities.

185. Manufactured milk, for instance, might be used in this way for school children and hospital patients. We have discussed in paragraphs 176-179 the most convenient and economical form in which to give it. Yeast is another substance which might also be used. As has recently been pointed out by a Sub-Committee of the Technical Commission on Nutrition of the Health Organisation of the League of Nations, it is rich in nitrogenous elements and in the B group of vitamins. It is of particular value in correcting deficiencies in diets composed largely of cereals. Methods by which yeast rich in water-soluble vitamins can be produced cheaply on a large scale in countries where cereal diets are general are certainly worth investigation.

186. Yeast extracts and autolysates are often given to assist in remedying specific deficiency diseases such as beri-beri. The proprietary articles are, however, too expensive to be used on a large scale. We think that Colonial Governments would do well to consider whether it would not be practicable to produce locally a concentrated article of similar nature which would be much cheaper and could therefore be more widely used. Thus, in Hong Kong, an extract of yellow beans (*Glycina soya*) and rice polishings is now given in cases of beri-beri in place of marmite and seems to give considerable benefit. In general rice bran or polishings is a valuable article which should not be wasted.*

187. There is little doubt that the local "beers" which are frequently found and largely consumed have great nutritional significance, providing vitamin B complex (in the yeast), vitamin C (from germinated grains) and probably other valuable constituents. The use of these beers in moderation thus undoubtedly has certain benefits from the nutritional point of view, whatever may be the other objections to it. In South America beri-beri has been shown not to exist in areas where local beer brewed from cereals is consumed. Again, it might be practicable in certain territories to supply vitamin deficiencies by such means as the local production of fish liver oil. This too is a matter which is worthy of investigation.

188. Similarly, as the Sub-Committee mentioned above have also pointed out, mineral elements can sometimes be supplied in concentrated form. Calcium salts, iron, iodine, etc., can be supplied cheaply to school children and other groups suffering from deficiency of these elements. Such a measure may be financially feasible when expense forbids the supplying of milk or other valuable foods. For instance it has been shown that one of the most important defects of the poor rice eater's diet is a deficiency of calcium. In such circumstances the regular provision of a calcium salt would do something to raise standards of nutrition. The same measure may be effective in the case of people living on other staples, for instance cassava (or tapioca), which are deficient in calcium. Prepared bone meal or flour has also been suggested as a source of calcium phosphate.

189. In some territories it would be useful if attention were given to the sources of supply of salt. Local sources are often capable of development and improvement and, where imports have to be relied upon, steps might be taken to ensure that the salt imported contained a minimum percentage of calcium, iodine and perhaps iron. We commend this suggestion to the attention of Colonial Governments.

* We deal with questions relating to the processing of rice in the next chapter.

CHAPTER IX.

THE HARVESTING, PRESERVATION, STORAGE, PROCESSING AND COOKING OF FOODS.

190. As we have already pointed out, there are many factors affecting the nutritional value of a foodstuff. In this chapter we propose to deal with the sequence of events that foodstuffs pass through between harvesting and consumption, omitting however questions relating to marketing and transport, which we shall deal with in the next chapter.

(*a*) HARVESTING.

191. The chemical composition of any crop is obviously very different at early stages of growth and at maturity, but less noticeable though perhaps as significant are the changes during the period of actual ripening. Alterations in the relative proportions of carbohydrate and protein or of fat and protein then take place, and in the case of grains and seeds, while the water content is progressively reduced, the relative insolubility of the foodstuff is increased. The vitamin C content of a crop also is directly related to the age and activity of the plant tissues. In the majority of cases ripe fruit contains more vitamin C than unripe fruit. Young growing shoots of spinach, lucerne and amaranth are richer in vitamin C than old leaves and stems of the same plants. Similarly, young green peas are richer in vitamin C than older peas.

192. The treatment of the crop in the field may also affect nutritive value considerably, especially as regards vitamins and vitamin C in particular. The vitamin C content of a vegetable, for instance, rapidly diminishes as the crop becomes stale. Cut greens as they wilt lose their vitamin C very quickly and the precursors of vitamin A are also oxidised and lost. Green peas may lose 50 per cent. of their vitamin C in as short a period as 48 or even 24 hours after picking. In the same way, the vitamin C content of potatoes is highest immediately after harvest and gradually diminishes during storage. In general, perishable vegetables should be consumed as soon as possible after collection, or if they are to be kept for future use they should be stored or preserved as soon as possible.

193. Somewhat similar considerations to those just set out apply to animal products. The nutritive value of a fish, for example, varies according to its maturity and age, its food value being highest immediately before spawning and lowest after spawning.* As regards the vitamin content of the livers, if the cod can be accepted as typical, the larger the fish of a given species from a given locality, the greater the proportion of vitamins in its liver-oils. The time between death and consumption or curing also affects the nutritive value of a fish. The flesh of fish is extremely perishable; the flavour is quickly lost, the texture deteriorates, the appeal to the appetite disappears and the flesh decomposes.

(*b*) Preservation and Storage.

194. Where immediate consumption of any perishable foodstuff is not possible it must be stored or preserved in some form or other, and it is important that a method of preservation should be adopted which will involve the minimum loss of nutritive value. This question of the preservation and storage of food is one to which a great deal of attention is now being paid in some European countries and in the United States of America. Investigations relating to produce grown under tropical conditions have so far been limited chiefly to fruit and vegetables for export. Valuable results have been obtained from this work and it is to be hoped that it will be continued and extended. It has, however, little direct relation to nutritional problems in the Colonial Empire.

195. From that point of view the main problems are not associated with large scale storage or with the preservation and storage of high grade commodities for overseas markets. Rather they concern storage by the individual or the small community from one harvest to the next of the crops that they themselves grow and keep for their own consumption and the preservation of highly perishable products such as fish, soft fruits and green vegetables so that they need not be consumed at once but can be kept for a while and if necessary distributed over a wider area. Many indigenous systems have been evolved and many of these are sound, effective and economical. The Chinese in particular have invented many ingenious forms of processing and storing their food.

196. We suggest that steps might be taken to collect together information regarding existing practice in the Colonial Empire and the points on which it is felt locally that there is room for improvement. The information thus obtained could then be collated for general circulation. The subject is important

* Obviously, however, if there is any chance of a depletion of the stock it is not to be advocated that fish should be caught when they are just about to spawn.

for there is no doubt that the losses due to faulty storing and the absence of proper methods of preservation are in many areas considerable and that much could be done by more effective methods to improve nutrition in those areas. It is of particular importance in those territories where there are seasonal shortages of food and the possibility that the staple crop may fail.* We hope that the survey we have suggested will also cover the various forms of preserving fish.

197. In a sense all forms of storage are only a second best. The ideal is that supplies of fresh food should always be available in succession. The homestead garden is the perfect store for green vegetables, as is the orchard for fruit and the lake, pond or river for fish. These three classes of foods, green vegetable, soft fruits and fish, are much more perishable than seeds, root crops and the hard fruits, and moreover important food values are lost in proportion to the time which elapses between their collection and their consumption at the table. However, storage and preservation must normally be resorted to. Indeed, it is essential where there is an alternation of gluts and famines and where an all the year round succession of fresh foodstuffs does not occur.

198. Food can be preserved in a large number of ways: by physical methods, such as cooling, heating or drying; by chemical methods such as salting, smoking, sugaring, souring, mixture with condiments, the addition of alcohol and other chemical substances; or by a combination of two or more of these methods. All treatments are really designed to prevent or slow down chemical changes in the substances preserved, to destroy or inhibit the action of contaminating organisms and, when these conditions have been reached, to maintain them. The process of drying is employed because the more water that is removed from a product the better it will keep. High temperatures sterilise the products by killing bacteria and fungi and their spores, and so prevent fermentation if contamination after cooling is avoided. Heat also destroys enzymes which would otherwise hydrolise the fats into fatty acids, whereby the product would become unpalatable. Salt is added because very few bacteria or fungi will multiply in high salt concentrates. The use of hot smoke, which partly dries and cooks the product,

* In such territories a communal store may often be useful. Thus in parts of Uganda a levy is imposed on each producer in the community, and this is kept in a communal store. After the levies have accumulated during a period of anything up to four or five years, the producer on handing over his next levy is given in return an equivalent amount from the store containing the oldest grain or seeds. Not only does this communal store provide a reserve which can be utilised in times of famine, but it serves to increase the sense of security, the thriftiness and the foresight of the members of the community.

adds to it also certain organic compounds, which serve as preservatives. Acids and sugars are employed because when present above certain concentrations they create media unfavourable to the growth of micro-organisms, while refrigeration and storage at low temperatures prevent their development. Canning is resorted to because the process involves the sterilisation of the product by heat while the subsequent hermetic sealing of the cans prevents reinfection; the spores of any organisms which may have resisted heat sterilisation are almost invariably aerobic and cannot develop if air is excluded.

199. Of the various forms of treatment, drying is one of the most common. It is the process normally employed for the preservation of grain and it may also be used for a great many other commodities. One of the advantages of dried products, particularly those which originally had a high water content, is their relatively light weight, which makes them easier than most forms of preserved food to transport.

200. The amount of drying required will depend on the nature of the product to be treated. In the case of fresh fruits and vegetables the moisture to be removed is very considerable, amounting often to over 60 per cent. of the weight of the fresh product. It may be removed by drying in the sun as in the case of raisins, apricots, prunes and often (in the tropics) of fish, or by drying in some form of evaporator in which artificial heat is used, sometimes under reduced pressure.

201. The nutritive value of the dried article need not differ greatly from that of the fresh article, except that there will be some loss of vitamins, notably vitamin C. Dried fruits and vegetables have little vitamin C content compared with their fresh counterparts. Conditions of drying affect the matter; the vitamin C content of the dried article will be highest when drying has taken place at a low temperature, and at any given temperature the more quickly the drying has taken place the greater will be the retention of vitamin C. Bruising, peeling, cutting and crushing should also be avoided or reduced to a minimum.*

202. Drying may also affect the time required for cooking. For instance, it has been shown that beans dried to a zero water content without rupture of the testa still remain hard after ninety minutes' cooking, whereas ordinary commercially dried beans would be softened and cooked in an hour.

203. The successful storage of grain depends on the moisture content being reduced to a satisfactory level and kept at that

* Green foods are sometimes partially cooked before being sundried. The principle appears to be sound as the quick heating should lead to a greater retention of vitamin C.

level. The level varies for different crops, ranging between 10 and 14 per cent. The best means of reducing the moisture content depends upon the atmospheric humidity and other climatic conditions; often drying in the field in the sun before threshing presents no difficulty, but where the atmospheric humidity is high special provision may be needed. This may take the form of grain driers in which a current of heated air is forced by blowers or suction fans through the grain, but the older and more general form is drying floors or barbecues on which the grain is spread out and subjected to the direct heat of the sun, usually with provision for covering it up rapidly should rain suddenly occur.

204. Not only, however, must the moisture content of stored grain be reduced to a satisfactory level, but it must be kept at that level during storage. In countries where there is an alternation of dry and wet seasons this is important. Articles which have kept well in months of dry weather may go bad in a few days when the wet season begins. It must also, of course, be kept as free as possible from attack by insects and vermin which at present cause very considerable loss of stored foods in the Colonial Empire. Incidentally grain insufficiently dried is much more liable to insect attack than grain which has been thoroughly dried.

205. Under primitive conditions and where atmospheric humidity is not too high, as in many parts of Africa, maize can be dried in the husk in the field to a satisfactory degree, and it can then be kept still sheathed in the husk in the homes of the growers for moderately long periods in fair conditions. The leaves of the husk will prevent the entry of insects. With other types of grain, e.g. millets or paddy, and with maize when the atmospheric humidity is high, greater precautions are needed. Various indigenous types of granary have been evolved and some of them are moderately efficient. The grain should if possible be stored in airtight containers, either stone jars or iron tanks or tins. Old petrol tins do well for storage on a small scale. In India grain stored in this way has been successfully " sealed " and kept airtight by covering it with a layer of sand, a sheet of cloth or a piece of wood or iron being placed in between to prevent the grain becoming mixed with the sand. On the Gold Coast maize stored in airtight petrol or kerosene tins showed no appreciable loss of weight and was free from weevils after eight months, whereas well-sheathed corn stored in a native barn showed a decrease of 25 per cent. in weight and was of a less attractive appearance.

206. For the large scale storage of grain, specially constructed granaries have been erected in some Dependencies. The rice granaries of Ceylon and Mauritius are examples of such stores.

The most satisfactory method for the bulk storage of grain is in large concrete or metal tanks which can be hermetically sealed and which are also provided with facilities for fumigation in the event of the contents being attacked by insects. Grain is, however, often stored in bags in large stores. It is important that such stores should always be made rat-proof since otherwise a large amount of damage may occur and there is the added danger of providing foci for rat-borne diseases, particularly plague. Grain stored in bags is also much subject to attack by insects. It is very difficult to guard against this, though recent experiments in Malaya indicate that an addition of 5 per cent. of quicklime to rice will prevent weevil attack. In general storage in bags, though for various reasons it may often have to be used, is not so effective as storage in concrete or metal tanks.

207. Indeed as a general rule it may be said that wherever possible stored products, whether dried or not, should be kept in airtight containers. Not only will bacterial and fungal activity thus be reduced to a minimum, but also there will be no danger of attack by insects. If the product is free from pests when sealed in the container it will be free when the seal is broken. If the product stored is living, e.g. grain or seeds, then respiration will take place in the container. In airtight containers, as a result of progressive replacement by carbon dioxide of the oxygen in the air between the stored products, the rate of respiration is progressively retarded. For this reason, and because of the dry environment, the life of the grain is prolonged. At the same time the accumulation of carbon dioxide will first check the activity of any insect pests that may be amongst the grain and then will asphyxiate them.

208. If a container is airtight it will very often be ratproof. If it is not, means must also be found of affording protection against attack by rats, since not only will they cause direct loss but also, by damaging the container, they will permit the entry of damp air and insect pests.

209. If the stored product has to be transported, this should be taken into account. If transport is by head porterage, bicycle or lorry, then the type of storage should be adapted to this method. For example, if fish is the commodity in question and head porterage or the bicycle the method of distribution, then the storage container employed should not exceed in size one load. This is not always practicable but the principle should be borne in mind.

210. Drying may be accompanied by chemical treatment of the article to improve its appearance and keeping qualities and to conserve its nutritive value. Sulphur dioxide, for example, is employed in California where it is desired to preserve fruit

by artificial drying with improved colour and with a relatively higher water content than in the sun-dried product. Drying is also more readily effected if combined with treatment by sulphur dioxide. This treatment in the case of apricots, prunes and raisins preserves both vitamin A and C, as compared with the sun-dried products where these vitamins are largely lost.

211. Sulphur dioxide must be used with discretion and under supervision. There are however other and more simple methods applicable to special products of combining drying with a chemical process. Fish, for example, besides being simply sun-dried (stock fish), may be salted and dried (dried salt cod), lightly salted and lightly smoked and dried (kipper), salted and dried with heavy smoking (red herring), lightly salted and lightly smoked but in a hot smoke which cooks as well as dries (bloater). The drying, salting, smoking and cooking all play their part in increasing the keeping quality of the fish.*

212. Brining (not to be confused with brine freezing, an expensive process seldom applicable in colonial conditions) is a useful method of preservation which is applicable to fish, meat and the leaves and roots of vegetables. It is a method much used by the Chinese in Malaya. Brined products have in the past been regarded as of doubtful nutritional value. We consider, however, that the evidence on this point is inconclusive, and that where a poor state of nutrition has been observed to accompany diets largely consisting of foodstuffs preserved in this manner, the explanation may be found in the low nutritive value of the remainder of the diet. It is possible that prolonged brining in the case of certain vegetables results in the formation of toxic substances; this is referred to below. There is recent evidence that the presence of cooking salts prevents the loss of vitamin C from lemon juice. If this finding is confirmed for other foodstuffs it is clearly of importance.

213. Where wet storing is used for the preservation of roots and vegetables, the addition of bran from, say, rice will be found useful in the course of pickling, since by this means vitamin B1 can be introduced, the vitamin diffusing from the bran into the wet vegetables. The bran used must be fresh, i.e. recently removed from grain which has been stored under conditions in which the vitamin B1 content has not been lost. There is, however, no necessity for the grain to have been

* Salted fish should be kept dry, and where humidity is high this will entail an airtight container. Lightly smoked fish will only keep a few days even in temperate climates, and on ice will only keep at the most for a few weeks. There is evidence to show that in the processes of salting and drying fish practically all the vitamins A and B normally disappear, but it is possible that methods can be devised to diminish this loss.

stored previously in the husk. Since vitamin B1 is soluble in water, it follows that the volume of the pickling fluid should be kept as low as possible.

214. Smoking is a method of preservation which is particularly applicable to fish. In some parts of the Colonial Empire fish are smoked by primitive methods; the more common method, however, is to dry them in the sun. It seems reasonable to suppose that the methods of smoking at present in use destroy a considerable part of the nutritive value of the fish. There are no specific data on the subject, and it is possible that the condition in which the fish has been kept before smoking may be responsible for this loss.

215. The use of acids in souring products and thereby preserving them is of considerable importance. The precursors of vitamin A, vitamin B complex and vitamin C are all stable in acid conditions. Acids are used in the preparation of pickles, and acetic acid, the acid principally employed, is easily prepared by the action of certain organisms on the alcohol present in beers, wines or a variety of locally brewed drinks. In the pickling of vegetables and fruits in vinegar the same results are achieved, but it should be noted that the water soluble vitamins B and C will be equally distributed in vegetable and pickling fluid, and as the latter is often wasted it should be kept to a minimum volume.

216. Two other preservatives in general use are saltpetre and sugar. Saltpetre is used in conjunction with salt in the curing of meat, and sugars are employed chiefly in the preserving of fruits, either as whole fruits, as preserves or as jams. Salt pork is perhaps the most widely used of the salted meats.

217. A number of recipes for preserving eggs have been devised, in which drying or salting are most general. Sometimes a mixture of salt and the ash of rice husks is used. In another method tannin derived from an infusion of tea, salt, soda, ash, lime and charcoal are mixed to form a paste in which the eggs of hens, ducks and geese are preserved. In East Africa eggs are preserved in a mixture of beeswax and crude simsim oil. Still another device involves the use of salt, rice bran and rice wine. The use of sodium silicate (water-glass) and of other commercial methods is not applicable to native conditions on account of their cost.

218. In the modern world refrigeration is familiar as a means of food storage, and the use of cooled containers assists in the distribution of perishable products. In many parts of the Colonial Empire there are now cool stores in important towns, but for a long time to come they can only have a very limited

effect upon the foodstuffs consumed by the poorer classes. In a few cases refrigerated trucks or vans are provided for the transport of fish, meat or perishable vegetables to central markets. Again, however desirable such a development may be, it can only be of limited utility for a long time to come.

219. Canning is a form of food storage which is much developed now in western countries, and is being developed in certain parts of the Colonial Empire. It is the best method of preserving watery tissues. Canning in the Colonial Empire is at present chiefly for export markets, but a beginning has been made in some parts in canning for local consumption. Locally canned pineapples are consumed in Malaya, and locally canned grape fruit in Jamaica, British Honduras, Trinidad and the Gold Coast. Plans are on foot for a local factory for the manufacture of milk products in Jamaica. Canning for the local market may, it seems, develop considerably in certain parts. On occasion, the imported canned foodstuff may also play an important part in nutrition. Canned foodstuffs have the great advantage that they will keep for a long time, and in tropical countries where fresh foods are liable to more rapid deterioration than in temperate climates this is a factor of importance. For instance, we have already in a previous chapter recorded the view that condensed milk, being of known purity and quality, is from a health point of view preferable to fresh milk of low grade which is often adulterated or contaminated before it is consumed. Certain precautions must be taken in the use of canned foods, for in many instances when the tin is once opened the contents become contaminated by flies or bacteria more quickly than the fresh article.

220. In the circumstances of the Colonial Empire, moreover, there are other considerations which must be taken into account. Chief among these is the relative cost of canned food as compared with the fresh product. Whatever the relative nutritive value of tinned and fresh spinach, if the purchase of the tinned product entails the disbursement of some of the purchaser's scanty cash resources while the fresh spinach requires no cash payment at all, the fresh product obviously has the advantage. Again, as we have tried in an earlier chapter to point out, there are many advantages—social, economic and even nutritional—in persuading as many people as possible to grow their own food.

221. For these reasons the canned foodstuff will never, we think, play as important a part in the economy of the Colonial Empire as it plays in some western countries. At the same time, when there is a known deficiency of an essential element of nutrition which cannot be easily supplied from local foodstuffs, as for instance in the case of milk products, the supply

of canned foods may be the most effective and cheapest means of remedying the deficiency. In such cases they may be of value even in rural areas, and in urban areas their value is naturally likely to be greater.

222. There is a considerable amount of misapprehension regarding the value of canned foods and indeed of stored foods of all sorts. It may therefore be useful if we quote the following statement which has been authorised by the Medical Research Council:—

> "There is still so much to be learnt about food and nutrition that it is impossible, in the present state of knowledge, to state categorically whether or not stored foods are as nutritious as fresh foods. Nor is it feasible to undertake research with a view to answering this question directly. Many years of intensive work on large groups of human beings would be entailed, and even then there would be little prospect of arriving at a definite decision, for, with further knowledge of the effects of dietary factors on nutritional processes, it would be found that the results of the first few years' studies would have to be reconsidered in the light of fresh evidence. Nevertheless, useful information can be obtained by comparing the chemical composition of stored foods with that of fresh foods, and the general conclusion can be accepted that relatively little loss of known constituents occurs in foods stored by modern methods. Moreover, experiments have been carried out on animals in which satisfactory nutrition has been maintained with diets composed solely of stored foods. The available evidence therefore suggests that modern methods of storing foods caused little depreciation in their nutritive value; in fact, it may be said that food of good initial quality that has been stored by the best modern methods is likely to be superior in many respects to similar food that, though still technically fresh, is in reality stale. One substance of important biological significance, especially associated with fresh fruit and vegetables, namely vitamin C or ascorbic acid, is well known to be easily destroyed by heat, applied either in ordinary cooking or canning; to a less extent vitamin B_1 is liable to be similarly affected."

223. In framing this statement the Medical Research Council refer to "modern methods of storing" and no doubt they had canning primarily in mind. Whether the statement would hold good of many methods in use in the Colonial Empire is perhaps doubtful, but while one cannot be too dogmatic, at least it seems that, weight for weight, canned foods are not much, if at all, inferior in nutritive value to food which has not been canned, and may in certain circumstances be superior.

(c) Processing.

224. It has long been recognised that the processing of foodstuffs may have great nutritional significance. For instance, one of the most striking discoveries ever made in the field of tropical nutrition was the discovery that the removal of the fine covering of the rice grain in the process of milling removed also the nutritive substance, vitamin B1, the absence of which in the diet causes beri-beri. Consequently, people who live largely on polished rice and do not supplement the rice with other foodstuffs rich in vitamin B1 are very liable to suffer from the disease. In the same way, the vitamin B1 content of even lightly milled rice may be removed if the grain is thoroughly soaked or washed and the water thrown away. The methods of processing, handling and storing rice are nutritionally of the first importance in territories where rice is the staple diet, and they should receive the careful attention of the authorities in those territories. We commend to their careful consideration the valuable memorandum by Dr. B. S. Platt which is attached as Appendix 6 to this report. The memorandum embodies the results of original work and the conclusions set out on pp. 196 and 197 are of much practical importance in countries where rice is the staple diet.

225. In the case of other grains, such as wheat, a high degree of milling also reduces nutritive value. For this reason wholemeal flour is greatly to be preferred to other kinds, especially where the diet is approaching deficiency level. Dependencies which are substantial importers of flour might consider the practicability of legislation to regulate the quality of imports. The question is not, however, of the same order of importance as in the case of rice.

226. In several other cases the normal commercial processes destroy a substantial part of the nutritive value of the article. Such is the case, for instance, with red palm oil, the produce of *Elaeis guineensis*. This in its original condition is very rich in carotenoid precursors of vitamin A, so much so that its use has been proposed as a substitute for cod liver oil or halibut liver oil as a means of administering this vitamin. The act of bleaching for commercial use, however, almost completely destroys the carotene content. Actually in West Africa, the only part of the Colonial Empire where palm oil at present forms an important constituent of the diet, it is used without any bleaching treatment; but it is important that the point should be appreciated, as it is to be hoped that its use will be introduced into other parts of the Colonial Empire. To obtain the maximum nutritive value, the fruit should be collected carefully with the minimum of bruising. The whole fruit should be subjected to steam-heat to destroy the enzymes which liberate

free acids from the oil. The pericarp should then be removed and the oil extracted from it. The oil should then be sterilized by steam-heat. The principle to be borne in mind is that if the oil is broken down at any stage, free fatty acids will be formed and a percentage higher than five per cent. makes the oil unpalatable*.

227. Some of the processes to which fresh foodstuffs are subjected before consumption or storage may give rise to by-products which are of nutritional value. Reference has already been made to the high nutritive value of bran recently milled from rice stored under good conditions. The example *par excellence* of a by-product which has nutritional value is skimmed milk, which is a by-product of the manufacture of butter or ghee. Another example is the livers of certain fish including many tropical fish, such as sharks, bonito and albacore, which are exceedingly rich in vitamins A and D and in blood-forming substances. In certain Colonies it might be worth while to consider the possibility of setting up plants to enable the oil to be extracted from these livers for consumption in concentrated form.

228. There are many forms of processing which add to the value of the product. For instance in Chapter VIII paragraph 170 we said that curds were a form of milk product likely to be valuable in the Colonial Empire. The reason for this is that in the acid medium of soured milk there is a peculiar bacterial flora in the presence of which many organisms such as those which cause bacillary dysentery, cholera and typhoid, cannot flourish. In a primitive community therefore curds are a much safer commodity to handle than milk in that there is less likelihood of these diseases being spread.

229. Similarly if peas, beans and grain be allowed to germinate, vitamin C is produced in appreciable quantities. An important side-dish of the Chinese consists of the soya bean sprouted in the dark. Indeed soya beans in any form must be properly processed if they are to be readily eaten. We have referred to this in Chapter VIII, paragraph 141.

230. Again, it is now generally recognised that grinding, by assisting digestion, may indirectly increase the nutritive value to the consumer of seeds and grains of all sorts. When grains are cooked whole, some of the cell walls are left intact, and in consequence digestion of the contents of these cells can only be accomplished if the digestive juices penetrate the cell wall. In the case of many grains, therefore, powdering or some other treatment such as pre-heating should be an aid to digestion.

* The same principle underlies the manufacture of ghee, namely, first sterilisation by heat to destroy the enzymes which if left result in rancidity and secondly storage in airtight containers.

231. Similarly, with many other foodstuffs chopping and mincing make digestion easier. In the case of fruits and vegetables, however, fine division of this kind should only be carried out a short time before the food is to be consumed or cooked, since disruption of the cell allows changes to set in which may destroy food values.

232. One point which should be made in regard both to methods of preservation and storage and methods of processing is the danger of poisoning. Care must, for example, be taken with cassava and some of the pulses. It is also probable though direct evidence is at present lacking, that certain green vegetables (especially Cruciferae—cabbages, etc.) may after prolonged brining contain poisonous matter which, owing to the wet nature of the food, would not necessarily be removed in subsequent cooking. It is also possible that prolonged smoking of fish, which might be advocated in the tropics to enhance keeping qualities, would produce toxic compounds, but here again direct evidence is lacking. The danger of canned foodstuffs where the can has not been absolutely air-tight is well known.

(*d*) Cooking.

233. The final stage in the handling of food is its preparation for the table, and in this cooking generally, though by no means necessarily, plays a part. Some food reformers have maintained that all processes of cooking are unnatural and are to be discouraged because of the loss of food values which follows the application of heat. To accept this view however is to lose sight of the purposes which cooking fulfils. In the first place food is sterilised by cooking and its keeping qualities enhanced. A second and more important object is the conversion of foods which are indigestible when raw into a state in which they are appetising and digestible. The appeal to appetite is particularly important. Well cooked food is more attractive to the eye, and its flavour is improved. The pleasure which it gives performs a definite physiological function in promoting secretion of the digestive juices and mobility of the alimentary tract. In other ways also cooking enables food to be more easily masticated and digested. For example, the fibres of meat, softened by suitable cooking, are more easily separated and the digestive juices are better able to penetrate the chewed food. Starch-containing foods, which are generally prepared by the grinding of seeds and grains, are more digestible when cooked, preheated, or puffed, both because the covering of the starch grain is broken and also because some at least of the starch itself may have been converted into substances more readily digestible.

234. Nevertheless the loss of nutritive factors which takes place in cooking may be important. These may be of constituents which contribute to flavour, or of mineral salts or other essential food factors such as vitamins. Of the vitamins, vitamin A and its precursor carotene are insoluble in water, and are stable at high temperatures, though they are readily destroyed at all temperatures in the presence of oxygen. The ordinary processes of cooking animal and vegetable products are accordingly unlikely to occasion significant loss of either vitamin A or carotene. Vitamin B1 shows considerable resistance to heat in an acid or slightly acid medium and during the cooking of fruit, vegetables, meat, fish, and eggs destruction of vitamin B1 is likely to be insignificant provided that the practice of adding soda to vegetables be rigorously excluded. Nevertheless, the fact that vitamin B1 is soluble in water may lead to serious loss of the vitamin if the water in which the cooking has been done is thrown away. Vitamin C is rapidly destroyed by heat especially in the presence of alkalies.*

235. In general it may be said that except as regards the conservation of vitamin C a long period of cooking at comparatively low temperatures is better than a shorter period at high temperatures. The essential chemical changes in cooking take place at a temperature considerably below boiling point. For example, in the cooking of protein-rich foods, such as meat, fish and eggs, the object is to coagulate the proteins. This occurs at a temperature of 140° F. Cooking therefore at any temperature above this point up to boiling point is as effective as cooking in boiling water. The same holds good in the case of meat. It may in fact be said that in stewing meat the temperature of the stew should not be allowed to rise above 180° F. Again in the case of cereals cooked with water, what is essential is to reach the " gelatinisation point " characteristic of starchy foods. This ranges from 149° F. for potato to 185° F. for oat starch. Fats on the other hand in contrast to proteins and cereals may be subjected to comparatively high temperatures (350-390° F.) without serious changes.

236. In cooking meat therefore it may be said that stewing is, if properly carried out, an ideal method. The liquid should never boil, as this hardens the proteins. The flour used for thickening should be added as late as possible as starch has a toughening effect on proteins. Where meat is stewed at the proper temperature the losses in cooking may be reduced to a minimum if the gravy is consumed.

* Most of the destruction of vitamin C takes place during the first few minutes of heating before the enzyme is destroyed. Boiling directly over a flame whereby a high temperature is rapidly attained is therefore less destructive of vitamin C than steaming where the rise of temperature is slow

237. Fish so readily loses its flavours in the process of cooking that it is best to employ some method by which these are conserved. Deep fat frying in which the fish is immersed in fat heated nearly to boiling point is, from this point of view, the best method. Where fish is boiled the losses in mineral salts are considerable, and may amount to as much as 40 per cent.

238. The losses of mineral salts which occur in the cooking of vegetables have been found to be surprisingly small. The principal loss which occurs is of vitamin C.*

239. Vitamin B1, while resistant to heat in an acid or slightly acid medium is, like vitamin C, rapidly destroyed in alkaline solutions such as those produced when alkali salts are added to the water during cooking. The object in so doing is to increase the rate of cooking and to preserve the green colour and pleasing appearance of the vegetables. Local salts are used in the preparation of many vegetables, for example, by the peoples of East Africa. These are often prepared from pot-ashes such as burnt maizecobs, cow pea-pods and leaves. Although, as we have seen, this practice leads to the destruction of the vitamins, it has been found by careful inquiry amongst the peoples who use them that they are employed only for cooking certain kinds of green leafy vegetables which, if not so treated, are regarded as inedible. It is obviously undesirable in a case of this kind to attempt to interfere with local custom.

240. Although it is in general desirable that the water in which vegetables have been cooked should be consumed, there are exceptions to this rule. In some territories, for example, there are methods in existence for the cooking of certain vegetables such as beans, aroids, yams and cassava in which the cooking water is thrown away. Sometimes several changes of water are made. It has been found by experience, and confirmed in some instances by chemical investigation, that this repeated change of cooking water has the effect of removing some poisonous principle in the foodstuff. Manifestly in such a case it would be undesirable to advocate methods of cooking which conserve the original character of the food.

241. New knowledge is gradually throwing a clearer light on the various elements which enter into the flavour of foodstuffs and the reasons underlying food preferences and traditional cooking practices. As we have already suggested in an earlier chapter every attempt should be made to understand these traditions and preferences before existing practices are condemned or superseded. Existing methods should be examined and their

* In the preparation of stews made on a large scale, as is usual in institutional and camp cookery, and cooked slowly for a long period, care should be taken to add the vegetables at a later stage in the cooking process so as to reduce as far as possible.loss of vitamin C.

value assessed with a view to suggesting the lines on which improvements may be effected. But in all such suggestions for improvement, as also for the introduction of new foodstuffs, due attention must be paid to local preferences for certain flavours and to the methods of cooking adopted to obtain them. It may well be more important to fulfil these requirements even though some loss of food value may be involved rather than to cook food in an ideal but novel manner which may be unpalatable and thus lead to its total rejection.

242. In later chapters of this report we have dwelt on the importance of educating women in questions of hygiene and domestic economy. No subject is likely to be of greater interest or value to them in improving the nutrition of their community than a study of cooking methods. In fact upon the proper training of the cook depends the well-being of the family. Where cooking is properly understood it leads naturally to an interest in and demand for a wider range of foodstuffs. The way is thus prepared for the work of agricultural departments in introducing new crops and giving instruction in their production.

CHAPTER X.

THE PURCHASE OF FOODSTUFFS.

243. Bought foodstuffs may have been imported from abroad or they may have been produced within the country of consumption. As we have already said, some territories import little or no foodstuffs; others, like Hong Kong, import practically all their requirements; others again import part and produce part themselves. But even though imports may be relatively low there is often a substantial internal trade.

244. The importance of this internal trade is often overlooked, largely because it is difficult to measure. Yet it can be a big factor in a colonial economy. In Nigeria, for instance, the internal trade in forest products alone is estimated at £3 millions a year, and the trade in livestock is probably only a little lower. In most colonial territories the main articles of internal trade are foodstuffs of one sort or another.

245. The importance of this trade will in most territories inevitably increase, as a purely subsistence economy gives place to a monetary economy. From a nutritional point of view this will usually prove of advantage. While home production of foodstuffs is excellent and to be much encouraged, it must often be that the man who lives solely on crops of his own production is unlikely to have a sufficiently varied diet. As he comes to purchase more foodstuffs, he will be able to obtain more variety. He may live solely on cereals and fruits and suffer from a deficiency of high class proteins, while a little way away there is a surplus of meat for which no market can be found or a potential supply of fish. Examples of this could be found in most of the larger territories of the Colonial Empire.

246. One fundamental requirement for the development of the internal market is the provision of adequate if simple communications, which make it practicable to transport a commodity from a district where a surplus of it exists to a district in which there is a deficiency. In Uganda the recent establishment of recognised cattle routes and of a satisfactory marketing system has resulted in a reduction of the price of meat in the principal towns from 1s. per pound ten years ago to 25 to 30 shilling-cents per pound now. In Nigeria there are plenty of cattle in the North and a great shortage of meat in the South. A special cattle train leaves Kano for Lagos once a week, but

for places off the railway the trade is not yet organised. The carcases cannot be brought all the way and consequently the cattle must be trekked long distances on the hoof, passing through areas infested with tsetse fly, with the result that there is heavy mortality and the cattle that survive arrive in poor condition. The cost of meat varies from 1d. to 1s. per lb., according to the locality and is often not obtainable at all.

247. In the Gold Coast much useful work has been done since rinderpest was brought under control, in supplying to some extent the needs of the South with meat from the North. In Nyasaland there are plenty of fish in Lake Nyasa and a considerable trade in dried fish with districts away from the Lake. Much of this trade is done by head porterage and bicycles. With improved communications the radius of the trade and the quantity sold could be greatly increased.

248. Communications by themselves may not however be enough. In the Jaffna peninsula of Ceylon, which is well supplied with roads, many villages live mainly on rice and vegetables while those on the coast, never more than eight miles away, subsist on rice and fish. An exchange of fish and vegetables would be of benefit to all. It has however not followed automatically on the development of roads.

249. This example shows that there may often be need for attention by Government to the organisation of systems of marketing. This is a subject to which in recent years a good deal of attention has in fact been given and much has been done, both by central Governments and by local authorities, to improve marketing arrangements. In regard to export produce, legislation has been passed which provides for the establishment of markets at specified places. At these places grading and weighing facilities are provided and buildings may be available for hire. Often produce can only be bought and sold at these markets, sales elsewhere within the district being forbidden. The system has proved most useful in improving the quality of export produce and the return obtained by the grower for it.

250. One result of the development of local markets, whether for export crops or for foodstuffs for consumption in the towns, has been that there has been an increased demand by the producer himself for bought foodstuffs. In Tanganyika, for instance, butchers' shops have been opened at many market centres and in Uganda at the cotton markets the demand for meat and bananas often exceeds the supply.

251. In general the internal trade in foodstuffs is bound to expand. In those Dependencies which rely in the main on the efforts of small producers it is particularly important that attention should be paid to its development and that adequate numbers of district and village markets or market centres should be provided. We are satisfied that more can be done

in this direction and that with increased market facilities stimulus would be given to added local production of foodstuffs of all sorts, particularly perhaps in the West Indies.

252. It is also probable that Colonial Governments may be able to assist materially by developing the provision of storage facilities at market centres, cool chambers for the storage of fish and meat, and refrigerated vans on railways. Charges for their use would perhaps be sufficient to cover the interest charges on the capital cost of construction but even if they do not these facilities might well prove to be a useful and economical social service.

253. There can be little doubt that the development of local communications and the encouragement of market facilities at desirable centres with storage facilities at selected places will be immediately beneficial to Colonial standards of nutrition and ultimately will have far-reaching effects upon productivity and the character of the economic organization. It should be noticed that while the provision of these facilities will add greatly to the capital equipment and to the productive capacity of Colonial populations, they will not involve any very substantial capital expenditure. The quantities of materials and of labour necessary are likely to be small and the chief outlay is likely to be for personnel.

254. Where there are at present substantial imports of foodstuffs, Governments can of course encourage local production of foodstuffs by the imposition of duties on the imported article or by subsidizing the home-grown article. The extent to which it is legitimate to do either must always be difficult to determine and involves many other considerations besides those of nutrition. From the nutritional point of view, with which alone we are concerned, the cardinal consideration must always be that the greatest possible quantity of nutritive foodstuffs should always be available at the cheapest possible price, though even from the nutritional point of view this may occasionally require qualification, e.g. home-grown produce if fresh may be of more value than imported produce even though its cost may be slightly higher.

255. Most Colonial territories raise a substantial proportion of their revenue from import duties and it sometimes happens that there are substantial revenue duties on nutritive foodstuffs which could not possibly be produced locally. We recommend that all Colonial Governments should review their tariffs and take the first opportunity of removing duties on foodstuffs which cannot be produced locally, the revenue being raised if necessary from other sources. In general we feel strongly that unless there is some very good social or economic reason to the contrary or unless it is necessary to retain a duty in order to comply with obligations under agreements with the Dominions or to

assist Empire trade, imports of nutritive value should be free of duty.

256. If for social or economic reasons it is desired to assist local production for home consumption, there are, at any rate in theory, a good many arguments in favour of assistance being given by way of subsidy where this is at all practicable.* Wisely administered subsidies are probably more effective and less of a burden on the community than protective tariffs, if the aim is to encourage production which will ultimately be self-supporting. In the first place the cost is not paid by the consumers as such, who may be the poorest classes, but by the taxpayer in the same way as the other expenses of Government, and the burden should therefore (if the incidence of taxation is fair) be borne approximately in proportion to ability to pay. Secondly, when subsidies are given, Government retains a direct interest and responsibility for what is being done, and the cost of the subsidy to the public is generally known and realized. Thirdly, when demand is elastic, it may be that a small amount added to the retail cost will cause a more than proportionate decrease in demand and conversely that a small decrease in price will cause a more than proportionate increase in demand.

257. Actually in the conditions of most Colonial dependencies it will often be quite impracticable to administer subsidies. In such cases if assistance in competing with imports is considered essential it must be given by way of a protective duty. Sometimes it may suffice if the local industry is assured against a sudden reduction in the price of imported produce. It may often be that the guarantee of a stable price would be sufficient to induce the growing of a foodstuff which is not grown at present. This guarantee could be effected without raising the local price simply by the passing of a law to provide that if at any time the c.i.f. price of the imported article fell below a specified figure, a duty should be levied sufficient to bring it up to that figure. If, for instance, the present price of imported rice were £9 per ton and it was considered that rice could be remuneratively produced in a Colony at that price, the law would provide that if at any time the c.i.f. price of imported rice fell below £9 a duty would be imposed sufficient to bring it up to that level. Arrangements of this nature have been tried in one or two Colonial Dependencies with success,† but there should be

* We do not wish to be taken as in any way recommending subsidies for export crops.

† There are two means of giving effect to this proposal. One is for the Director of Customs or some other authority to specify periodically what shall be the assumed value of all imports of the article in question during the next period. The other method is to make the duty vary according to the declared cost of each particular consignment. The former method is greatly preferable, but it is only practicable in regard to commodities which have a " world " market or at least a large market so that their price outside the territory is readily ascertainable.

provision for the periodical revision of the pivotal figure so as to ensure that the local price of the commodity does not become seriously out of step with the world price.

258. The number of cases in which the local producer will be assisted by a duty on the imported article is, we think, considerably smaller than is sometimes supposed. In all the Tropical African territories, with the single exception of the Gambia, imports of food are very small, and in those Dependencies outside Africa in which a larger quantity of foodstuffs is imported part of the imports does not compete with any article which is or could be produced locally. In Trinidad, for instance, of total retained imports of foodstuffs in 1936 amounting to some £1,270,000, some £340,000 consisted of imports of wheat flour, which could never be produced locally. Of the remainder part was no doubt of high priced articles which do not compete with local production, while condensed milk accounted for £116,000. The case of condensed milk is a rather special one. In the circumstances of the Colonial Empire fresh and condensed milk normally supply different markets. Except in those few territories where conditions are favourable, bought fresh milk must nearly always be a luxury article. The people who buy fresh milk are normally the wealthier members of the community; the poor man may consume it if it is produced by his own animal; otherwise he consumes condensed milk or no milk at all. We doubt whether in most territories imports of condensed milk really compete seriously with a local production of fresh milk.

259. In general, we believe that it is relatively seldom that imports of foodstuffs adversely affect Colonial agriculture although greater local production of foodstuffs is in almost every case undoubtedly to be aimed at and encouraged. This is not to deny that there are cases where imports compete with local production; rice in Ceylon is one very important such case and there are others; but their number is smaller than is sometimes supposed. We trust that whenever protective measures are proposed full consideration will be given to the effect of any change on the state of nutrition of the people.

CHAPTER XI.

THE NUTRITION OF PAID LABOURERS.

260. The remarks that we make in this chapter apply just as much to earnings in the employment of Government as to earnings in private employments. In all Dependencies Governments are important employers. The conditions of employment in Government service should be a model to all private employers. The recommendations which we make in this chapter are much less likely to commend themselves to private employers if the Government which puts them forward is itself liable to the retort " Practice what you preach."

261. There is unfortunately abundant evidence that in some occupations where it is not customary to provide the employee and his family with food the wages earned are not sufficient to provide adequate nutrition for the worker and his family. Much depends, of course, on the way in which the wages earned are spent. The report received from Barbados, however, says that it is known that the weekly wage of parents (paid on Saturdays) is insufficient to feed the whole family for a week and that many children have no regular meals after Wednesday in each week and come to school hungry on Thursdays and Fridays. Somewhat similar instances could be given in Jamaica, Grenada and most of the other West Indian islands. In the case of Ceylon it is calculated that the minimum cost of a diet, made up of those foods generally eaten in Ceylon, which could be regarded as adequate but not optimal is about 15 rupee cents a day. For a normal family having a man-value of five, the cost would be 75 cents. The wages of the working classes vary between 40 cents and Rs. 1 a day—and these have, of course, to provide for other things besides food. It is clear therefore that wages at this level are insufficient to provide adequate food for a normal family unless several members of the family are working. To some extent this situation may be eased by the fact that the wage-earner in rural areas grows some of his food himself. As we have already said, this is a factor which renders any precise calculation very difficult. But we do not think the general proposition would be disputed in regard to many colonial territories. Nor can the fact that the employee supplements his wages from other sources be regarded as in any way justifying a low level of wages, though it may mitigate the effects of it.

262. The obvious reaction to such a situation is to say that the rate of wages should be increased. Apart altogether from considerations of humanity and social justice, it may well be that increased wages may be justifiable as a purely economic proposition. They might well lead to a more than proportionate increase in efficiency. Much labour in tropical countries is notoriously inefficient at present and there is striking evidence of the extent to which this is due to malnutrition. At the same time it may be that in some cases an increase in wage rates would not lead to an increase in total earnings, because there would be less employment and the wages earned might therefore be more intermittent. In many of the sugar-producing colonies, for instance, sugar is almost the only possible export crop. The price of it is low and the quantity that can be produced is limited by international agreement. It may well be that if employers were forced to pay higher wages less labour would be employed and the total wealth of the labouring community would not in the result be increased. Moreover an increase in wages does not necessarily mean improved nutrition for the worker's family. While it is true that any increase in the standard of living is to be welcomed, it cannot be expected that the whole of an increase in wages will be spent on food. Wages may be spent in plenty of other ways.

263. Generalization regarding rates of wages is difficult and rash, and it imports many other considerations besides those of nutrition. We have not regarded it as our business to investigate all these considerations in full, though we are glad to learn that much attention is being given to them at present and that a Labour Adviser has recently been appointed by the Secretary of State for the Colonies. We must content ourselves with stating the fact that, at present, wage rates are often insufficient to provide a man and his dependants with adequate nutrition; we must leave it to others to determine how far in those Dependencies where this state of affairs exists the end which everyone must desire can be attained by an increase in wage rates.

264. Though we have felt bound to make no recommendation on the subject of wage rates, we feel that we need have less hesitation in regard to various measures whereby Governments and private employers can contribute to the better nutrition of their labourers. We think that there are opportunities for immediate action which will be of benefit to all concerned, employers, employed and the community as a whole. It has long been realised that poor feeding is one of the chief causes of high mortality and morbidity and low efficiency in labour in the tropics. Proper feeding, proper housing, proper hygiene and proper attention to the habits and customs of the labourer: these are as important as questions relating to hours of work and

rates of pay in securing a contented and efficient labour force, and of these proper feeding is certainly not the least important.

265. It is perhaps not unnatural that the question has received most attention in those parts of the world where it is the habit for the labour contract to provide for food to be given in addition to wages. In paragraphs 266 to 281 of this chapter we deal with the question in relation to those territories. In the remaining paragraphs we discuss its application in other parts of the Colonial Empire where too often the food obtained by his employee has in the past been regarded as of no concern to the employer.

266. The first valuable evidence on the subject came from South Africa, where the incidence of pulmonary tuberculosis among the employees on the Rand had long been remarked as tragically high. A specially appointed committee suggested that the predisposing cause was probably dietetic in origin, and in 1911 Government scales for the feeding of native employees were drawn up. Since then the importance of the diet of the labourer has become much more generally realised both by Governments and by private employers, at any rate in those territories where it has been customary for the labour contract to stipulate that the employer should provide food in addition to wages. This is normally the case in East and Central Africa, in the Katanga and on the Rand, where many East Africans are employed.

267. The whole question of the treatment of native labour has been most carefully studied in the Belgian Congo, on the Rand, and by the big mining companies in Northern Rhodesia, and a great body of information has been built up as to the best form of diet to give to the labourer, having regard to his traditional food habits. Hand in hand with attention to the dietetic needs of labourers there has been a great improvement in their housing, in the prevention of disease and generally in the care for their welfare. While it is difficult accurately to distinguish the part played by improvements in feeding as distinct from improvements in other directions, the net result of them all has been an immense decrease of mortality and an immense increase of efficiency. Thus in the seven years between 1926 and 1932 the mortality on the Union Minière properties in the Katanga fell progressively from 53 per thousand to 8 per thousand.

268. Much work has also been done in South Africa by Orenstein, Fox and others. On the Rand at present the Central Mining-Rand Group, employing 300,000 labourers a year, include in the ration mealie meal bread having not less than 64 per cent. of wheat flour, beans, meat, nuts and fresh vegetables to a calorie value of 4,400 on the minimum scale. This diet which is considered to have proved adequate in all respects,

with the possible exception of vitamin A, costs, cooked, per worker per day, approximately 4d. Provision is made for the cooking in central kitchens of such dishes as meat stew, to which slightly cooked vegetables are added after they have been finely minced by special machines. This ensures that the worker profits by the minerals and vitamins in the vegetables. Records have been kept of over 20,000 discharged workers of whom over 66 per cent. gained substantially in weight during their term of residence in the mines of six months or more, the average gain in weight being nearly 7 lb.

269. In Northern Rhodesia an elaborate minimum scale of food is now laid down by Government for labour working on the mines. Several of the big mining companies give food substantially in advance even of this scale. The Rhokana Corporation, for instance, have recently decided to alter the diet given to their workers in the direction of reducing the total number of calories and increasing the supply of meat and fat. The existing and new scales are attached as Appendix 4. On the basis of 6,000 employees this improvement will cost the Corporation £7,500 a year. The manager of the mine writes: " If an increased efficiency of as little as 5 per cent. could be guaranteed by the balanced dietary advocated it would be a sound economic proposition ". It is too early yet to state the result of the experiment.

270. In East Africa too a good deal has been done. Improper feeding was undoubtedly largely responsible for the terrible mortality among the East African Carrier Crops during the earlier part of the War and for the heavy mortality in some of the earlier railway construction. Since then there has been a great improvement. Post-war labour rations may be illustrated by reference first to the Lake Magadi Soda Company in Kenya, which in 1927-28 supplied to a yearly average of 750 employees a ration of 2 lb. maize meal daily, 2 lb. meat and bone weekly in two portions, 2 lb. beans and peas, weekly in two portions and salt *ad libitum*. This diet was admittedly deficient as regards fresh vegetables and meat, but in spite of this, the medical examiners reported a striking improvement in health and physique, an increase in weight of 8-9 lb. per man over a period of six months and entire absence of scurvy and other food deficiency diseases. The higher-paid workers who supplemented the rations with supplies purchased from the local shop and with herbs and green leaves bought from itinerant vendors, showed a lower sickness rate than the more poorly paid labourers. Taking medical cases only into account, the number admitted to hospital in 1928-9 was, for the better class labourer, 13 per cent.: for the others, 40 per cent. These figures show that the diet provided for the majority was still capable of improvement.

271. On the Kisumu-Yala Railway Construction (1929) again, the diet of the labourer received particular attention, maize meal, pulses, fresh meat, ground nuts or ghee, fresh vegetables and salt being provided to a monthly average of 2,200 labourers. The average number of working days lost was .25 per head per month and the monthly hospital admissions were 0.5 per cent. The very lower ulcer rate of 20 per month strongly suggests (as the medical officer writes) " that a properly balanced ration combined with proper attention to minor injuries will go far to eradicating ulcers as a cause of loss in a labour force ". In this scheme only seven men are recorded as having died, equivalent to one death per $3\frac{1}{2}$ miles of line, whereas in pre-war constructional works of the same kind in this territory the death rate was many times this figure. Improvements in general hygiene contributed to this change, but undoubtedly improvements in diet were one of the most important factors.

272. Other striking instances in which private employers have found the benefit of giving adequate rations have occurred more recently. In Kenya, according to the Annual Report on Native Affairs for 1935, three gold mining companies " issued liberal cooked meals to their labourers three times a day, consisting of maize flour with sugar, beans, green grams, meat, fresh vegetables, fruit and salt ".* The Report states that the satisfactory scale of rations undoubtedly contributed very largely to the excellent health which the labourers enjoyed during the year and also to their state of general contentment.

273. Another striking experiment was introduced within the last two years in Zanzibar. In August, 1937, the Clove Growers' Association decided as an experiment to provide well-balanced meals for an average of ninety labourers a day at a cost of 49 cents of a shilling (about 6d.). Unfortunately the experiment had to be interrupted before it had been going very long and has only recently been resumed. The indications were, however, that provided the employee remained in regular employment for some weeks, his capacity for work was greatly

* The morning and mid-day meals consisted of maize flour, gruel; the evening meal of maize flour porridge with the following supplements :—

Monday	Meat, 1 lb., cooked together with vegetables (curly kale, carrots, onions and chillies).
Tuesday	Vegetables cooked in ghee (curly kale with tops of leeks).
Wednesday	Meat, 1 lb., with vegetables (tomatoes, green beans, onions)
Thursday	Beans or mixed vegetables cooked in ghee, and lemons.
Friday	Meat, 1 lb., with vegetables (curly kale, mint, beetroot, leeks).
Saturday	Beans or mixed vegetables cooked in ghee, bananas if available.
Sunday	Soup of green grams and ghee.

In addition hot cocoa was given to all labourers coming off shift, except those working on the surface during the day shift.

increased by regular nourishing food in sufficient quantity, and that increased efficiency more than compensated for an addition of a little over 50 per cent. in the average individual cost of a labourer.

274. In Tanganyika one large employer of labour used to reckon that of his total labour force only from 45 to 50 per cent. could be relied upon to turn out for work on any one day. More recently, it is reported, the figure has increased to over 90 per cent., the increase, it is said, being due solely to an improvement in the diet given.

275. In Uganda, as an example to private employers of labour, Government has recently provided a well-balanced diet for the labourers employed on road construction. This has resulted in a very much lower incidence of sickness than is usual in such constructional work.

276. Naturally most has been done by large companies which can face the immediate increase of expenditure that is usually involved in improved feeding of labour. It is partly because there are so many large-scale enterprises in the Belgian Congo that so much progress has been made there on this question. Some of them, besides providing more adequate rations for their employees have incurred great expense on providing for their housing and for the prevention of disease, on the acclimatisation of labourers coming from a distance, on organizing agricultural production so that the desirable foodstuffs may be available, and so forth. We believe that on a long view such expenditure is remunerative. It is difficult for the smaller concern or the farmer, often struggling with many difficulties, to take a long view. We believe, however, that whatever may be the case with other measures of social welfare, the benefits of improved feeding should very quickly disclose themselves in increased efficiency. We regard it as almost certain that in Africa, quite apart from humanitarian considerations, any money spent on bringing the food consumed by the labourer up to an adequate well-balanced ration will be money well spent from the immediate point of view of an employer.

277. Nevertheless, the tradition that a labourer can do all that is required of him on rations of cereals and little or nothing else is slow in dying. It is still not uncommon in East Africa and it is widely prevalent in West Africa and in other parts of the Colonial Empire where, because it is not the habit of the employer to provide food for his employees, less attention has been given to the subject. It cannot be sufficiently emphasised that while a diet of little or nothing but cereals may keep body and soul together, it cannot suffice for full efficiency.

278. We feel sure that there is considerable room for further action both by Governments and by employers to improve the feeding of their labourers. Still confining ourselves for the moment to the case of the labourer who is fed by his employer, we consider that Governments should themselves lead the way by providing a well-balanced diet for all their labourers. We also consider that legislation should be tightened up. A law which provides merely that adequate rations must be given is not sufficient unless backed up by detailed measures to ensure that the term is properly interpreted by the employer. At present it is often interpreted as meaning no more than so many pounds of maize meal or other cereal with a little salt and possibly a few vegetables and meat if available. We recommend that the Governments of all African territories—and of any other territory where the labourer is fed by the employer—should provide as soon as possible that where the labour contract provides for rations to be given to labourers, either by Government or by any other employer of labour, they should not be below a scale approved by the Health Department as being sufficient to provide a well-balanced diet, having regard to modern nutritional knowledge and the normal diet of the employee.

279. The legislation should specify as exactly as possible the diets to be given. Naturally there must be a certain amount of latitude to permit of the foods given varying according to what foods are available in a particular district at a reasonable price. There must also be latitude to permit of the ration given being related to the normal diet of the employee, which may vary greatly according to the particular race or tribe from which he comes.* The exact food to be given by any particular employer should therefore be a matter in the first instance for the employer himself but he should be required to work out a schedule of diet in consultation with the local health authorities and for their approval, and this schedule should be in accordance with provisions as precise as possible in the legislation of the territory.

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* On the Rand mines, however, men from all tribes are given the same diet, except that those who are normally fish eaters are given fish instead of meat. The ration given is equivalent on the average to the following number of ounces daily:

Mealie meal... ...	24	Soup meat (or fish)	1·7
Bread	6	Ground nuts ...	2
Beans or peas ...	1·5	Sugar	1
Germinated beans or peas	1·5	Vegetables	5
		Salt	0·5
Meat (or fish) ...	6·85	Cocoa	0·25

About 16 ozs. of Kaffir beer (made of millet) are given twice weekly. The raw ingredients of this diet cost about 4d. per man per day, the low cost being made possible by the large quantities purchased. Overhead charges incurred in cooking probably double this cost. The meat (other than soup meat) is given to the men about three times a week for them to cook themselves. The rest of the food is provided ready cooked.

280. Where there are such wide variations in diet as there are in Africa, we suggest that Colonial Governments would do well to arrange for the issue of a handbook for the use of employers setting out the main constituents of the normal diet of each tribe from whom labour is recruited.*

281. The food provided by the employer is sometimes given cooked and is sometimes handed over to the employees for them to cook themselves. Arguments are advanced in favour of both practices. It is said that when the food is cooked by the employees themselves it will be cooked in accordance with their usual habits, while if it is cooked for them it will always be difficult to be sure of doing this. It is also certainly less trouble for the employer to leave his labourers to cook their own food. The arguments on the other side are, however, strong. Men without the help of their womenfolk are seldom likely to make the best use of the rations given out to them for them to cook themselves. The food given may be such that they cannot cook it properly without considerable trouble. Cases have been known, for instance, where the rations consisted solely of maize and beans and the beans required eight hours cooking to make them properly digestible. Not unnaturally they would seldom be properly cooked. If the food is provided ready cooked it is possible to see that it is properly prepared and not over-cooked or undercooked. It is also possible to include unpopular items of nutritional value, such as germinated beans, and to ensure that the food is really eaten by the employee and not sold by him, in which case, of course, the employer derives no benefit. For these reasons we believe that the clear balance of advantage lies with the giving of food ready cooked. Those employers who have provided communal kitchens for feeding their labourers have found that it has paid them. It should, of course, go without saying that where food is provided uncooked or where labourers are expected to provide their own food adequate facilities should be given for the food to be cooked.

282. In the previous paragraphs we have been concerned with the position in those parts of the Colonial Empire, chiefly in East Africa, where it is customary for the employer to feed his labourers. Elsewhere the labourer is expected to find his own food. Sometimes where this is the practice, the employer has paid a certain amount of attention to the diet of his labourers, as on certain estates in Malaya, Ceylon, Mauritius and elsewhere, but it is perhaps natural that in general the question has aroused less interest than in areas where the labourer is fed by his employer. We consider that although

* One such handbook has been prepared already by the Government of Tanganyika—see " The Tribes of Tanganyika, their Districts, Usual Dietary and Pursuits " by R. C. Jerrard, Dar-es-salaam, Government Printer, 1936, 1s.

the employer in these territories has no direct responsibility for the food of his labourers there is still a great deal that he can and should do in his own interests to see that they do in fact obtain food which is adequate to maintain them in full health and efficiency. The main conclusion, we believe, still holds good: it will pay the employer to see that his labourers are properly fed.

283. The inefficiency and irregularity of tropical labour has in the past been taken too much for granted; it has been regarded as irremediable. We believe this to be untrue. It is common ground among all those who have experience in the matter that the less the labourer is regarded as merely a person who works for so many hours a day and receives a wage for it and the more the employer makes it his business to care for the social welfare of his employee, the more satisfactory are the results. Too often at present the employer is apt to regard his responsibilities as finished when he has paid his wage bill. We feel it to be important that in the areas where the development of paid labour is proceeding fast, as for instance in West Africa, Governments should see that employers in their own interests do not neglect to provide for the welfare of their employees. Similarly in some of the Colonies where paid labour has long been in existence, as in the West Indies, there still sometimes persists what may not unfairly be termed an eighteenth century attitude in the relationship of employer to employee. Governments by their own example as employers of labour and by their legislation should lead the way to improved conditions of employment. Where there is a shortage of labour, there will be some incentive to employers to improve conditions without action by Governments. But where (as in many territories) there is an ample supply, it is the more important that Governments should by example and legislation provide the necessary stimulus. Adequate nutrition will not by itself make the labourer a model employee, for, as we have seen, there are many other aspects as well; but nutrition might well make him a great deal more efficient and happy than he is at present. As the report from Trinidad suggests, a 20 per cent. increase in the efficiency of the labourer might well make all the difference between a profit or a loss on the year's working, and we do not regard such an increase as by any means impossible as the result of improved nutrition. We are happy to think that public opinion is increasingly realising the importance of the proper feeding of labourers and the frequent inadequacy of the diets that they are at present able to obtain.

284. We do not wish to be taken as necessarily suggesting that there should be a change-over to the system prevailing in East Africa of the employer being entirely responsible for

feeding his labour. There are many reasons why this system does not prevail now. The labourer may bring his wife and family with him and the employer could seldom be expected to feed them all—though in the Katanga food is provided for the women and children of labourers as well as for the labourers themselves. It may not be customary for the labourer to work six days a week for his employer. In the West Indies, for instance, he often prefers to work two days a week for one employer, two days for another, and to do nothing, or to work on his own holding if he has one, for the remaining three days. The West Indian labourer is of an independent nature and often does not like to be tied to any particular plantation. Similarly in West Africa much of the labour is very transitory. Again sometimes the labourer might resent as lessening his independence an attempt on the part of the employer to provide him with all his food.

285. Indeed while the feeding of labour by the employer may in some areas be necessary and valuable as an interim policy designed to promote an immediate improvement in physical well-being and as a convenient practical means of introducing a better diet, on wider grounds its perpetuation may prove undesirable. We do not for one moment intend to recommend a condition of perpetual dependance by the employee on the employer as in itself desirable. Obviously a preferable alternative would be the education and advancement of the labourer and his family so that when he freely exercises his own choice his choice of a diet is a good one, and he has the money to buy it.

286. For all these reasons it is perhaps unlikely that the custom of employers providing labourers with all their food will spread much beyond the areas where it exists at present. At the same time where conditions appear favourable, as perhaps in parts of West Africa, we hope that the possibility will at least be considered.

287. There are, however, many other ways in which employers can assist. One way is by enabling as large a proportion of their labourers as possible to have their own gardens, whenever the labourers and their families are more or less permanently resident on the land of the employer. We have already made this point in a previous chapter (Chapter VII, paragraph 121). We recommend that every possible effort should be made by employers in their own interests to provide for each labourer a plot of land, however small, where he and his family can grow vegetables and other foodstuffs for their own consumption and can also keep poultry and some livestock.

288. Another way in which they can assist is by distributing *some* food to their employees in addition to their wages, even though they do not undertake to feed them entirely. This

already occurs in various parts of the Colonial Empire. In Sierra Leone, for instance, rice is given in addition to the wages. In the West Indies the labourer sometimes has by custom certain perquisites. We are strongly of opinion that employers would often find that it paid them to extend this practice and to give meat and fresh vegetables and other specially nutritive food to make up the known deficiencies in the local diets. It is most important that any such food should be given *in addition* to and not in lieu of wages. (We return to this point in paragraph 293 below).

289. If for one reason or another it is not possible to give specially nutritive foodstuffs free, it may be possible to make them available at a cheap rate. Thus, in Ceylon, estates in European ownership usually arrange for supplies of rice to be available at reduced rates. The practice might well be extended to other foodstuffs with benefit to all parties. In the Gold Coast certain of the mining companies have recently erected refrigerators and arranged for the importation of special supplies of meat which they make available at cheap rates. It is reported that the experiment is proving successful. This, too, is an example that might well be copied elsewhere.

290. In some cases employers might well pay more attention than is done at present to the production of foodstuffs for their employees on their own lands or on neighbouring lands. Indeed, the recent report of a locally appointed Commission on the disturbances which took place in Barbados in 1937 recommends that all owners of estates should be required by law to plant with vegetables every year at least 5 per cent. of their arable acreage, under the direction of the Department of Agriculture. With the limitation of the total quantity of sugar that can be produced, estates in many of the West Indies may well have land which they cannot use for sugar cane and which is not obviously suitable for any other export crop. They may well find that a very advantageous way of using such land is to grow foodstuffs for free distribution or for occasional free meals to their employees.

291. Sometimes it may well be that it would pay big employers such as mining companies to keep their own agricultural staff to promote the growing of nutritive foodstuffs in the vicinity of their enterprises. Much has been done in this way in the Belgian Congo, where mining companies have gone so far as to create agricultural colonies and to create a stock-rearing industry by the introduction of thousands of head of cattle in order to build up a food supply for their labour.

292. Governments might often assist employers by ensuring freedom from import duty and cheap freight rates on railways for food of nutritive value which cannot be produced locally

in adequate quantities. It may be, for instance, that in West Africa the freight rates on meat products are at present so high as to make it difficult for the employers to make meat available for their employees at a reasonable cost.

293. There are dangers in several of the above recommendations and some care on the part of Government may be necessary to ensure that the evils of the truck system do not creep in. The essence of the truck system is that the labourer is paid part of his wages in the form of credits at a store run by his employer or that he is otherwise compelled to buy the necessities of life from his employer. There is legislation in most Dependencies to prevent this and we do not think that our recommendations are likely to open the door to serious abuses. In some of the colonial truck laws provision already occurs on the following lines:—

> " Nothing in this Ordinance shall render illegal an agreement or contract for giving to him food, a dwelling place or other allowances or privileges in addition to money wages as a remuneration for his services."

Our recommendations do not go beyond this. The essential points are (1) that any food or perquisites given shall be *additional* to wages and not in lieu of wages and (2) that there shall be no compulsion on the employee to spend his money in any particular manner that may be desired by the employer.

294. Employers may often do most valuable work both for themselves and the community at small cost by organising maternity and infant welfare work and other such work among the families of their employees. Much, we know, is already being done in Malaya and Ceylon in this way. Some employers in these Colonies provide free meals for children on their estates and maternity, infant welfare and other social services. Expenditure for such purposes may not at once prove remunerative, but the work is of considerable social significance, and makes for a contented and permanently established labour supply of better physique. By such measures employers may make a real contribution to the well-being of the community.

295. We believe that the whole subject discussed in this section is one on which considerable immediate improvements could be effected to the benefit of employer and employed and of the community as a whole. We have emphasised our opinion that increased attention to the feeding of labourers would be remunerative, not because this aspect is more important than the human consideration that it would bring increased health and well-being, but because it is perhaps less obvious and because the financial factor is naturally an important consideration. We believe that this is a case where the interests of finance and humanity coincide. There is also another aspect. In several parts of the Colonial Empire one of the main limiting factors

to development is the shortage of labour. It is essential, therefore, from the point of view of the community as a whole that the most should be made of the labour that is available. In those territories where at the same time there is an actual or potential shortage of labour and the labour is inefficient and has a low output, any measure to increase the work done per man is an obvious economy. Another advantage from the point of view of the community of accustoming labourers to a nutritionally adequate diet is that it should have considerable educational value. The men who have benefited from a good diet while in paid employment will be less ready to acquiesce in an inadequate diet in their own homes. For all these reasons we hope that real progress will be made in improving colonial nutrition generally by increased attention by governments and employers to the feeding of labourers.

CHAPTER XII.

THE FACTOR OF IGNORANCE AND THE NEED FOR EDUCATION AND PROPAGANDA.

(*a*) INTRODUCTORY.

296. In previous sections we have considered the various directions in which a low standard of living leads to malnutrition. We now turn to what we have called the second main cause of malnutrition, ignorance coupled with prejudice.

297. The ignorance (and sometimes the prejudice) is not confined to those who are themselves undernourished. It exists also among those who have power over nutrition of others, Government officials, members of Legislative Councils, employers of labour, education authorities, missionaries. That this should be so is not to be wondered at, for the study of nutrition is a new science and it is only quite recently that some of its broadest conclusions have obtained general acceptance. It is therefore no reflection upon those responsible for agricultural development if their policy has not always recognised the importance of promoting adequate nutrition, nor upon medical authorities if they have failed sometimes to appreciate that one of the best means of preventing some of the most prevalent diseases is to improve the state of nutrition of the population. Nor again is it to be wondered at that education authorities, whether missionary or Government, have often spent time and money in trying to instil knowledge into the heads of children who, it is now realised, may be too ill-nourished to be able properly to absorb it; nor that employers of labour should often have been content to employ labourers who, owing to their state of nutrition, cannot do a full week's work and are frequently off duty. For the bearing of nutrition on health, efficiency and happiness has only recently begun to be fully appreciated.

298. The first requisite is that there should be a wider general appreciation of the importance of nutrition. We have emphasized that malnutrition is largely the result of a low standard of living, but there is no doubt that a properly directed policy could do much to remove malnutrition even at the present economic level. We do not wish to imply that nothing has been done already. The " Summary of Information " contained in Part II of our report shows that in almost every part

of the Colonial Empire some part of the problem is being tackled. Meals are being given to school-children, infant welfare centres and health visiting are increasing, more attention is being given to the growth of food crops, the diets in Government institutions have been improved, investigations are being made into the extent to which nutritional diseases exist, and an agricultural or health bias is being given to education. A beginning has been made: but only a beginning.

299. One of the difficulties in securing a proper regard to nutrition in the direction of policy is that, while the subject is rather a technical one, it is also vast, varying as it does from infant welfare to agricultural or veterinary science or to complicated considerations of economics. It thus affects many departments of Government, few of whose officers have the opportunity to appreciate its whole range. The departmental proposals must be co-ordinated by officers who themselves have little technical knowledge. It is necessary therefore that many Government officers should have some knowledge of the principles of correct nutrition and the practical means of securing their application. Accordingly we recommend that some instruction on human nutrition, particularly the practical application of scientific knowledge in colonial conditions, should be given not only to Medical and Health Officers but also to Administrative Cadets during their courses at Oxford and Cambridge; to Agricultural and Veterinary Officers during their courses at Cambridge and the Imperial College of Tropical Agriculture, Trinidad; and to all Education Officers and Teachers in both Government and Mission schools who attend courses at the Institute of Education or elsewhere. We know that the courses, particularly those taken by the Administrative Cadets, have already a very full syllabus, but we feel that the importance of this subject certainly warrants its addition to the syllabus.

300. Medical and Health Officers already normally receive some instruction in the subject but it is not normally related to the circumstances of colonial territories. As we have already pointed out, it is little use considering colonial nutrition in terms of European foodstuffs. Knowledge of colonial nutrition is still scanty but we hope that in future every attempt will be made to make the teaching of nutrition given to colonial officials immediately applicable to colonial conditions. This report will sufficiently indicate the lines that instruction should take. Possibly it may itself be useful for purposes of instruction.

301. Colonial Governments should also consider ways and means of giving instruction on the subject to staff recruited locally for the Administrative, Health, Agricultural, Veterinary

and Education services. All officials who in their work will be in any way in a position to influence the nutrition of the mass of the people should know at least how the most common deficiencies in their diets can best be remedied. Moreover, those who are nearest to the people will have the most power by the example of their own lives and those of their families to demonstrate the advantage of, say, more scientific feeding of children. We return to this point later.

302. There will be no difficulty in rousing the interest of those who occupy positions of responsibility in the administration and development of the Colonial Empire. It is when we come to consider the ignorance and apathy of those who are themselves undernourished that greater difficulties occur. The first difficulty is innate conservatism, often backed up by prejudices, religious scruples or taboos. For instance, eggs are not eaten by certain peoples, though eggs are obtainable and the diet is lacking in protein, minerals and vitamins. In Grenada there is a superstition that milk is the cause of worms in children; in some parts of Ceylon it is believed to cause illness, and milk or milk products never occur in the diets of large classes of the population. In the New Hebrides milk is regarded as a dirty food. In Africa taboos are found in parts of Tanganyika which prevent women from eating eggs or drinking milk, and in Buganda they prevent them from eating chicken or mutton. In other parts of Uganda adult males may not drink milk.

303. The opinion has been held in the past that people always know what is best for them. While that easy-going view is admittedly no longer tenable, we should none the less hesitate to condemn their prejudices, for they often have foundation in fact. For example, as the Ceylon report points out, the fear of the dangers of milk is probably well founded, in view of the highly insanitary conditions under which milk is at present produced. However, some of these prejudices are clearly wrong and provide a barrier to progress, which will be difficult to surmount until general education has advanced much further than it has at present in most parts of the Colonial Empire.

304. In considering how to set about removing ignorance on the subject of nutrition, we wish to place the greatest possible emphasis on the importance of the part played by women. In many parts of the Colonial Empire it is hardly too much to say that they alone affect the nutrition of the people. In some parts of Africa according to tribal custom it is the women who decide what food crops to grow, who actually grow them, who reap them, store them, cook them and serve them. Even if they do not themselves grow the food crops, they have the cooking of them and the selection of the menu for each day, and if the family buys its foodstuffs, it is the women who do the marketing. How important skill in marketing may be in securing

adequate nutrition has been shown many times in advanced countries. For instance, in an inquiry in the United States of 900 families with identical expenditure on food approximately one-third secured an adequate diet while the other two-thirds did not. The only varying factor was the competence of the housewife. We can hardly doubt that it is an equally important factor in the Colonial Empire. Further, the women are naturally responsible for the feeding of infants and young children, and their own diet during pregnancy and lactation can have a great influence on the health of their children. Finally it is the women who are the home-makers and who set the standard of life for the whole family. It is difficult therefore to exaggerate the importance of the women's part. We hope that with an increasing realization of the value of improved nutrition, increased attention will be given to the education of women. There has recently been a considerable move in this direction, but undoubtedly too little attention has been given to it in the past.

305. A corollary of this is the greater use of local women as Government welfare agents—as schoolmistresses, health workers, midwives, etc.—and in some cases the increased employment of European women to supervise and organise the work.

306. We may divide the attack upon ignorance into two sections: first the attack upon ignorance among adults, which is sometimes known as community education or welfare propaganda, and secondly the education of the younger generation in the schools. It will also be convenient to deal separately in the next chapter with one aspect of the matter of great importance, namely infant welfare work.

(*b*) Welfare Propaganda.

307. The people who must be reached will be largely illiterate. The art of welfare propaganda among such people is still undeveloped; the one thing that is certain is that it requires a different technique from that applicable in a country where the majority are literate. The efficacy of the printed word is restricted and the sphere of the personal agent enlarged. But the technique will necessarily vary according to the traditions and civilization of each people. Amongst other things it will have to take into account in many territories the communal nature of society, which often implies that for a change to be effectively introduced it must be accepted not by a few individuals but by the community as a whole. Indeed even apart from this factor many of the changes are of such a nature that in any case they would be ineffective unless introduced by all the community, for instance, some kinds of anti-malaria work.

308. The working out of the technique of welfare propaganda in the Colonial Empire will require understanding, imagination, and ingenuity. The whole subject is one which would well repay further study, and we commend it both to the Secretary of State and to Colonial Governments as a fruitful field for inquiry. We regard it as so important, however, and as having so direct a bearing on the remedying of nutritional deficiencies that at the risk of somewhat extending the scope of our inquiry we have ventured to include in the following paragraphs a discussion of the subject as a whole, not confining ourselves strictly to the application of propaganda to nutrition matters. A very great deal of welfare propaganda is being done in the Colonial Empire but so far as we know no attempt has yet been made to collate and consider as a whole the experience gained. Many of the measures we discuss will of course be equally valuable for other forms of social and economic progress besides nutrition. Nutrition, as we have said before, is not a self-contained subject.

309. We consider first the various means of propaganda—the printed word, broadcasting, cinemas, gramophones, etc., secondly the agents or personnel of propaganda, and thirdly the principles which seem to us to be suggested by our consideration of the subject.

(i) THE MEANS OF PROPAGANDA.

310. *Circulars.*—The greater the degree of illiteracy, the greater the prestige of the written word. Circulars in this country are generally thrown away unread. In Tropical Africa every word is read with the utmost attention by those who can read and they will in their turn read it aloud to a circle of listeners. Thus in a sense the very fact of illiteracy may help to " get across " any idea that it is desired to disseminate.

311. The following example illustrates this apparent contradiction. In a certain district of Tanganyika a campaign was started to persuade mothers not to give solid food to their infants. As the culmination of the campaign, when the subject was already much under discussion everywhere, several hundred copies of a suitable letter were cyclostyled and sent out addressed personally to women prominent in village life. " The psychological effect," write the originators of the idea, " was colossal. . . . Not one of the women could read, and it requires little imagination to picture the stir and excitement in the villages when they received a letter from the Boma. It was the first letter they had ever received, it was, as they soon discovered on rushing to the nearest literate man, an official doument personally directed to them by the district officer himself, and it was obviously of immense importance. The news, of course, became public at once, and the letter had to be read out again

and again, or its contents recounted over and over, to friends as they crowded round to hear what the excitement was all about. The prestige of the recipients went up by leaps and bounds, and as a result of all this they began to take the contents of the letter very seriously, as befitted a matter so weighty that the Bwana Shauri had had to write to them personally about it."*

312. In this example the women's inability to read was turned to account, in that any letter they received became a public occasion. The ground had already been prepared by other means of propaganda, and the letter was the culminating and decisive factor in the campaign. Obviously the same process could not be repeated very often.

313. *Reading circles.*—There are, however, other ways of reaching the illiterate by means of the printed word. Another project which has been tried in the same district of Tangaryika and also, we believe, elsewhere is the formation of reading circles, that is to say gatherings at which one literate person reads aloud to a circle of illiterate listeners. Reading circles may be found to form naturally with a little encouragement from the administrative authorities. They could be quite informal and it should not be difficult to find a literate man who would be ready to act as leader to a circle, for the position gives prestige and prominence. In describing experiments in Tanganyika, the writers say that " the system makes use of what already exists—a sprinkling of literates, the African's inherent histrionic ability and the age-old custom of gathering together to listen to a story ", and it has the great merit of involving little or no expense.

314. *Leaflets.*—But not all the people of the Colonial Empire are entirely illiterate, nor is it only the illiterate that must be reached. The printed word may therefore be of direct propaganda value. For example specimen diets might be prepared in different parts of the Colonial Empire. These might well be embodied in leaflets in the local vernacular, setting out in very simple and non-technical language the principles of correct nutrition. Other leaflets may be prepared on the proper feeding of infants and infant welfare generally. Such leaflets should be widely distributed by every available means. They may sometimes be used most profitably in association with the cinema van, the magic lantern and broadcasting. Many Colonial Dependencies have already prepared literature of this kind, and a great deal of use has been made of propaganda leaflets in the Netherlands East Indies.

* See " Social Propaganda in Illiterate Africa " by A. T. and G. M. Culwick in " Oversea Education," April, 1938.

315. *The Press.*—The local Press too is obviously a powerful influence and we suggest that Colonial Governments should take steps to interest its representatives in the subject of nutrition and welfare propaganda generally. It may often be possible to secure regular weekly articles on some aspect of nutrition or on other social welfare problems, and the time spent by Government officers in preparing them would not be wasted. We hope that this Report will itself provide material or at any rate ideas for a number of such articles. Governments should also keep the Press informed of any new developments in social welfare work, both by the issue of bulletins to the Press and by inviting its representatives to " write up " the subject. It should be the special duty of the Nutrition Officer whose appointment is recommended in each territory to see that these possibilities are not overlooked. In many Dependencies the Agricultural and Health Departments publish regular bulletins to keep the public informed on agricultural and health topics. This we regard as a most valuable practice and we commend the example to all Colonial Governments. Education Departments in some of the larger territories issue journals for teachers and others. This too seems to us a valuable practice. The circulation of the Nigerian journal now exceeds 9,000 copies a month.

316. *Lending Libraries.*—An idea which may be worth considering is the forming under Government auspices of lending libraries of vernacular literature. Obviously one limiting factor in the circulation of vernacular literature is inability to afford the cost of buying it. Such libraries might be found to be very useful in connection with the readers' circles suggested above. They have been largely developed in the Netherlands East Indies where there are now over 3,000 such libraries controlled by the Bureau of Popular Literature.

317. *Cookery books.*—Various Colonial Governments have suggested that cookery books applicable to local conditions would be of value. Some already exist, though many of them have been written mainly for the use of European residents. What are required are simple cookery books dealing with indigenous foodstuffs, prepared in a form suitable for use in domestic science training at schools. We understand that one or two such books are now being prepared.

318. *Adult classes.*—Direct instruction in regular " adult classes," conducted by schoolmasters, health visitors or the like may in some territories be a useful form of propaganda, especially if coupled with the use of the wireless, the cinema, the magic lantern or the gramophone (all of which we consider below). Particularly it may be valuable in teaching women domestic science in all its forms. But coupled with theoretical

instruction there should always if possible be practical demonstration. Teaching about the care of children might for instance be linked up with the work of an infant welfare centre. Plenty of opportunities of course occur for Administrative and Health Officers and others to give informal talks on nutrition and connected matters. The lecture with or without cinema or slides remains one of the most potent forms of propaganda.

319. *Posters.*—Posters will obviously often be most effective. But their value for propaganda purposes among the more primitive peoples of the Colonial Empire is a matter of some doubt and discussion. It seems likely that the more primitive the people the less effective is the poster, or at any rate the poster as we know it in Europe. Any words used will probably be most effective if they are on the lines of local proverbs. Any illustrations must be clear and simple, using only local figures and subjects, exemplifying a proverb, contrasting bad with good or telling a simple story.

320. *Broadcasting.*—Obviously broadcasting is a very potent means of welfare propaganda in European countries. Experience in the Colonial Empire is still somewhat limited. In some territories it is undoubtedly a useful means of propaganda, at any rate if the propaganda is combined with entertainment, and it is bound to become more useful. There are, however, various factors limiting the extent to which the wireless can be used for welfare purposes among backward people.

321. In the first place there is the question of cost. A special local broadcasting service cannot in most Colonial Dependencies be a paying proposition. It will usually require substantial assistance from Colonial Governments and it might well be found that, having regard to the cost, other means of propaganda would be more effective.

322. Secondly, unless special measures are taken, the circle of listeners will not be wide. In most colonial territories few people can afford receiving sets. If the mass of the people are to be reached communal wireless sets must be provided and maintained, and this again will be an expensive item*. In Palestine central receivers connected to loud-speaker equipment have been installed in schools, halls, etc., in a number of large villages and welfare talks are given from the local broadcasting station. We understand that a similar system has been tried in parts of India and that so far as experience goes at present the broadcasts on, for instance, agricultural matters and market prices are widely listened to and appreciated. In Ceylon experiments with communal listening centres have recently been

* In Palestine the first cost of each receiving set was about £33 and the annual cost of maintenance about £16.

begun. Certain village schools have been provided with wireless sets and this has attracted the villagers in large numbers to " adult classes " whenever an attractive programme was offered. It is too early however to draw conclusions from the experiments so far made.

323. Thirdly, it is by no means certain to what extent broadcast propaganda " gets across " among colonial people. This is a factor which will naturally vary from territory to territory but it may be one of fundamental importance. In East Africa, for instance, it is doubtful whether the mass of Africans could be persuaded to listen to welfare talks after the initial novelty had worn off, and if they did, whether they would be able to profit from them. The movement and discourse might be too quick, the speakers too remote, the subject-matter not sufficiently applicable to their own circumstances for the lesson to strike home.

324. Finally, there is in many parts of the Colonial Empire the language difficulty. Broadcasting to be effective must be in the vernacular language. Often there will be a number of different vernaculars in one Dependency. This of course is a difficulty common to many forms of welfare propaganda, but it obviously affects broadcasting in particular.

325. For all these reasons, there is a considerable body of opinion which inclines to the view that at present broadcasting will not be found to be an economical or even a very effective means of welfare propaganda, at any rate among uneducated rural communities. At the same time it is too early to be at all dogmatic and it is quite possible that most of the difficulties mentioned above may be surmounted. In urban areas there seem to be considerable possibilities in " wire broadcasting "—that is, broadcasting along land lines, existing telephone wires often being used. By this means broadcasts can be efficiently made at relatively small capital and recurrent cost, and the system has worked successfully in several territories. The radius of diffusion is at present small, however, so that it is not suitable for use except in predominantly urban areas.

326. *The cinema and magic lantern**.—Somewhat the same considerations apply in the case of the cinema as in the case of broadcasting. Considerable expenditure is required, the film may not be sufficiently " localized " to appeal to the audience and the movement may be too quick for them to apprehend the lessons which it is desired to teach. Broadcasting has

* Since these paragraphs were in print our attention has been drawn to a new development which may have great importance. This is the film strip or film slide process, which appears to combine many of the advantages of the magic lantern and the cinema with few of their disadvantages. We understand that the Colonial Office is about to circulate full particulars to Colonial Governments.

the advantage over the cinema that a wider audience can be reached, but the cinema has this advantage over broadcasting, that the film must be presented by someone to each audience to whom it is shown. That person can be a person who knows his audience and can help in interpreting the film to them. Possibly too the difficulties mentioned above are more easily surmounted than in the case of broadcasting. No high degree of technical efficiency need be required and the small film made by the amateur with a little experience will often be quite good enough to convey the lesson desired. The cost of such films will be relatively small so that they can be more "localized", and some films can be stopped by the demonstrator to explain particular points. Moreover, the actual taking of the films might be good propaganda for the actors taking part. We suggest that colonial governments should consider assisting selected officials who show keenness for the work to obtain portable cinematograph cameras and to receive a little training in their use. We understand that the British Film Institute have recently published a pamphlet containing information as to the most suitable types of camera and projector, and that this has been circulated to colonial governments.

327. In a good many Colonial territories effective use of the cinema is already being made and films exist dealing with such things as malaria prevention, the importance of pure milk supplies, the danger to health from rats and flies, hookworm, maternity and child welfare, and rural sanitation generally Malaya, Ceylon, Cyprus, Trinidad, Nigeria and other territories have all done a considerable amount of work on the subject, and in East Africa valuable experiments have recently been carried out by the Bantu Educational Cinema experimental team. A catalogue of films on public health matters made in Colonial territories has been prepared by the British Film Institute.

328. We should perhaps explain that in discussing the use of the cinema for propaganda purposes in the Colonies we assume that as a rule the cinema would come to the people rather than the people to the cinema. Travelling health vans equipped with portable cinema apparatus have been found most useful in various parts of the Colonial Empire. The films can be shown either in the open air or in any local hall that may be available.

329. The magic lantern may have decided advantages over the cinema in cheapness and in the fact that a smaller degree of technical efficiency is required and that the still picture can be explained in detail by the demonstrator at leisure. It seems at present to have definite advantages over the cinema in explaining technical processes. Even still pictures if they are to

be of the fullest value should represent local scenes and local people.*

330. *The gramophone.* The gramophone with loud speaker may, we think, be a useful vehicle of propaganda. A record is cheap to produce; it can be repeated to an audience as often as desired; a record of the same lesson can be made in many different languages; and it can be explained by the demonstrator. It may often be used profitably in connection with a cinema film. Again, to produce the maximum of effect, records must be extremely local. The main requisite seems to be a cheap and portable machine for making records. We suggest that the Colonial Office should obtain information on this subject for distribution to Colonial Governments.

331. *Models.*—We think that models, that is houses and holdings which have been specially constructed and laid out to

* The following conclusions reached by the Conference of Colonial Directors of Agriculture held last July may be quoted here (Colonial Office publication No. 156) :—

The Conference desires to record that close attention to propaganda and publicity is necessary if satisfactory progress in extension work is to be achieved. It has examined the different systems in operation and concludes that the use of films and, in certain dependencies, broadcasting can form a useful adjunct for reinforcing normal extension activities and of attracting attention to them.

Films, for the purposes of agricultural propaganda and instruction, may be divided into three classes :—

(*a*) General interest films designed to secure the interest of the audience.

(*b*) Background films depicting familiar local scenes and operations designed to provide a background for more detailed instruction.

(*c*) Films aiming at detailed instruction in agricultural processes.

The Conference notes that up to the present time experience in certain dependencies appears to indicate that, with regard to category (*c*), detailed instruction in agricultural processes is better conveyed by means of still lantern pictures with a spoken commentary, but that there is need for further experiment on this point, while films under categories (*a*) and (*b*) appear to be valuable as an adjunct to detailed instruction whether by films or by slides.

The Conference considers that films under categories (*b*) and (*c*) can serve a useful purpose only if they are prepared with a precise regard to local circumstances and conditions, i.e., that in general they should be prepared locally or under local guidance from technical departments. The Conference further believes that it is in general practicable for Colonial Governments to prepare reasonably satisfactory films of this nature locally without importing expensive professional assistance. The possibility of securing help from selected amateurs interested in cinematography and professional assistance when it can be obtained cheaply should not be overlooked.

In any case propaganda or publicity through the medium of the film or broadcasting requires to be " followed up " intensively by extension workers if it is to secure a lasting measure of success and the Conference attaches importance to demonstrations and lectures at district shows, village council meetings and schools and to the organization of visits to agricultural and demonstration stations and selected farms.

exemplify the principles of hygiene and cultivation which it is desired to emphasise, will be found to be a most useful and effective form of propaganda. Generally the most useful kind of model will be found to be the permanent, full-size, working model, seen in action; the model house should be occupied by a picked family and the model holdings should be worked by them. The family should be under an obligation to take every opportunity to show their friends round; they should be able to explain the construction and use of the model, and advise others how to copy it. It is of fundamental importance that the models should be based on the traditional practice of the neighbourhood and that the aim should be, wherever possible, to adapt and not to alter it. Moreover, models should not embody alterations and improvements which are too elaborate and expensive and which the neighbours will not be able to copy; experience has shown that it is often a mistake to demonstrate too drastic an alteration; it will not be understood by those who see it and will therefore fail in its purpose. Demonstration must not be too far in advance of public opinion. All houses built by government for their employees should in themselves be models to the general public. Government should themselves set the standard to be followed.

332. *Demonstration plots and farms.*—An effective means of agricultural propaganda is the demonstration plot on which the effects of improved agricultural practices will be visible to all. Such demonstration plots should obviously be in places where they will attract attention. Only those things which are absolutely proved should be demonstrated—experiment and demonstration should be kept quite distinct. Instead of the Government demonstration plot, the Agricultural Department may find it preferable to carry out demonstrations on the land of selected individuals working under their supervision.

333. Agricultural and Veterinary Departments will normally run Agricultural Stations and Stock Farms both for research purposes and also for the provision of improved seed and planting material for distribution and of improved cattle, sheep, goats, and poultry. Producers should be encouraged to visit these Government stations and to make use of them and they may also provide useful object lessons.

334. *Health weeks and agricultural shows.*—There is no doubt that shows and " weeks " of all kinds provide a great impetus to social welfare work especially if they are not always held at the same centre, and we suggest that the effect is increased if they are a combined effort by all the agencies, official and unofficial, engaged in welfare work in the locality. Apart from anything else such joint enterprises provide a useful opportunity for co-operation and for each department to learn

what its fellows are doing; each gains in keenness from the example of the other. Some of the exhibits—for instance model homes and model holdings—will require many months to prepare.

335. Again we would emphasize that everything demonstrated must be of proved value, practical and within the powers and means of the people who will see it. The success of the whole " week " or show will largely depend upon the ability of demonstrators to show off the exhibits and explain them to the people, and the training of these demonstrators will in itself be good propaganda. Often shows will develop in a few years into a sort of fair. Some years ago, for instance, an Orange Day festival was started in parts of Cyprus with the object of stimulating local interest in citrus growing and the consumption of citrus fruit. It has now come to be a pageant followed by many side-shows, sports, the recitation of poems specially written for the occasion, dances and the like. Sometimes too it may be possible to combine the show with an already existing festival occasion, though if there is any danger of this providing a rival attraction a different date would obviously be preferable.

336. *Competitions, prizes.*—One feature of the shows mentioned above would normally be competitions, with prizes; these may be a very effective means of stimulating—and maintaining—interest in improved practices. One of the chief difficulties of all propaganda is to secure that the effect of the initial impact is maintained. The " follow up " of all propaganda is most important; otherwise much of the effort will be wasted. We suggest that the holding of annual competitions with prizes will be a most effective means of maintaining progress secured. The prizes should be practical: the prize for the best milch cow, for instance, should preferably be something that will be useful in animal husbandry, coupled probably with some medal or token that may be permanently prized.

(ii) THE PERSONNEL REQUIRED.

337. It will, of course, be for the central Government of each territory to give the broad direction to social welfare work and to allocate funds for it. Beyond this the function of the central Government will be chiefly to encourage local effort and initiative. The actual carrying out of work must be a matter for each province or district or village. The more the interest of local authorities and the local population can be aroused the better, for welfare services which are spoon-fed by Government are not appreciated nearly so much as those in the creation of which the people themselves have taken a hand. There is thus full scope for individual initiative.

338. In his despatch of the 18th April, 1936, the Secretary of State recommended the setting up either of special nutrition committees or of general welfare committees in each territory of the Colonial Empire. Very often there will be advantage in having similar local committees, committees not only of officials, whether of the central Government or local authorities, but also of prominent members of the local community. A village welfare committee can be a most important agent in securing social betterment. Such committees already exist in several territories and have proved very valuable. They inspire the local community to take an interest in the work themselves and the plans of campaign are drawn up by the people, who thus do not feel that they are imposed upon them from above.

339. Other local organisations may also be used with profit. The co-operations of missionary societies would naturally be sought. Boy scouts and girl guides can often be enlisted to help, for social betterment work is eminently suitable for senior scouts and guides and would be assured of the warm support of the authorities of the movement. The Red Cross is another institution whose aid can often be invoked. In some territories it may be possible to start something approximating to the Women's Institute—i.e. a sort of women's club, meeting periodically, partly for recreational purposes and partly for talks and demonstrations on such things as infant welfare and domestic science. A very successful Womens' League has recently been started in Jamaica and is doing much good work. Somewhat similar Social Service Leagues are in existence in other territories. We have already mentioned in an earlier paragraph the idea of " readers' circles " which has recently been started in East Africa.

340. The local officials must necessarily be important agents in " getting across " welfare work. Whatever his substantive post, it should be a recognized obligation on every minor official stationed in country districts to take a part in fostering local welfare efforts. His home should be an example of the virtues of domestic science. His garden or holding should in itself demonstrate improved agricultural practice. In particular this applies to the school teacher. For these reasons alone we regard it as of the greatest importance that as many rural school teachers as possible should be trained in domestic science and agricultural subjects and, as we shall show later, we think that such subjects should normally form part of the curriculum in the schools themselves. These ideas are very far from being new; indeed the principle is generally accepted and in many parts of the Colonial Empire already a proportion of the teachers are trained at a " Jeanes " school or at an institution embody-

ing similar principles.* There is, however, room for a far larger development of work of this kind, and we strongly recommend that all Colonial Governments and all missionary bodies engaged in education should make it their policy to see that teachers appointed for work in rural areas should have some knowledge of local agriculture, elementary hygiene and " home building," and that women teachers, whether in rural areas or not, should be qualified to teach the kind of domestic science applicable to local conditions.

341. Another important agent in welfare work is the health visitor, a local woman specially trained to advise parents on health matters generally and particularly regarding the health of pregnant women and of infants. Health visitors are at present at work in many parts of the Colonial Empire, and there is plenty of evidence to show that their services are appreciated and that they have a really big effect in decreasing infant and maternal mortality and in improving the nutrition of children generally. The health visitor is a comparatively new arrival even in European countries but one who, we consider, has amply proved her worth, and we recommend that Colonial Governments who have not so far done so should take every opportunity to develop a health visitor service.

342. Apart from the resident agents of the Government much can be done by travelling propaganda units. We have already referred to the useful work done by health vans with cinema apparatus. The activities of the staff of health vans need not be limited to the giving of cinema shows. With the aid of such movable units it is possible to make a concentrated propaganda drive upon one particular district over a short period of time. Malaya and Nigeria led the way in the use of travelling propaganda units and have found their work most valuable. Other Governments are now following their example and it is greatly to be hoped that others will do so in the future. The work of the travelling unit must be followed up by the resident officials in the area. Otherwise much of the value of its work will be lost.

* The " Jeanes " school is an application of the principles stated above. It derives its name from the fact that these principles have been intensively applied in the training of supervisors of negro schools, paid from the Jeanes Fund in the U.S.A. The courses last usually for two or three years and those taking them are usually accompanied by their wives and families. While naturally one object is to train each candidate in his special duties as a teacher, an equal importance is attached to securing that his whole household shall constitute in itself a model and an object lesson for the community among whom he is to work. Much valuable information on this and similiar questions is to be found in the " Memorandum on the education of African communities ", Colonial Office pamphlet No. 103, issued by H.M. Stationery Office 1935, Price 6d; and in " Overseas Education " published quarterly for the Secretary of State for the Colonies by the Oxford University Press, 1/- net.

343. In general it may well be that welfare propaganda will be more effective if a number of Departments concentrate together upon the same district. The Far Eastern Conference on Rural Hygiene, for instance, reached the conclusion that experience in India, Ceylon and elsewhere shows that health work in rural districts is productive of excellent results if it is carried on in an intensive way in limited areas. In Ceylon what are known as health units are now permanently at work in 11 areas covering over 800,000 people or about a sixth of the whole population. These units, the first of which started in 1926, are each in charge of a Medical Officer of Health who has a staff of Sanitary Inspectors, Public Health Nurses and Midwives under his control. They carry out a programme of health propaganda work covering all aspects of community and individual hygiene. They cover 63 maternity and child welfare centres,* as well as work at all the normal activities of Health Departments. " Health weeks " are carried out and several thousand talks and lectures given in schools, villages and clinics, some with lanterns or films.

344. Similarly, a very carefully thought out rural development scheme involving joint action by agricultural, veterinary, education and health authorities as well as by unofficial organisations and the people themselves is now being introduced in eighteen villages in Cyprus.† Somewhat similar work is already being done in Macedonia by the Near East Foundation, who are taking a lively interest in the scheme. Further examples could be given from other parts of the Colonial Empire. We suggest that other Colonial Governments might find these examples worthy of imitation.

345. We suggest also that Colonial Governments should do their best to interest prominent local residents and, perhaps particularly, the wives of officials in local welfare work, especially among women. The wives of civil servants have often that rare commodity, leisure, at their disposal and they can do much to assist local populations. We have suggested earlier that organisations on the lines of the women's institutes in this country might be started in some territories, and we have referred to the valuable work of the Women's Welfare League in Jamaica. In organisations such as these and infant welfare centres the wives of Government officials can and often do play an important part.

346. We have suggested elsewhere in this report that employers of labour should be encouraged to pay more attention to the proper feeding of labour. Apart from the immediate

* It has incidentally been discovered that better attendances are obtained if ante-natal clinics are held at different times from baby clinics.

† See "Proposed Rural Development Scheme", Memorandum by B. J. Weston, Cyprus Government Press, Nicosia.

benefit to the employed—and thus to the employer—we think that this should have considerable propaganda value, for the employee who has been well fed and well housed for say six months at a time will be more inclined to insist upon better standards for himself when he returns to his home. Similarly Government institutions, such as hospitals, and even prisons, have a very considerable propaganda value in improving standards of nutrition. It should go without saying that the diets provided in Government institutions should be such as will be adequate for good nutrition. A great deal has been done to improve these diets in recent years. Hospitals can often arrange to have their own vegetable gardens where convalescent patients will see the vegetables they are given being grown. During their stay in hospital they will become accustomed to eat these vegetables and the present of a packet of seeds when they leave may lead them to grow them for themselves when they go home.

347. This section of our report would not be complete if we did not refer to the obvious fact that the success of social welfare work depends largely upon the officers of Government or local authority understanding and obtaining the confidence of the people among whom they work. The best intentioned efforts will break down in the face of the passive resistance of the people it is sought to assist. Conversely if the people trust the author of a new idea, they will often adopt it with surprising readiness.

348. Finally, mention must be made of the role of co-operative societies in schemes for rural betterment. The co-operative movement has achieved a fair degree of success in some parts of the Colonial Empire, though it has not yet played the important part in any Colonial Dependency that it plays in some other countries. The existing societies in the Colonial Empire are mostly concerned with the provision of credit and thrift facilities to their members or with the marketing of their produce or with both of these two activities. But a few societies have been formed in Malaya and Ceylon having for their object the improvement of village conditions and general rural betterment. A great deal of good has been done by such societies as these in other countries, and undoubtedly they could be most valuable in the Colonial Empire. We hope that Colonial Governments may find means of extending the movement as quickly as is possible consistently with adequate supervision. Perhaps the greatest value of co-operative societies lies in the fact that they are an effort of the people to help themselves. They therefore take a personal interest in their success. Moreover, whatever its object, each society consists of a group of people who have to some extent at any rate appreciated the need for communal action and the advantages it brings. Its members are therefore likely to be receptive of

new ideas in other directions. Co-operative societies are thus valuable as centres for propaganda and the dissemination of information, whatever may be their immediate objective.

(iii) GENERAL PRINCIPLES.

349. Without wishing to be too dogmatic on a subject which has been too little explored to permit of much dogmatism, we suggest that the following general principles emerge from our survey of the means and agents of welfare propaganda. We suggest that they should be taken into account by anyone who has to plan welfare propaganda:—

(1) Changes will be more readily accepted if they are not regarded as having been imposed from above. The people themselves or at least their leaders must be inspired to make the changes of their own accord.

(2) The type of propaganda to be used will vary according to whether the whole community must be converted before a change can be effective or whether it will suffice to convert in the first place only a few individuals.

(3) A dramatic improvement, such for instance as results from a campaign against yaws, will be invaluable in winning the confidence of the people.

(4) The least intelligent members of the community can perhaps only be reached by means of the more intelligent. Convert the more intelligent first and they will convert the masses.*

(5) Use to the full the influence of any local aristocracy or leaders. If they are not used as leaders of advance, they will almost inevitably become leaders of reaction.

(6) If people are to be inspired to make changes of their own accord, they must fully understand them. Propaganda then must be devoted (*a*) to making the more intelligent members of the community understand what changes are wanted and (*b*) to inspiring them to carry them out.

(7) Older people often have more power in the community than the younger people. But the young people of to-day will be the older people of to-morrow. Other things being equal, a pound spent in changing the habits of those who may well live 40 years will be more economically spent than a pound spent on those who can hardly live ten. At the same time the young man will find it hard to retain his enlightened ideas if he is constantly subjected to grinding discouragement from reactionary elders.

* This needs some qualification. The man who has been so educated as to have lost touch with his original environment will obviously not have much power to influence those who have remained in that environment.

(8) Most forms of propaganda should be directed primarily to the women and more particularly to the mothers. It may then be effective from generation to generation whereas the effect of propaganda on a man may die with him.

(9) Ocular demonstration is much more effective than any amount of explanation. If people see that the crop grown on a particular piece of land with improved methods of cultivation is better than that grown on the next piece of land by the ordinary methods, they will copy the new methods, provided that they can understand them and that they are not too far removed from those to which they are accustomed. In other words,

(10) Exploit the power of the illiterate to imitate.

(11) Hasten slowly. It is no use telling people that their children will never be healthy until they drink a pint of milk a day, if at present they are subject to taboos which prevent their drinking milk at all, or if the price of a pint of milk is equivalent to the earnings of a family for a week. Make sure that any changes recommended are practicable.

(12) Demonstrate and recommend only that which has been fully proved by experiment. Do not recommend people to plant a new crop if there is any risk that when they have begun to take the advice it will be found that it will not grow in that particular area.

(13) All propaganda must be immediately applicable to the people to whom it is directed. The more primitive the people, the more essential this is. In East Africa for instance a film depicting tribe A will probably convey little if shown to tribe B.

(14) The *tempo* of propaganda must be adjusted to the power of the people to take it in. There is evidence for instance to show that the magic lantern is sometimes more effective than the cinema, because the cinema moves too quickly for its lessons to be assimilated.

(15) It is a mistake to try to introduce too many innovations at once. If you do, people will be frightened and the power of the reactionaries will be strengthened.

(16) At the same time the power of a people to progress in one direction will be limited by their ignorance in other directions. For instance no infant welfare campaign can be entirely successful so long as general housing conditions remain insanitary. All aspects of public welfare react upon one another.

(17) Repetition without causing boredom is the essence of propaganda. The same lesson repeated ten times in

slightly different form is more than ten times as effective as a single lesson.

(18) For this reason effort diffused will often be effort wasted. The objects of a propaganda campaign should be clearly defined, concrete and concise.

(19) Make sure that the limited money available is being spent to the best advantage. Before, for instance, beginning the taking of an expensive film, consider whether the same object could not be as effectively obtained for less money by means of, say, gramophone records and magic lantern slides.

(20) Propaganda concentrated upon one district, carried out by several departments working together, and with a few clearly defined objectives, will often be the most effective.

(21) Always take great care to follow up a campaign; otherwise ground gained may subsequently be lost and much of the effort be wasted.

(*c*) The Education of the Young.

350. We have considered at some length the subject of community education, that is the education of the adult in social welfare matters and the means of securing it. The education of the younger generation on social welfare matters is only the particular application of the principles laid down above; it will not therefore be necessary to add much in this part of our report.

351. It will, we think, be sufficiently obvious from what has been said elsewhere in this report that consideration of the factor of nutrition emphasizes the importance of education being environmental in character; that is to say, it should not be purely literary but should have a direct application to and bearing on the circumstances in which the children of each territory live. It follows from this that we attach the greatest importance to the teaching of agriculture to pupils in rural areas, in mission schools as well as in government schools.

352. For any agricultural teaching to be effective, there must be the possibility of practical demonstration. The school garden or farm is therefore a necessity to rural education. It should be a place where the children not only learn the principles of sound agriculture but also how to grow food crops of nutritive value. The school garden should also be linked with teaching in cooking and domestic science, and where possible the children should themselves cook and eat the food they grow.

353. A variation of the school garden system which has been tried with success in some Colonies in what is known as the

" home garden " or " project system," whereby the parents of the children are induced to give them a set portion of the family land to cultivate and the children cultivate it under the supervision of their teacher. One advantage of this idea is that it brings the parents also into contact with the improved agricultural practice which is taught to their children. Obviously, however, it can only be adopted where the community live fairly close to the school.

354. It is hardly an exaggeration to say that in some cases the main purpose of the school should be to improve the agriculture of the people and that in the early stages other education should be subsidiary to this main theme. One example may be given from the Suk district of Kenya. The people inhabiting that district are pastoralists by tradition who have now much reduced quantities of cattle. In 1930 the only crops grown in the district were two kinds of millet, sorghum and finger millet. In years of drought the district suffered from serious food shortage. In 1930, after considerable enquiry and discussion, the Education Department decided to start a boarding school for 40 boys. The boys were to clear and cultivate a plot of land round the school and to grow on it a crop of potatoes and other vegetables. In addition a certain amount of instruction in the three Rs was given and they obtained the discipline of boarding school life. The first crop grown on the communal plot was a great success. The boys became so keen that they asked to have their own gardens. After a year or two it was possible, with the help of the boys, to start demonstration plots in various parts of the district. Despite many difficulties these too eventually proved a success. Every opportunity was taken to show the plots to the general community. For instance, the meetings of the Local Native Council were always held at the plots. By 1936 considerable quantities of yellow maize, white maize, ground nuts, sweet potatoes, European potatoes, several varieties of beans and pulses, cassava, sesame, yams, carrots, onions and tomatoes were being grown where, six years before, nothing but millet had been grown. The improvement in the physique of the tribe was remarkable and there was beginning to be a surplus of vegetables for export to other parts of Kenya. Moreover a beginning had been made in checking soil erosion by, for instance, planting sweet potatoes in strips on hillsides.

355. As rural children should be taught agriculture, so all children whether in town or country must be taught the elements of hygiene and health—personal cleanliness and so on. Similarly for the girls the teaching of domestic science in all its branches should be one of the most important parts of the curriculum. Those aspects of it which particularly concern us are cookery classes and the teaching of infant and child welfare. We should like to see a very great development of both these aspects. We

deal in the next section with the importance of infant welfare work, but we think that the beginning of training in the subject should most certainly be given in all schools for girls.

356. We have emphasised that from a nutritional point of view education should be environmental, but it is also necessary to bear in mind the close and very real connection between the application of intelligent methods in agriculture and domestic science on the one hand and an improvement in general intelligence on the other. It is a mistake to over-emphasise environmental education to the exclusion of general education. In the case of girls, for instance, it is a constant complaint, repeated from many Colonies, that it is impossible to develop a service of health visitors, midwives, nurses and so forth because it is impossible to obtain girls with sufficient general education to assimilate special instruction on these matters. As we have already said it is quite as important, if not more so, to educate the women of the community as to educate the men and we feel that female education has received insufficient attention in the past.

357. Considerations of finance limit the extent to which general education can be given—in most Colonies the days of universal education are unfortunately still remote—but much thought is now being given to the possibility of reducing the cost per pupil of elementary education and so making possible an increase in its range. Probably the most important factor is the training of more local personnel.

358. If more teaching is to be given on agriculture, health and domestic science, the first requisite is the better training of teachers in these subjects. We think that so far as girls' education is concerned the teaching could probably best be given by women teachers. Some territories—for instance Palestine—already give a good deal of attention to the training of teachers in " environmental " subjects. Some territories also already employ considerable numbers of women teachers and have special training colleges for them. In Palestine there are two colleges, one for teachers who are going to be employed in urban schools and the other for those who will be employed in the country. In some parts of the Colonial Empire, however, little progress has been made either in " environmental " training or in the employment of women teachers. The report from one Colony in the West Indian area, for instance, shows that in the past little or nothing has been done to train teachers either in agriculture or in domestic science. Similar instances could be given from many other Colonies.

359. There should be relatively little difficulty in arranging for the training of teachers in agriculture, for it should generally be possible for a member of the Agricultural Department to take

on this work. In the case of domestic science and health work among women generally, however, there may at present be no one in Government employment who could arrange and supervise training courses. The task is obviously one for which women are much more suitable than men, and it may be necessary to appoint someone specially from outside the territory. We suggest that it should be possible to find suitable persons in this country who have, amongst other things, taken a diploma in dietetics. Sometimes it might be possible to make a beginning by enlisting on a voluntary or semi-voluntary basis the services of a local resident with some knowledge of domestic science.

(*d*) Meals for School Children.

360. It is now beginning to be realised that it is uneconomic to attempt to teach children who are too poorly nourished to be able properly to assimilate the teaching given. We have already quoted the report from Barbados that many children have no regular meals after Wednesday in each week because the family wage is exhausted. Barbados have now made a beginning in the feeding of school children, and a sum of over £10,000 was provided in the estimates for 1938 for the purpose—a sum which is considerable for a territory of the size of Barbados. From Zanzibar similar reports come. In the report received it is said: " The routine medical examination of the rural schoolboys displays the fact that a very large number of children are undernourished and that in many the grossest physical signs of avitaminosis are evident. On questioning the children it is usual to find that only comparatively few have had a satisfactory meal, and some have had no food at all before coming to school. In many places it is not uncommon that the majority will have no regular food until the evening meal is cooked at dusk; one meal a day is the rule and not the exception." The report goes on to emphasise the importance of providing a meal for the school children and a beginning in this direction has now been made. In Ceylon no less a sum than Rs.1 million is being spent by the Central Government on the provision of nutritionally adequate meals to some 80,000 school children. Local authorities and voluntary agencies also provide meals for school children and in all, the children in 520 different schools are now receiving mid-day meals. In Jamaica a voluntary " Children's Lunch Fund " provided lunches in 1937 to about 500 children a day in Kingston, or about 4 per cent. of the children on the rolls of the elementary schools. The fund is now being assisted by a Government grant. There are also 23 school canteens in rural areas operated by the teachers in conjunction with the kitchen gardens at these schools. The scheme, which is assisted by the Jamaica Women's League, also receives financial assistance from the Government. In British

Guiana a scheme for the provision of extra milk to a selected group of school children has recently been started. Many other instances could be given of a beginning being made in work on this subject.

361. We commend these examples to Colonial governments. The great limiting factor is, of course, the cost. This is considerable and in many Colonial territories it would be impracticable to provide food for anything like the number of children at present going to school, even though that number may be only a fraction of the total children in the territory. In rural areas a good deal could be done by using the produce of the school gardens, which we consider should be universally attached to rural schools. Elsewhere it may be possible to make a small charge. For instance, in Freetown, Sierra Leone, some of the schools have arranged for the supply of a mid-day meal by a contractor at a charge of 1d. a day to each child. The constituents of the meal accord with suggestions made by the Health Department. Apart from the provision of this proper meal no other food, e.g., sweetmeats, etc., may be sold in the school compounds. We suggest that the system of providing food against payment might well be copied in other parts of the Colonial Empire where the parents would normally have to buy food for their children. Apart from the reduction in cost there may be something to be said for requiring a small payment for meals provided, in that it does not decrease the sense of responsibility of the parents for the wellbeing of their children.

362. Cost being so important a factor, it is naturally desirable that the maximum amount of nutritive value should be obtained for a minimum amount of money. It may be that here there is a large scope for the use of dried skimmed milk imported in bulk, or of concentrated foodstuffs in one form or another. We have referred to this matter in Chapter VIII, paragraphs 176-79 and 184-89.

CHAPTER XIII.

PRE-NATAL SERVICES AND INFANT WELFARE WORK.

363. We now come to a part of the subject which we believe offers great scope for immediate improvement. We have tried to show in Chapter III above that pregnancy and lactation on the one hand and infancy and childhood on the other are from a nutritional point of view of outstanding importance. There can be no doubt that ignorance on the subject of nutrition, as indeed on all other aspects of health, is responsible for much preventable sickness and mortality during these periods.

364. As regards the infant, it would obviously be wrong to ascribe the appallingly high infant mortality rates which now exist in some parts of the Colonial Empire solely to malnutrition, since obviously where malaria, congenital diseases, hookworm and other infestations are very prevalent these must also play a significant role in the state of well-being of the child. There seems to us, however, to be no reasonable doubt that malnutrition mainly resulting from unsuitable feeding is one of the most important factors in causing high infant mortality in tropical countries. On the one hand there is ample evidence that at all times digestive troubles are one of the primary causes of infant mortality. On the other hand there is ample evidence that throughout the Colonial Empire many infants are fed most unsuitably. For instance, in Swaziland and in many other parts of Africa it is the custom to give babies sour porridge during the first week of life in addition to breast milk. In some of the West Indian Colonies infants are weaned at one to three months, and thereafter are fed on sugar tea and corn meal pap, with the addition of potatoes, rice and biscuits as they grow older. Many other similar examples could be given.

We have no doubt that improved feeding of infants would lead to a great reduction of infant mortality rates.

365. The reasons for the improper feeding of nursing mothers and children in the Colonies are not far to seek. In part it is due to one or other of the various aspects of poverty with which we have dealt in previous sections. In part it is due, at any rate in the West Indies, to the high percentage of illegitimacy due to casual unions. But when due allowance has been made

for these causes there can be no doubt that sheer ignorance is one of the chief factors.

366. This, though it may seem paradoxical, is encouraging, for it means that it is possible to make considerable progress at the present economic level. There can be no doubt that in general the women of the Colonial Empire welcome instruction on infant welfare work, and that it is only necessary for instruction—enlightened, sympathetic and understanding—to be given for real progress to be made. Thus without any change in the economic level it should be possible everywhere to reduce infant mortality rates very considerably by increased attention to infant welfare and particularly to the feeding of mother and child.

367. When it is realised that infant mortality at present exceeds 200 per thousand live births in many parts of the Colonial Empire, and sometimes even exceeds 300 per thousand, it will be seen that the field of work is great. Excellent work is already being done in almost every part of the Colonial Empire but even where the services have been most developed they at present touch only a small fraction of the whole population. We think that Colonial Governments would find that on any long view increased attention to infant welfare work was one of the most productive forms of expenditure. It should lead to increased efficiency in production and decreased expenditure on medical services; where shortage of population is a problem, it should lead to an increase. It is probably one of the cheapest forms of attack on many tropical diseases, malaria amongst them. We recommend therefore that Colonial Governments should greatly extend infant welfare work. We recognise that the funds available are strictly limited. We suggest therefore that they should invoke the assistance of voluntary workers wherever possible. The subject is one on which voluntary workers can be of great assistance; indeed much of the work already being done is being done by missions or owes its beginning to the enterprise of the wives of officials and prominent local residents. Further we suggest that in those countries where it is customary for the labourer on estates or mines to be accompanied by his family, the estate or mine should be encouraged to provide infant welfare facilities. Some already do this in varying degrees.

368. There will of course be many other subjects for the infant welfare worker to deal with besides the actual feeding of the child, but we feel that in the conditions of the Colonial Empire the first lesson which must be taught is the importance of breast-feeding without the addition of other unsuitable food. The Final Report of the Mixed Committee of the League of Nations says: " Complete breast-feeding of infants is of very great importance. It is cheaper, simpler and cleaner than

artificial feeding and in the case of a properly fed mother the benefits brought to the infant are great"*. This conclusion was applicable of course primarily to temperate countries, but we consider that it applies even more strongly to Colonial conditions where the difficulties, economic and hygienic, of securing a proper artificial food supply must be so much greater. In large parts of the Colonial Empire breast-feeding is the rule and may last as much as two years and even longer. Nearly always, however, at the same time the child is given unsuitable solid food. It is this which is the main cause of digestive troubles.

369. But the whole problem has not been solved when breast-feeding has become the rule; it is merely thrown back from the child to the mother. As we have seen the nursing mother herself requires a diet very considerably above that of the ordinary adult, and unless she gets it the health of her child may suffer as well as her own health. It is important therefore that instruction in infant welfare should include instruction to mothers as to their own diet during lactation.

370. Moreover the problem does not end with weaning; it is important that instruction should also be given in the proper dietary of children after they are weaned. The activities of infant welfare workers should not be confined to infants in arms but should if possible be carried further, to cover children up at any rate to the school age†. During this period, as we have shown in Chapter III, children have certain special requirements beyond those of the adult. The period is one in which there is great susceptibility to infection and in the absence of proper nutrition this susceptibility will be greatly increased. It is often found that when children come to be examined by the School Medical Officer many have developed defects that have arisen during the pre-school period, either directly from malnutrition or indirectly from infection resulting from malnutrition, and that by the time these defects are seen it is too late to remedy them. As in the case of adults, it will of course be found that diets regarded as optimum by European standards are quite beyond the means of the majority of the local population. In advising mothers regarding the diets of their children it will be useless to prescribe foods which however desirable in themselves absorb an unduly large proportion

* Pages 68–69.

† In Malaya it is the general practice for children to be breast-fed up to the age of six months. At that age they are weaned. Experiments carried out in Singapore show that up to the age of six months the weight of babies coincides with European standards. It is only after weaning and the transference to white polished rice unsupplemented with milk that a falling off occurs, until at sixteen years of age Chinese are 18 per cent., Malays 13 per cent., and Eurasians 10 per cent. below European standard. It is not possible to say whether these differences are due to diet or heredity, but it is certainly possible that they may be due to diet.

of their income. The diets recommended must be diets which it is practicable for the parents to provide.

371. As regards the means of promoting infant welfare work, it is not necessary for us to go into detail. Ante-natal and infant welfare clinics, health visitors and propaganda on the lines we have discussed earlier should all play their part. Information from certain Dependencies suggests that little progress can be made in infant welfare work until more trained local women are available, and this in its turn presupposes a higher standard of general education than is usually obtainable among women at present. Once more we come back to the importance of increased attention to female education.

372. One factor which is a very important cause of malnutrition in the West Indies, in some African towns and in one or two other parts of the Colonial Empire, is the absence in the parents of a sense of responsibility for the welfare of their children. In the primitive community there is normally a clear obligation on one or other of the parents to look after their children. Where however the primitive sanctions no longer obtain, the obligation is apt to be disregarded. The sanctions of the primitive organisation are not immediately replaced by the sense of responsibility that obtains in the normal civilised community. In the West Indies for instance many of the children are the result of casual unions. The father accepts no responsibility for their welfare and the whole burden of it falls on the mother. She may well be unable to depend on any regular earnings and as often as not will have to work for wages herself. The children are often not wanted and even if they are wanted the mother will be unable to give them proper attention. She will often for instance be unable to breast-feed her babies for to do so would interfere with her power to earn money for their upkeep.

373. This state of affairs constitutes a social problem of the first magnitude and is linked with the general need for developing the social and economic conditions making for a more stable family existence. We consider that in almost all the West Indian islands one of the first aims of Government should be to educate their people in the duties of parenthood. This is of course important from many points of view besides that of nutrition. Amongst other things we think it may well provide the clue to the problem of the increase of population—an increase which with greater attention to infant welfare services will be all the quicker—for an increased sense of parental responsibility should lead to a reduction in the birth rate. The whole subject is one to which we do not doubt that the West India Royal Commission will devote much attention and we need not consider it further here.

374. Our primary concern in this chapter has naturally been with malnutrition as a factor in infant mortality and sickness. It is obvious that there are also other factors. The infant mortality rate in any place is usually regarded as a clear and reliable index of the state of public health in that area and where it is high, and intrinsically and climatically the area should not be an unhealthy one, it must be accepted as an indication that special action is called for on general public health work as well as on the nutritional aspect. The proper feeding of infants and young children can only yield its full results if they are preserved from concurrent infections.

CHAPTER XIV.

THE NEED FOR FURTHER KNOWLEDGE.

375. The preceding chapters of our report have been concerned with an analysis of the problem of nutrition in the Colonial Empire as it appears in the light of existing knowledge, and with an attempt to define the directions in which a practical advance towards better conditions can be achieved. In the course of that analysis it has become evident that there is much that can and should be done to effect an improvement at the present time on the basis of the knowledge already available. Some of the deficiencies which exist are sufficiently evident and the task of remedying them does not call for further scientific investigation. At the same time no one who undertakes to study, as we have done, the evidence which is available regarding the nutrition of colonial peoples can fail to be deeply impressed by the great range and complexity of the problem and by the extent to which our knowledge of it is still imperfect and incomplete. The general outline of the picture may be clear enough, but much of the detail is lacking or can be filled in only by intelligent conjecture. Or again where the facts of the problem are clear the solution may still await discovery. However important, therefore, may be its political and administrative aspects, the problem of malnutrition is still to a considerable degree also a scientific problem. New knowledge is required in a field which is still comparatively unexplored. To stimulate the growth of such knowledge must be amongst the first aims of government policy.

376. This need was rightly recognised in the circular despatch addressed in 1936 to all colonial governments by the Secretary of State for the Colonies, and the matters on which governments were explicitly requested to report included the present knowledge of human nutrition in each dependency and the further studies and researches on the subject which appeared desirable. A full summary of the replies received from the various governments under these two heads is included in the survey which forms Part II of our report. At an early stage in our inquiry we took steps to consider what action might be taken in the light of this information. It appeared to us that the organisation of research was essentially a question on which assistance might be given to Colonial Governments from the centre. Research must of course to a large extent be carried out locally by personnel of the local Government. Nevertheless there was, we

felt, a great need for co-ordination, for some attempt to formulate a single scheme capable of application to the widely varying needs and conditions of the Colonial Empire. We accordingly appointed a Research Sub-Committee under the Chairmanship of Sir Edward Mellanby to prepare for our consideration a co-ordinated plan of field surveys and research which might with advantage be carried out. In the following paragraphs we summarize in broad outline the conclusions reached by the Research Sub-Committee.

377. The Research Sub-Committee began by observing that a distinction may be drawn between laboratory research of a more or less elaborate kind and field surveys of nutrition in relation to health. The facilities available for work of the former character are naturally confined to one or two laboratories in the larger colonial terrotiries, such as Malaya, Kenya and Nigeria. In all of these laboratory research on nutritional questions has been actively prosecuted.

378. Two main questions have been investigated, the composition of local foodstuffs and the determination of the basic metabolic rate. In Malaya, as the result of the very thorough work done by Rosedale and others, information is now available regarding the composition and relative values of the local foods. In Kenya the chemical composition of local foodstuffs has been extensively studied, analytical data being available in a number of publications. In Nigeria the composition of local foodstuffs has been determined in the Government Nutritional Laboratory at Katsina. In regard to Ceylon, mineral analyses and vitamin assays of all the most commonly used local foodstuffs have recently been carried out in this country on samples specially sent from Ceylon. To these investigations may be added the important work which has been undertaken by the Imperial Bureau of Animal Nutrition who in their Technical Communication No. 6 have published valuable data regarding the composition of African foodstuffs.

379. The second main question which has been investigated in the laboratory is that of basal metabolic rates and energy exchange. In Malaya it has been found that the average Asiatic inhabitant has a basal metabolic rate about 10 per cent. lower than that of the normal European. Further it appears that the basal metabolic rate of the European becomes lowered in Malaya and can be raised by leave in Europe and even by local leave at a hill station. The conclusions which these investigations suggest is that environmental conditions are a more important factor than race in determining the level of the basal metabolic rate. In addition to the work done on basal metabolic rates in Malaya, the question of energy exchange amongst East African peoples is being studied in the Medical Research Laboratory at Nairobi.

380. The second of the two main heads under which nutrition research in the Colonial Empire may be grouped is that of nutritional survey work. This includes (i) field surveys, the purpose of which is to determine what the people eat and the state of their physique, (ii) studies on the relation between diet and disease carried out where groups of people are provided with food by Government or other responsible body, as in hospitals, prisons, police and military forces, labour on mines and estates, (iii) observations on specific deficiency disease conditions encountered by medical officers in the course of their day-to-day work.

381. Dietary surveys were begun in Nigeria by McCulloch in 1927 under the auspices of the medical department, and have been continued since that date by Turner, Fitzgerald-Moore, and Clark. They are being pursued, at the present time, by the Medical Officer in charge of dietetics research. One of the most comprehensive and best known field surveys of African dietaries was that undertaken in Kenya by Orr and Gilks relating to the physique and health of two contrasted tribes, the Masai and the Kikuyu, which although inhabiting adjoining territories have entirely different dietary habits. Investigations in Kenya include also a good deal of work falling under the second and third of the heads mentioned in the previous paragraph. Much important work on nutrition has been done in Uganda during recent years, and a valuable series of papers has been published by Loewenthal, Mitchell, Owen, Hennessey and others, dealing with such subjects as vitamin deficiencies in Uganda prisons, the ulcer syndrome in Uganda and vitamin A deficiency among the population of Teso. Further surveys are in progress and the Government are detailing a medical officer who will give his whole time to the work.

382. A noteworthy survey was that carried out in Northern Rhodesia by Gore Brown and by Richards and Widdowson among the Bemba, a millet-eating tribe inhabiting the high north-eastern plateau. Detailed observations were made of the dietary customs of the tribe and very careful records were kept of food consumption and cooking practices. The samples of food obtained were subjected to analysis in the Biochemical Department of King's College Hospital, London. Conditions in the millet-eating villages of the Bemba tribe were also compared with those in a typical cassava and fish-eating village situated in the territory of the Bisa.

383. In Basutoland and Swaziland, valuable studies of dietary conditions have been carried out by Ashton and Kuyper respectively. In Malta data have been collected by the local nutrition committee on the composition of the diet of working-class families in various villages and towns, and family budget studies have been undertaken by the Labour Department. In Palestine

surveys of the diets of certain Arab and Jewish communities have been undertaken by Maclennan and Kligler respectively.

384. An important nutritional survey was undertaken in Ceylon by Nicholls whose main studies consisted of an investigation of the diets of children in upper, middle and poorer class schools. The diets of 16 labouring coolie families were studied in detail and compared with those recorded in studies made in the Netherlands East Indies of the diets of Javanese peasants.

385. In Malaya the knowledge available regarding the dietary conditions of the population as a whole is not as extensive and complete as that available regarding the mineral and vitamin content of tropical foodstuffs. A beginning has, however, been made with the collection of the necessary data, and an investigation into dietary standards in Kedah has been carried out by Strahan. A report on nutrition amongst Malays in coastal districts has also been prepared by Burgess.

386. Finally, in Trinidad investigations have been carried out during the last fifteen years by Lassalle, Seagar and Clark. Seagar studied food consumption by industrial workers on cacao and sugar estates on which both East Indians and West Indians were employed. Clark who has done much work in the Colonies (notably in Nigeria) on the toxic principles which occur in underground foods, was engaged for some time in Trinidad on an examination of the relationship between diet and the occurrence of nephritis. In Jamaica also an inquiry has been carried out on the nutrition of children in the corporate area of Kingston and St. Andrew.

387. From the foregoing survey of the present position of nutrition research in the Colonial Empire certain salient features appeared to the Research Sub-Committee to emerge. In the first place, although work on nutrition has been going on in various parts of the Colonial Empire for many years and valuable contributions to our knowledge of the subject have thus been made, nevertheless there is a very noticeable inequality in the amount and nature of the knowledge available not only as between one territory and another but also, in some of the larger dependencies, as between different areas in the same territory. The progress of nutrition research in the past has depended partly on local or individual initiative, partly on a series of special investigations of particular questions financed from this country. No concerted attempt has hitherto been made to secure a general advance over a wide field. Secondly, and perhaps as a natural result of this circumstance there has been a tendency for research to develop disproportionately as regards the amount of attention devoted to particular problems.

It is natural that individual workers, carrying on their investigations more or less independently and with limited resources, should become interested in one particular line of inquiry and should concentrate their attention on the solution of a comparatively narrow range of questions. What is necessary, therefore, at the present time is to provide, so far as possible, for the acquisition over the whole extent of the Colonial Empire of a knowledge of the elementary facts of the situation in regard to nutrition. There are of course territories in which such knowledge is to a considerable extent already available. But even in those where most has been done there are gaps to be filled. In particular there is a lack of data derived from direct quantitative observations of the dietaries of the peoples of the Empire, with which few exceptions (e.g., among the Bemba in Northern Rhodesia, in Basutoland and Swaziland), have not so far been attempted. The lack of such information is particularly marked in the less developed territories where such observations are naturally more difficult to carry out.

388. In the light of the foregoing observations the Research Sub-Committee did not consider that the chief need at the present time is for elaborate laboratory research on such questions as the basal metabolic rates of tropical races. The work which has been already carried out, for example, by Rosedale and others in Malaya has sufficiently shown that the contrast with European conditions is not great enough to exercise an appreciable effect on the question of dietary standards. Moreover the average diet in tropical countries in present conditions falls so far short of the ideal that it is of secondary importance to lay down in precise terms what the ideal diet should be. Economic conditions alone would make it impossible of attainment within a reasonable time. The Sub-Committee did not propose, therefore, any considerable extension at the present time of the scale on which laboratory research is now being carried on in the Colonial Empire, though where facilities are available investigations which show promise of useful results will no doubt be continued.

389. The main need, the Sub-Committee felt, was for field survey work, embracing within that term studies of the diet of both rural and urban peoples including labour employed by mines and plantations. They recognised that there would be considerable variations in the methods and objects of such surveys in different territories. In some of the dependencies where the conditions of life are comparatively advanced, government officers are already broadly familiar with the composition of the local dietary. In territories such as these it will be possible to use the information already available as a basis on which to carry out more specialised inquiries into such questions as the relation between diet and disease or the relation between

diet and income. In other territories, as for example in parts of tropical Africa, even those familiar with local conditions have only an incomplete knowledge of the influences determining the diet of the indigenous tribes. In these cases, field surveys should include a study of the living conditions of the people and must embrace in the range of inquiry such questions as methods of producing, storing and preparing food, systems of land tenure, the organisation of labour, and of distribution, sale and exchange, incentives to work under modern conditions and the various tribal eating customs and magico-religious attitudes towards the use of foods. Obviously, a somewhat different personnel will be required to carry out surveys in these two contrasted types of territory. Moreover, the technique of dietary surveys must be adapted to the varying circumstances in which they are to be carried out. Amongst backward and illiterate peoples special problems are presented by such factors as the absence of the use of money or of units of measurement either of size or of weight. Seasonal changes of considerable importance also occur in the food consumed in many areas.

390. Again a differing emphasis may be laid according to local conditions on the various aspects of the nutrition problem. In the large majority of Colonial territories the agricultural side of the survey will be of much importance. The survey of health and agriculture carried out in the Teso district of Uganda may be quoted as an instance. In this case statistical evidence suggested that the presence of fish in the diet of one of the two areas compared was one of the main causes of the superior health (probably referable mainly to the absence of ulcer) observed in that area. The results of the inquiry suggested that steps should, therefore, be taken to increase the amount of animal food or fish consumed. For this purpose, it was suggested that further surveys would be desirable to determine the effect, if any, of the following factors on nutritional health; a pronounced dry season, failure of the main cash crop, failure of the food crops, and the relative acreage of individual food crops, e.g., millet, sweet potatoes, cassava.

391. If, however, a survey were concerned with an urban population or with labour working on estates, agriculture would naturally not play such a large part. The Research Sub-Committee considered that surveys both of urban populations and of mine and estate labour would often yield most valuable results. Again, a large part of the urban populations of the Colonial Empire consists of peoples who have migrated recently from country districts. In such cases, interesting comparisons could often be made between the state of nutrition of the townsman and that of the rural community from which he came.

392. Whatever the variations, however, in the method of approach to be adopted, all surveys of this kind should have two sides. They should seek as their first object to throw fresh light on the actual composition of dietaries. At the same time attempts should also be made to establish a significant correlation between the character of the diet and the physique and health of the peoples studied. In this way it may well prove possible to obtain more than a mere record of the facts to be interpreted in the light of existing knowledge. Field surveys, if conducted on the right lines, should enable valuable contributions to be made to the study of the etiology of certain types of disease and of the effects of dietetic abnormalities which could not be obtained by research work in this country.

393. Surveys should also provide much information of value for other purposes besides the improvement of nutrition. For instance, they may contribute to the study of population trends and of such questions as the sociological effect of the prolonged absence of male members of the community (which occurs, for instance, in some parts of Africa, where labour is recruited for work at a distance). Without unduly adding to the cost of surveys it should often be possible to include in their scope investigation of some special aspect of the life of the community which would not otherwise be covered. In this way surveys may be expected to furnish information which will be of great interest and value to all concerned with the welfare of the people in question.*

394. The general conclusion of the Sub-Committee was that the work of field surveys could only be satisfactorily carried out if steps were taken to secure a proper uniformity both in the methods to be adopted and in the standards to be applied. The lack of such uniformity tends to impair the value of much of the information which we possess at present on nutritional conditions not only in colonial territories but in European countries also. From all parts of the Colonial Empire come reports of a wide variety of conditions of malnutrition and even of manifest disease which are ascribed to some deficiency factor. But in the absence of uniform standards and of much fuller scientific evidence than is at present available many of the conclusions formed are little more than intelligent conjectures. If further field surveys were now to be undertaken in colonial territories the Sub-Committee regarded it as essential that there should be some means of co-ordinating the methods adopted by the workers in the field and of securing the application of uniform

* It is important that, in order to supply a basis of comparison, surveys should contain data regarding standards of height, weight, etc., for all sections of the community studied. Without such standards it will be impossible to judge in a few years' time whether physique has altered as a result of the improved dietaries which it may be hoped will be introduced.

standards. It is equally important that those engaged in the work of survey should be kept in touch with the latest findings of experimental research, since these may suggest new conditions of disease and new syndromes, which should be studied in the field. Research again may throw fresh and unexpected light on the precise nature of the causative dietetic error responsible for some well-known condition. An example may be found in the recent experiments carried out by two groups of workers in the United States and this country on the value of nicotinic acid as a pellagra-preventive factor. In all these matters it is essential to provide a firm scientific foundation on which the work of surveys in the field can be built up.

395. In order to make provision for this need the Research Sub-Committee considered that it would be of great value if a small whole-time staff could be provided which would act as a scientific nucleus for the purpose of co-ordinating the survey work to be carried out in the field. No more satisfactory method of securing such a staff could be imagined than its association with the Medical Research Council, a body which in recent years has been linked with some of the most important developments in the science of nutrition and is, moreover, the Government organisation officially responsible for research in medical science. The Research Sub-Committee believed that the object in view would best be met if the Council would be willing to appoint a small staff of, say, three persons for a period of five years in the first instance, whose duty would be to undertake the scientific co-ordination of a series of field surveys of diet in relation to health and physique in the Colonial territories. They recommended accordingly that the Secretary of State for the Colonies should inform the Medical Research Council that he would welcome the appointment of such a staff for this purpose and would be prepared to arrange for an application to be made for a grant from the Colonial Development Fund to meet the charges which would be incurred by the investigators for travelling, subsistence and other expenses in the course of their duties. They estimated that the amount required would be of the order of £1,500 a year for five years.

396. The Sub-Committee went on to discuss the means by which surveys should be carried out and concluded that these need not be of an elaborate character though some assistance from external sources would doubtless be necessary in each territory.

397. They also recommended that in each territory there should be at least one officer specially charged to interest himself in problems of human nutrition. He need not always be an officer possessing full medical qualifications. The larger territories may find it possible to appoint one or more officers who

are able to devote their whole time to the subject. For other territories what seems to be required is that there should be one officer—possibly the Secretary of the Nutrition Committee where such a Committee has been set up—who, without in every case devoting more than a part of his time to the subject, should make it his business to keep in touch with developments in nutritional knowledge both in the territory itself and in the world at large.

398. Wherever it is decided to undertake a survey in a particular Dependency the officer referred to above should be responsible for the preliminary organisation, and should, if possible, himself take part in the work. It should not be necessary for special officers recruited from outside the territory to conduct the survey. Given the general direction of the central organisation to be appointed by the Medical Research Council, and if necessary the skilled assistance of one member of its staff, officers seconded from the local service should be able to carry out the survey efficiently. Any lack of technical experience which they may have would be more than counterbalanced by their knowledge of local conditions. In some territories however, the assistance of a trained anthropologist may be desirable and in the case of the African territories, the Sub-Committee hoped that the International Institute of African Languages and Cultures would be prepared to co-operate to the best of their ability.

399. For each survey one Medical Officer, one Agricultural Officer and possibly one Veterinary Officer would be required as well as subordinate staff. It might also be found desirable that an Administrative Officer should take part. In any event, the close co-operation of the Administrative Officer of the district would certainly be needed. The richer territories should be able to afford to second the officers required for the necessary period without assistance. Some territories, however, will not be able to meet the cost from local resources. The Sub-Committee considered that it would be very desirable that funds should be available to enable assistance to be given in such cases, and they suggested that application might appropriately be made for assistance from the Colonial Development Fund.

400. Assistance might also in certain cases be desirable in order to provide facilities for the analysis of samples of local foodstuffs collected in the course of the surveys. It should be possible to carry out the simpler forms of chemical analysis in any well equipped laboratory. A certain amount of work would be involved, however, for which extra staff might be required. Further, biological analysis (vitamin estimation) is still a matter requiring considerable laboratory resources. Where biological analysis is necessary, samples may have to be sent to this country. The Sub-Committee hoped, however, that

it would in the course of time become possible for such analysis to be carried out in one principal laboratory within each main region of the Colonial Empire. Thus in Malaya ample facilities are already available. In East Africa a similar part might be played by the medical laboratory in Nairobi, while in the case of the more southern territories the Institute of Medical Research, Johannesburg might be invited to co-operate. In West Africa the necessary facilities could be made available at the laboratories of the Medical Department in Lagos or Accra. In the West Indies the work could perhaps be undertaken in Trinidad. Any work necessary in the Western Pacific might perhaps be done in Fiji itself or, failing that, assistance might be sought from laboratories in Australia.

401. The Sub-Committee suggested that the Colonial Development Fund might reasonably be asked to provide the funds which would be required to give effect to the proposals for dietary surveys in the field outlined above. The total sum involved would not be large. They recommended accordingly that the Secretary of State for the Colonies should arrange for an application to be submitted for assistance for these purposes from the Colonial Development Fund on the scale indicated.

402. These recommendations put forward by our Research Sub-Committee appeared to us to be well conceived and we accordingly submitted their report to the Economic Advisory Council for transmission to the Secretary of State for the Colonies. In accordance with the conclusions of their report the Colonial Development Advisory Committee recommended that a sum of £24,000 (which would, it is hoped, be increased if necessary) should be earmarked as a token figure from the Colonial Development Fund for the purpose of providing over the next five years assistance to Colonial Governments to enable them to carry out surveys on these lines. The Medical Research Council have also taken action on the lines suggested in the Sub-Committee's report, and have appointed a central staff to undertake the scientific co-ordination of nutrition surveys in colonial territories. Dr. B. S. Platt, M.B., Ch.B., M.Sc., Ph.D., who has had experience of nutritional survey work in China, has been appointed to be the senior member of the new organisation. In addition to the sum of £24,000 referred to above to be set aside from the Colonial Development Fund, the Fund will defray the cost of the travelling, subsistence and incidental expenses to be incurred by the staff for a period of five years.

403. With the assistance of the organisation thus created it is hoped to arrange for a series of surveys throughout the Colonial Empire. Proposals are in train for surveys in several territories, and the first survey is already in progress in Nyasaland. In view of the fact that it is the first of a series and that

the experience gained will largely determine the lines which future surveys should follow, special attention has been given to the organisation and co-ordination of the work. Dr. Platt himself will have spent the greater part of a year in Nyasaland. In addition to himself and his assistant the staff includes a nutritional investigator, an anthropologist provided through the assistance of the International Institute of African Languages and Cultures, a medical officer and an agricultural officer seconded from the service of the Nyasaland Government, and an economic botanist. Simultaneously a survey is being made of the fishery resources of Lake Nyasa and the other waters of the Protectorate by Miss C. K. Ricardo, D.Sc., with the assistance of Miss E. Trewavas whose services have been lent by the British Museum (Natural History). Miss Ricardo and Miss Trewavas will have the help of a local administrative officer. They are working in close touch with the nutritional survey party and are under the general guidance of Dr. Platt. Dr. Platt is also able to draw where necessary on the services of technical officers of the Nyasaland Government in such matters as land surveys and analysis of samples.

404. The investigation is divided into four sections as follows:—

(a) *An economic and agricultural survey.*—This study is most important and the fullest data should be obtained from it. The study includes matters relating to land utilisation (climate, soil composition, soil erosion, systems of cultivation employed, use of manures, irrigation, methods of harvesting and storing) and amounts of the various crops produced (per agricultural unit with information as to proportion of " cash " and " consumer " crops, and distribution in relation to consumer). Other resources are also being studied such as fisheries, livestock, etc. Data will also be obtained on the systems of land tenure, the organisation of labour and tribal customs in relation to agricultural and economic matters. Accurate botanical identification of foodstuffs is essential.

(b) *A dietary survey.*—The amounts of food eaten by the members of typical households in the areas selected will be measured. Arrangements have been made for the analysis of native foodstuffs of unknown composition. Observations are to be recorded on the methods of preparation of foodstuffs for consumption (methods of milling and grinding, amounts of and utilisation of waste products, recipes for " relishes " or " side-dishes," methods of cooking, etc.)

(c) *Physical and clinical survey.*—A physical and clinical examination is to be made of the natives living in the areas surveyed as in (*a*) and (*b*) above. Records will be made of simple physical measurements, of a clinical examination of a general

nature and of evidence of disease with special attention to defects of nutrition and to the sequelae of parasitic infestations. Vital statistics are to be collected in the selected areas and existing statistics examined. Particular consideration is being given to the diets of pregnant and lactating women and to the methods of feeding infants, weanlings and children. An investigation of the factors concerned in infant mortality is being carried out. Observations on native medical lore are also to be recorded.

(d) *Anthropological and social survey.*—A general study of the social and economic life of the native is to be made in the various areas selected. This will, in some of its aspects, be concerned with matters already mentioned in the preceding paragraphs. It will include a study of customs in relation to the production, preparation and eating of foods; land tenure, organisation of labour; distribution, sale and exchange; and incentives to work under modern conditions. Special attention will be paid to the effects on village life of emigration of adult males for labour outside the area.*

405. We look forward to the achievement of valuable results by means of the survey which as described above is being carried out in Nyasaland. In the course of his visit to East Africa, Dr. Platt has taken the opportunity of conferring with the other East African Governments and of discussing with them plans for the initiation of nutrition surveys in their territories. It is hoped that it will also be possible shortly to organise surveys in other parts of the Colonial Empire such as the West Indies and West Africa. There can be little doubt that the knowledge so gained will be of the greatest assistance in enabling Governments to formulate measures for the improvement of the nutrition and well-being of the peoples of the Colonial Empire.

406. We have emphasised in this section the need for the co-ordination of field research on nutritional matters and we have described proposals for surveys of a rather elaborate type carried out under the aegis of a central organisation. We are

* The statistical aspect of these surveys will clearly be one of much importance. One major point of method is worth mentioning here. When quantitative food data has been collected it is not uncommon to find that mean values are given for a group of individuals or for a mean daily intake of a single individual for whom values have been ascertained over a period of time. There are, however, certain disadvantages in the statement of data in this form. In the case of a group of persons there is a risk that considerable differences between individuals may be neglected. In the case of a single individual important seasonal fluctuations of intake may be obscured by this method of presentation. Where we have to deal with the varying individuals who compose family groups the criticism may be met to some extent by expressing the data in terms of " adult male units " using the table of co-efficients given in Chapter III, paragraph 18.

far, however, from wishing to suggest that no research work other than the surveys which this central organisation can superintend should be undertaken in the Colonial Empire. There are plenty of opportunities for work on particular problems which arise in individual territories, and it would be a great mistake not to make use for this purpose of the enthusiasm and experience of officers who are already available on the spot. The central organisation will mostly be concerned with the first of the three types of nutritional survey work which we set out in paragraph 380 above: that is with more or less elaborate field surveys. Besides this there is plenty of room for studies on the relation between diet and disease carried out where groups of people are provided with their food by Government or other responsible body, and for observations on specific deficiency disease conditions made by medical officers in the course of their day to day work. In carrying out such work we hope that the officers concerned will keep in touch with the central organisation whose advice will be available on any points of special difficulty.

407. When Governments or other authorities are entirely responsible for the feeding of a group of people a most valuable means is provided of testing out suggestions for dietary improvements, for control of the experiment is relatively easy. Control is less easy where only part of the food consumed is provided, as where children attending day schools are given supplementary meals; but even in such cases it is possible to obtain valuable data from observing, for instance, the results of specific additions to the diet. In fact, a good deal has already been done, not only by Governments but by other authorities and by private companies, such as mining companies, in observing the effect of particular diets on health.

408. Cost will be an important factor in all such diets, both because there is a limit to what the authority providing the food can afford and also because it is desirable that the meals so provided for the individual should be of a scale which he himself is able to copy in his own home. It is important, therefore, that the food should be of a kind which they themselves will be able to obtain in their own homes.

409. We think it would be well that all diets provided for bulk feeding should be reviewed at regular intervals with the object of providing, with foods which would be available to the people concerned in ordinary life, the maximum nutritive value at the minimum cost, and that the health authorities should as occasion arises vary diets, so as to test out under proper conditions of control the benefits derived from specific alterations in it.

410. The time should be past when deficiency diseases occur in public institutions. Unfortunately, however, they are not alto-

gether unknown, and in other cases the diets given at present are not sufficient for full health. For various reasons it may well be impossible to provide anything like an optimum diet—it may be too expensive, or the necessary foodstuffs may not be available, or in the case of prisoners the provision of a diet too much above that which they enjoy in their own homes might make imprisonment too attractive, and so forth—but there can be no excuse for the continuance of deficiency diseases, and if such are found to exist it follows automatically that the diet is in need of alteration.

CHAPTER XV.

THE NEED FOR CO-OPERATION BETWEEN GOVERNMENT DEPARTMENTS AND FOR THE INTERCHANGE OF INFORMATION.

411. Our discussion of the problem of nutrition, including both its influence upon the welfare of the people and the measures which are needed for its solution, will have shown how many-sided are the issues which it raises. Few other problems are indeed in our view more far-reaching in their repercussions upon almost every aspect of the life of the community. As a scientific problem it is true it has originated in the striking discoveries made by medical investigators in recent times. But when we attempt to measure its practical consequences and to devise remedies, it becomes evident that the solution is bound up with the much wider need for securing a general advance in the standard of living of Colonial peoples and for the spread of knowledge which will enable them to make the best use of their existing resources. Economic and educational progress of this kind cannot be achieved at a single stride. There are, it is true, individual measures which can and should be taken at once which will have a beneficial effect in certain directions; a number of these have been indicated earlier in this report. We look forward also to the achievement of valuable progress as a result of the nutrition surveys, the organization of which is described in the preceding chapter. But for a general and substantial improvement we must depend upon the steady and concerted efforts over a period of years of many government departments and voluntary agencies.

412. The primary responsibility necessarily rests with the Medical and Health Departments. It is by the Medical and Health Officers that the effects of dietary deficiencies will be most immediately observed and it is to them again that Governments naturally look for advice regarding the short-comings of the existing dietary and the directions in which improvement is necessary. Moreover as primarily responsible for the maternity and infant welfare services, they are entrusted with a task of vital importance in the supervision of the diet of nursing mothers and infants.

413. But to make good defects of nutrition it is evident that the activities of other departments must be brought into play. In the predominantly rural conditions of the Colonial Empire it is primarily through the efforts of the Agricultural Departments working in conjunction with the Veterinary Departments that

changes and adjustments in the consumption of foodstuffs must be made.

414. At the same time, as we have endeavoured to show, defects in the composition of the dietary are due in no small part to a general lack of knowledge on the part of the people regarding their dietary needs and the best way of meeting them. Much can be done, therefore, by the Department of Education in contributing to an improvement in nutritional conditions. Apart from direct measures such as the provision of milk and meals for school children, there are, as we have seen, three principal directions in which the educational authorities may bring their influence to bear. They will be responsible in the first place for raising the general level of the intelligence of the people so that the work of the Health and Agricultural Departments may be understood, appreciated, and intelligently applied. Secondly they should see that elementary instruction is given in the schools in the essentials of agriculture, food production and supply, domestic science, personal hygiene, and child welfare. Finally they should take a direct part, working in co-operation with the Agricultural, the Veterinary and the Health Departments under the general supervision of the Administration, in an endeavour to educate the adult mass of the people in the principles of better nutrition.

415. The efforts of the more specialized departments are unlikely to achieve their full effect, unless they receive the support and co-operation of the Administrative Service. It is of the highest importance that Administrative Officers should be alive to the importance of the question of nutrition and should be on the watch for opportunities of promoting better conditions. The central organs of Government also have a large part to play. It is they who finally determine agricultural and health and education policy and allocate funds between the departments. It is for them also to bear in mind the nutritional factor in arriving at decisions on tariff policy.

416. It is not enough, however, to emphasize the individual responsibilities of the various Government Departments. Of equal importance is the need for securing co-ordination between their activities. Each Government must undertake the task of maintaining the balance between progress in all departments. Such a balance implies that the work of one department should not lag behind that of the rest. The efforts of the educational authorities cannot be effective if the children in the schools are weakened and their attention blunted by the effects of malnutrition and disease. Medical services must inevitably be hampered in their task of raising the standard of health if the people undergo privation and hardship because their cattle die through lack of pasture and because the fertility of the soil is impaired through primitive and faulty methods of agriculture. Yet

neither the Health nor the Agricultural Department can make headway if the people are too ignorant or indifferent to be able to understand the importance of sound methods of agriculture, of greater cleanliness and of better housing. The problem therefore is in a sense a vicious circle which can only be broken by the united efforts of every department of government.

417. It was with the object of securing co-ordination of this kind that the Secretary of State in the circular despatch which he addressed to Colonial Governments in April, 1936, suggested that in each territory there should be established a nutrition committee composed of representatives of each of the departments concerned. In most territories a committee of this kind has now been constituted. In certain instances, however, the need has been sufficiently met by an extension of the functions of an existing body, e.g. in Nyasaland the Native Welfare Committee, in Uganda the Agricultural Survey Committee. These local nutrition committees should be capable of exercising an important influence upon the success of Governments in dealing with this problem. In most cases they have already discharged a useful task by the preparation of the surveys of the present position which are summarized in Part II of this report. We hope that every effort will be made to ensure that they continue as active bodies and that full use is made of their services. We are strongly of the opinion that the co-ordination of the services on which an effective nutrition policy depends can only be secured if there exists some such body functioning as a permanent and essential part of the administration of every territory, even the smallest. Indeed we feel that the advantages of a central co-ordinating committee of this nature will not be confined to nutrition but will apply equally to other welfare activities.

418. We consider also that there may often be room for similar co-ordinating Welfare Committees in each province, district, or town, and even in each village. As we have emphasised in paragraph 338 above local Welfare Committees may do a great deal of most valuable work. A further means which may be adopted to secure that attention is adequately focused on the many different aspects of the nutrition problem is that in each territory a single officer (not necessarily a whole-time officer) should be entrusted with the responsibility for keeping his government informed in regard to developments in this field. Our Research Sub-Committee put forward a proposal on these lines to which we have already referred in the previous chapter.

419. In addition to co-operation within the limits of each territory there is also much to be gained from interchange of information within a wider sphere. The conditions of life in the Colonial Empire differ so greatly from territory to territory that a close parallelism in the problems which arise is not to be

expected except perhaps in the case of neighbouring territories. Nevertheless nothing but good can come from a wide dissemination throughout the Colonial Empire of all the knowledge and experience available on this subject from whatever quarter. It is with this object that we have arranged for the preparation of the comprehensive summary of information which appears as Part II of our report. But we wish to emphasize in addition the importance of exploiting fully all the existing channels for the dissemination and interchange of information. In the sphere of international co-operation the Health Organisation of the League of Nations is doing most valuable work in promoting the investigation of the problem of nutrition. On the more purely scientific side also valuable assistance can be given to scientific workers by organisations which help to keep them informed of the progress of research throughout the world. For this reason we attach great importance to the building-up of an adequate system for giving publicity to the results of research, including both information of a more technical kind, such as is furnished through the medium of abstracting journals, and also broader statements of the facts of nutrition addressed to wider audiences. We consider that an important contribution to such a system is provided by the work of collecting and disseminating information, more particularly amongst scientific workers, at present carried on by organisations such as the Bureau of Hygiene and Tropical Diseases and the Imperial Bureau of Animal Nutrition, Aberdeen. We may mention the valuable series of technical communications issued by the Imperial Bureau, and also the extremely important publication "Nutrition Abstracts and Reviews," issued in co-operation with the Reid Library and the Medical Research Council. We hope that the Executive Council of the Imperial Agricultural Bureaux will be prepared to continue and expand the existing functions of the Imperial Bureau of Animal Nutrition in this direction.

420. Finally we may add a word as to the future. It is only comparatively recently that governments have begun to appreciate the full importance of the nutrition problem. The last few years however have been years of great activity, and the place of nutrition as one of the main factors affecting health and well-being has been increasingly recognised. We hope that this activity will be continued and that the question of nutrition will not be allowed, for any reason, to fall into the background. We are convinced that as time passes its importance will become more and more evident as the progress of science reveals new directions in which hitherto unsuspected consequences of dietary errors are traceable. The great need is that the growth of such knowledge should be reflected in Government policy, particularly in regard to agriculture. With the new measures which are now being taken to stimulate investigation of every aspect of the problem, we hope and believe that this will prove to be the case.

CHAPTER XVI.

SUMMARY OF CONCLUSIONS.

421. We summarise our principal conclusions as follows:—

IMPORTANCE OF THE PROBLEM.

1. The material we have had to handle is extraordinarily diverse covering forty-eight different territories with a population of rather over fifty-five millions, divided into countless groups having the most different food habits and customs that it is possible to imagine. It is because of this diversity that much remains to be added to our knowledge before we can lay claim to a complete understanding of the problem. At the same time the variety of the material before us adds to the opportunities for a scientific study of the inter-play of race and environment. The science of nutrition is still young and little is known of conditions in tropical countries. Of one conclusion, however, we have no doubt and that is the great importance of the subject. We are confident that improved nutrition will bring very great benefit to the Colonial Empire. At the present time the effects of malnutrition are seen not only in definite disease but also in general ill health and lowered resistance to infection, inefficiency of labour in industry and agriculture, maternal and infantile mortality and a general lack of well being. In particular there can be no reasonable doubt that wrong feeding is one of the principal causes of the very high infantile mortality which prevails in most colonial territories. (Paragraphs 1-11.)

2. One of the most striking features of our inquiry has been the almost complete absence of milk and indeed of all animal products from most tropical diets. (Paragraphs 12 and 13.)

3. Throughout the greater part of the Colonial Empire the fundamental cause of malnutrition is the low standard of living of many of its inhabitants. Ignorance is a very important factor also. (Paragraph 14.)

PRINCIPLES OF CORRECT NUTRITION.

Food requirements of the body.

4. In order to maintain a state of good nutrition the food supply must be adequate both in quantity and quality. Diet must be sufficient in amount to satisfy the energy demands of

the body, assessed in Calories. These are in the main dictated by the type and amount of muscular work carried out and by other factors such as the age, sex and size of the individual. Climate does not apparently exert any very marked influence. In addition to energy-yielding foodstuffs there is a further class of foodstuffs containing materials which though yielding no energy are essential for all metabolic processes, namely water, mineral salts and vitamins. (Paragraphs 15-19.)

5. The protein component of the diet holds a unique position as the sole source of the essential nitrogen, and it may be said that Calories derived from protein should form some ten per cent. of the total calories ingested. The protein needs of the growing organism per kilo body weight are greater than those of the adult. Certain proteins referred to as first class proteins, and derived in the main from animal sources, are of special value. A mixture of proteins enhances their biological value through the supplementary action which takes place. It may be taken as a guiding principle that especially in the diet of the young there should if possible be included a certain proportion of protein of animal origin, such as that contained in milk. (Paragraphs 20-23.)

6. Fat is a valuable store of energy, though that energy is not so readily available as that derived from carbohydrates. It is usually assumed that the amount of fat required in the tropics is smaller than in temperate countries. Fat also contains certain indispensable vitamins, in particular vitamins A and D. (Paragraph 24.)

7. Carbohydrates, or starchy foods, are abundant and cheap sources of energy. (Paragraph 25.)

8. Of non-energy yielding substances a plentiful supply of water is essential, as about seventy per cent. of the body weight is water. The various mineral salts play an equally essential role as they participate in probably all the tissue activities. Some five or six vitamins have been definitely identified, and these play an essential, but as yet not definitely determined, role in the normal metabolic processes. Vitamin A is important for health and growth and apparently for the normal functioning of the epithelial cells. Vitamin B1 is the anti-neuritic or anti-beriberi vitamin. The vitamin B2 complex includes the anti-pellagra or P-P. vitamin. Vitamin C is the vitamin the lack of which is the causal factor in scurvy. Vitamin D (which may be a complex) is intimately related to the utilisation of calcium and phosphorus in the body and hence to the disease rickets. Vitamin E seems to play some part in the control of the reproductive processes. (Paragraphs 26-35.)

The Special Requirements of Certain Classes.

9. At certain periods of life—during pregnancy, lactation, infancy and childhood—an extra physiological strain is imposed upon the body and certain additions to or departures from the normal diet are needed. Under average conditions it is the mother rather than the foetus which suffers during pregnancy in the event of dietary insufficiency. The chief additional needs during pregnancy are for minerals and vitamins which should be supplied by giving as much as possible of the protective foods such as milk, green leafy vegetables, fresh fruit, potatoes if available, beans and bean products, etc. The demands made during lactation are much greater and an increased supply of protein is required as part of a good mixed diet rich in vitamins and minerals. (Paragraphs 36-42.)

10. Complete breast feeding of the infant is of very great importance and while the baby is so fed the need for supplementary dietetic substances is largely diminished. Certain additions may nevertheless be desirable. In the absence of breast feeding artificial feeding for the infant must be carefully thought out and in such cases the inclusion of the different specific protective substances becomes of much greater importance. (Paragraphs 43-45.)

11. The nutritionally important period does not end when the child ceases to be an infant. The next few years also are of great importance. The child is more liable to attacks of infective and possibly debilitating disease and it is therefore highly important that the diet should be both quantatively and qualitatively adequate.

Other Factors affecting Correct Nutrition.

12. Many factors affect the relationship between the food and health. For example the chemical composition of a foodstuff as actually consumed is by no means constant but depends upon the soil in which it is grown, the methods adopted for manuring, harvesting and storing, for marketing, processing and cooking. The power of the individual to benefit from the food he eats is affected by many factors such as the mental state and by environmental conditions, such as faulty hygiene, high humidity, overcrowding, noise and vermin. Pathological conditions may also interfere with the absorption and utilisation of the food consumed. (Paragraphs 46-49.)

13. Nutritional requirements may, it seems, vary somewhat in accordance with race and climate. Other factors which must be studied in assessing the value of a diet are the interaction of various foodstuffs upon one another and the possible action of toxic substances in food. An important but often overlooked criterion for the drawing-up of dietaries is that the food

prescribed, its cooking and its serving should conform so far as possible to the dietary habits of those to be fed. (Paragraphs 50-54.)

GENERAL CHARACTER OF COLONIAL DIETARIES.

14. The dietaries in colonial territories are, with some exceptions, predominantly vegetarian, and relatively small quantities of animal products are consumed. Judged by western standards, an unusually high proportion of the energy value of the diet is derived from carbohydrates. The amount of fat in the diets is usually low. (Paragraphs 55-59.)

15. One of the most striking facts which emerges from our survey is the extent to which colonial peoples are dependent on a single crop for their main supply of food. With few exceptions, almost no milk is consumed, or the amounts are so low as to be of little account from the nutritional standpoint. Fish is perhaps the one animal food which is, or could be, most often included in colonial diets. (Paragraphs 60-62.)

16. As a result of the absence of animal products colonial diets are low in proteins derived from animal sources. There is also general deficiency of fat, and of green leafy vegetables, and fruits. Calcium and phosphorus are also deficient in some colonial diets, and the intake of iron and sodium is inadequate. In many territories there is at present a scarcity of water supplies. The general character of colonial diets suggests that there are deficiencies of the various vitamins. (Paragraphs 63-71.)

17. To sum up, few of the constituents considered necessary in Europe for a nutritionally adequate diet are generally available in sufficient quantities in the Colonial Empire. Diets are frequently insufficient in quantity and still more frequently insufficient in quality. Judged by European standards they lack variety and protective value. (Paragraphs 72-73.)

EFFECTS OF MALNUTRITION IN THE COLONIAL EMPIRE.

18. Food deficiencies may cause well-recognised deficiency diseases, and lead also to general ill-health, lowered resistance, and impaired efficiency and well-being. Amongst definite deficiency diseases those caused by lack of vitamin A are perhaps the most common in the Colonial Empire, and there are reports from a wide selection of territories of affections of the eye, changes in the skin, and other symptoms which may be attributed to a deficiency of this vitamin. Beri-beri, known to be caused by a deficiency of vitamin B1, occurs with frequency in rice-eating countries and is found in various parts of the Colonial Empire. Cases of some degree of deficiency of this

vitamin are probably widely prevalent where the full disease has not been recognised. Pellagra, due to the absence of another member of the B group of vitamins, is reported fairly frequently. Scurvy, caused by absence of vitamin C, is reported only very occasionally in its classical form, chiefly from those few territories in which there is a recurring famine period. Diseases due to the absence of vitamin D are not very often reported. There are reports of the absence of proper bone formation which point to inadequate supplies of calcium and phosphorus. (Paragraphs 74-83.)

19. Apart from these well-recognised disorders there are reports of a number of diseases which are possibly of dietetic origin, but which have not yet been positively identified. These include chalchaleh in Somaliland, chiufa and onyalai in Northern Rhodesia, decoque in the Seychelles, kwashiokor in the Gold Coast and burning feet and butterfly wing in British Honduras. (Paragraph 84.)

20. There is now a general consensus of belief that there exist with great frequency, especially in the tropics, deficiency states which while not resulting in manifest disease prevent the full enjoyment of health. These states, although less obvious, are more insidious than the clearly-defined deficiency diseases and are a much more important factor in the lives of the people. Moreover, the prevalence of malnutrition aggravates many other diseases. This is particularly the case with ulcers and a number of skin affections, leprosy, tuberculosis and malaria. (Paragraphs 85-87.)

21. We do not doubt that if it were possible (as unfortunately it is not) to remove at one stroke all traces of malnutrition in the Colonial Empire there would be an immense gain in physical health, in mental alertness, and in material welfare. Money spent on improved nutrition should be a sound investment, yielding its dividend in the increased welfare of the community as a whole. (Paragraphs 88 and 89.)

THE GENERAL CHARACTER OF THE PROBLEM.

22. The main causes of malnutrition in the Colonial Empire are, in our view: first, that the standard of living is often too low; secondly, that there exists great ignorance coupled with prejudice both with regard to diet itself and to the use of land. We should add also, as a third main cause, the influence of other diseases which react upon the state of nutrition of the individual. This is particularly true of the various types of parasitic infestations which are widespread amongst the inhabitants of tropical countries. (Paragraphs 90-92.)

23. We have no hesitation in saying that in general the fundamental cause of malnutrition is the low standard of living. In almost every part of the Colonial Empire the income of a very

large proportion of the population is a long way below the minimum required for satisfactory nutrition. Money plays a comparatively small part in the economy of many of the Colonial Dependencies and the measurement of incomes is difficult. In general it is the income of the community as a whole that is too low, and not merely that of the less favoured classes. The resources available are too scanty to provide optimum nourishment and at the same time to supply other essential needs as well as all the services of local authorities and the central Government. (Paragraphs 93-100.)

24. Improved nutrition is largely dependent upon economic development, and this, in the Colonial Empire, means primarily an improvement in agricultural production. The Colonial Empire is at present predominantly rural, and the bulk of the foodstuffs consumed are produced within the territory of consumption. But while the main problem is that of rural communities, the problem of the town dweller where it arises is even more acute. Another factor which is of great importance nutritionally in some dependencies is the rapid increase in population that is at present occurring. (Paragraphs 101-110.)

AGRICULTURE AND NUTRITION: GENERAL CONSIDERATIONS.

25. In framing agricultural policy the nutritional needs of the community are of the first importance. It is for the health authorities to say what are the main deficiencies of the diet of a particular territory, and for the agricultural authorities to consider how those deficiencies may best be met. Close co-operation between the two Departments is therefore necessary. Naturally the nutritional factor cannot alone determine agricultural policy. The aim should be the establishment of a balanced agriculture for the production of commodities to be used either for direct consumption by the producer and his family or for sale for consumption elsewhere in the territory or for sale in overseas markets. As regards commodities produced for export, it appears that the colonial producer must continue to expect to see wide variation in his income from money crops. Family production of food to meet family needs is a great safeguard against some of the worst social and economic effects of fluctuations in the income from money crops. This applies especially to the protective foods, which are usually more expensive to buy and hence less attractive than others of less nutritive value, especially where the wages of the purchaser are low in relation to his nutritional needs. (Paragraphs 111-120.)

26. Colonial Governments should endeavour to ensure that as many people as possible should grow a part at least of the foodstuffs that they consume. Where a labourer for wages is

more or less permanently employed on an estate as in the West Indies, Mauritius, parts of East Africa and Malaya, the estate owner should normally provide him with land for a garden and perhaps even require him to make full use of it and in appropriate cases permit or even require the maintenance of animals, and the production of meat or milk products. In some territories it may be necessary to require by law that a certain proportion of estates should be given over to the production of foodstuffs either by the estates themselves or by co-operation with resident labourers. Satisfactory fences should be provided for food gardens and allotments, wherever the prevalence of predial larceny causes difficulties. Where there is a landless class Colonial Governments should do all they can to provide such persons with, at any rate, some land. (Paragraph 121.)

27. The growth of crops of nutritive value, such as fruit, may be hampered by the fact that the local system of land tenure is such that the individual has no inducement to plant crops of a permanent nature. Another factor which sometimes prevents the increased growth of food crops is the prevalence of predial larceny. (Paragraphs 122-124.)

28. In many parts of the Colonial Empire the seasonal fluctuation of diet is a factor of importance, and various remedial measures such as the encouragement of the drying of green foods, the development of better storage facilities and of early maturing or drought resistant varieties of the normal staple, or the planting of special famine reserve crops, may all be of value. It may thus be possible to guard against a pre-harvest shortage of the staple foodstuffs or a shortage of the important protective foods in a fresh state just before the rains begin. (Paragraphs 125-126.)

29. A valuable increase in foodstuffs may be obtained by improving the yield per acre from crops both by the use of better seed and of better methods of husbandry, combined with organic manures or composts. (Paragraphs 127-130.)

THE DESIRABLE ADDITIONS TO COLONIAL DIETS.

New crops.

30. A good working rule for the improvement of colonial dietaries would be to endeavour to increase the quantity of foodstuffs consumed by increasing the variety. The energy yield per acre of different crops is also a factor of great importance. Diversity may be secured by the introduction of additional staple food crops or by the addition of various extras. The supplementary action of different elements of the diet in combination with one another is a consideration to which weight should be given. From the point of view of nutrition, a combination of cereals and legumes is strongly to be recommended.

Amongst legumes, the soya bean and the ground-nut may be mentioned as being worthy of special consideration. Of the extras green leafy vegetables as a source of calcium have a special importance to colonial nutrition. They are, however, liable to lose their food value owing to their perishable nature. Fruits are in many instances of outstanding importance as sources of vitamin C and contain in addition mineral salts and the precursors of vitamin A. Edible fungi and sea-weeds are valuable for their mineral content, and oil seeds of all kinds have an important bearing on the supply of fats. In particular, red palm oil is of outstanding value, provided that its nutritive qualities are not destroyed by bleaching. (Paragraphs 131-152.)

Animal Husbandry.

31. Wherever practicable, great nutritional value may be derived from increasing the consumption of animal products and this will also assist in the maintenance of soil fertility. In many cases it may be easier to provide good class proteins from vegetable rather than from animal sources, but, subject to considerations of cost, increased consumption of animal products is desirable in almost every part of the Colonial Empire. Not only cattle but also tethered milch goats, poultry and sometimes buffaloes, sheep and pigs may be most valuable sources of animal protein. (Paragraphs 153-163.)

Milk and milk products.

32. Fresh whole milk, besides being the most valuable of all foods, may also, unfortunately, be one of the most dangerous, particularly in the conditions of primitive communities. In these circumstances condensed or dried milk of a good market quality, protected from contamination in use, may be preferable if not too expensive. It is possible that local supplies might be preserved by some form of heat treatment. Milk may be turned into butter or ghee, but this process is wasteful unless the valuable skimmed milk which remains is also used. There is room for development in the use of curds in the Colonial Empire. They are less liable to contamination than fresh milk. Cheese and whey are also of great value. Attention should be directed towards the production of those milk products which are suited to the tastes and requirements of the people, and the conditions under which they live. (Paragraphs 164-173.)

33. Wherever possible Colonial Governments should remove all import duties on milk and milk products. Even if admitted duty free, however, milk and milk products may still be too expensive to provide a solution of the problem. Of all the forms of manufactured milk, dried skimmed milk will yield for a given expenditure by far the largest quantity of all the valuable constituents of milk, except fat and its attendant vitamins. It is especially suitable for bulk use, and valuable results

would be obtained by its increased use—e.g. for distribution to schoolchildren. (Paragraphs 174-179.)

Fish.

34. Fish is a most valuable foodstuff, and we regard it as most important that the supplies of fish in and around colonial waters should be developed to the maximum possible extent. We believe that much useful work might be done by some central organization to advise and assist colonial governments on these matters. (Paragraphs 180-183.)

Concentrated foodstuffs.

35. Circumstances may arise in which certain groups, such as school children, hospital patients, or labourers, may benefit from the distribution of highly protective foods in pure and concentrated form, provided that these can be obtained cheaply in large quantities. The use of local "beers" by colonial peoples in moderation undoubtedly has benefits from the nutritional point of view. Vitamin deficiencies might perhaps be avoided in certain territories by the local production of fish liver oil. Mineral elements may also be supplied sometimes in concentrated form. In some territories steps might be taken to ensure that salt imported should contain a minimum percentage of calcium or iodine. (Paragraphs 184-189.)

HARVESTING, PRESERVATION, STORAGE, PROCESSING AND COOKING OF FOODS.

Harvesting.

36. The chemical composition of any crop is obviously very different at early stages of growth and at maturity. Changes also take place during the period of actual ripening. The treatment of the crop in the field may affect nutritive value considerably, especially as regards vitamins, and vitamin C in particular. Perishable vegetables should be consumed, stored or preserved as soon as possible after collection as they quickly lose much of their nutritive value. Similar considerations apply to animal products. Fish in particular is extremely perishable. (Paragraphs 190-193.)

Preservation and storage.

37. Where food is preserved it is important that a method should be adopted which will involve a minimum loss of nutritive value. Steps should be taken to collect information regarding existing practices adopted in the Colonial Empire for the processing and storing of food and the points on which it is felt locally that there is room for improvement. The information thus obtained should be collated for general circulation. A

large number of methods of preservation and storage are available. Of these drying is one of the most common and need not affect the nutritive value of a foodstuff except in regard to vitamin content. It may, however, affect the time required for cooking. Grain stored in this way must be kept as free as possible from attack by insects and vermin, which at present cause very considerable loss of stored foods in the Colonial Empire. Wherever possible stored products, whether dried or otherwise, should be kept in air-tight containers. Drying may be accompanied by chemical treatment which improves the appearance and keeping qualities of the foodstuff and conserves its nutritive value. Brining is a useful method of preserving fish, meat, and leaves and roots of vegetables. Smoking is a method particularly applicable to fish. The use of acids in souring products and thereby preserving them is of considerable importance. Two other preservatives in general use are saltpetre and sugar. In many parts of the Colonial Empire there are now cool stores in important towns, but for a long time to come they can only have a very limited effect upon the foodstuffs consumed by the poorer classes. Canning is at present employed in the Colonial Empire chiefly in production for export, but a beginning has been made in some parts in canning for local consumption. For a number of reasons, however, canned foodstuffs will never play as important a part in the economy of the Colonial Empire as in some of the western countries. (Paragraphs 194-221.)

38. The available evidence suggests that modern methods of storing foods cause little depreciation in their nutritive value. In fact food of good initial quality that has been stored by the best modern methods is likely to be superior in many respects to similar food which though nominally fresh is in reality stale. (Paragraphs 222 and 223.)

Processing.

39. The processing of foodstuffs may be of great nutritional significance. Methods of processing rice are, for example, of great importance and should receive the careful attention of the authorities in those territories where rice is the staple diet. We have attached as Appendix 6 a valuable memorandum by Dr. Platt on this subject. A high degree of milling also reduces the nutritive value of other grains such as wheat, and in several other cases the normal commercial processes destroy a substantial part of the nutritive value of the article. Processing of foodstuffs may on the other hand give rise to by-products which are of nutritive value such as rice-bran, skimmed milk and the livers of certain fish. Many forms of handling such as grinding, chopping and mincing, add to the value of the product. In some cases, however, methods of preservation,

storage and processing may involve danger of poisoning. (Paragraphs 223-232.)

Cooking.

40. The loss of nutritive factors which takes place in cooking may be important and care is needed in the choice of suitable methods. Due attention, however, must be paid to local preferences for certain flavours and to the methods of cooking adopted to obtain them. In the education of women no subject is likely to be of greater interest or value than a study of cooking methods. (Paragraphs 233-242.)

THE PURCHASE OF FOODSTUFFS.

41. In some territories internal trade, principally in foodstuffs, is important. Its growth will help to diversify the diets of those who live mainly on the foodstuffs which they themselves produce. The development of the internal market will be stimulated by the provision of simple but adequate communications. In those dependencies which rely on the efforts of small producers, there may be need for Government assistance in other directions, such as the establishment of marketing centres and the provision of storage facilities, including warehouses at market centres, cool chambers for the storage of fish and meat, and refrigerated vans on railways. Such measures will be immediately beneficial to Colonial standards of nutrition and will ultimately have far reaching effects upon productivity and the character of the economic organisation. (Paragraphs 243-253.)

42. As regards imports the cardinal consideration must be that the greatest possible quantity of nutritive foodstuffs should be available at the cheapest possible price, though there may be cases in which this principle requires qualification. Imports of nutritive foodstuffs, other than luxuries, should be duty free, unless there is some very good social or economic reason to the contrary. Colonial governments should review their tariffs from this point of view. It may often be that the guarantee of a stable price would be sufficient to induce the growing of a foodstuff which is not grown at present. The number of cases in which the local producer will be assisted by a duty on the marketed article is, we think, considerably smaller than is sometimes supposed. (Paragraphs 254-259.)

THE NUTRITION OF PAID LABOURERS.

43. There is, unfortunately, abundant evidence that in some occupations where it is not customary to provide the employee and his family with food, the wages earned are not sufficient to provide adequate nutrition. To some extent the situation may

be eased by the fact that the wage earner in rural areas grows some of his food himself, and any precise calculation is very difficult. Increased wages may well be justifiable as a purely economic proposition on the ground that they will lead to a more than proportionate increase in efficiency. In some cases, however, an increase in wage rates may not lead to an increase in total earnings. (Paragraphs 260-263.)

44. The importance of the diet of the labourer is now much more generally realised both by governments and by private employers, at any rate in those territories where the labour contract stipulates that the employer should provide food in addition to wages. This is normally the case in East and Central Africa, in the Katanga and on the Rand, where many East Africans are employed. Instances may be quoted of the benefits to health and efficiency of improved dietary scales for labourers. We regard it as almost certain that in Africa, any money spent on bringing the food consumed by the labourer up to an adequate well-balanced ration will be money well spent from the immediate point of view of the employer. There is considerable room for further action both by governments and by employers in this direction. Governments themselves should lead the way and existing legislation should be strengthened. Employers should be required to work out a schedule of diet in consultation with the local health authorities and for their approval. Typical dietaries adequate for proper nutrition should be worked out by the central authorities of each territory for general guidance. Where food is provided by the employer, the clear balance of advantage lies with the giving of food ready cooked. (Paragraphs 264-281.)

45. In areas where the labourer is expected to find his own food, there is still a great deal that the employer can and should do in his own interests to see that the labourers in fact obtain food which is adequate to maintain them in full health and efficiency. Where conditions appear favourable, as, for example, in parts of West Africa, we hope that consideration will be given to the possibility of extending the custom whereby labourers are provided with food by their employers. Assistance may, however, be given in other ways as, for example, by enabling labourers to have their own gardens, or by the provision, either free or at reduced rates, of food of special nutritive value such as meat and fresh vegetables, even where the employer does not undertake to feed his labourers entirely. (Paragraphs 282-293.)

46. Employers may often do most valuable work both for themselves and for the community at small cost by organising maternity and infant welfare work and other such work among the families of their employees. (Paragraphs 294 and 295.)

THE FACTOR OF IGNORANCE AND THE NEED FOR EDUCATION AND PROPAGANDA.

Introductory.

47. The study of nutrition is such a new science that its conclusions may not always be generally understood amongst those who have an influence on the nutrition of others, such as government officials, members of legislative councils, employers of labour, education authorities and missionaries. Even at the present economic level steps could be taken which would have the effect of improving the standard of nutrition in colonial territories. Some instruction in human nutrition, particularly in the practical application of scientific knowledge in colonial conditions, should be given not only to medical and health officers but also to administrative cadets during their courses at Oxford and Cambridge; to agricultural and veterinary officers during their courses at Cambridge, and the Imperial College of Tropical Agriculture, Trinidad; and to all education officers and teachers in both Government and Mission schools, who attend courses at the Institute of Education or elsewhere. Colonial Governments should also consider ways and means of giving instruction on the subject to staff recruited locally for the Administrative, Health, Education, Agricultural and Veterinary Services. (Paragraphs 296-301.)

48. Instruction in the principles of nutrition will have to overcome innate conservatism, prejudice, religious scruples and taboos. It will in part be dependent on the progress of general education in the Colonial Empire. A highly important role may be played by women in removing ignorance on this subject. In some parts of Africa, according to tribal custom, it is often the women who decide what food crops to grow, who actually grow them, who reap them, store them, cook them and serve them. As a first step, therefore, increased attention should be given to the education of women in these matters, and greater use might be made of women as government welfare agents, such as school mistresses, health workers, midwives, etc. (Paragraphs 302-306.)

Welfare propaganda.

49. Education is required, not only amongst the younger generation but also amongst adults, in the principles of nutrition. The people who must be reached by propaganda will be largely illiterate, and a special technique will be required, calling for understanding, imagination and ingenuity. Various means of propaganda are available. The greater the degree of illiteracy the greater the prestige of the written word, and circulars may

hence prove valuable amongst the illiterate. Reading circles also may usefully be formed with encouragement from the administrative authorities. Amongst the literate, leaflets in the local vernacular might be issued, setting out in simple and non-technical language specimen diets suited to the local conditions. The Press may also exercise a powerful influence, and the publication by the Agricultural and Health departments of regular bulletins for the information of the public has proved a valuable practice in some dependencies. ..An idea which may be worthy of consideration is the forming, under government auspices, of lending libraries of vernacular literature. Suggestions have been made for the preparation of cookery books applicable to local conditions. Direct instruction in regular adult classes may in some territories be a useful form of propaganda, especially if coupled with the use of wireless, the cinema, the magic lantern, or the gramophone. The value of posters for propaganda purposes among the more primitive of colonial peoples is doubtful, and there are various factors which at present limit the extent to which the wireless can be used for welfare purposes among Colonial peoples. In urban areas broadcasting by landlines may have possibilities. Travelling health vans equipped with portable cinema apparatus have proved most useful in various parts of the Colonial Empire. Colonial Governments should consider assisting selected officials who show keenness for the work to obtain portable cinematograph cameras and to receive training in their use. The magic lantern may be of great value. It is cheaper than cinema apparatus and requires less technical knowledge; moreover, the pictures can be accompanied by explanation from a demonstrator. The gramophone with loud speaker also has its advantages. The Colonial Office should obtain information for distribution to Colonial Governments regarding the most suitable type of machine for the making of gramophone records to be used for propaganda purposes. Models, demonstration plots and farms, agricultural stations and stock farms, and shows of all kinds (health weeks and agricultural shows) including competitions with prizes, may all be found valuable means of spreading a knowledge of the principles of nutrition. (Paragraphs 307-336.)

50. An important agency in securing social betterment may be found in village welfare committees which already exist in several territories. Other local organizations may also be used with profit, and the co-operation of missionary societies would naturally be sought. Local officials have an important part to play, and we regard it as of the greatest importance that as many school teachers as possible should be trained in domestic science and agricultural subjects, and that such subjects should normally form part of the curriculum in the schools themselves. Health visitors are of great service in decreasing infant and maternal mortality, and in improving the nutrition of children generally.

Valuable welfare work may also be done by travelling propaganda units and it is to be hoped that the number of such units may be increased. In general, welfare propaganda will be more effective if a number of departments concentrate their activities upon the same district. Examples of schemes involving action on these lines can be found in various parts of the Colonial Empire, and other governments might find these examples worthy of imitation. Governments should do their best to interest prominent local residents, and perhaps particularly the wives of officials, in local welfare work, especially amongst women. A number of co-operative societies exist in the Colonial Empire but there is room for a far wider use of them. (Paragraphs 337-348.)

51. A number of general principles emerge from our survey of the means and agents of welfare propaganda which should, we suggest, be taken into account by anyone whose duty it is to plan such propaganda. (Paragraph 349.)

The education of the young.

52. We attach the greatest importance to the teaching of agriculture to pupils in rural areas. The school garden or farm is a necessity to rural education. An alternative is the " home garden " or " project system " whereby the parents of the children are induced to give them a set portion of the family land to cultivate, under the supervision of their teacher. Similarly all children, whether in town or country, should be taught the elements of hygiene, and for girls the teaching of domestic science should be one of the most important parts of the curriculum. For all these purposes the first requisite is better training of teachers in agriculture, health, and domestic science. Colonial Governments and all missionary bodies engaged in education should make it their policy to see that teachers appointed for work in rural areas should have some knowledge of local agriculture, elementary hygiene, and " home building " and that women teachers both in rural areas and elsewhere should be qualified to teach domestic science of a kind applicable to local conditions. It may be necessary to appoint persons specially to undertake the training of teachers in domestic science and health work. (Paragraphs 350-359.)

Meals for school children.

53. Schemes have been instituted in some territories for the provision of meals to school children. A limiting factor is, of course, the cost involved, but we commend these examples to colonial governments for imitation wherever possible. (Paragraphs 360-362.)

PRE-NATAL SERVICES AND INFANT WELFARE WORK.

54. Pregnancy and lactation, infancy and childhood are from a nutritional point of view, of outstanding importance. Malnutrition, mainly resulting from unsuitable feeding, seems to be undoubtedly one of the most important factors in causing high infant mortality in tropical countries, which at present exceeds 200 per 1,000 live births in many parts of the Colonial Empire, and sometimes even exceeds 300 per 1,000. Excellent work is already being done, but we think that colonial governments would find that on any long view increased attention to infant welfare work was one of the most productive forms of expenditure. The assistance of voluntary workers should be invoked wherever possible, and estates or mines should be encouraged to provide infant welfare facilities in those countries where it is customary for the labourer to be accompanied by his family. The first lesson which must be taught is the importance of breast feeding without the addition of other unsuitable food, and instruction in infant welfare should include instruction to mothers as to their own diet during lactation. It is important that instruction should also be given in the proper dietary of children after they are weaned. Ante-natal and infant welfare clinics, health visitors and propaganda on the lines discussed in Conclusions 44-49 above should all play their part. (Paragraphs 363-371.)

55. A very important cause of malnutrition in the West Indies, in some African towns, and in one or two other parts of the Colonial Empire, is the absence in the parents of a sense of responsibility for the welfare of their children. In the West Indies, for instance, a large proportion of the children are the result of casual unions, and this state of affairs constitutes a social problem of the first magnitude. (Paragraphs 372 and 373.)

56. Our primary concern has been with malnutrition as a factor in infant mortality and sickness, but it is obvious that there are also other factors concerned, such as malaria, congenital diseases, hookworm, and other infestation. (Paragraph 374.)

THE NEED FOR FURTHER KNOWLEDGE.

57. The nutrition of colonial peoples is a problem of such range and complexity that our knowledge of it is necessarily still imperfect and incomplete. A distinction may be drawn between laboratory research of a more or less elaborate kind, and field surveys of nutrition in relation to health. The facilities available for work of the former character are naturally confined to one or two laboratories in the larger Colonial territories. (Paragraphs 375-379.)

58. Apart from laboratory studies a good deal of work has been carried out in parts of the Colonial Empire in investigating the diet and health of the population. This includes (i) field surveys the purpose of which is to determine what the people eat, and the state of their physique, (ii) studies on the relation between diet and disease carried out where groups of people are provided with food by Government or other responsible bodies as in hospitals, prisons, police and military forces, labour in mines and on estates, etc., (iii) observations on specific deficiency disease conditions encountered by medical officers in the course of their day-to-day work. (Paragraphs 380-386.)

59. The chief need at the present time is not for elaborate laboratory research on such questions as the basal metabolic rates of tropical races. The main need is for field survey work including studies of the diet of both rural and urban peoples. These surveys should provide as complete a knowledge as possible of the elementary facts in regard to the diet, health and physique of the peoples studied. It should be borne in mind that in the large majority of cases agricultural conditions must play an extremely important part in causing abnormalities of diet. (Paragraphs 387-393.)

60. The work of field surveys can only be satisfactorily carried out if steps are taken to secure a proper uniformity both in the methods to be adopted and in the standards to be applied. It is equally important that those engaged in the work of survey should be kept in touch with the latest findings of experimental research. In order to make provision for this need, we considered that it would be of great value if a small whole-time staff could be provided which would act as a scientific nucleus for the purpose of co-ordinating the survey work to be carried out in the field. We accordingly welcome the action of the Medical Research Council who, in accordance with a recommendation submitted by us and with financial assistance from the Colonial Development Fund, have appointed a central staff to undertake the scientific co-ordination of nutrition surveys in colonial territories. Assistance will also be given from the Colonial Development Fund to meet the expenses of these surveys, the first of which is already in progress in Nyasaland. It is hoped that it will be possible also shortly to organise surveys in other parts of the Colonial Empire, and there can be little doubt that the knowledge so gained will be of the greatest assistance to government in formulating measures for the improvement of the nutrition and well-being of the people. (Paragraphs 394-405.)

61. In addition to the surveys of a comparatively elaborate kind, carried out under the aegis of the central organisation, there are many opportunities for work on particular problems arising in individual territories, and especially for studies on

the relation between diet and disease where groups of people are provided with their food by government and other responsible bodies, and also for observations on specific deficiency disease conditions made by medical officers in the course of their day-to-day work. As regards the former, we think that it would be well that all diets provided for bulk feeding in institutions should be reviewed at regular intervals, and that the health authorities should, as occasion arises, vary diets so as to test out, under proper conditions of control, the effects of specific alterations. In particular, if deficiency diseases are found to exist, it follows automatically that the diet is in need of alterations. (Paragraphs 406-410.)

THE NEED FOR CO-OPERATION BETWEEN GOVERNMENT DEPARTMENTS AND FOR THE INTERCHANGE OF INFORMATION.

62. A general and substantial improvement in nutrition in the Colonial Empire must depend upon the steady and concerted efforts over a period of years of many government departments and voluntary agencies. The primary responsibility necessarily rests with the Medical and Health Departments, but it is through the efforts of the Agricultural Department, working in conjunction with the Veterinary Department, that changes and adjustments in the production of foodstuffs must be made. Much can be done also by the Department of Education in contributing to an improvement in nutritional conditions. The efforts of the more specialised departments will not achieve their full effect unless they receive the support and co-operation of the Administration. Of equal importance is the need for securing co-ordination. Local nutrition committees should be capable of exercising an important influence in this direction, and we hope that they will continue as active bodies, and that full use will be made of their services. (Paragraphs 411-418.)

63. In addition to co-operation within the limits of each territory there is also much to be gained from an interchange of information within a wider sphere. We hope that, if funds permit, the Executive Council of the Imperial Agricultural Bureaux will be prepared to continue and expand the existing functions of the Imperial Bureau of Animal Nutrition in this direction. (Paragraph 419.)

64. We hope that the activity displayed by governments in dealing with this problem in recent years will be continued and that the question of nutrition will not be allowed for any reason to fall into the background. We are convinced that its importance will become more and more evident as the progress of

science reveals new directions in which unsuspected consequences of dietary errors are traceable. The great need is that the growth of knowledge should be reflected in Government policy particularly in regard to agriculture. With the new measures which are now being taken to stimulate investigation of every aspect of the problem, we hope and believe that this will prove to be the case. (Paragraph 420.)

(Signed) DE LA WARR, *Chairman.*
E. P. CATHCART.
GERARD L. M. CLAUSON.
PHILIPPA C. ESDAILE.
RAYMOND FIRTH.
N. F. HALL.
J. M. HAMILL.
FRANCIS HEMMING.
E. M. H. LLOYD.
E. MELLANBY.
A. J. R. O'BRIEN.
J. B. ORR.
H. S. SCOTT.
F. A. STOCKDALE.
HANNS VISCHER.

(Signed) D. H. F. RICKETT.
C. G. EASTWOOD.
Joint Secretaries to the Committee.

Gwydyr House,
Whitehall, S.W.1.

12th June, 1939.

APPENDIX I.

Circular Despatch from the Secretary of State for the Colonies to the Officers Administering the Governments of the Colonies, Protectorates and Mandated Territories.

Downing Street,
18th April, 1936.

SIR,

I have the honour to address you on the important subject of nutrition, its relation to public health and especially the bearing which it should have upon agricultural, veterinary, educational and general policy in the Colonial Empire.

2. The subject of nutrition is one in which there has been a great advance of technical knowledge in the last 30 years and one to which much public attention is now directed. It is probably true to say that it is now regarded as one of the most important aspects of public health work in all countries.

3. Thirty years ago it was generally believed that the dietary requirements of human beings are satisfied so long as they have a large enough quantity of food to eat. It is now known that the adequacy of a dietary depends on the presence of a number of factors, and that with quantitative sufficiency there may be qualitative defects producing the most serious physical consequences. In many European conditions the deficiencies of diet are normally not so much in the " energy-giving " foods as in the " protective " foods containing vitamins and mineral salts. While a man may continue to exist on a diet which is sufficient in the energy-giving foods but deficient in the protective foods, the absence of these latter may render him an easy prey to infectious diseases or may impair all his capacities and his efficiency for any form of activity. Their absence has especially deleterious effects upon children and nursing and pregnant mothers.

4. While this much has been comparatively common knowledge for some years, attention has recently been focused on the matter by reports and inquiries carried out by various organs of the League of Nations and particularly by a report of Drs. Burnet and Aykroyd which was published in the Quarterly Bulletin of the Health Organisation of the League of Nations for June, 1935. Copies of a reprint of this report have already been sent to a number of Colonial Dependencies in a note of the 13th of December last. In the case of those Dependencies to which copies were not so sent, copies will be found enclosed* in this despatch. This report is, I consider, a most useful survey of the state of present knowledge of the subject, and will be found of interest to those without special technical knowledge as well as to Medical Officers.

5. An aspect of the matter whch is attracting much attention at the moment is that of the application of the new knowledge to the economic and agricultural problems of the present day. The whole subject was considered in an interesting debate which took place at the Assembly of the League of Nations in September last. Mr. Bruce, on behalf of the Commonwealth of Australia, spoke in the Assembly of the benefits which would come of " a marriage of health and agriculture." Assuming an affirmative answer to the preliminary question, " Does the evidence show that increased consumption of certain foodstuffs would improve national health? " there were, he said, three main aspects of the problem:—

(i) Were there any practical means of increasing consumption?

(ii) Would such an increase in consumption contribute to the improvement of the world's agricultural position? and

(iii) What would be the effect of such improvement on the general economic situation?

* Not reprinted here.

6. In the subsequent discussion there was general agreement that there were considerable possibilities of increased consumption of agricultural products as the result of expenditure and efforts by Government directed towards improved nutrition; and it was agreed that such expenditure and efforts constituted a direct and practical means of attacking the problem of agricultural surpluses and the low prices consequent upon them. At the conclusion of the debate the Assembly adopted a Resolution in which, " having considered the subject of nutrition in relation to public health and the effects of improved nutrition on the consumption of agricultural products," it " urged the Governments to examine the practical means of securing better nutrition "; it requested the Council of the League to set in motion various further inquiries and to arrange for a general report on the whole matter to be submitted to the Session of the Assembly in September next.

7. As the first result of this Resolution a report has been produced by a commission of experts of great authority on the Physiological Bases of Nutrition; copies of this report are enclosed* in this despatch. It will be seen that the report sets out an agreed estimate of the various constituents of an adequate diet required for persons of European race living in temperate climates. It thus provides not only an objective towards which to aim but also an authoritative standard by which to measure the degree of malnutrition at present existing in temperate countries. Such a standard has in the past been lacking.

8. There is no doubt that the potentialities of improved nutrition in affecting not only public health but also the economic and agricultural problems of the day are great. For instance if in the United Kingdom alone the average consumption of milk a head a week increased from its present low level of $2\frac{3}{4}$ pints to 4 pints (a figure still well below what medical opinion regards as adequate), not only would the health of the nation be very greatly improved but also it has been estimated that it would be necessary for 800,000 more cows to be kept—with results which would be far-reaching to agriculture not only in this country but in the Dominions and the Argentine and indeed throughout the world (including, incidentally, certain parts of the Colonial Empire). On the public health aspect, there can be little doubt that every part of the Colonial Empire would benefit from an improved nutrition of its peoples. On the economic and agricultural aspect, while I doubt whether the Colonial Empire has at present any substantial contribution to offer, by way of increased consumption, to the solution of world problems (the monetary resources both of its Governments and of its peoples being too slender to enable them to increase more than slowly their purchases from abroad), I do feel that within its own borders increased attention to dietetic needs might well lead to an amelioration of some of its own economic problems. Not only will greater consumption of foodstuffs within each territory, small though it be in terms of world consumption, increase the local market for local food products, but also expenditure on improved nutrition may well be directly remunerative itself, leading as it should to a greater well-being, greater efficiency in production and less waste of human life and effort. I am therefore most anxious that the Colonial Empire should not be behindhand in the attention devoted to this subject. I would invite your co-operation to this end.

9. I am far from wishing to imply that the subject has been neglected in the past in the Colonial Empire. Indeed, much important work has been, and is being, carried out. Measures for the control of beriberi in Malaya were an early example in the dietetic field of the application of scientific knowledge to public health questions on a large scale, and much useful work is being carried out to-day in the Colonial Empire not only in

* Not reprinted here. A revised edition has now been published (League of Nations Publications 1936 II B4.).

research but also in the application of scientific knowledge. I would especially mention the valuable work that is being done in Nigeria, the Straits Settlements, and Uganda. I feel, however, first that there must be much knowledge on the subject which is unrecorded or not easly accessible, and secondly that medical knowledge on questions of nutrition may not in some Dependencies be fully reflected in agricultural, veterinary, educational and other aspects of Government policy.

10. In these circumstances, I consider it most desirable that there should be a comprehensive survey of the position in each Dependency. In order that it may conform with suggestions likely to be made as a result of the further studies to be undertaken by the League Organisations, I think it is desirable that the survey should cover:—

(*a*) A review of the present knowledge of human nutrition in each Dependency.

(*b*) A review of the further studies and researches on the subject which appear desirable.

(*c*) A review of the practical measures which have been taken in the past to apply scientific knowledge to the improvement of nutrition.

(*d*) A review of the further such measures which it appears desirable to take in the future.

(*e*) A review of the consequences which improvements in nutrition may have upon the economy of the Dependency.

I have to request that you will send me as soon as practicable, a survey on the above lines, in a form suitable if need be for publication.

11. Under heads (*a*) and (*c*) a list should be given of any literature which has been published on the subject.

As regards head (*b*), while the planning of further research must be primarily for the Medical Department, it will not, of course, be overlooked that much information of value has been acquired from studies carried out by Agricultural and Veterinary Departments on animal nutrition. Nor can a research programme be drawn up without regard to (*d*), the practical measures to be taken in the future to apply scientific knowledge to the improvement of nutrition. This is a matter which concerns many branches of Government, notably the Secretariat, the Administration, and the Education, Agricultural, Veterinary and Medical Departments; and if a proper plan of action is to be laid down and effectively carried through, there must be close co-operation between them all. In some Dependencies I believe that there already exists a Standing Committee including representatives of these Departments, whose duty it is to co-ordinate and inspire the policy of the Government on this important matter. I suggest that the establishment of a similar Committee should be considered in every Dependency as a first step towards the formulation of policy which will be necessary before heads (*b*) and (*d*) of the survey can be completed.

12. Progress towards improved nutrition must, of course, be slow, and the policy to be adopted in each Dependency must vary according to the soil and climate and according to the habits and resources of the population. There can be no question of any sudden change of dietary habits and no doubt the populations of the Colonial Empire will be more conservative than those of European countries have proved to be. Nevertheless, the marked change which has taken place in the diets of European nations in the last 50 years shows that there is nothing immutable about dietary habits and that they are determined less by choice and instinct than by the variable factor of economic necessity.

13. Government has to its hand many agencies by which improvements in nutrition can be effected. First and foremost are the activities of the Medical Department itself, and especially its maternity and infant welfare services. It is to-day generally recognised that from the nutritional point of view the pre-natal and immediately post-natal periods are the most

important in the life-span, and that the diet of mother and child during these months may affect fundamentally the child's whole development. The supervision of diet must therefore be one of the most important aspects of all maternity and infant welfare services. I would urge upon all Colonial Governments the desirability of an expansion of these services to the limit that funds permit. It will no doubt be borne in mind that this is a branch of Government activities for which it is often possible to enlist much most valuable voluntary assistance.

14. Apart from the Medical Department, the most obvious agency for effecting improvements in nutrition is the school. In a variety of ways it is possible to instil into the younger generation improved ideas on diet, for instance by lessons in cooking and domestic science and by encouraging the development of school gardens where crops may be grown for consumption by the pupils, thereby not only improving their own health at the time but also initiating them into habits which may be of benefit to them all their lives. I have no doubt that many other means exist suited to each Dependency. I have been particularly interested to hear of proposals for giving milk to schoolchildren in Ceylon and Malta. While action of this nature on any large scale may be impracticable in many Dependencies at present, there can be no doubt of the immense benefit which children derive from an increased supply of milk. Some interesting information on this point is given on pages 82 to 94 of the Burnet-Aykroyd Report. I am arranging for copies of this despatch to be laid before my Advisory Committee on Education in the Colonies with a view to obtaining their recommendations on the subject generally, and in particular on such matters as training of education officers, preparation of text books, &c.

15. The Agricultural and Veterinary Departments have also an important part to play in the subject. In planning the production of the territory the aim should be twofold; on the one hand the provision to the entire population of a food supply of a nature considered adequate by medical science and, on the other, the growth of remunerative export crops. It is one of the main purposes of this despatch to draw attention to the importance of an adequate supply of locally grown foodstuffs and to urge that it should be given first consideration in the formulation of agricultural policy.

16. Much can, I feel, be done by the instruction of those who are in a position themselves to instruct others, for instance all members of Education Departments and all members of the Administration and of Agricultural, Veterinary and Medical Departments. I, therefore, suggest that it might prove useful to issue to all such officers a brief circular explaining the importance of the subject and what should be the aims of Government in regard to it. I have recently seen one such circular issued in Tanganyika and I have read with interest of instructional courses for schoolteachers in Malaya.

17. The nature of the tariff can also have an important effect upon nutrition. Many other considerations, of course, must be given due weight in framing tariff policy, but I consider it of the greatest importance that the tariffs of Colonial Dependencies should be framed in such a way as to encourage as much as possible the consumption of foodstuffs of high nutritive value. This is an aspect which has, I think, received little attention in the past so that often it happens that those articles which are of high nutritive value are among those contributing most highly to customs revenue. It should, of course, always be the policy to exempt from duty so far as practicable articles consumed only by the poorer classes, but I consider it important that this policy should be extended to the greatest degree possible to cover all foodstuffs of high nutritive value by whatever class they are consumed.

18. There are no doubt many other agencies by which Government can influence dietary habits. For instance in Dependencies in which large

scale enterprises exist, e.g., mines and large estates, great opportunities occur (and indeed are already for the most part taken) for the inculcation of improved dietary habits. The individual is in such circumstances normally engaged in an occupation where some change of his habits is inevitable; it is the duty of Government by the laying down of minimum scales of rations and by proper inspection and supervision to ensure that that change shall be in the right direction.

19. These and other possibilities will no doubt be considered by the Committee which I have suggested earlier in this despatch if you decide to adopt that suggestion.

20. In conclusion I would remind you that one of the objects which may be assisted by the Colonial Development Fund is " the promotion of public health in the Colonial Empire." Assistance has already been granted from the Fund for the study of nutrition problems in Malaya and Nigeria. While, of course, I cannot foretell the attitude which the Colonial Development Advisory Committee may take, I need hardly say that I shall be very ready to consider favourably any further proposals that may be put forward, for submission to them, for the grant of assistance towards the improvement of nutrition.

I have, &c.,

J. H. THOMAS.

APPENDIX 2.

List of reports on nutrition published locally in the Colonial Empire.

The following is a list of the Reports which have been published in the Colonial Dependencies as a result of the Secretary of State's circular despatch of the 18th of April, 1936. Copies are on sale by the Crown Agents for the Colonies, 4, Millbank, London, S.W.1.

	s.	d.
Barbados:		
Report of the Committee appointed to consider and report on the question of nutrition in Barbados		9
Bechuanaland:		
Food in Relation to Health and Disease, by M. Gerber, M.D.		6
British Guiana:		
Report of the Nutrition Committee (Third Legislative Council, Second Session, 1936-37)	2	6
British Honduras:		
A Report of the Committee on Nutrition in the Colony of British Honduras	5	0
Ceylon:		
Report on Nutrition in Ceylon, February 1937 (Sessional Paper II—1937)		4
Further Report on Nutrition in Ceylon (December 1937; Sessional Paper XXIX, 1937)	1	1
Dominica:		
Survey of the Position as regards Nutrition in Dominica—1937		4
Falkland Islands:		
Report on Nutrition and Public Health in the Falkland Islands		3
Grenada:		
" Nutrition "—Memorandum by Dr. B. Spearman, O.B.E., Senior Medical Officer. (Council Paper No. 5 of 1938) ...		6
Jamaica:		
Report of the Nutrition Committee, 1936-37	1	0
Malta:		
Report of a Committee appointed to inquire and report on the question of Nutrition in Malta and Gozo		4

	s.	d.
Nigeria:		
Food in Relation to Health		3
Northern Rhodesia:		
A Report of the Committee appointed to make a Survey and present a Review of the present Position of Nutrition in Northern Rhodesia	2	6
Nyasaland:		
Review of the Nutrition of Natives	2	6
Sierra Leone:		
Review of the Present Knowledge of Human Nutrition with remarks of Practical Measures taken by the Medical Department in the past to its improvement in Sierra Leone. Sessional Paper 5/1938	2	0
Somaliland:		
Arrangements are being made for the publication of the report from Somaliland. Copies will be obtainable from the Crown Agents for the Colonies but the price is not yet fixed.		
Tanganyika Territory:		
Preliminary Survey of the Position in regard to Nutrition amongst the Natives of Tanganyika Territory	1	6
Trinidad:		
Food in Relation to Health. Issued by the Nutrition Committee, 1937	1	3
Report on the Activities of the Nutrition Committee from its inception up to 30th September, 1936. (Council Paper No. 104 of 1936)		4
Uganda:		
Agricultural Survey Committee: Report of the Nutrition Sub-Committee		6
An Investigation into Health and Agriculture in Teso, Uganda —Nutrition Report No. 1—Teso	1	0
Zanzibar:		
Nutritional Review of the Natives of Zanzibar ... ... Nutritional Problems of Zanzibar Protectorate. (Sessional Paper No. 10 of 1937)	1	6

Note.—The prices given do not include postage.

APPENDIX 3.

Note on the nutritive value of imports of preserved milk into the Colonial Empire.

1. The object is to determine what kind of preserved milk when imported into a Colonial Dependency gives the highest nutritive value per £1 spent when consumed in combination with the existing dietary.

2. Unfortunately for a number of reasons an unequivocal answer to this question is impossible. In the first place, the prices of different kinds of milks do not by any means bear the same relation to one another throughout the Colonial Empire. Secondly, full information is not available about prices in any Colonial Dependency. Thirdly, the needs of all Dependencies are not the same. For instance, the people of most territories suffer from a shortage of fats. In such cases the fat content of manufactured milk may be more than usually important, though it will probably be found that there are cheaper ways of making up the deficiency than by the use of milk fat.

3. The different types of preserved milk which have to be considered are:—

Condensed sweetened whole milk.

Condensed unsweetened whole milk (also known as evaporated milk).

Condensed sweetened skimmed milk.

Dried whole milk, manufactured

(*a*) by the roller process.
(*b*) by the spray process*.

Dried skimmed milk, manufactured

(*a*) by the roller process.
(*b*) by the spray process.

The bulk of the Colonial imports of tinned milk consists at present of condensed sweetened whole milk. In some territories imports of skimmed milk products are at present prohibited.

4. The following table gives typical figures for the composition of fresh English milk and of various forms of preserved milk. In Great Britain the minimum contents of fat and of total milk solids are laid down by legislation for all three types of condensed milk, so that the figures quoted may be taken as applying to products of a high standard. Although the constituents of products imported into the Colonial Empire may not always coincide with those in the table, the latter will afford a satisfactory guide to the comparative nutritive value of the various forms of preserved milk.

TABLE I.

CONSTITUENTS OF ENGLISH MILK AND OF CERTAIN MILK PRODUCTS.

Per 100 grammes.

	Protein.	*Fat.*	*Carbo-hydrate.*	*Calcium.*	*Phos-phorus.*	*Iron.*
Fresh whole milk† ...	3·3	3·6	4·8	0·120	0·093	0·00024
Fresh skimmed milk†...	3·4	0·3	5·0	0·122	0·096	0·00025
Condensed sweetened whole milk ...	8·4	9·2	54·0	0·306	0·237	0·00060
Condensed unsweetened whole milk (evaporated milk)	8·4	9·2	12·3	0·306	0·237	0·00060
Condensed sweetened skimmed milk ...	9·7	0·5	61·0	0·353	0·273	0·00070
Dried whole milk ...	25·8	28·2	37·5	0·937	0·727	0·00187
Dried skimmed milk ...	35·8	1·5	52·1	1·302	1·009	0·00260

† These figures are given per 100 millilitres, which are equivalent to roughly 103 grammes.

5. The price of milk varies so much from territory to territory and from time to time that it is not possible on the basis of Table I above to make any exact calculation, which will be generally applicable, of the quantity of each of the chemical constituents of milk which can be obtained by the expenditure of £1. Table II below may, however, be useful as a general guide, and it should be easy to make an exact calculation locally where full particulars of the prices of various types of milk can be obtained. The prices on which the figures in Table II are based do not correspond with the actual market prices at any spot on any particular

* Dried whole milk, whether roller or spray, would be liable, in the conditions of most Colonies, to suffer changes owing to oxidation unless packed and stored under special conditions i.e. in a vacuum and under nitrogen, which would be expensive. It cannot therefore be recommended at present. The figures for it are however given in the following tables. Special dried whole milk products—infant foods, etc.—are left out of account, since as normally sold they are expensive foods. If sold direct in bulk, however, they need not be very much more expensive than dried whole milk powder.

TABLE II.

APPROXIMATE AMOUNTS (IN GRAMMES) OF VARIOUS CONSTITUENTS OBTAINED PER £1 SPENT ON DIFFERENT KINDS OF PRESERVED MILK.

1.	2.	3. Price per cwt.	4. Fat.	5. Protein.	6. Carbo-hydrates.	7. Calcium.	8. Phosphorus.	9. Iron.	10. Raw milk equivalent (gallons)†
		s. d.							
Condensed whole, sweetened ...	Bulk*	35 0	2,670	2,440	15,680	89	69	0·17	17
Condensed whole, sweetened ...	1 lb.	50 0	1,870	1,710	10,975	62	48	0·12	12
Condensed whole, unsweetened	Bulk	35 0	2,670	2,440	3,570	89	69	0·17	17
Condensed whole, unsweetened	1 lb.	50 0	1,870	1,710	2,500	62	48	0·12	12
Condensed, skimmed, sweetened	Bulk	22 6	225	4,380	27,550	159	123	0·32	32
Condensed, skimmed, sweetened	1 lb.	30 0	170	3,285	20,660	120	92	0·24	24
Dried whole, roller	Bulk	50 0	5,730	5,245	7,620	190	148	0·38	38
Dried whole, roller	1 lb.	70 0	4,095	3,745	5,445	136	106	0·27	27
Dried whole, spray	Bulk	70 0	4,095	3,745	5,445	136	106	0·27	27
Dried whole, spray	1 lb.	90 0	3,185	2,915	4,235	106	82	0·21	21
Dried, skimmed, roller... ...	Bulk	20 0	760	18,190	26,470	662	513	1·32	132
Dried, skimmed, roller... ...	1 lb.	40 0	380	9,095	13,235	331	256	0·66	66
Dried, skimmed, spray... ...	Bulk	32 0	475	11,370	16,545	413	320	0·83	83
Dried, skimmed, spray... ...	1 lb.	52 0	295	6,995	10,180	254	197	0·51	51

* Packages of from 56 lbs. to 112 lbs.

† For explanation see paragraph 9.

day, but it is believed that they may be regarded as broadly typical of the c.i.f. prices at Colonial ports of the cheapest type of good quality product. While, therefore, too much reliance should not be placed on the calculations based on these prices, the variations from them are not likely to be sufficiently wide to affect materially the general conclusions.

6. From this table various points of interest emerge. In the first place, naturally the whole milks provide much more fat than the skimmed milks, and dried whole milk will provide at least twice as much as condensed whole milk, whether sweetened or unsweetened.*

7. As regards protein, dried skimmed milk, especially packed in bulk, will contain several times as much as any other form of processed milk. At the prices given in the table skimmed milk dried by the roller process and packed in bulk will yield more than seven times as much protein as condensed whole milk and more than four times as much as condensed skimmed milk. It must be remembered, however, that some portion of the proteins of roller-dried products is rendered insoluble during manufacture and cannot be reconverted into soluble form when mixed with water. It is therefore less convenient to handle and also less palatable to consume than spray-dried milk. Though it is possible that the proteins, even if not dissolved before consumption, are in fact digested, these factors do undoubtedly reduce to some extent the advantage of roller-dried milk. But even the more expensive spray-dried skimmed milk will yield on the figures given more than four times as much protein as condensed whole milk and nearly three times as much as condensed skimmed milk.

8. In regard to calcium, phosphorus and iron, the table shows that in every case dried skimmed milk gives several times as large a quantity as any other form of processed milk. All these figures are very striking. Compare, for instance, the advantages of roller-dried skimmed milk packed in bulk with the condensed whole sweetened milk most usually consumed at present. The figures for other forms of dried skimmed milk are scarcely less striking.

9. Vitamin content is not shown in the table. To estimate this it is necessary to take into account (1) the original vitamin content of the raw milk used, (2) the effects of manufacture. As regards the original vitamin content a column (column 10) has been included in Table II headed "raw milk equivalent," i.e., the quantity of raw milk (whole or skimmed as may be) which will have been used in the manufacture of that quantity of the final product obtained for £1. The skimmed milk products, because of the very low fat content, will naturally be lowest in vitamins A and D; the remaining vitamins will have been present in the raw milk in the relative proportions shown in column 10. The vitamin content of the final product will, however, have changed considerably as the result of manufacture. While it is not possible with present knowledge to state exactly what the effect of the various processes will be, some general indication can be given. Vitamins D and the B2 complex will be unaffected. Vitamin B1 (of which, however, fresh milk is not an important source) will also be unaffected except in the case of evaporated milk. Dried milks will lose vitamin A through oxidation processes. Vitamin C (of which, however, fresh milk is never an important source) will be almost entirely destroyed in all cases. Comparing therefore the dried skimmed milks and condensed sweetened whole milk, the net result is likely to be that condensed sweetened whole milk will have a distinct advantage as to vitamin A and, to a somewhat less extent, vitamin D, but that the dried skimmed milks will have a big advantage in regard to the vitamin B group.

* Though, as already explained, dried whole milk may not be suitable for use in Colonial conditions.

10. In brief, £1 spent on either form of dried skimmed milk will purchase a very great deal more protein, calcium, phosphorus, iron and the B vitamins than £1 spent on any form of manufactured whole milk. On the other hand, any form of whole milk will yield several times as much fat and vitamins A and D as any form of skimmed milk.*

11. It must be repeated that the variations in price from territory to territory and from time to time are so great that it does not follow that exactly similar relationships will hold in any particular Colonial Dependency, and it is important before any action is based upon these calculations that their validity should be tested in the circumstances of each territory. But the advantage of dried skimmed milk in everything except fat and vitamins A and D seems so great that any alteration in prices is not likely to challenge it.

12. A similar conclusion results from consideration of the following facts:—

1 cwt. of condensed whole milk contains about 30 gallons of full cream milk, while 1 cwt. of dried skimmed milk contains about 125 gallons of skimmed milk, whether spray-dried or roller-dried.†

Skimmed milk is much cheaper to buy in the raw state than full cream milk. Indeed, in butter manufacturing countries it can often be obtained for practically nothing. The cost of 125 gallons of skimmed milk would normally be less than the cost of 30 gallons of full cream milk.

Dried milk is considerably cheaper to manufacture than condensed milk.

These facts point to the conclusion that by importing dried skimmed milk rather than condensed whole milk a Colony should obtain the equivalent of 125 gallons of skimmed milk for considerably less cost than the equivalent of 30 gallons of whole milk.

13. There are however two factors which have not yet been taken into account which might conceivably modify these conclusions. The first is the keeping qualities of the various forms of milk and the second is the relative suitability of the two kinds of milk for infants.

14. As regards the relative keeping qualities, the keeping quality of condensed sweetened whole milk and condensed sweetened skimmed milk is likely to be the same. Dried whole milk (as explained in an earlier footnote) is somewhat liable to oxidise unless packed and stored under special conditions which are expensive. Similarly condensed unsweetened milk will be liable to putrefaction. The main question would therefore appear to be the relative keeping qualities of condensed sweetened milk, whether whole or skimmed, on the one hand and of dried skimmed milk on the other hand. On this question the following remarks may be made.

15. Condensed sweetened milk though not sterilised in manufacture will remain wholesome for a long time in the tin if the original milk was clean and the manufacture was carried out under hygienic conditions, for the sugar content is sufficiently high to prevent the growth of micro-organisms. Once opened, the milk will remain edible for an appreciable time, but it is liable to become progressively more dangerous to health. The tin cannot usually be tightly closed again, since it has normally to be cut open by a tin opener, and the milk can therefore easily become contaminated by insanitary handling or by flies to which on account of its sweetness it is

* Milk is not normally consumed for its carbohydrate content, but skimmed milk, dried or condensed, gives more than whole milk whether dried or condensed.

† 1 cwt. of condensed skimmed milk contains about 34 gallons of skimmed milk. 1 cwt. of dried whole milk contains about 90 gallons of full cream milk.

very attractive. The sugar content will be sufficient to prevent multiplication of disease-producing organisms in the milk itself, but these may survive and multiply rapidly as soon as the milk is diluted for use. It is probable therefore that condensed sweetened milk will find its greatest use in individual households where the supply will be obtained in small tins and where the risk of serious contamination such as might occur in bulk supplies will be minimised.

16. Dried skimmed milk if manufactured under hygienic conditions should have a low bacterial content on leaving the factory, and the unopened tin should keep at least as well as condensed sweetened milk. Once the tin has been opened it has usually the advantage over condensed sweetened milk that, unlike the most usual forms of condensed milk, it is packed in containers with lids which can be replaced so that the container is kept more or less airtight. If it remains open and able to absorb moisture the usual defects that develop are, first a loss of solubility, secondly a stale flavour and odour. Some slight tallowness and rancidity might also develop as a result of decomposition of the small quantity of fat. Under such circumstances the product will fairly quickly lose attractiveness and may ultimately become quite unpalatable, though it is unlikely to become actively dangerous to health unless a very high degree of moisture is absorbed and contamination has been great. Dried milk is not so readily suited for household use as condensed milk, since if it is to be used as a liquid it requires reconstitution. It can, however, be used in dry form in all sorts of cooked dishes, bread, etc., and it can be readily handled in bulk, provided satisfactory containers are used.

17. The general conclusion as regards keeping qualities seems to be that condensed sweetened milk is more convenient for household use but that dried skimmed milk is perfectly suitable for institutional use or for use in schemes which involve the supplementary feeding of selected groups of the population. We have already noted that spray dried milk is both more convenient to handle and more palatable to consume than roller dried milk but roller dried milk is considerably the cheaper article.

18. The other factor to be taken into account is the relative suitability of the two milks for infants. Skimmed milk in any form is not suitable as the sole food for infants, and there is considerable risk that dried skimmed milk if used by the general public might be used for this purpose. Against this risk must be set the advantages of a larger supply of proteins, calcium, phosphorus, iron, etc., that would be obtained by the general population by the general use of dried skimmed milk. To some extent the risk might be guarded against by requiring skimmed milk to be clearly marked " not suitable as a sole food for infants ", but the value of this would clearly be small in a largely illiterate community. Condensed whole sweetened milk is also not an ideal food for infants, because the large quantity of sugar it contains replaces Calories that should be obtained from more valuable foods containing fats, proteins, etc.

19. The conclusions which emerge from this memorandum may now be summarised as follows:—

(1) As regards keeping qualities and ease of handling, dried whole milk cannot at present be recommended for general use in colonial conditions. Unsweetened milk is also liable to putrefaction. The real choice thus lies between condensed sweetened whole milk and dried skimmed milk. The condensed product is more convenient for household use but dried skimmed milk is just as suitable for use in institutions or for the supplementary feeding of groups of the population, e.g., school children.

(2) £1 spent on condensed sweetened whole milk, or indeed on any form of whole milk, will purchase considerably more fats and vitamins A and D than £1 spent on any form of skimmed milk.

(3) But £1 spent on the purchase of dried skimmed milk, will give a very much larger quantity of proteins, calcium, phosphorus, iron and the B vitamins than £1 spent on condensed whole sweetened or any other form of processed milk.

(4) No form of skimmed milk is suitable as a sole food for infants. If it were made available for general consumption, the risk of its use for this purpose would have to be set off against the advantage to the general population of increased quantities of protein, calcium, etc., being made available. Condensed whole sweetened milk is also not an ideal food for infants.

APPENDIX 4.

Existing and improved scales of diet issued to employees of Rhokana Corporation, Ltd.

TABLE 1.

EXISTING DIETARY SCALE FOR MALE EMPLOYEES, WOMEN AND CHILDREN.

MEN.

Foodstuff.	Weight (oz.).	Weekly Ration. Calorie (oz.).	Total Calories.	Daily Ration.	
				Weight (oz.).	Calories.
Maize meal	168	106·0	17,808	24·0	2,544·0
Meat	44	35·4	1,558	6·3	222·5
Vegetable and fruit ...	47	20·7	973	6·7	139·0
Peanuts	7	160·0	1,120	1·0	160·0
Beans	47	97·4	4,581	6·7	654·5
Biscuit...	16	102·0	1,632	2·3	233·0
Fat	4	262·0	1,048	0·6	149·7
Salt	3·5	—	—	0·5	—
Native beer	140	10·5	1,477	20·0	211·0
Totals	476·5	—	30,197	68·1	4,313·7
ADDITIONAL TO MEN UNDERGROUND.					
Cocoa	140	1·5	210	20·0	30·0
Bread	28	64·0	1,792	4·0	256·0
Totals	644·5	—	32,199	92·1	4,599·7
WOMEN.					
Mealies	112	99·7	11,166	16·0	1,595·2
Offal	32	40·3	1,290	4·6	184·3
Totals	144	—	12,456	20·6	1,779·5
CHILDREN.					
Mealies	48	99·7	4,786	6·9	683·7

TABLE 2.

IMPROVED DIETARY SCALE FOR NATIVE EMPLOYEES, WOMEN AND CHILDREN.

Foodstuff.	Ration.		Calorie—Value.		
	Oz./ week.	Oz./ day.	Calorie (oz.).	Total Calories.	Calorie/ day.
Maize meal	112·0	16·0	106·0	11,872	1,696
Meat	84·0	12·0	35·4	2,974	425
Vegetable and fruit ...	47·0	6·7	20·7	973	139
Peanuts	7·0	1·0	160·0	1,120	160
Beans	31·5	4·5	97·4	3,068	438
Wheat roll	42·0	6·0	68·6	2,881	412
Fat	5·0	0·7	262·0	1,310	183
Salt	3·5	0·5	—	—	—
Native beer	140·0	20·0	10·5	1,470	210
Total, surface ...	472·0	67·4	—	25,668	3,663
ADDITIONAL FOR UNDERGROUND EMPLOYEES.					
Cocoa	140·0	20·0	1·5	210	30
Sugar	7·0	1·0	116·0	812	116
Bread	28·0	4·0	64·0	1,792	256
Total, underground	647·0	92·4	—	28,482	4,065
WOMEN.					
Mealies	112·0	16·0	99·7	11,166	1,595
Offal	32·0	4·6	40·3	1,290	184
Wheat roll	42·0	6·0	68·6	2,881	412
Total, Women ...	186·0	26·6	—	15,337	2,191
CHILDREN.					
Mealies	48·0	6·9	99·7	4,786	684
Wheat roll	42·0	6·0	68·6	2,881	412
Fat	4·5	0·7	262·0	1,310	183
Offal	32·0	4·6	40·3	1,290	184
Total, Children ...	126·5	18·2	—	10,267	1,463

APPENDIX 5.

The place of sugar in the diet.

Memorandum by Dr. F. C. Kelly, Ph.D.

In the despatch from Jamaica, the Governor makes special reference to the place of sugar in the diet and considers that enquiry is desirable into the food value of sugarcane, raw sugar and molasses as distinct from refined sugar which is completely free of fat, protein, vitamins or mineral elements. In the sugar producing countries of which he has experience the belief is apparently held by many that the chewing of sugarcane, a practice common among labourers and cane-cutters, has a valuable and stimulating effect not solely due to the commonly accepted food value of sugarcane as a source of carbohydrate. A survey of the relevant literature reveals but one reference to similar observations elsewhere(1). In the early days of the sugar industry in the United States, the sugar mill was regarded as a very healthy place in which to work. The breathing of the vapours escaping from cauldrons during the evaporation of cane juice was considered beneficial and large quantities of cane juice were drunk and other products of the sugar factory included in the diet.

The suggestion is that these beneficial effects may be attributable to some special nutritive properties present in cane juice and crude sugar but destroyed or eliminated in the process of refinement. In view of this, several workers have investigated both the vitamin and mineral content of sugarcane and its products. For convenience the results of these investigations are given below in tabular form.

TABLE 1.

VITAMIN CONTENT.

Sugar Cane.	A	B Complex.	C	D	Reference.
Fresh juice ...	Absent	Poor source	—	Absent	Nelson (E. M.) and Jones (1).
,, ,, ...	—	—	Absent	—	Delf (2).
,, ,, ...	—	—	0·2*	—	Chakraborty (3).
,, ,, ...	—	—	0·4*	—	Chi and Read (4).
Products of Evaporation: Cane Syrup	—	Absent	—	—	Nelson (E. M.) and Jones (1).
Molasses (blackstrap)	—	Absent	—	—	Nelson (E. M.) and Jones (1).
,, ,,	Absent	Good source	—	—	Nelson (V. E.) Heller and Fulmer (5).

From the above findings it may be concluded that, so far as present knowledge goes, sugarcane juice and the syrups and molasses obtained therefrom by evaporation, are of no account as sources of vitamins A, C and D. Sugarcane juice undoubtedly contains vitamin B; but it cannot

* mg. ascorbic acid per 100 ml.

TABLE 2.

MINERAL CONTENT OF SUGARCANE PRODUCTS.

(Per cent., fresh basis.)

	Description.	Moisture.	Ash.	Iron.	Copper.	Calcium.	Phosphorus.	Reference.
Sugarcane syrup	Average of 10 samples; method of evaporation not stated.	25·81	0·81	0·0029	—	0·049	0·034	6
,, ,,	Average of 24 samples evaporated on iron pans.	23·51	0·96	0·0049	0·00027	0·055	0·035	7
,, ,,	Average of 3 samples evaporated on iron pans.	27·45	1·93	0·0107	0·00005	—	—	8
,, ,,	Average of 7 samples evaporated on iron pans.	24·98	—	0·00718	—	—	—	9
,, ,,	Average of 11 samples evaporated on copper pans.	23·93	1·11	0·0021	0·00040	0·090	0·031	7
,, ,,	Average of 7 samples evaporated on copper pans.	22·32	—	0·00142	—	—	—	9
,, ,,	Average of 7 samples evaporated on porcelain pans.	22·58	—	0·00192	—	—	—	9
Molasses ...	Average of 4 different varieties marketed for human consumption.	22·63	5·41	0·0185	0·0010	0·3193	0·0562	7
,, ...	Blackstrap; not used for human consumption.	21·67	7·39	0·0982	0·0010	0·7925	0·0712	7
Brown sugar ...	Average of 3 different varieties ...	2·86	1·60	0·0027	0·00059	0·0874	0·0105	7

Iron content of some other foods high in iron: Beef (lean), 0·0035, Egg yolk, 0·0086; Lentils, 0·0076; Spinach, 0·0030; Ox Liver, 0·0067, per cent. fresh basis.

be regarded as a rich source. Nelson (E. M.) and Jones found that the juice from the upper portion of cane stalks was definitely richer in this vitamin than juice from the lower portions. The recorded results on the vitamin B content of molasses are conflicting. Nelson (E. M.) and Jones found none in blackstrap molasses, whereas Nelson (V. E.) and his co-workers conclude that it is a very good source of vitamin B. Whichever may be correct, however, the vitamin B content of blackstrap molasses is a question of doubtful practical significance so far as human nutrition is concerned since this product is used primarily in the feeding of livestock.

In Table 2, the mineral content of sugarcane products is compared with that of certain other foodstuffs selected on account of their high iron content.

In general, syrups and molasses are good sources of iron although, as is to be expected, syrups evaporated in copper or porcelain pans contain less than those evaporated in iron pans. Investigations undertaken by Sheets and Frazier(8) showed that sugarcane syrups contain substances (iron and copper) qute potent in the production of haemoglobin in the rat although none of the syrups tested was quite as efficient as calf liver. When sugarcane syrup was fed to anaemic rats at a level of 0·5 mg. of iron daily, the haemoglobin content of the blood increased from 5·1 g. to 11·2 g. per 100 cc. in 16 weeks.

From these studies of the vitamin and mineral content of cane juice and crude sugar products, our conclusion is that there is as yet insufficient experimental evidence to decide on scientific grounds whether the benefits to health reported from some quarters as due to the consumption of sugar in the raw state are likely to be real or are only fancied. In areas where the customary dietaries are known to be deficient in iron, however, sugarcane syrups and molasses might find a place as valuable supplementary sources of iron, especially if other foodstuffs high in iron are not available.

On the more general aspects of the place of sugar in the dietary, we maintain the already accepted view of dietary experts that *excessive* consumption is to be discouraged. Over-indulgence in sugar causes disturbances of digestion and absorption thus blunting the appetite for more essential foods. It is responsible for abnormal water retention and overactivity of the pancreas and liver; and, it is urged by many, is a factor predisposing to certain eye diseases, catarrhal conditions, dental caries and diabetes. Cases have also been described of a condition involving high water retentior and dilation of the heart, considered to be due to partial vitamin B_1 deficiency, caused by excessive sugar consumption(10, 11, 12, 13, 14).

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APPENDIX 6.

Rice and its importance for Human Nutrition.

Memorandum by Dr. B. S. Platt, M.B., Ch.B., M.Sc., Ph.D.

Contents. *Paragraphs.*

Extent and importance of rice cultivation.

1. Rice is at the present time the staple food of nearly one half of the world's population. It is being produced in amounts sufficient to supply about one fifth of the calorie requirements per capita per annum. There are about 200 million acres of land under rice cultivation, two thirds of this area being shared equally between China and British India; in the latter about 67 million acres are under rice out of a total of 186 million acres devoted to the production of food crops.([33])* Of the total rice production in the world, it is estimated that as much as 60 per cent. is grown in the British Empire. Rice is placed first amongst foodstuffs of world importance, yet, notwithstanding the scale on which it is being produced, it has been stated([43])* that only about 3 per cent. of suitable land in tropical countries is under rice culture.

2. Peoples using rice as their staple food consume in the form of rice as much as 80 to 90 per cent. (measured in terms of energy value) of their total food intake. They are usually peoples living on " marginal " diets, and the first consideration is the provision of sufficient amounts of food to cover their energy requirements. This is the situation, for example, in India, of which Sir John Russell writes:

> " I am very strongly of the opinion that the best varieties (of cereals) for home food supply are those that give the largest yields per acre. The really vital matter is the food value per acre, not per ton of produce."

* The numbers on this page and through the rest of the text refer to the authorities quoted in the Bibliography, which appears on page 192.

Variation in yields of rice.

3. Yields of rice vary considerably. Big differences are recorded between " dry land "* and " upland " rices (i.e., those grown on land permanently under cultivation and relying on rain for water, or produced on freshly cleared hillsides or in places having a heavy rainfall), and the " irrigated " or " swamp " rices raised on land flooded by irrigation or natural inundation. Some average yields for the years 1929-33 are:

Italy	93 bushels per acre.
Japan	68 bushels per acre.
China	67 bushels per acre.
U.S.A.	47 bushels per acre.
India	29 bushels per acre.

The " cup-weight " of rice varies considerably, so that the bushel-weight is variously recorded as being 40-50 lb. per bushel. Weights per unit area are, however, recorded([5]) in a recent survey in China, in which maximum and minimum yields are given as 84·46 and 10·74 quintals per hectare, i.e., 7,700 and 960 lb. per acre respectively. In Malaya, average yields have been reported([8]) of 1,545 lb. per acre for " wet " rice, and 817 lb. per acre for " dry " rice. The average yield for Japan and China is close upon 3,000 lb. per acre per year; in some places it should be noted that two or even three crops may be obtained off the same land in the one year.

Factors affecting the yield of rice.

4. The yield of rice is affected by a number of factors, of which seed, soil, water and climate are the most important.

> " Seed should be sown that is clean, viable, and free from mixtures of different types, of obnoxious weed seeds, and of red rice. Fields should be irrigated and drained at the right time. The crop should be harvested at the right stage of maturity. When harvested with a binder, the rice should be shocked promptly in such a way that it will cure satisfactorily before it is threshed. The crop should be threshed as soon as the kernels are well cured."([36])

Importance of " protective " principles in staple crops.

5. More and more emphasis is being laid in nutrition precepts on the importance of " protective " foodstuffs; these are in general costlier than the " energy bearing " foods. The protective principles—proteins, minerals and vitamins—are, however, contained in the latter class of food to some extent. When, as is the case with the predominantly rice-eating peoples, they cannot afford money, land or labour to provide themselves with sufficient protective foods, it becomes necessary to ensure that their staples shall as far as possible contribute the protective principles to their diet. There are differences in nutritive values of different kinds of rice, and of the same rice grown under different conditions with respect to amount and nature of water supply, soil composition, etc.; but such variations of food value are of secondary importance in comparison with what can be attained by measures directed towards the conservation of the food value of the rice ordinarily produced.

Calorific value of rice produced per acre.

6. Assuming a milling yield of 65 per cent. and a calorie value for rice of 1,600 per pound, then—when a yield of 3,000 lb. per acre is obtained—there are 3·12 million calories produced per acre in a year. It would be difficult to equal this production over so large an area in

* Dry land and upland rices will be referred to collectively as " dry " rice, and irrigated rice as " wet " rice.

any other form of food; in fact it is generally conceded that food of two or three times the energy value can be obtained per acre in the form of rice as compared with wheat. This holds good for rice as against wheat in China itself, and for rice production in China as against wheat production in the United States of America.

Composition of rice.

7. The following table for the composition of rice has been compiled from various sources; it will be found that most published analyses approximate to these values.

TABLE 1.

REPRESENTATIVE VALUES FOR THE COMPOSITION OF RICE.

	Hulled Rice.	Polished Rice.
Wt. of 100 kernels. Gms.	2·47	2·13
Moisture ... Gms. per 100 gms.	12·0	12·0
Protein ... ... ,, ,, ,, ,, ...	8·0	7·0
Fat ... ... ,, ,, ,, ,, ...	2·0	0·25
Fibre ... ... ,, ,, ,, ,, ...	1·0	0·5
Carbohydrate (other than fibre) ... ,, ,, ,, ,, ...	75·5	80·0
Ash ... ... ,, ,, ,, ,, ...	1·5	0·5
Calories ... ... ,, ,, ,, ,, ...	350	350
Calcium ... ... ,, ,, ,, ,, ...	0·02	0·01
Phosphorus ... ,, ,, ,, ,, ...	0·2	0·1
Iron (available)... Mgs. ,, ,, ,, ...	1·7	0·4
Copper ... ... Microgms. per 100 gms. ...	—	1·0
Manganese ... ,, ,, ,, ,, ...	—	14·0
Iodine ... ... ,, ,, ,, ,, ...	6·0	2·5
Vitamin A ... Internat. units per 100 gms. ...	50	?
Vitamin B1 ... ,, ,, ,, ,, ,, ...	100	20–40
Vitamin B2	Present	—
Vitamin C	0	0
Vitamin E	Rice oil is an excellent source.	—

Constituents of rice important in nutrition.

8. The proteins of rice are generally considered to be of good quality; its biological value for man is shown in the following list along with those of some others from common sources.

Protein.	*Biological value for man.*
Beef	104
Haddock	85-103
Milk	51-99
Rice flour	83-86
Potato	56-80
Bread	25-80

Some amino acids—notably cystine, histidine, lysine and tryptophane—essential for good nutrition are found([9], [10]) in rice proteins in amounts

which compare favourably with those occurring in other proteins held to be of good value. It has indeed been maintained([38]) that if the energy requirements of a subject are met by rice alone, either during growth or for maintenance in adult life, then the protein needs will be satisfied.

9. The amounts of mineral constituents of rice are low, and even when large quantities of rice are eaten daily the needs for calcium, phosphorus and iron would not be met either by unmilled or polished rice.

10. Unmilled rice contains only small amounts of the precursors of vitamin A; it is, however, an excellent source of fat-soluble vitamin E([5]). It should be remarked that both these essential substances will be largely removed in the course of milling, as more than two-thirds of the oil in rice is taken off with the bran([42]). There is no evidence that rice contains vitamin C; in common with a number of other cereals, however, this substance develops([25]) in the course of germination. Rice bran, and therefore unmilled rice, contains some of the vitamin complex B2([27]). Most important of all the vitamins in connection with rice is vitamin B1, the deficiency of which leads to the occurrence of beri beri. This substance is present in amounts in unmilled rice adequate for proper human nutrition, but the losses are so great in storage, processing and cooking that in some circumstances intake of vitamin B1 in the rice is very small. It will now be considered what the effects of various treatments are on these components of special nutritive significance.

Effects on rice of conditions of ripening and harvesting.

11. Whilst it is known that, in general, profound changes in the chemical composition of seeds occur during ripening, only gross observations have been made on rice. As a matter of practical experience, it is appreciated that milling yields vary considerably with conditions of harvesting. The regulation of irrigation is a critical factor in ripening, and provision should be made for the removal of water as the rice approaches maturity. Harvesting must proceed rapidly as soon as a proper state of ripening has been reached, on account of the damage and losses resulting from lodging, sun-checking, unseasonable rains and depredation by birds. It has been shown([36]) for a number of varieties of rice that optimal conditions of harvesting obtain when the standing rice has a moisture content of from 28 to 23 per cent. This appears to be reached in a characteristic number of days after the panicles (heads) are formed, or in a period which elapses after the heads begin to droop. The kernels in the upper parts of the panicles are found to be fully mature* whilst in the lower parts of the head they have reached the "hard-dough" stage. Practical rules relating the optimal water content of the standing grain to the best conditions for harvesting may need to be determined for different varieties and for different local conditions. When appropriate measures are taken at harvesting, the moisture of the grain gradually decreases and is followed by a "marked increase in the weight of the air-dried kernel, in the yield per acre, in the percentage of the whole kernel obtained in the test for milling and in germination." Attempts to control the moisture in rice, whether by natural or artificial means, are fraught with difficulties. Rapid drying, for example, in the windrows and shocks (stooks) in the field may lead to stresses in the grain causing fractures called sun-checks;([4]) the grain breaks along these in the course of milling, and there is considerable reduction in the yield of whole grain.

* A guide to immaturity is the proportion of chalky kernels (commonly called "white belly"—a chalky mass appearing along that keel of the rice grain in which the embryo is situated) found in the milled product.

Methods of storage of rice and its relation to food values.

12. During storage, serious changes detrimental to the value of the rice as food may occur. Small producers keep the grain—with the husk intact—in bags, baskets or some form of granary. It is generally believed that rice stored unhulled* is safe from damage by insects; careful investigation, however, will show that this is not necessarily the case. If a count of healthy and damaged grains is taken, it will be found that even under good conditions there may be as much as 8 to 10 per cent. affected by weevils after less than one year in store. This fact does not usually obtrude itself, since the hollowed grains are removed by the winnowing([22]) to which the paddy is subjected before it is dehusked. It is possible, as will be shown, to store hulled rice under such conditions that it emerges as good a product, if not better, than that stored in the husk. This is a matter of considerable importance, since for storage and transport the presence of the husk doubles the bulk and is half as heavy again as the de-husked product.

13. There are four chief factors which need to be reckoned with in providing for the successful storage of rice. These are temperature, moisture content, contamination with insect pests and the amount of oxygen available in the store. All these factors are to some degree inter-related. A high moisture content leads to " self-heating," in part due to favourable conditions for the proliferation and metabolism of insects and micro-organisms; the removal of insects by some process of fumigation results in a lowering of temperature of the store. Rice in the husk heats less than hulled rice; and, other conditions being equal, there is less loss from damage by weevils when rice is kept in the husk during storage. Milled rice is very rapidly destroyed by weevil. It is important in the control of infestation by weevil to put the rice into store immediately after harvest, before it is heavily inoculated; also to take care that the container is free from infested debris. In the presence of carbon dioxide, the development of insects is inhibited, and it appears as if the respiration and metabolic activities of the grain are also depressed. It will be clear that this condition of carbon dioxide laden atmosphere could be attained by allowing the seeds to respire in an airtight container.

14. There is a long experience([6]) of storage of grain in air-tight containers in India, Japan and Malta. In a Royal Society Report([7]) on Grain Pests the advantages of this method for the storage of wheat were stated to be:

(i) Sterilisation from insects and vermin.

(ii) Prevention of access of more insects and vermin.

(iii) Prevention of mildew even at high temperatures.

(iv) Prevention of heating even with high moisture content, though the development of acidity is not avoided as this arises as a result of anaerobic fermentation.

(v) Avoidance of uptake of moisture from the air, i.e. if the grain is put in dry it remains dry.

(vi) Labour and expense of turning the grain over is saved.

Since this time (1920) investigators in Japan have applied these principles to the storage of rice. They([17]) have found stocks of hulled rice, dried in the sun to 11-13 per cent. moisture and stored in hermetically sealed containers, that are equivalent after 26 and 28 years storage to that stored in straw bags for two and three years respectively. The properties investigated([12]) include taste, smell, palatability, hardness, ability to absorb

* Un-husked or un-hulled, rough and " paddy " rice are terms in use implying that the grain is still in the husk.

water, germination power and vitamin B1 content. The two latter properties appear[16] to run parallel. On the basis of the result of many years of investigation, the Japanese recommend[18] for storage in air-tight or carbon dioxide containing chambers, a water content of 10 to 12 per cent. if required to store for 3 years or more; 14 per cent., for storage of from 1 to 2 years, and if the grain contains 16 to 18 per cent. of water it is not safe to store for more than a year.

15. In the consideration of methods of rice storage, preference should be given to those in which the vitamin B1 content is conserved as far as possible, for it is well established now that insufficiency of this substance in the diet leads to disease of the nervous system, to disturbance of metabolism in several tissues of the body including muscle, to impaired function of the heart and circulatory system, and to derangements in the digestive system, one of the earliest to appear being a small appetite. The fully developed disease which follows deficiency of vitamin B1 is beri-beri; it can be prevented by ingestion of sufficient vitamin B1, and the most severe and previously fatal cases have been cured[31] by doses of 3-5 milligrams of the pure natural or synthetic substance.

16. The effect on the vitamin B1 content of grain stored under various conditions is shown in the data presented in tables 2a and 2b.

TABLE 2A.

The vitamin B1 content of hulled rice after storage under various conditions.

Length of time stored.	Method of storage.	Percentage of value for vitamin B1 in fresh rice.
1 year ...	In straw bags [15]	92 per cent.
2 years ...	,, ,, ,, [15]	82 ,, ,,
3 ,, ...	,, ,, ,, [15]	56 ,, ,,
4 ,, ...	,, ,, ,, [15]	23 ,, ,,
4 ,, ...	In airtight container (moisture 10 per cent.) [16]	Equal to new rice.
4 ,, ...	In carbon dioxide (moisture 11·5 per cent.) [16]	Equal to new rice.
26–28 years ...	In airtight container (sun dried ; moisture 11–13 per cent.) [17]	84—54 per cent.

TABLE 2B.

Comparison of vitamin B1 content of hulled and unhulled rice after storage

	Percentage of value for vitamin B1 in fresh rice.	
	Hulled.	Unhulled.
Two varieties stored in straw bags for 2 years. [21]	(*a*) 82 per cent. (*b*) 95 ,,	(*a*) i. 75·4 per cent. ii. 87·0 ,, (*b*) i. 98·0 ,, ii. 84·0 ,,
Stored in airtight concrete silo for 3 years. [20]	Equal to fresh rice.	95 per cent.
Stored in airtight concrete silo for 5 years. [20]	95 per cent.	75 ,,

In so far, then, as the vitamin B1 content is concerned, storage in straw bags in a granary is possible without serious loss up to about two years; but under such storage it has been found([14]) that after one year in a straw bag the taste of the rice was undesirable, after two years taste, smell and colour were very bad and the rice could scarcely be eaten, whilst after three years in the straw bags the grain was bad and could not be used. It will be shown later that the development of an undesirable smell and taste affects the treatment required before cooking, and consequently the vitamin B1 content, so that mere retention of the vitamin during storage is only part of the story.

17. From the evidence we now have, it may be concluded that when no special precautions are taken—or when these are impracticable—rice is best stored in the husk. Where it is possible to store in air-tight containers, this should be done. The rice may then be stored hulled, for, as a result of experiment, it has been shown that when kept under these conditions, in no respect was un-hulled rice superior after storage to the hulled product([21]). Even better results are claimed([14]) when the grain is stored under carbon dioxide. When, as is sometimes the case, fumigants are employed to rid the grain of insects, it is also more convenient to use hulled rice as it is difficult for heat and gases to penetrate the husk. It is of some interest to note that when carbon dioxide is used in combination with fumigants, the toxicity of the latter for the infestation is increased, as carbon dioxide is a respiratory stimulant.

18. Under primitive conditions, with limited material at hand, the best method of attaining completely air-tight storage is still a matter of experiment. There is evidence that successful storage of foodstuffs on a small scale is possible with glazed crocks covered with raw hides. The value of heavily mudded containers is being investigated. Metal tanks have been used([19]) (1·7 metres high and 0·9 metres diameter) with quick lime to act as a " drier "([13]) (1 kg. per 30 litres of rice) introduced at intervals in the tanks, relatively more " drier " being placed in the lower parts of the tanks. Good results are claimed([20]) with concrete silos (capacity of 1·8 kilo-litres, i.e. about 64 cu. ft.; height not more than 3 metres) having walls 15 cms. thick; they must be thoroughly dried out, and care taken to see that they are hermetically sealed. The oxygen in the air introduced with the grain is used up by the latter in the course of respiration; to assist in using up the dead-space oxygen, a lighted candle may be introduced([29]) immediately before the container is closed.

19. From time to time evidence has been present in support of the view that substances are produced in rice during storage which are toxic to human beings. It has been thought that the toxicity might be due to poisons produced by fungi or bacteria growing on or in the grain. The opaque patches occasionally seen in grains of non-glutinous rice were at one time considered to be the result of changes following the growth of invading organisms. These views are now said([22]) to have been based on results obtained by a faulty technique. Investigations of the toxicity of rice were originally made in regard to the causation of beri beri; then it was presumed that epidemic dropsy, a disease occurring among rice-eaters and believed to be different from beri beri, was caused by rice toxins. Recently, however, it appears([23]) that epidemic dropsy may be the result of poisoning from consuming some brands of mustard oils.

20. In a small area of China there is a method of storage in use in which rice after de-husking is milled, mixed with the bran removed and placed in large plaited grass containers of about 200 cu. ft. capacity. Heating is started by a bundle of twigs and green leaves placed in the middle of the mass of grain. The temperature is allowed to rise considerably, and is controlled by ventilation from time to time by means of a basket-work chimney inserted into the store. This " curing " process is allowed to go on for from six to eighteen months, the condition of

the batch being determined at intervals by examination of samples taken out by means of a hollow probe. The product is known as Kashing rice (after the town in and around which the method is practised) or " yellow " rice, on account of the colour of the product. It is greatly appreciated by some for its flavour, and it is believed to have special dietetic properties. We have evidence that there is breakdown of carbohydrates in the process. There is a similar process in use in India([41]). As a method of storage over long periods under primitive conditions, especially to " improve " coarse rices, it may prove worthy of trial and investigation.

The parboiling of rice.

21. A well-known and widely used method of processing rice is called " parboiling ". The process consists of soaking rough rice in either cold, warm or hot water in cement or metal tanks. The water is drained off and the rice is placed in metal cylinders, in which there are one or more perforated steam pipes. Steam is blown into the rice until the hulls are opened slightly. The parboiled rice is then removed from the cylinder, thoroughly dried in the sun or by artificial means, and milled.

22. Not only may the soaking process last as long as four days, but more than one change of water may be employed.([37]) The duration of steaming is usually only ten to twenty minutes. The length of these operations, and the nature of other details in the process such as the use of excess water or several changes of water, are probably of considerable importance in so far as they affect the vitamin B1 content of the final product. It is believed([2]) that during soaking and steaming, vitamin B1 from the germ and pericarp diffuse into the endosperm. When subsequently the outer layers of the grain are removed in milling, some of the vitamin is left behind in the endosperm, which does not contain the vitamin when the whole kernel has not been treated by parboiling or other treatments with a similar effect (e.g. the " josh " method in use in India).

23. In the course of soaking, vitamin B1 may also diffuse *out* into the water in the tanks; if the water is in excess of that taken up by the grain, and particularly if the water is changed during soaking, losses may be expected to occur. The process is indeed similar to the washing which, as we shall show later, effectively removes the water-soluble vitamin B1 from the grain. Some recent experiments([11]), however, tend to the conclusion that only 12 hours soaking at 60-70 degrees Centigrade are required to give a good product. If this time period were combined with soaking in amounts of water just sufficient to swell the grain, losses of water-soluble food factors would be avoided. It would be an advantage to acidify the water used at this stage, not only because of eliminating foul odours which may arise in the process, but also because it would stabilise vitamin B1. It is obviously desirable in preventing loss of vitamin B1 to avoid the use of changes of water during soaking.

24. The process appears to have been introduced in the first instance in order to facilitate de-husking, for after the treatment the husk swells and splits. The kernel is also toughened, so that checked grains are strengthened and there is a higher percentage of head rice on milling. The pericarp is, however, more difficult to remove in the toughened grain, and some may remain especially after milling by primitive methods; this may be an advantage from a nutritional point of view. In the opinion of some authorities([32]), there is still insufficient vitamin supplied in a diet in which parboiled rice is substituted for ordinary white rice. Indeed, beri beri has been known([40]) to appear in communities eating parboiled rice, probably because the vitamin has been washed out before cooking, though it has been shown([39]) (table 7) that the vitamin is less easily removed by washing after a preliminary soaking.

25. A number of advantages, then, are evident in the use of parboiled rice. There is, however, a distinctive flavour which develops in the treatment which, whilst highly appreciated by some, is disliked by others. This point should be kept in mind when the introduction of the method is under consideration. It has been claimed that the parboiled product is more sustaining than a similar rice not so treated. From a commercial aspect, too, it is of value as a treatment of rice used in canning, as the grain keeps its shape better after toughening.

The milling of rice and the nutritive value of the products.

26. In the preparation of rice for human consumption, the husk and usually some or all of the outer layers of the grain beneath the husk (the pericarp) are removed. The shelled grain is called hulled or de-husked* rice. The pericarp and more or less of the embryo is taken off by pounding by hand or foot, or with the aid of mills worked by animals, or with power driven mills. Sometimes de-husking and removal of the outer layers is effected in one process. The portion removed is known as rice bran. If the milling is pushed further to obtain a fine product, the outer layers are more completely removed in fine particles known as polishings, and the product is " white rice." The bran and polishings together may be referred to as " rice meal." A final process in milling consists of a further polishing process in which a coating or glaze, usually containing talc, is applied to the rice. This facing is believed to enhance the appearance of the grain, and to protect it from the attacks of insects. Some polishing powders are definitely harmful to the human body if eaten; and they give rise to the need for washing before cooking which, as will be shown below, is a procedure which might be eliminated with advantage to human nutrition. The practice of using polishing powders, however, seems to be falling into disuse, for in 1931(1) out of 195 samples of rices imported into Great Britain, only 16 were coated and only 3 of these had more than 0.5 per cent. of powder on them.

27. The chief product of milling is known technically as " head rice "; it consists mainly of whole kernels. Smaller whole kernels and prescribed proportions of broken pieces are found in other fractions known as " second head rice," " brewers' rice " and " screenings." In a sample of " Fortuna," for example, the following yields have been reported(36):—

	Per cent.
Milled (head) rice	57
Second head rice	8
Brewers' rice	2
Screenings	1
Hulls	19
Bran	8
Polishings	3
Dirt and shrinkage	2

Efforts in the rice trade are naturally directed towards securing a high percentage of head rice of high grades which are determined largely by appearance and soundness of the grain, freedom from foreign matter and not more than a prescribed amount of moisture (usually taken as 14.5 per cent.).

28. There are, however, important nutritional aspects of rice milling which need to be considered. Beriberi is known to be associated with the consumption of large amounts of highly polished rice, and the disease does not develop when lightly or un-milled rice is substituted for the refined cereal. The solution recommended in the past has been that the latter should be replaced by a partially milled rice. It is by no means certain

* De-husked rice, which is not further milled, that is it still retains its pericarp, may be referred to as " milled rice," " brown," " red," or " silver skin " rice.

that this is the best way of combating beriberi and, in practice, it is extremely difficult to introduce the necessary measures among peoples already accustomed to eating white rice, or to prevent those eating the "home-pounded" grain from substituting white rice when they can get it.

29. It is indeed physiologically uneconomical to consume un-milled or only very lightly milled rice, as will be seen from the figures(34) quoted in the following table:—

TABLE 3.

Digestibility and utilisation of rice.

Form of rice.	Average mean (per cent.) digestibility.				From 100 grams of rice.	
	Total nitrogen.	Carbohydrate.	Fat.	Inorganic substances.	Calories. Actual quantity utilised.	Calories. Waste (as faeces).
White; 100 per cent. polished.	85·79	99·68	86·81	90·88	315·99	4·83
70 per cent. polished	82·99	99·59	80·51	87·30	303·63	6·95
50 per cent. polished	81·98	99·29	74·35	84·36	283·55	10·19
Unpolished ...	74·86	98·61	58·27	77·98	273·50	19·72
Unpolished rice flour	—	—	—	—	282·01	12·00

These show that there is an appreciable loss of nitrogenous matter, fat and mineral substances when unpolished rice is eaten in place of white rice. This is due(30) to the fact that in the course of digestion, the juices in the alimentary canal must penetrate not only the wells of the cells of the endosperm, which largely remain intact even after cooking, but also in the lightly or unmilled grain they must pass through the cells of the outer layers of the grain, which are particularly difficult to penetrate. It is clear, too, that digestion will be assisted if the grain is broken up by grinding. Starch which is left undigested inside the cells is likely to be liberated in the colon when the walls of the cells are broken down by bacterial action; fermentation of the starch follows, with gas formation giving rise to the condition known as starch or carbohydrate dyspepsia.

30. Against the losses in digestion must be placed those entailed in milling; these are shown in the following table:—

TABLE 4.

Composition of rice before and after milling with percentage loss in weight and of constituents (24).

Average of 5 samples.	Moisture.	*On moisture free basis.* Fat.	Crude Fibre.	Ash.	Protein (N×6·25)	Carbohydrates.	Weight per 1,000 kernels.
Composition of unmilled rice (brown) ...	9·26	Per cent. 2·45	Per cent. 0·88	Per cent. 1·22	Per cent. 8·67	Per cent. 86·70	Gms. 20·11
Composition of white rice ...	9·37	0·37	0·16	0·36	8·15	90·79	18·24
Losses on polishing	—	86·1	83·7	73·2	14·9	5·7	9·5

It has been estimated([24]) that of the annual yield of unpolished rice in the United States (a thousand million pounds), one hundred million pounds are removed in polishing; this is mainly disposed of as feed. This material includes twenty million pounds of fat, twelve and one half million pounds of protein and nine million pounds of mineral substances. More than 50 per cent. of the latter is a combination of phosphorus with calcium, magnesium and sodium, fully 25 per cent. of it being in the form of potassium phosphate.

31. Vitamin B1 is also removed in the milling process. The extent to which this occurs is seen from the figures([30]) given in the table below:—

TABLE 5.

Form of rice.	Vitamin B1 content (international units per 500 gms.)
Unmilled	400–500
Lightly milled ...	250–400
White rice	100–200

These figures are given for amounts of 500 gms. of rice; this amount will provide about 1,750 calories if it is all absorbed and utilised; it is probably an average figure for consumption for rice eating peoples, though as much as twice this amount may be consumed daily. The values were obtained from work done in the Dutch East Indies, but have been confirmed by another method of assay in the writer's laboratory in China. Their significance for human nutrition can, however, only be appreciated if the requirements of man are known.

32. An exact statement of human needs is not possible without qualification, since a number of conditions associated with increased metabolic activity of the body, such as occurrence of fever, unusual amounts of exertion, high total energy value of the diet and so forth may increase the amount required.([31]) As a guide it may be taken that an adult man requires a minimum of 300 international units of vitamin B1 daily; and it is desirable that double this amount be available. Symptoms of hypovitaminosis are likely to occur on diets which contain less than the physiological minimum; an intake of less than 150 units per day is attended by grave risk of the development of beriberi. On a mainly vegetarian diet such as is taken by peoples living principally on rice, 100-150 international units of vitamin B1 are commonly consumed from sources other than rice. Beriberi may well develop unless vitamin B1 is contributed in the rice. From the data given above, it is possible that highly polished rice may supply 100-200 units in 500 gms. of rice, i.e. if there is no loss in cooking. This question may now be discussed.

33. There are numerous ways of cooking rice—the ultimate aim in all is, or should be, to produce a thoroughly cooked product which is attractive in appearance and in which each grain is separate. The basis of most methods of cooking is either boiling or steaming, or a combination of both procedures. Sometimes an excess of water is used, and substantial losses are found, especially in mineral salts and vitamin B1. A simple method is given below; the product it yields fulfils the requirements laid down. It is necessary to learn by experience, however, the right amount of water to add for different varieties of rice to end up with a " dry " dish.

To one pound of rice placed in the cooking vessel one and a half pints of water are added; a lid is put on, the water is brought to the boil and then allowed to simmer. The time of cooking is twenty minutes; this can be shortened by five minutes if boiling water is used

in the first place. If the rice is left undisturbed it will cook much better. Should the product be too wet it may be stirred up with a wooden spoon, and excess moisture driven off with the vessel over a small fire. Larger quantities than those given will require a longer time to cook.

In this method the water added is taken up completely; consequently there are no losses.

34. It is customary to wash rice thoroughly before cooking. This is done in, say, a running stream or in some three changes of water. At the same time, the cook often rubs the grain vigorously against the side of the basket or container in which it is being washed. There is no doubt that this stage in the preparation of rice is responsible for vital losses of essential food factors. Some indication of this may be obtained by studying the accompanying table:—

TABLE 6.

Losses entailed in washing white rice with water (34).

Loss in washing.

White rice (100 per cent. polished with polishing powder).	Total solid matter.	Protein.	Carbo-hydrate.	Fat.	Inorganic substances.
1 kgm.	gms. 42·3 (4·2%)	gms. 12·4 (15·7%)	gms. 17·8 (2·0%)	gms. 2·7 (42·6%)	gms. 4·2 (73·0%)

35. For many years there have been indications that washing rice is an important factor in the outbreak of beriberi. At a conference in Hong Kong in 1912, it was reported that there were two institutions in which the same rice was being eaten. In the one were monks, none of whom had beriberi; in the other, a nunnery, the disease was known to occur. The difference was ascribed to the fact that the monks, being less fastidious than the nuns, omitted to wash their rice, which therefore retained sufficient vitamin B1 to protect them against the disease.

36. Experimental evidence on which this view of the importance of washing rice is partly based, is produced in the following table:—

TABLE 7.

Vitamin B1 in rice of different grades of milling following various treatments.

International units of vitamin B1 in 500 gms. of

Treatment of rice.	Unmilled.	Lightly milled.	White rice.
Original	400–500	250–400	100–200
Washed	250–300	125–200	Less than 100
Steamed	—	250–400	100–200
Washed and steamed ...	About 250	75–125	Less than 100
Soaked and steamed ...	—	200–250	—
Soaked, washed and steamed	—	125–200	—
Boiled and steamed ...	—	250–400	100–125
Washed for a long time	—	Much less than 100	Much less than 100

The figures in this table are of profound importance, and will repay careful study. It will be seen, for example, that after thorough washing both lightly and highly milled examples of rice are almost completely depleted

of their vitamin B1. Again the findings were reported from Java[39], and have been confirmed by the writer. Further than this, a feeding experiment has been carried out on groups of factory workers in Shanghai. One group of workers was fed on rice freshly and highly milled each day, and cooked by the method described above, without preliminary washing. Control groups were observed fed on rice milled to a similar degree, but washed thoroughly in the ordinary way. Side dishes and other conditions were comparable in all the groups. No signs of beriberi developed in the group on the unwashed rice, whereas in the control groups nearly half the subjects developed signs attributable to vitamin B1 deficiency. The rice used in this experiment was actually stored in bags in the husk, as no facilities were available for storage in airtight containers; but the evidence presented above suggests that this would have been a more satisfactory way of conserving the vitamin B1. It may then be claimed, on the grounds of these results and on the basis of what we now know of the requirements of vitamin B1 and of its behaviour in rice under storage, processing and cooking, that—under properly controlled conditions—it is possible to feed highly milled rice without special provision of foodstuffs rich in vitamin B1 in the diet, and yet avoid the development of beri-beri even in its earliest clinically-recognisable forms.

37. When it is recalled that better utilisation of rice follows powdering (see para. 29 and table 3), especially when some of the outer layers still remain, it is worth while drawing attention to the various methods of cooking rice flour. These include various types of vermicelli, some of which are especially nutritious when egg, fish and other products are incorporated in them, and biscuits or rusks.

38. One other preparation which is not widely known has properties which justify a short description. This is a rice "bread" prepared[26] by the Annamites of French Indo-China, and known to them as "banh-duc". Rice is softened by soaking overnight, and is ground to a paste with five times the amount of lime water (containing about 1·25 gm. of lime per litre of water). It is cooked over a low fire for about thirty minutes, when it turns into a pasty mass. This is beaten on a wooden platter, and 1 per cent. of sea salt is mixed into the mass, which is then allowed to cool into loaves of rice bread. The final product is rich in calcium; roughly thirty times as much calcium is ingested when rice is prepared in this form compared with the amount supplied in the same quantity of rice cooked by ordinary methods.

Main conclusions.

39.—(i) It is possible to feed rice, which has been well-milled, as a sole staple food without the development of any signs of beriberi provided:—

(*a*) the rice is stored under conditions such that its vitamin B1 is not lost;

(*b*) it is not washed before cooking;

(*c*) there is no superfluous water at the completion of cooking;

(*d*) not less than 150 international units of vitamin B1 are supplied daily in other components of the diet.*

(ii) Storage of rice is a crucial factor in adequate nutrition with respect to vitamin B1 amongst rice-eating peoples. It has been established that rice can be stored without its husk with as good if not better results than those obtained with rice stored with its husk on. To succeed with the former method, however, there must be control of the moisture content of the grain, and it must be kept in airtight containers, or, better still, in an

* This amount is usually found in diets in which rice is the staple cereal; it is provided, for example, in 6 oz. of dried beans or 3 oz. of ground nuts.

atmosphere of carbon dioxide. Storage without the husk has great advantages in bulk storage or where the article has to be transported, since the removal of the husk results in a considerable reduction in both weight and volume. Incidentally, the rice bran will be, nutritionally, a far more valuable product if it is used immediately after removal from the grain.

(iii) Washing of rice before cooking may drastically reduce the beri beri-preventing factor; this is true for rice of all grades of milling. The need for washing can be eliminated:—

(*a*) if polishing powders are abolished—they appear to serve no useful purpose, and must be washed off as they may be definitely harmful if eaten;

(*b*) if the storage is so good that the grain does not develop an undesirable flavour—storage of de-husked grain in hermetically sealed containers meets this requirement;

(*c*) if milling is carried out shortly before the rice is required for consumption—milling is itself a cleansing process, and if the product is subsequently handled hygienically, further cleaning would be superfluous.

(iv) Cooking must be carried out in a manner in which there is retention of vitamin B1.

(v) Parboiling affords a partial solution of the problem of conservation of sufficient vitamin B1 to prevent the occurrence of beriberi. It may not be acceptable, however, if there are definite prejudices against the flavour of parboiled rice. In the process there are steps in which losses of the vitamin may occur; these can be reduced by modifications based on the knowledge that *vitamin B1 is soluble in water,* and is more stable in slightly acid than in alkaline solutions. No advantage is gained by substituting parboiled for other rices if it is washed before cooking, as the vitamin B1 is then reduced to levels at which beriberi develops.

(vi) The yield of rice attained in Far Eastern countries contrasts markedly with that in many Colonial Territories. This is a matter for Agricultural Departments to take up; it involves mainly the provision of irrigation works, the control of seed selection, weeds, and harvesting and the maintenance of soil fertility.

(vii) Large tracts of undeveloped land are to be seen in some Colonial Territories which, under proper irrigation, should provide suitable ground for rice cultivation.

(viii) Whilst there are differences in variety and cultural conditions which, to some extent, modify the nutritional value of rice, increased yield per unit area should be the first consideration. When conditions permit of optimal production, there is no food crop of comparable nutritional value which can approach rice in the amount of food produced on a given area. Moreover, it has a valuable sociological feature; it anchors a community to the place in which it has expended capital in the form of irrigation works, including terraces, conduits, bunds, pumping and other devices for water conservation and control.

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INDEX (to Part I)

(*Note.*—References to the Summary of Conclusions are given in **heavy** type.)

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