First Scientific Meeting—First English Meeting

Physiological Laboratory, Cambridge, October 18th, 1941

THE EVALUATION OF NUTRITIONAL STATUS

(Summarized Reports without Bibliography)

Morning Session: Chairman, Sir Charles Martin

Assessment of Level of Nutrition in Man

Dr. L. J. Harris (Dunn Nutritional Laboratory, Cambridge) said that he greatly appreciated the compliment of having been asked by the Committee to read the first scientific communication to the new Society. The large attendance was a good augury for the success of the Society, and he only regretted that it had prevented the meeting from being held, as planned, at the Dunn Nutritional Laboratory, and the members from seeing something of the work in progress there. He proceeded to deal with laboratory methods, the biochemical and physiological techniques for assessing accurately the nutritional level of each specific dietary essential. He stressed first the need for such tests. Their use made it possible to detect evidence of deficiency earlier than could generally be done by clinical examination; mere clinical appearance was not always a sufficient guide to a subject's nutritional status. Even in absence of deficiency it was often useful, particularly in war time, to determine whether the reserves of a particular nutritional factor were low, medium or unnecessarily high. Again, the final symptoms of deficiency of, for example, vitamins C and K were often of extremely sudden onset, and hence it was desirable to be able to detect their approach. Finally, it had to be realized that partial deficiencies were the cause of definite ill health even in the absence of obvious clinical signs or symptoms.

This idea of partial deficiencies was not yet universally accepted. It was, however, a mistake to suppose that because frank scurvy or beriberi was rare in this country everyone was having enough vitamin C and vitamin B_1. Two simple examples might be cited to prove the reality of partial deficiencies: the administration of extra iron to apparently normal babies and mothers, or of extra milk to apparently normal children, had caused indisputable improvement in health and physique. The current method of classifying the nutritional status of school children by superficial examination was unsatisfactory because the criteria were variable or inadequate; also existing weight and height standards were too low, being founded on past averages instead of on true normals, as was proved by the recent steady improvement. In other branches of medicine the aid had had to be called in of scientific tests, such as radiography, test meals and tests for kidney function, and nutrition should be no exception.

Partial deficiencies of vitamins in man and experimental animals had been proved to cause among others the following ill effects: vitamin A, poor dark adaptation, incipient xerosis, sub-optimal growth; vitamin B_1,

gastro-intestinal hypotonia, sub-optimal growth; vitamin C, liability to infection, increased capillary permeability, imperfect growth of bones and teeth; vitamin D, lowered assimilation of Ca and P, minor bony defects, increased dental caries, impaired muscular tone; vitamin K, liability to haemorrhage.

The concept of partial deficiencies could be illustrated most clearly by animal growth curves. One unit of vitamin B_1 would prevent symptoms of deficiency, two units would promote reasonable growth, but many times more were needed to obtain optimum performance; that is, the response was logarithmic.

With these principles in mind the speaker had, in 1936, proposed that tests for specific nutritional factors should be carried out on random groups of the community, to obtain a view of the general nutritional status. The methods available now included: for vitamins C, B_1 and nicotinic acid, urinary saturation tests or blood tests; for vitamin B_1, glucose pyruvate tolerance tests; for vitamin A, assessment of dark adaptation, of incipient xerosis, of liver reserves *post mortem* and possibly of blood level; for vitamin K, measurement of blood prothrombin; for vitamin D, estimation of blood phosphatase and of phosphate and calcium; for iron, estimation of blood haemoglobin.

As an example the speaker described in detail the saturation test for vitamin C. It was based on the experimental observation that the response to test doses depended on the past dietary intake. Subjects with scurvy required a week or ten days of standard test dosing before the tissues became saturated and a resulting sudden jump in the excretion occurred. Subjects whose diet had contained more than the daily requirement became saturated, and hence showed a response, on the first or second day, while with intermediate intakes responses were intermediate. Hence the assessment of requirement could be based on the number of days' delay before the peak of excretion was reached. A simplified method which had been used satisfactorily in surveys on large numbers of school children consisted in giving a large test dose during morning school and collecting a three-hour specimen of urine during the afternoon, when the response was at its height. Curves were shown illustrating the following: the difference between children from poor schools and those at institutions where the diet was good; the improvement when orange had been added daily to the diet; the higher levels in late summer as compared with winter; relatively lower levels on war time diets as compared with peace time for both poorly and well fed children; and the graded responses seen after various graded supplements of vitamin C had been given in the diet of large groups of schoolchildren. Contrary to expectation, variations between individuals on a given level of intake were not large and, therefore, whatever theoretical objections might possibly be suggested, the method actually worked in practice. The application of the test had shown that low levels of vitamin C were found in patients with acute infectious diseases, notably phthisis, in patients kept on "gastric" diets (*"scorbutus per culpam medici"*), in infants on cow's milk, and in the lower economic classes.

For vitamin B_1 a similar method of test on the urine was available and had lately been simplified by the substitution of the chemical thiochrome test for the earlier biological bradycardia method. The urinary excretion

of vitamin B_1, however, was more labile than that of vitamin C, and responded fairly promptly to every change in the dietary intake. The diagnosis of deficiency was based on one or more days' delay before the full response to test dosing. When the reputed requirement, 300 I.U., was consumed daily the excretion was of the order of 150 to 250 I.U. Excretions below 30 I.U., together with a subnormal response to test dose, indicated subnormality. The application of this method had confirmed the conclusion that symptoms of neuritis seen in association with pregnancy, with inebriety, with gastro-intestinal obstruction or with faulty absorption, were frequently due to a conditioned deficiency of vitamin B_1.

In pellagra in experimental animals or in man, the excretion of nicotinic acid was diminished and this could be used as the basis for a test. Trigonelline in the urine might be derived either from nicotinic acid or from the biologically inactive trigonelline itself, present in the diet. If therefore the method were based on the excretion of trigonelline rather than of nicotinic acid, a control diet free from trigonelline would have to be used; otherwise nicotinic acid should be estimated.

The dark adaptation method for diagnosing deficiency of vitamin A had been questioned, but experience proved it could be used safely if certain precautions were taken. Groups of subjects receiving a deficient diet showed a progressive decline in adaptation, which was restored to normal when vitamin A was given in sufficient amount. If in groups of schoolchildren it was found that low adaptation did not improve in the absence of vitamin A, but did respond after dosing, it was legitimate to conclude that there was evidence of deficiency. Independent budgetary surveys had proved that the low adaptation performances were in fact correlated with a past history of dietary insufficiency.

Work was still in progress to develop these and similar techniques. It could be claimed, however, that, with proper safeguards, they could be used as reliable methods for obtaining exact information about the level of nutrition of individuals or groups in single nutritional essentials.

Dr. H. M. Sinclair (Oxford Nutrition Survey, 10 Parks Road, Oxford): I fully agree with Dr. Harris about the importance of laboratory tests. The earliest changes in deficiency states are changes in function only, and are difficult to detect clinically until structural changes supervene. The importance of detecting deficiency before the latter have appeared is illustrated by a recent paper by Kruse who found that the early vascular changes in the eye produced by deficiency of vitamin A and only visible with a slit lamp microscope took months to heal with intensive therapy; neuritis due to deficiency of the vitamin B complex may be permanent.

Sir Charles Martin mentioned the nutrition of the cells of the body, and that depends on the nutrients brought to them by the blood. Estimations of these in blood, therefore, gives an assessment of the state of nutrition of the body. The main disadvantage of this method is that all the nutrients cannot be covered, but since deficiencies are usually multiple this is not a crippling limitation.

Sir Frederick Hopkins mentioned the antagonism of clinicians to the concept of vitamins, and even in the presence of the President of the Royal College of Physicians I may venture to compare

the assessment of the state of nutrition with the diagnosis of, say, typhoid fever. For this the clinician notes at a glance that the patient is ill, just as school medical officers assess at a glance the nutritional state of children; such information is of little value in itself. The clinician then notes the fever, the rash, the enlarged spleen and the abdominal tenderness, and the diagnosis is then made *in the laboratory* by the bacteriological examination of blood, urine or faeces and by Widal's agglutination test. Similarly, in the assessment of the state of nutrition, the clinical signs and symptoms must be sought, and recourse then made to the laboratory. The laboratory is as important in the assessment of the state of nutrition of an individual or a population as it is in the diagnosis of a single case of typhoid fever or of an epidemic. To illustrate this I have drawn up a list of the methods being used or recently used in nutrition surveys in Tennessee, North Carolina, Pennsylvania, New York City, Toronto, Marseilles, Scotland (Carnegie Survey), and Oxford. In particular I want to stress the importance of a slit lamp examination of the eye in the diagnosis of early deficiency of riboflavin or of vitamin A; according to Kruse, deficiency of the latter can be detected earlier by this method than by measuring dark adaptation. Of equal importance are determinations in blood of vitamins A, B_1 by both the cocarboxylase and *Phycomyces* methods, C particularly in white cells, and of nicotinic acid, protein, phosphatase and prothrombase. In almost all these surveys, a university well equipped for fundamental biochemical research is collaborating with clinicians and public health authorities, and the work is assisted financially by the Rockefeller Foundation or the Milbank Memorial Fund. In no other field is there such widespread collaboration, and this will be strengthened and fostered in this country by the Nutrition Society.

Dr. J. Yudkin (Dunn Nutritional Laboratory, Cambridge) and Mr. G. W. Robertson (O.R.S., Coastal Command) said that poor dark adaptation in single individuals might be proved to be due to deficiency of vitamin A by the improvement which occurred when the vitamin was given. In comparing large groups of people, however, a comparison of the proportion in each group whose dark adaptation was good, bad or indifferent was sufficient to show the relative status of these groups as regards their vitamin A intake. Thus, in a study carried out in children from three Cambridgeshire schools, 60 per cent. of the children from two of the schools, and only 35 per cent. from the third school, were classed as having good dark adaptation. In adults, it was necessary to compare groups of similar age, since there was a deterioration of dark adaptation with age. Of three groups of young people below the age of 22, two, nurses and medical students, showed 80 to 90 per cent. with good dark adaptation, whilst the third, workers in a Midland factory, contained only 55 per cent. in this grade.

The factory workers were also examined as to their haemoglobin levels. Nearly 800 subjects were investigated; more than 30 per cent. of the women and some 6 per cent. of the men had some degree of anaemia.

Afternoon Session: Chairman, SIR JOSEPH BARCROFT

Clinical Signs of Dietary Deficiency

Dr. B. S. Platt (London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1), speaking from his experience of deficiency disease in the Far East and in Central and East Africa, said that assessments of state of nutrition should be made at two levels, a low level at which clinical signs of dietary deficiency could be distinguished, and a high or optimal level. The test used to establish the attainment of the upper level should be designed to measure performance. Different types of laboratory tests and investigations were required for working out the presenting features of both these states. In the past, presenting signs of the occurrence of the lower state and tests of the degree of attainment of the upper state of nutrition had been confused. Sometimes the clinical content of the two states had not been determined and was nothing more than an impression. Recognition of clinical signs of deficiency at an early stage was important; the effect of the duration and of the degree of deficiency on the nature of the clinical lesion should be taken into consideration.

Investigations in the field as well as in hospital practice were needed in order to obtain a knowledge of the natural history of deficiency states and a correct estimate of their incidence. Some minor signs of deficiency were in some populations so commonplace that they were considered to be normal. When deficiencies of food factors were slight they were often multiple in character. Deficiency of different food factors often gave rise to the same or similar clinical signs. The application of certain stress factors, work, extremes of climate, growth and childbearing, might determine the appearance of signs of a deficiency disease or its localization in a particular part of the body.

Infective agents often gave a characteristic appearance to a lesion in malnutrition and might, in fact, be regarded at times as biological indicators of a deficiency disease. The relationship between a disease and a dietary defect could often be established by observing the effect of curative and preventive treatment; sometimes a lesion did not respond, or only slowly, to treatment.

The incidence of signs of deficiency disease could be correlated with the level of intake in the dietary of specific nutrients. Wide differences in behaviour and state of well being were found associated with nutrition at the two different levels. With the two levels of nutritional status corresponded two limits of requirements for specific nutrients. A balanced diet should be assured at least at the lower limit of intake, thereby securing freedom from signs of dietary deficiency disease. Attention should then be directed towards achieving optimal nutrition.

For the most part, the aim in human nutrition had been to keep above the level of the lower plane; on the other hand, in animal husbandry emphasis had generally been on feeding for optimal efficiency and production.

Dr. R. H. Dobbs (135 Harley Street, London, W.1): An estimate of the state of nutrition of children is obscured by the overlapping of the

signs of malnutrition with those of disease. Failure to gain weight may indicate either a lack of sufficient nourishment or the presence of a chronic ailment; if the disease is cured weight will be gained, or if a weight increase is induced an improvement in the condition will be brought about. Height and weight measurements are a reflection of the growing child's nutritional state. Weight alone is of less value than when related to height, and this index is of greater accuracy than that relating weight to age. Single estimations are, however, notoriously inaccurate and progress over a period of time is the only really satisfactory way in which nutritional state can be estimated on the basis of somatic measurements. The reduction of these measurements to factors or indices, cannot overcome the basic inaccuracy of the original measurements.

The clinical estimation of the state of nutrition is based on an examination of the skin, build and musculature and on the state of the bones and teeth, on the mother's and on the school teacher's report of the child's energy and vitality, and on a search for the clinical evidence of specific vitamin deficiency. Postural defects, especially flat feet and knock knees in children not grossly overweight, are often evidence of wrong or insufficient feeding. The appearance of the back, with arms extended, is likewise accepted as a useful guide. A poorly formed dorsal median furrow, dorsal lordosis and scoliosis indicate long standing malnutrition.

Gross vitamin deficiencies always indicate malnutrition, but it is the marginal deficiency that needs to be constantly kept in mind and looked for. In addition, indications of mixed deficiency states are now being recognized, and also disease processes arising out of underlying deficiency states. Denudation and atrophy of the marginal mucous membrane of the mouth are known signs of vitamin deficiency; angular stomatitis is an infection that occurs when the appropriate organisms gain entry into the point of previously lowered resistance. Further knowledge may indicate that, in this country, some conditions occurring in the poorer classes are of this nature.

Malnutrition or partial malnutrition can sometimes be inferred from the mother's history. The family financial status may be such that a deficiency of some essential foods can be assumed. In view of the work of Mackay and of Davidson, anaemia can be expected with considerable certainty if iron therapy had not been practised in the early months of infancy, an anaemia which is reflected in an added liability to infections. Gastro-enteritis, the most serious disease of the first year of life, is practically unknown in breast fed infants, and the incidence of respiratory infections is greater in bottle fed infants, and remains so until at least 18 months of age. It must, therefore, be accepted that a state of malnutrition exists in children up to two years from whom breast feeding has been withheld during the first six months.

Finally, therefore, though the overt signs of specific deficiencies are comparatively rare, and though marginal deficiency states may not be apparent, a fully adequate state of nutrition is not present unless the human machine, like man made machines, can stand up to stress of performance. One such stress, peculiar to childhood, is the stress of growth. Another, common to childhood and maturity, is that of infection, and evidence of malnutrition may be absent until brought out by the application of such stresses.

Mr. W. C. W. Nixon (Paddington Hospital, Harrow Road, London, W.9) said that the strain of pregnancy would expose a border line state of nutrition as one of deficiency, and thus pregnancy was a test of the sufficiency of a diet. When in Hong Kong, he came face to face with a degree of malnutrition which he hoped would never be reached in this country. Amongst a poor Chinese population vitamin B_1 deficiency was endemic. Some of the pregnant women appeared quite normal early in pregnancy, but later would increasingly show signs of incipient beriberi with each additional month of pregnancy. Others early in pregnancy would complain, just like women in this country, of cramp, pins and needles, fatigue and oedema. It had been shown that wives of unemployed in the poorer quarter of Amsterdam had a higher incidence of these symptoms than their non-pregnant sisters or pregnant women of the better class. A survey in Philadelphia had revealed the same lack of vitamin B_1. In 1937 in Hong Kong university obstetric clinic 27 cases of polyneuritis were collected; vomiting was common to all. Oedema was commonly seen in vitamin B_1 deficiency. In Professor King's 1940 report of the work in his clinic at Hong Kong there were quoted 155 cases of beriberi complicating pregnancy. Of these 17 died, a mortality of 11 per cent., and the combined foetal and neonatal mortality was 16·8 per cent. Three of the deaths were before the thirty-third week, and it was significant that oedema was noticed early. Women in this country frequently had oedema, and though it might be due to toxaemia, protein lack, excessive salt intake, anaemia or pressure, yet in their absence vitamin B_1 lack could be the main causative factor.

Osteomalacia was one of the best examples of the strain of pregnancy. Whether dental caries in pregnancy was evidence of calcium deficiency was debatable. Nutritional anaemia had an incidence of about 10 per cent. in pregnancy.

Very many women accepted as normal in pregnancy such symptoms as cramp, aches, pins and needles, oedema, fatigue. Some of these were nutritional in origin. Premature senility after two or three confinements might be evidence of the strain exerted by pregnancy in a border line state of nutrition; it was common amongst women of the lower income group. The size of the child, premature labour, lactation, toxaemia, might all be affected by nutritional factors. Veterinarians had proved that the type of progeny and success of lactation were directly related to the feeding of the mother. Platt had shown how the Chinese appreciated the importance of good feeding for successful lactation. When cattle rations were lacking in vitamin A premature and dead calves resulted. The same might hold good for human beings.

Nutrition of Farm Animals

Dr. C. Crowther (Harper Adams Agricultural College, Newport, Salop) compared nutritional problems in man and animals.

In studying these problems in animals, there were certain disadvantages, variety of livestock, varied range of nutritional objectives, crudity of food materials, greater variability of dietaries, and the incidence of economic factors upon dietary aims and practice. On the other hand, there were certain advantages, such as greater scope for experimentation, and greater uniformity of experimental material through control of

breeding. The fact of having a wide choice of species and type of animal enabled the worker to trace the variable incidence of individual nutritional factors through a wide range of environmental conditions, and offset the disadvantage of having a variety of livestock with varying nutritional problems. Moreover, closer control of rationing was possible. The methods of research were fundamentally the same, but there were differences in detail and in the degree of accuracy attainable.

In discussing food analysis Dr. Crowther dealt with difficulties of sampling and of protein estimation, with complications due to bacterial synthesis of protein in ruminants and to the effect of fibre on the volume of the ration, and with the large possibilities of error in assessment of carbohydrate.

In estimating digestibility it was necessary to depend on the "difference" method, since carbohydrates could not be determined directly. The digestive action of bacteria further complicated the problem.

The general methods for assessment of nutritive value were essentially the same as those employed for human dietaries, with important differences only in detail.

Energy, protein, minerals, vitamins and other known assessable accessory factors were measured. Palatability and general suitability were assumed or left to direct trial. Data were usually available only for the separate foodstuffs included in the ration, and their effects were assumed to be purely additive, an unwarranted assumption.

Accepted standards were at best only a rough guide to the needs of the individual animal; adjustments had to be made by the feeder himself. The speaker discussed in detail, from the critical standpoint, the total digestible energy, the metabolizable energy and the net energy. The term net energy meant the energy available for all purposes other than mere heat supply, and was universally employed in this country and the greater part of Europe outside Scandinavia.

Reference had to be made to the question of mineral and vitamin requirements in animal feeding. The system of animal husbandry influenced the risks of shortage. The commonest mineral deficiencies in Great Britain were those of Ca and Na. Animals were relatively less susceptible to vitamin deficiencies than human beings, but in certain circumstances, as in the intensive system of poultry keeping, marked deficiencies might occur.

Though the methods employed in the study of animal nutrition had greatly improved, there were still obvious imperfections. The fundamental weakness lay in assessing the values of rations from analysis of individual feeding stuffs. For example, the biological value of a dietary protein varied according to the nature of the basal ration which it supplemented. The digestibility and therefore the energy value of a food substance varied also with the plane of nutrition and the balance of the ration.

The ration as a whole should be regarded as the practical nutritive unit, and in the present state of knowledge there seemed to be no alternative to a separate determination for each ration for which information was required.

Dr. H. H. Green (Veterinary Laboratory, New Haw, Weybridge, Surrey) pointed out that the main difference in the study of nutritional disorders in man and in farm animals arose from the fact that animals

were reared as sources of food and that no sentiment was attached to their lives as individuals. The problem was, therefore, not one of curing the individual, but of preventing by the most economical methods the occurrence of disease on a large scale.

Vitamin deficiencies were rare in grazing animals except in special circumstances such as prolonged drought, but were encountered in farm animals, particularly pigs and poultry, kept under intensive conditions. While vitamins D_2 and D_3 were effective for man and for most farm animals, birds utilized efficiently only vitamin D_3, present in cod liver oil.

Mineral deficiencies were, however, extremely important. Since cereals, though containing sufficient phosphorus, were poor in calcium compared with grass or hay, it was necessary to add calcium supplements when animals were fed mainly on grain and grain offals. Osteoporosis occurred in horses maintained on a diet containing excess of phosphorus and relatively little calcium. In South Africa the soils and pastures were deficient in phosphorus, which was the cause of poor growth and reduced fertility in cattle, and also gave rise to rickets in calves and osteomalacia in cows. *Lamsiekte*, though directly due to the consumption of remnants of carcasses infected with *Clostridium botulinum*, was indirectly due to the phosphorus deficiency of the pasture. Animals grazing on such pastures developed osteophagia and consumed eagerly any skeletal material, which was frequently infected with this organism. The feeding of phosphorus supplements revolutionized the cattle industry in South Africa by abolishing *lamsiekte* (botulism) and *styfsiekte* (osteomalacia).

A deficiency of trace elements, minerals which were required only in minute amounts, such as copper and cobalt, gave rise to a different series of deficiency diseases. Examples of these were the bush sickness of cattle and sheep in New Zealand, which was associated with deficiency of cobalt, and the enzootic ataxia in lambs in Australia, which was preventible by administration of copper to the ewes during pregnancy. In Britain, swayback in lambs corresponded to enzootic ataxia in Australia, and some forms of sheep pine were attributed to deficiency of cobalt. Cobalt deficiency might be complicated by copper deficiency and by concurrent infestation with worm parasites.

Nutritional anaemia occurred in young pigs reared in sties and could be prevented by administration of iron salts. Deficiency of iodine, though rare in England, was common in some parts of the world, and could be controlled by feeding iodized salt.

Trace element poisoning, as apart from trace element deficiency, occurred in grazing animals. Examples were the alkali disease or chronic selenium poisoning in the United States, the teart of Somerset, which was due to a high molybdenum content of the pastures, and the industrial fluorosis in dairy cows which had been investigated in Bedfordshire.

Dr. J. Hammond (School of Agriculture, Cambridge) expanded Dr. Crowther's remarks on the necessity for an adequate total quantity of energy and protein in the diet for growth, the ration being otherwise of good composition.

Examples were given by the speaker showing how great was the effect of an adequate amount of energy and protein on the weight and size of the animal. In rabbits he had found that variation in the amount of

milk consumed during the first month of life caused a difference in size, not only at the time, but even after 7 months.

Henseler had found that when their food intake was restricted pigs became stunted, so that at 5 months old they weighed only 25 lb. as compared with 121 lb. for animals on a normal ration.

A comprehensive experiment by Frederiksen in Denmark had shown how body growth in cattle could be limited by a control of the food intake. Bulls which up to 2 years old had consumed 3998 food units weighed 708 kg. as compared with 319 kg. for those which had consumed only 1387 food units.

The effects of a ration inadequate for the mother on the development and weight of the young at birth had been demonstrated by Verges in sheep. By keeping the weight of the ewe constant during the last 2 months of pregnancy the weight of twin lambs was reduced to 6·1 lb. as compared with 9 lb. for those adequately fed. By maintaining the lambs on low and high planes of nutrition until they were 290 days old, he obtained large differences in weight, 107 lb. as compared with 180 lb.

There was a normal change in the proportions of the body as the animal grew up. The effects of nutrition could be seen to the greatest extent on those parts and tissues of the body which were the latest to develop. McMeekan found that he could alter the proportions of the body and the tissues in pigs by controlling by nutrition the rate of growth. Whether considered at the same age (16 weeks) or at the same bodyweight (200 lb.) animals fed on a low plane of nutrition showed a far greater inhibition of growth in the parts of the body which developed late than in those which developed early. By changing the planes of nutrition at different phases of growth, he could obtain pigs of different body conformation. These effects persisted into adult life.

General Discussion

Professor J. P. Maxwell (E.M.S. Hospital, White Lodge, Newmarket, Suffolk) stressed the importance of detecting early signs of deficiency. He suggested that pain in the back and legs, and instability in walking often occurring in pregnancy were possibly early signs of vitamin D deficiency. It was necessary also to bear in mind that deficiencies were likely to be multiple rather than single.

Professor E. J. Bigwood (Belgian Committee for the Study of Post-War Problems, 115 Eaton Square, London, S.W.1) said that night blindness in Austria in 1918 appeared first in pregnant women, another example of the effect of pregnancy revealing a latent deficiency. In a prisoners' camp in Germany the Russians developed scurvy and the Rumanians developed pellagra although all were given the same deficient diet. It had often been asked whether, with a factor such as vitamin C, saturation necessarily represented the optimal condition. If guineapigs, one of the few species of animals which could develop scurvy, were allowed a free choice of diet they became saturated with vitamin C. Moreover, the amount of the vitamin in the blood reached the same level as that of other species of animals in whom scurvy could not be produced because they synthesized the requisite vitamin.

Dr. D. C. Wilson (Rye House, Boar's Hill, Oxford) appealed for the standardization of the signs of early deficiency so that workers could be trained, as in India, to recognize them easily. She had been able to recognize several cases of angular stomatitis in Oxfordshire school children.

Dr. G. Bourne (University Laboratory of Physiology, Oxford) pointed out that among the early signs of vitamin B_1 deficiency were increased irritability, lassitude and a general deterioration in mental alertness. In the detection of early deficiency he had found the Göthlin test for capillary fragility of use in assessing the intake of vitamin C by patients with peptic ulcer.

Dr. S. K. Kon (National Institute for Research in Dairying, University of Reading) suggested that a further test for nutritional status was the estimation of vitamins in the milk of nursing mothers. Tests already begun showed that there was a considerable drain on the vitamin A reserves of the mother and that the amount of vitamin C in the milk was considerably lower than that found in 1934 by Dr. Harris.

Professor H. D. Kay (National Institute for Research in Dairying, University of Reading) wondered whether the statement of an earlier speaker, that the vitamin requirements of farm animals were of much less importance than those of the human population, might not lead to misconception. The vitamin content of the feeding stuffs of these animals was reflected in several instances in the nutritional value of the human foodstuffs they produced. Vitamin A in cow's milk, for example, was controlled in quantity by the carotene content of the feeding stuff of the cow. In winter, at least, the vitamin A and carotene of milk and milk products provided a relatively large proportion of the total vitamin A potency of the national diet, particularly for the younger part of the population. Hence the desirability, recognized in Finland some two years ago by legislation, of feeding the cow in such a way as to maintain the winter vitamin A potency of the milk at a certain level.

Prof. Kay also emphasized the importance, for control of both animal and human nutrition, of a greater knowledge of ruminant digestion, which was so different from that of most animals studied by physiologists. He gave instances of this difference. He, like many others engaged in agricultural research, was delighted that this subject was now being tackled seriously.

Dr. C. Crowther (Harper Adams Agricultural College, Newport, Salop) took up the point raised by Professor Kay as to the dependence of the vitamin content of milk upon the cow's diet. He agreed in principle but suggested that until a specific vitamin content of milk was made a statutory obligation, the farmer's obligation was purely moral and might need to be supplemented by a financial advantage to ensure its general recognition. He would make it obligatory in cases of milk specifically designed for infants and adolescents, but was not persuaded that the adult, who was free to choose his diet, required this specific safeguard.

Professor O. Kestner (School of Agriculture, Cambridge) recalled some of his work on protein deficiency in Germany in the last war. He also pointed out that while vegetable proteins might singly be of low

biological value, together they might act complementarily so that defects in one might be made good by another.

Dr. S. W. Swindells (1 and 2 Albion Terrace, Cartergate, Grimsby) hoped that one of the objects of the new society would be to disseminate accurate knowledge of nutrition.

Dr. E. H. Wilkins (Public Health Office, Birmingham) looked forward to the adoption of simple tests for malnutrition and mild deficiencies which would be easily applicable by medical officers of health. He instanced the importance of a study of posture in children as a guide to nutritional status.

Dr. R. Sutherland (Health Office, Brighouse, Yorks.) stressed the importance of the prophylactic rather than of the curative aspects of the study of nutrition.

Summing Up

Sir Joseph Barcroft (Physiological Laboratory, Cambridge), in summing up from the Chair, referred to the present status of laboratory methods in the diagnosis of deficiency disease and recalled a similar position which arose after the introduction of such diagnostic aids as the electrocardiograph by Mackenzie and Lewis. Clinicians were at first sceptical as to their usefulness, but this was mainly because the apparatus was costly and the technique specialized. He felt that laboratory methods in the study of malnutrition would soon reach a state of recognition and applicability comparable with that subsequently enjoyed by the technical methods used in cardiology. As far as the question of the separate study of the various nutritive factors was concerned, he felt no apprehension that this would detract from a proper study of malnutrition as a whole. He looked forward to the time when enough was known about nutrition to construct a completely synthetic diet.