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PREFACE

Researches on nutrition in India commenced in the first decade of this century and since then have made uninterrupted progress for over 40 years. Some of the results obtained have provided adequate data to enable executive action to be taken for bringing about improvement in the nutritional state of the population. The Nutrition Advisory Committee of the Indian Council of Medical Research, acting on the suggestion made in the Constituent Assembly of India (Legislative) in 1948 decided to appoint a Sub Committee to prepare a draft review of nutrition work done in India and to indicate if it had any effect on the nutrition of the people. The present review is the outcome of that effort. It has been essentially written for the laymen in non technical language. Its value to scientists will be in the list of references to scientific literature in nutrition in India contained in Section V of the review.

C G Pandit

Secretary,

Indian Council of Medical Research

New Delhi
the 14th December, 1951

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SECTION—I

HISTORICAL INTRODUCTION

The importance of food in its relation to health was well recognized in ancient Hindu Medicine. Sushruta Samhita in one of its earlier chapters mentions that bodily diseases may be brought about by irregularities in food and drink. In Hindu Medicine there is an exhaustive list of the nutritive qualities of each of the different types of foods. Apart from a detailed treatment of diet therapy in various diseases, a good deal of information has been given about incompatible foods which if taken together are likely to prove injurious to health. Records of further contribution to our knowledge on food and dietetics if made during the dark ages in India between Sushruta and the first ten centuries are not available. Books written in some Indian languages between the first and second millennium A. D. give an idea of the culinary art as then practised, such writings also broadly indicate the health giving properties of certain foods.

Scientific research in nutrition can be said to have commenced in India only in the 20th century. Captain D. McCay of the Indian Medical Service was the first to undertake scientific investigations on diet, physique and health. His researches which commenced approximately in 1908 dealt with the influence of the protein element in Indian diets on the health of the people. Dr. Chunalal Bose, Chemical Examiner to the Government of Bengal, also evinced keen interest in the nutritive value of foods and did much to attract the attention of scientific workers to the science of food and nutrition.

It is during the last thirty years, however, that nutrition research has grown rapidly in volume thanks to the assistance rendered by the Indian Council of Medical Research, formerly known as the Indian Research Fund Association. This Association was formed in 1911 with the object of initiating and promoting research in medical and allied sciences in India. It is no exaggeration to state that the present status achieved by nutrition research in the country has been possible only on account of the consistent and generous financial support extended by the Indian Research Fund Association over a period of nearly forty years. Under its auspices, Sir Robert McCarrison commenced his investigations on beriberi at Coonoor in 1918. The scope of his inquiry soon increased and for a few years it was known as 'Deficiency Diseases Inquiry'. In 1926, the Royal Commission on Agriculture paid a visit to Coonoor to acquaint themselves with researches of McCarrison. They were impressed by the results achieved till then and realizing the importance of fundamental work in nutrition in relation to the food and agricultural policy of the country, recommended the formation of a Central Nutrition Research Institute. Acting on these recommendations, McCarrison submitted a proposal for the establishment of a Nutritional Research Centre under him at Coonoor. The Governing Body of the Indian Research Fund Association accepted the proposal and converted the inquiry at Coonoor into the Nutrition Research Laboratories. Till 1930 this was the only institution primarily devoted to researches in nutrition.

The generous assistance of the Rockefeller Foundation enabled the Government of India to establish the All India Institute of Hygiene & Public Health at Calcutta. The Institute commenced work in 1932 and included among its various departments one devoted to research and teaching in nutrition.

At about the same time other workers in India were getting interested in nutrition research. From 1929 onwards an increasing number of research proposals were submitted to the Indian Research Fund Association for financial support. The Association at that time had no organization to advise it on these proposals nor did it make any attempt to co-ordinate the work on nutrition done in the country till the year 1936.

The Nutrition Advisory Committee of the Indian Research Fund Association was inaugurated in 1936 by the then Viceroy and Governor General Lord Linlithgow. A year later this Committee was recognized by the Government of India as the National Nutrition Advisory Committee. The main functions of the Committee have been however to advise the Indian Research Fund Association in planning co-ordination and promotion of nutrition research. Not infrequently the Government have obtained the advice of the Committee in matters of nutritional interest. Since its formation this Committee has considered numerous proposals for investigations submitted to the Indian Research Fund Association. It has also reviewed each year the progress recorded in several enquiries supported by the Association and the work done by the Provincial and State nutrition organizations. The growing volume of such work led the Committee in 1943 to take stock of the results achieved with a view to co-ordinating researches in nutrition and drawing up a plan for the future. The work on nutrition subsequently has followed in outline the plans formulated in 1943.

The Committee was also called upon to advise the Health Survey and Development Committee (Bhore Committee) of the Government of India in its task of planning for post-war development in medical relief, education and research and health organization and services. The Nutrition Advisory Committee prepared and submitted a memorandum on nutrition research, provincial nutritional organizations, long and short term measures for the improvement of nutrition of the Indian people and population and food supplies. It is gratifying to record that the memorandum was accepted *in toto* by the Bhore Committee and was incorporated in its recommendations.

One result of planning for nutrition research has been the establishment of 'regional nutrition research units' under the Indian Research Fund Association to ensure continuity of work at certain selected centres and to provide security of tenure to workers engaged in nutrition research. The research units were established at the centres which had a good record of earlier work in nutrition and where facilities for further work and expansion were available. Two units were established in 1944—one at the Seth G. S. Medical College, Bombay, and the other at the University Biochemical Laboratory, Dacca. Subsequently two other regional units have been formed—one at the University College of Science & Technology, Calcutta, and the other at the Indian Institute of Science, Bangalore. With the partition of the country the unit at Dacca had to be closed.

The record of work done at these units is impressive and although no specific mention has been made in particular of the individual laboratories their contribution as also that of other workers in the field has been substantial in the advancement of knowledge of nutrition in India. Even after the establishment of regional nutrition units the Indian Research Fund Association has continued to provide financial support to enquiries on various aspects of nutritional science undertaken by individual workers from other institutions. The work done on these enquiries has also been included in the general review of the nutrition work done in India (Section III)

The formation of nutrition sections in the provincial public health departments after 1937 was a significant development. This had its origin in the desire on the part of the State Governments to translate and apply in practice the knowledge gained in the laboratory. The Nutrition Research Laboratories, the newly formed Nutrition Research Units, the Universities and other Institutions in India were the seats of origin of such knowledge and there was no doubt that the State Governments were best situated to apply it in public health practice.

Since the year 1934 short term courses in nutrition are being given annually at the All India Institute of Hygiene & Public Health, Calcutta. In the year 1937 facilities were provided at the Nutrition Research Laboratories, Coonoor for the training of medical and technical personnel. The State Governments deputed suitable candidates for training at both these centres with a view to employing them in their respective nutrition organizations. It is indeed unfortunate to have to record that the initial enthusiasm shown by the State Governments did not last long enough to result in the establishment of nutrition organizations in all the States. Only in Bihar, Punjab and Hyderabad States were the trained personnel employed and utilized for public health nutrition work. In these three regions the newly appointed nutrition officers provided with facilities which were none too generous carried out much valuable work before and during the war. The nutrition section in Bihar was provided with laboratory facilities as well. During the war Baroda, Central Provinces, Bombay, Madras and Travancore organized nutrition sections. Recently nutrition sections have been formed in Assam, Uttar Pradesh and West Bengal. The staff, funds and facilities provided in the various provinces and States have not been on a uniform basis. In most cases the provision of funds and facilities for work has been very meagre. In spite of this the nutrition officers have turned out excellent work within the limitations set by the above mentioned paucity of funds and staff as can be seen by reference to Section II dealing with the work in the States. These nutrition organizations have been of great help to their Governments in times of stress such as food shortage, outbreak of deficiency diseases, nutrition of displaced persons in relief camps, etc. It must be admitted however that most of the State Governments have not realized to the full the significance of the preventive aspects of nutrition. In Indian laboratories much basic knowledge has been accumulated. Its application for the benefit of the population in general should rest with those who are responsible for looking after people's health. It has to be confessed that so far as nutrition is concerned this responsibility has been only partially discharged. Much remains to be done in the field of public health nutrition and it is hoped that in future the States will not lag behind in their spheres of activity.

SECTION—II

PUBLIC HEALTH NUTRITION IN THE STATES

ASSAM

Public health nutrition work in Assam has been sporadic. With the exception of a diet and nutrition survey among tea garden labourers there was little to record till 1947. In that year a temporary post of nutrition officer was created. The newly appointed officer who worked for only a short period carried out a few diet and nutrition surveys. The diets of the poor people were inadequate and unbalanced, the consumption of protective foodstuffs being particularly meagre. Although gross nutritional deficiencies were not seen, mild and chronic malnutrition would appear to be prevalent among the poorer classes. The State of Assam has in view the formation of a nutrition section in the Public Health Department and has the requisite trained personnel for the same, but owing to financial stringency no action has been taken.

WEST BENGAL

In 1937 a Nutrition Section was established in the then undivided Bengal. Due to the untimely death of the nutrition officer soon after the activities of the section were cut short to be revived only in 1950. Some work was however done during the intervening period. The assessment of nutritional status was carried out in 14,783 school children and 2,681 adults from different economic groups. Diet surveys in families, institutions and displaced persons were also carried out. For a brief interval a nutrition officer from a neighbouring province was placed on duty to advise Government in the matter of relief and rehabilitation of sufferers from famine in Bengal.

In 1940, the Government of Bengal constituted a Nutrition Committee to advise it in matters connected with nutrition. The Committee had as its members some distinguished nutrition experts in India attached to scientific institutions in Calcutta and it is largely to their voluntary efforts that interest in public health nutrition work was maintained in Bengal during the last twelve years. The advice and services of the Nutrition Committee in connection with measures for dealing with starvation cases and destitutes during the Bengal Famine of 1943 deserve mention. It must be admitted however that their efforts have not materially advanced the cause of public health nutrition in the province because the Government did not take it up as a part of its preventive programme till March 1950.

BIHAR

Bihar was one of the first among the Indian States to take active interest in nutrition work. A modest beginning was made late in 1937 by organizing diet and nutrition surveys. Before twelve months were over a self-contained unit under the name Bihar Nutrition Scheme was established within the Public Health Department. It was staffed with a nutrition officer in charge, a medical assistant, a chemical assistant and the necessary field, clerical and technical personnel. The officer had a laboratory at his disposal to supplement his field investigations and to conduct

experiments in the laboratory In this respect Bihar organization was better conceived and as the results showed better fitted to tackle nutrition problems within the State than in most other provinces and States in India The Nutrition Scheme has now been functioning continuously for 13 years and has a satisfactory record of work as the following account will show

Diet Surveys —Up to 1949 diet surveys by daily 'weighment of foodstuffs' methods have been carried out in 5 201 families consisting of 30 219 individuals and covering 12 out of 16 districts of Bihar The families were sampled from various economic groups mostly however they were from the lower middle and poor classes The diets were found inadequate in protective foodstuffs—a fault which is common to all poor Indian dietaries Of particular interest were (a) a repeat survey in 200 families after a period of five years and (b) diet surveys in industrial workers i e iron and steel factory workers of Jamshedpur and coalfield workers in Jharia

In repeat surveys carried out at the time of acute food shortage it was found that cereal intake had slightly increased and the consumption of protective foods had sunk to a lower level Among the industrial workers an attempt was made to study the relation between income and diet It was observed both at Jamshedpur and at Jharia that with the increase in income the consumption of non leafy vegetables oils and fats milk and milk products fruits flesh foods and sugar and jaggery increased On the other hand there was a marked decrease in the intake of green leafy vegetables which in fact are cheaper than the other variety These observations and others made in some surveys carried out before the days of food shortage lead one to believe that ignorance of healthy food habits was to a certain extent responsible for the consumption of unbalanced diets

Nutrition Surveys —In conjunction with diet surveys in some cases and independently in others over 42 000 children have been examined during the last 13 years for the evaluation of nutritional status Beside recording the age heights and weights of these children a clinical appraisal of nutrition was made and the incidence of clinical manifestations of nutritional deficiency states recorded With the exception of Chota Nagpur plateau (where mainly the aboriginal and semi aboriginal tribes were surveyed) the deficiency states like phrynoderma xerophthalmia angular stomatitis sore tongue etc were not prevalent in Bihar A survey of some groups of children in the days of food shortage revealed a greater incidence of general malnutrition although the incidence of manifest signs and symptoms had decreased This apparent paradox was later on found to be corroborated by observations in the prisoners of war camps One piece of field investigation deserves special mention In the days when the etiology of angular stomatitis was still uncertain a therapeutic trial with riboflavin was conducted and proved highly successful This work thus provided additional evidence on the role of riboflavin in the causation of angular stomatitis

Laboratory Investigations —These have covered a wide field, such as (a) analyses of foodstuffs (b) the determination of biological value of proteins by animal and human experiments (c) studies on the effect of processing on nutrient contents of foodstuffs and (d) clinical studies Over 300 different foodstuffs were analysed for their proximate principles and

mineral content and in 70 vegetables carotene and ascorbic acid were determined chemically. Several of these foodstuffs were peculiar to Bihar and the information about their nutritive value was not available elsewhere. The biological value of cow milk, buffalo milk and goat milk proteins was determined by rat experiments. Whereas the biological value of the former two was almost the same, goat milk proteins gave lower values. Muscle meats of these three animals were also studied by similar technique; no significant differences were however found. The biological value of proteins from pulses in comparison with that of milk proteins was determined in human subjects. Similarly, the nutritive value of rice, wheat and other cereal proteins was also determined in human volunteers. When rice was the only source of cereal in the diet, it provided a protein of high biological value; the mixture of wheat and rice gave proteins of lower biological value. The effect of partial replacement of wheat in a wheat diet was next studied. The addition of barley, maize, *bajra* and *ragi* improved the biological value, that of *jowar* on the other hand brought about a slight fall.

Among other investigations may be mentioned two of particular interest. In the early years of the war, dried amla (*Phyllanthus embelica*) powder was used as a source of vitamin C supply to troops in India. The fruit had been found by Indian workers to be a rich and easily available source of vitamin C. As amla powder was being manufactured and supplied to the Army, it was essential to know the effect of drying and storage on the vitamin C content. It was found that at room temperature, under ordinary conditions of storage, 36 per cent of the vitamin was destroyed at the end of three months, whereas if stored at zero degree, the loss was in the neighbourhood of 20 per cent after a year.

The juice and other edible products from palmyra trees came up for investigation in view of the necessity to find alternate uses for the former if prohibition policy had come into force. It was found that fresh palm juice, *Nira*, could be well preserved over calcium hydroxide, no other preservative being necessary. It was noticed that the fresh pulp of the fruit was a good source of carotene and vitamin C, both of which were stable to an appreciable extent even after the fruit was sun-dried and stored.

Other Activities —The Nutrition Scheme assisted in the development of mid-day meal programmes in schools in Bihar. It also worked in collaboration with maternity and child welfare centres and advised in the distribution of the supplementary foods and development of industrial canteens. A considerable amount of educational and propaganda activity was undertaken by the Nutrition Scheme. It consisted of lectures, broad-casts over the radio, publication of illustrated pamphlets in English and regional languages and arrangement of nutrition exhibitions. An inter-departmental committee on nutrition has recently been set up by the Government to co-ordinate nutrition work within the State.

UTTAR PRADESH

A Nutrition Section in the Public Health Department has been organized as recently as 1948. It is in charge of a Nutrition Officer who is assisted by chemists and the necessary technical and clerical staff and is

provided with laboratory facilities as well. The work of the section is planned along the lines followed by other provincial nutrition sections. Diet surveys in relief camps for displaced persons have been carried out and the state of nutrition of school boys in Lucknow, Gonda, Basti and Moradabad Districts has been assessed. The section undertakes analyses and examination of foodstuffs for quality. It is also engaged in educational activity and propaganda work. An inter departmental committee on nutrition has been set up by the Government. A milk feeding scheme is in operation in the primary schools in Kanpur and Lucknow municipalities.

DELHI

The dietary habits of the rural and semi urban population were surveyed in 1939 and in association with it a clinical examination of school children in the same area was conducted for the evaluation of nutritional status. The Health Directorate of the Province has been concentrating its efforts mainly in the field of education and propaganda by the usual methods.

EAST PUNJAB

The amount of work done in (undivided) Punjab before 1940 was second only to that done in Bihar during the same period. An investigation on Indian dietary habits and nutrition and physique of Indian children was commenced in the Punjab by Dr. D. C. Wilson in 1936 with a grant from the Royal Society, London and some other organizations from outside India. This worker collected a great deal of information in that province and also from the Central Provinces, Orissa and Hyderabad State. In 1938 the Government of Punjab appointed their own Nutrition Officer who also carried out diet and nutrition surveys and analyses of local foodstuffs. Among these the investigations in Kangra Valley are significant. Several diseases of nutritional origin are found within this district, the most important being simple goitre, rickets and osteomalacia. Goitre is common in the sub-Himalayan region all along the northern border of India and Kangra Valley forms part of that region. Some time after 1940 a field experiment to study the effect of providing iodized common salt was undertaken in this region, unfortunately however no records of the progress and outcome of the experiment are available.

Rickets and osteomalacia were found to be more common in Punjab than in other parts of India. Their incidence was particularly greater in poor people living in overcrowded houses and on inadequate diets. Social customs like purdah, early marriage, etc. contributed not a little. Even within Punjab the incidence of rickets and osteomalacia was greater in Kangra Valley than in other districts. Extreme examples of malformation of bones due to rickets and their softening resulting from progressive osteomalacia were to be seen among the children and women of child bearing age respectively in the Kangra Valley. Their diets seem to be similar to diets in other parts of India, being principally based on cereals and poor in protective foodstuffs. Sunshine also does not seem to be materially different from that experienced in other provinces. At present

no satisfactory explanation is forthcoming for the occurrence of these two conditions in this district

After the partition of India the East Punjab Government appointed a Nutrition Officer but the conditions in the province have been far from normal owing to the aftermath of partition and the movement of large bodies of population across the frontier. The Nutrition Officer has been saddled with numerous other duties and has not been able to devote attention to nutrition work. He was however able to carry out surveys in some of the relief camps intended for displaced persons. The officer was able to detect numerous cases of malnutrition his opinion being subsequently corroborated by other visiting experts. These surveys in relief camps materially helped the Government in improving the conditions by ensuring qualitative and quantitative adequacy of diets provided for the refugees

ORISSA

In Orissa there is no provision for a Nutrition Section in the Public Health Department. The activities of the latter have however since the year 1940 included diet and nutrition surveys. From 1940 to 1942 surveys were undertaken in Puri District Angul subdivision and Sambalpur District. These covered the low income groups from about Rs 2/ to Rs 3/ and above per month per member of the family. Children of these families were examined for signs and symptoms of deficiency disease. The diet surveys revealed the presence of dietary defects common also in other parts of India. Over 10 000 children were examined of which only 6.75 per cent could be classified clinically as being in a good state of nutrition.

Repeat surveys in the same localities were carried out in 1944-45 and minor changes in dietary composition were noticed. A comparison of the results obtained in the two nutrition surveys showed that there were marked changes in the incidence of certain deficiency symptoms e.g. in angular stomatitis there was a marked increase in phrynoderma a decrease whereas in xerophthalmia the incidence was more or less stationary.

Recently diet and nutrition surveys have also been done among the aboriginal tribes in Ganjam Agency and Khondmahals.

MADHYA PRADESH (CENTRAL PROVINCES AND BERAR)

The State Government established a Nutrition Section under the Public Health Department in April 1945. In the first instance diet surveys among poor agricultural labourers in the three cereal producing rural areas were undertaken. These surveys revealed that though the diets were adequate in cereals they were ill balanced and lacked in protective foodstuffs like milk vegetables ghee butter meat fish eggs and fruits. The effects of such ill balanced diets on the health of the population were reflected in the form of various manifestations of malnutrition.

The health surveys carried out among primary school children in rural areas revealed an incidence of 25 to 30 per cent of frank cases of deficiency diseases. This corroborated the findings of the diet surveys.

Repeat diet surveys which were carried out from 1946 to 1949 showed that the average diets were adequate in calories but ill balanced and deficient in protective foods. The economic study of the surveyed groups of families in 1948 also showed that the cost of the balanced diet was nearly four times that of the existing diets and hence beyond the means of the poor agricultural population.

In order to correlate the dietary deficiencies of the population with the availability of actual foodstuffs in the province the food production in the province was reviewed in 1945 taking into consideration the import export seed and livestock requirements. In accordance with the requirements of a balanced diet this State had a surplus of cereals pulses and fruits while there was deficiency of milk vegetables fats and oils sugars meat fish and eggs. For the purpose of calculation the meat eating population was taken to be 56 per cent and the population figures were based on 1941 census. A comparative assessment was again taken in 1947 which showed no improvement in the food supply except a slight increase in milk and fruits.

As a result of the findings of the nutrition surveys the State Government sanctioned free distribution of seeds of vegetables to selected poor families among the aborigines.

Supplementary foodstuffs and multivitamin tablets were distributed in maternity and child welfare centres primary schools orphanages relief camps etc.

The mid day meal in schools have not yet proved popular only about 25 schools are supplying snack lunches. Industrial canteens are gradually being established.

Nutrition Education and Propaganda —The Department has published popular pamphlets in Hindi Marathi and Urdu on some nutritional subjects. It also organizes nutrition sections in various exhibitions within the province.

Lathyrism —In the year 1945 there was an outbreak of Lathyrism in the province seriously affecting four districts. An extensive field investigation was made by the Nutrition Officer and the incidence during the time was recorded to be 8 426 cases (new and old) in the whole of the province. At the instance of the Public Health Department the Provincial Government passed the Teora Control Order (1946) prohibiting sale or purchase of Teora in pure form one could sell or purchase Teora (*L sativus*) only in a mixture with other grains in a proportion of less than one third of the total grains. The results of this step on the incidence of Lathyrism in the province are not known.

HYDERABAD

The nutrition section in the State Public Health Department was started in the year 1939 with only a small staff but in the year 1948 this section was expanded and changed into a Bureau of Nutrition and Industrial Hygiene.

From the inception of the Nutrition Section very extensive diet and nutrition surveys of both urban and rural areas of Hyderabad and its districts have been carried out with a view to ascertaining the dietary habits of the people and the extent of the deficiency diseases malnutrition and the economic status of the people

Besides extensive surveys in the lower middle and upper classes of people and several institutional enquiries in the City of Hyderabad nine districts have exhaustively been surveyed in different seasons of the year in order to have a true picture of the dietary habits of the people in general Several repeat surveys were also carried out In all 125 surveys concerning 7 500 families and 28 000 individuals have been completed

Nearly 50 000 children in rural and urban areas have been examined for deficiency states and an assessment of the state of nutrition and physical development of more than 20 000 school children was made and the report has been published

Nutrition propaganda by means of leaflets and reports in English Urdu Telegu and Marathi is also carried out The educational activity in this field appears to have made a large number of people nutrition conscious The Government has prohibited excessive milling of rice It has opened mobile canteens in Warangal Gulbarga and Hyderabad City Industrial concerns are organizing canteens for meals and snacks in increasing number

BOMBAY

Early in 1943 the Government of Bombay introduced rationing of foodgrains in Bombay City During the latter part of the same year a Nutrition Committee was formed with the object of advising the Government on the nutritional implications of rationing and on other matters relating to nutrition in general A Nutrition Section was established by the Government in July 1944 with a Nutrition Officer in charge In September 1949 this temporary section in the Civil Supplies Department and the Department of Nutrition and Experimental Pathology at the Haffkine Institute were amalgamated into a permanent department of Nutrition of the Government of Bombay The department as it now exists is staffed with medical personnel chemists and dietitians with the necessary technical staff and is also provided with well equipped laboratories

In addition to the work undertaken by the provincial department of nutrition there exists in the Seth G S Medical College a Regional Nutrition Research Unit established by the Indian Council of Medical Research The work undertaken at the Unit is mainly confined to laboratory experimentation and investigation and will be referred to elsewhere The record of work in the province given below will show that although the Government of Bombay was slow to undertake public health nutrition work it has already built up an organization capable of dealing with various aspects of the problem

Diet and Nutrition Surveys —The department has carried out over 450 surveys in families and institutions The former were sampled

from the lower middle and poor classes. Among the institutions were included certified schools, remand, rescue and foundling homes, backward class hostels and various hostels attached to schools, colleges and other institutions from all over the province. A survey on 42 families in the famine stricken district of Bijapur had also been carried out in 1945. In the City of Bombay itself there have been recorded a few surveys on wage earners and lower middle classes of Deccani, Gujarati and Parsi families.

Recently the department carried out rapid clinical nutrition surveys in primary and secondary schools in Bombay City and at a relief camp for displaced persons near Bombay. Of late the conditions regarding diet and nutrition in this and other relief camps in the province have been receiving special attention from the department both from the preventive and curative standpoint.

Clinical Investigations —The department has extended its activity to include clinical research. Early this year a nutrition clinic was started in the J. J. Group of Hospitals in Bombay City with ten beds reserved for the treatment of cases of nutritional disorders.

A type of anæmic condition locally known as Bille Jadu (white disease) was investigated in North Kanara. It is characterized by high prevalence and mortality especially among pregnant women of the rural population. An earlier study had indicated that chronic malaria, hook worm infestation and malnutrition were probably the chief etiological factors. A recent study of dietary habits and economic conditions together with clinical and hæmatological investigations has shown that the anæmic condition was more marked in poorer families among the vegetarian population and could be ascribed to the low consumption of milk, milk products and fresh vegetables in the diet.

Institutional Feeding —The department has on its staff a number of trained lady dietitians called Senior Nutritionists. They visit institutions, study the dietaries and advise on their improvement. In this way maternity and child welfare centres, creches, nursery schools, industrial canteens, etc. have been visited and advised. Active efforts have also been made to encourage mid day school feeding. A few of the schools visited are providing hot mid day meals to children. Lack of adequate and cheap supply of fresh or reconstituted milk and other protective foods are the main difficulties in instituting mid day meals in all schools. However nutritious snacks were worked out and recommended as alternatives. These in practice are proving satisfactory. There is evidence that the physique and general health of the school children have benefited. Canteens in industrial concerns such as factories and textile mills in several industrial towns within the State have been inspected and recommendations made for improving the quality of the meals or snacks provided there. A square meal canteen catering for 600 meals is run for the benefit of the secretariat staff under the expert supervision of the nutritionists from the department.

The existing diet scales in police hospitals and jails were scrutinized and recommendations for their revision and improvement have been made. The task of revising and preparing standard dietaries for general and special hospital needs has now been taken in hand.

Human Feeding Experiments —These were undertaken to assist in the enquiries on the (a) utilization of certain subsidiary foodstuffs and (b) nutritive value of vanaspati i.e. hydrogenated vegetable oil. The experiment with food yeast was conducted with children in an industrial school in Bombay. It was found that the addition of $\frac{1}{4}$ ounce of yeast to the daily diet of children did not have any appreciable effect on the growth and body weight of children. The department collaborated in a consumer trial investigation on groundnut cake flour. Working with a doubly pressed cake prepared from hand picked nuts it was found that the cake flour could be mixed up to 10 to 12 per cent with wheat or gram flour and used in making various food preparations. Such foods were not only acceptable to the palate but also agreeable to the digestive system.

Nutrition Education —The department has designed and collected a number of posters, charts, models, photographs, etc. and utilizes all opportunities for displaying them in exhibitions organized either under the Government auspices or by other well known public organizations. The department was awarded the first prize—a Silver Cup—for exhibiting some recipes in respect of subsidiary foods such as sweet potatoes, plantains and groundnut cake flour to supplement the cereals.

Talks on food and nutrition are given by senior nutritionists and the medium of wireless is also utilized for talks on nutrition.

Laboratory Work —The laboratory section deals with analysis of foodstuffs and proprietary preparations. In co-operation with the Indian Council of Medical Research it is closely connected with the research work on the possible role of nutritional factors in the production of cirrhosis of the liver. Besides there are also facilities for training in nutrition and post graduate research work.

MYSORE

There is no nutrition organization in Mysore State corresponding to those existing in some major States of the Indian Republic. Aside from a limited amount of nutrition work connected with general public health programme and some propaganda through their Bureau of Health Education, public health nutrition studies have been largely confined to the Mysore Health Training Centre at Ramanagaram (formerly Closepet). Nutrition and diet surveys had been carried out at the above Centre in 1937. During 1949 an intensive nutrition study was undertaken for the general purpose of reassessing the food habits and general nutritional status of the community and evaluation of the effect of supplementary feeding upon selected groups of school children. The experiment is in progress. An investigation on nutritional and other anæmias has also been undertaken in collaboration with an international organization.

MADRAS

The Government of Madras organized a Nutrition Bureau with the Department of Public Health in the year 1944. The Bureau commenced work with one Nutrition Officer and two Health Inspectors but was further expanded in 1946 by establishing two regional units, one working in the

northern and the other in the southern area of the State with Headquarters at Anantpur and Tiruchirapalli respectively. The Nutrition Officer at the Department Headquarters is in overall charge of the Bureau, he supervises and co-ordinates the work of the regional units.

The activities of the Bureau have covered a very wide field. It has completed 290 diet surveys in rural and urban areas of the State, a majority of which dealt with the diets of low income groups.

Rice is the staple cereal in the province. Parboiled rice is consumed by a majority of people in the west coast and the southern regions of the province. The inhabitants of the Andhra districts on the other hand prefer raw milled rice. It was not surprising therefore to find the incidence of beriberi within this region. In general the diets were found deficient in protective foodstuffs and hence the intake of some essential nutrients like vitamins and minerals was inadequate.

Recently a diet survey was carried out among alcoholic ex-addicts nearly two years after the introduction of complete prohibition. It was found that although the families had more money at their disposal to spend on food, the diets showed no improvement over those existing in pre-prohibition days. The health conditions were also not much different.

Approximately 34,000 children in different parts of the State were examined for the appraisal of their nutritional status. The data for height and weight have been statistically analysed and reference charts for height-weight-age have been prepared. The children were found usually under-nourished and showed signs and symptoms suggestive of deficiencies of vitamins A and B complex.

The Bureau has also taken part in the ameliorative schemes such as mid-day meal programmes in schools and distribution of free milk to expectant and nursing women, infants and children up to five years. The foodstuffs for such programmes were provided by the Government of Madras. In the year 1948 over 2,95,000 children received free mid-day meals and over 28,000 children in the City of Madras received free two-ounce supplement (supplied by the Madras Corporation) of reconstituted milk.

Educational activities are also undertaken by the Bureau. These consist of lectures, demonstration, arranging exhibitions, broadcast talks and publication of pamphlets in English and regional language.

Recently the Government of Madras has taken steps to recognize the Nutrition Bureau with a view to providing facilities for laboratory work and integrating the activities of the Bureau with the other developmental schemes now in progress within the State.

TRAVANCORE—COCHIN

The State Government of Travancore established a Public Health Laboratory in 1932 combining the work of four existing laboratories of bacteriology, vaccine, chemical examiner and entomology. A Nutrition Section was added to the laboratory in 1941. This works under the

direction of the Superintendent of the Laboratory. The section has carried out diet surveys in families and institutions and examined over 21 000 children for nutritional deficiencies. Experiments to demonstrate the beneficial effects of mid day meals were undertaken. The use of supplementary foodstuffs like separated milk powder, yeast, multi purpose food, groundnut milk etc. was demonstrated by feeding experiments on school children.

Diet surveys were carried out in rural and urban areas wherein families of different economic levels were included. In the lowest income groups the diets were found qualitatively and quantitatively deficient. Families with incomes up to Rs 50/ per mensem were on a marginal diet and those with higher income appeared to be slightly better fed. In rural areas the diets were on the whole better than in urban areas. The nutritional surveys provided supporting evidence of deficiencies among primary school children. In a group of 1 300 children anæmia was found to the extent of about 80 per cent, xerophthalmia 24 to 29 per cent and phrynoderma 29 per cent. In another set of 2 000 children in Trivandrum examined in 1944 phrynoderma was prevalent in 15 per cent, Bitot's Spots in 5.5 per cent and angular stomatitis in 1 per cent. Repeat observations on heights, weights and incidence of nutritional deficiency have been carried out before and after the war in some of the schools. Results however have not yet been published.

Cochin had no organization to deal with nutrition problems within the State. It is hoped that with the integration of Travancore and Cochin into a Union, nutrition activities will be extended to the Cochin State area in the near future.

NUTRITION ORGANIZATION AT THE CENTRE

The Central Government realized the importance of having expert nutritional advice particularly when they were making attempts to combat the food situation during World War II. The Ministry of Food instituted a nutrition section in 1945 to assist them in problems of rationing and food supplies.

In November 1947 the Ministry of Health appointed an Adviser in Nutrition with the function of advising the Ministry on nutritional matters and also to serve as a clearing house for information collected from the States.

Soon after his appointment the officer was called upon to deal with the problem of malnutrition in relief camps for displaced persons. Following the partition of India in 1947 the Government had to deal with the problem of refugees migrating to India from Pakistan in millions. These were temporarily distributed in relief camps spread all over the country. The population of the camps varied enormously. In some there were 2 000 individuals, in others the number was 90 000. The duration of stay of displaced persons in the camps was variable depending upon the ability of the Government to make permanent arrangements for their rehabilitation. After a stay of five to six months in these crowded camps signs and symptoms of nutritional deficiency began to appear among the inmates. Anæmias, night blindness, phrynoderma, angular stomatitis

xerophthalmia nutritional œdema spongy gums rickets osteomalacia and gastro intestinal disorders were the various conditions which had to be treated and prevented. The Nutrition Adviser in collaboration with the State Nutrition Officers was able to treat the more acute cases and advise on the changes in diets and supplements to be given. Fresh whole milk milk powder and multi vitamin tablets were distributed in large quantities. Several voluntary organizations in India and abroad supplied predigested cereals and other foods. Gradually the situation could be brought under control.

The immensity of the problem cannot be judged by the above description. Malnutrition in relief camps could only be prevented by heroic efforts. The situation gradually eased as rehabilitation progressed.

NUTRITION ORGANIZATION IN THE ARMED FORCES

In January 1943 a special nutrition section was organized in the Hygiene and Pathology Branch of the Medical Directorate at General Headquarters. Within a year the Section was expanded and effective liaison work with the various armies maintained through staff appointments at the G H Q and the H Qs of the three armies. The organization had to deal with subjects such as (a) the composition of military rations (b) development and use of special rations (c) supervision of the nutritional state of the troops and (d) nutritional research.

A network of military Food Laboratories was created to ensure that foodstuffs purchased for the armed forces satisfied high standards of quality. Diet surveys were carried out in the units and military hospitals. Improved ration scales for the Indian soldier were developed. Before the war he used to be given a ration which was nutritionally not quite adequate.

Early in World War II the standards for recruits joining the army were lowered considerably with the result that the new recruits were often of poor physique and carried various stigmata of malnutrition. Conditions such as dry lustreless and rough skin phrynoderma nasolabial seborrhæic dermatosis angular stomatitis glossitis xerosis of the conjunctiva etc were commonly found among the recruits. Anæmia of varying degrees was also a very common feature. Investigations were carried out at some recruiting centres by a specially constituted Anæmia Investigation Team to test the efficacy of the standard army ration in restoring the recruits to normal health. It was found that weight gain of 5 to 10 lbs took place within four months further gains in weight being slower. At the same time most of the signs of malnutrition disappeared. Anæmia responded quite well on the standard army ration the effect could be enhanced by administering 3 grains of ferrous sulphate per day by mouth. A supplement of 16 ounces of milk to the above diet did not add to the hæmopoietic response obtained without it. The recruits were often found harbouring hook worms. The hæmoglobin level could be improved in a majority of infested recruits merely by the improved diet with ferrous sulphate even without deworming.

It was the experience during the last war that Indian troops suffered more from anæmias and gastro intestinal disorders not unlike sprue

syndrome, etc., than their British colleagues under similar adverse combat conditions. Sickness recovery rates among the former were also slower. A poor nutritional background of long duration is believed to be the cause. A large number of investigations on sprue, marasmus, nutritional œdema, optic atrophy, etc. were undertaken on prisoners of war especially from the Japanese camps.

The nutrition organization within the armed forces and the military Food Laboratories have been maintained after the war although on a somewhat reduced scale. An effective liaison is maintained with nutrition scientists on the civil side. After India became independent in 1947, the responsibility of looking after the nutrition and health of the armed forces has devolved fully on Indian shoulders and it is expected that the Defence Nutrition Organization will be able to cope with the situation.

SECTION—III

RESEARCHES IN NUTRITION

COMPOSITION OF INDIAN FOODSTUFFS

The need for the evaluation of Indian foodstuffs was felt by the nutrition workers if only to understand the full potentialities of such foodstuffs to meet the nutritional requirements of the Indian population. Some information no doubt existed in the various agricultural departments but a compilation of analytical data based on results obtained by modern methods was not available till recently. In 1935 this problem received concentrated attention at the Nutrition Research Laboratories Coonoor with the result that within the space of two to three years over three hundred common Indian foodstuffs had been analysed. The results were published by the Government of India in the form of Health Bulletin No 23. This bulletin contains in addition basic information on applied nutrition and suggestions for balanced diets. The pamphlet has proved extremely popular and within the last 12 years has gone through four editions and several reprints. Work on the subject has continued and much valuable information has become available through the efforts of a number of active workers from different institutions in India. Even now the subject is not exhausted. Although some work on the effect of cooking and domestic processing on the nutritive value has been published much remains to be done. Further the realization of the importance of some newer vitamins in human nutrition must lead to a more detailed assessment of the nutritive value of our food stuffs.

Among individual foodstuffs rice has received particular attention since it forms the staple cereal of approximately 50 per cent of the population. Rice is usually subjected to processes such as milling polishing etc. Comparative studies on the losses in nutritive value resulting from hand pounding and machine milling have revealed that such losses are small when rice is hand pounded.

In India paddy is subjected to a process known as parboiling. Paddy is steeped in water steamed and then dried. The rice obtained from this paddy is known as parboiled rice. The latter also undergoes the further processes of hand pounding machine milling polishing etc.

Milling of raw rice entails great losses in nutrients. Parboiling causes a redistribution of vitamins in the grain and when parboiled rice is subjected to milling the losses in vitamins are not great. The comparative losses of nutrients when raw and parboiled rice are subjected to the above treatments are given in the following Table taking two pure strains as examples —

Variety	Hulled	Raw		Parboiled	
		Hand Pounded	Machine Milled	Hand Pounded	Machine Milled
		Thiamine in μg per gm			
Vadan					
Samba	2.5	2.1	0.6	2.1	2.1
CO 9	3.7	2.9	1.3	2.4	2.0

In order to make rice palatable and presentable it has to be milled to a certain degree hence it is more important to improve milling practices if nutrient losses are to be minimized. Similarly the process of parboiling which at present is conducted in rather a primitive manner should be standardized to yield an acceptable product of good quality. The Government of India is it is understood studying both the above problems.

Rice has to be washed before it can be cooked. Washing is usually done in repeated changes of water. It has been established that the first washing removes 40 to 50 per cent of vitamin B₁ contained in raw rice the subsequent washings removing about 10 to 12 per cent in addition. Under similar conditions of washing parboiled rice loses approximately 12 to 15 per cent of its vitamin. There are further losses of the vitamin during cooking particularly if the excess water is discarded as is usually the practice, but these are small as compared to the losses already suffered in processing and washing.

NUTRITIVE VALUE OF PROTEINS

In India McCay's researches between the years 1908-12 first drew attention to the low utilization of proteins from the Indian diets. He was of the opinion that this factor was probably responsible for the defective physical development and lack of stamina of certain sections of the Indian population. McCay's investigations on the jail dietaries in Bengal and Uttar Pradesh were undoubtedly the forerunners of the extensive work later undertaken in India on the nutritive value of proteins of Indian foodstuffs.

The nutritive value of a protein depends upon its digestibility and its capacity after absorption from the intestines to supply the body with essential amino acids for growth and/or maintenance. Owing to differences in digestibility and in the amino acid composition of proteins from different sources proteins differ considerably among themselves in respect of their nutritive value.

The problem is of particular importance to India for a major portion of protein in Indian dietaries is derived from cereals and pulses. The work on the composition and nutritive value of proteins first begun in 1925 at Bangalore was later taken up by different laboratories in India in which chemical and biological methods were employed the latter involving experiments on laboratory animals as well as human subjects. Information has now been accumulated with regard to the nutritional quality of proteins from the more important cereals and pulses.

The biological value and digestibility of proteins from a few foodstuffs are given in the following Table. More detailed information can be had by reference to original papers.

Foodstuff	Biological Value per cent	Digestibility per cent
Rice	80	97
Wheat	66	93
Ragi	90	79
Bengal Gram	62	86
Red Gram	70	75
Beef	69	97
Mutton	60	95
Fish—Hilsa	70	83

If the nutritive value of proteins from a single foodstuff is low it can be improved if proteins from another food source are available in the dietary. This is known as the supplementary effect and has been observed when pulses are mixed with rice or with skim milk. The information gained on such supplementary effects has provided a scientific justification for the practice of not depending on only a single variety of cereal or pulse in our daily diets.

The dietary protein not only supplies the building stones for the formation of new tissue and for the replacement of wear and tear in the body once the active growth has ceased but one other important role which protein plays is to help in the formation and regeneration of blood proteins. Recently work has been undertaken to study the blood protein regeneration as influenced by dietary proteins of vegetable origin. This study is expected to yield very valuable results.

FATS

India is rich in the variety of edible vegetable oils. The same cannot unfortunately be said about the adequacy of supplies. Mustard, coconut, groundnut, rapeseed, safflower and sesame are the principal oilseeds from which edible oil is obtained. Oils are used mainly as aids in cooking and the variety of oil consumed depends on a number of circumstances. The nutritive value of these oils has been extensively investigated with the result that all of them have been found to be equally nutritious. *Ghee* is the other variety of edible fat which is extremely popular throughout India. Recently acute shortage of *ghee* has been felt, this coupled with the rise in prices has considerably limited the consumption of *ghee*. Body fats from slaughtered animals are only rarely used in India.

From 1930 onwards hydrogenated oils have been gaining in popularity as edible fats. Groundnut oil is the principal raw material for hydrogenation although coconut, sesame and rapeseed oils are also used in small quantities. It was but natural that nutrition workers should turn their attention to the nutritive value of edible hydrogenated oils. While experimental work was in progress the public was supplied with information based on certain incomplete investigations to the effect that certain harmful effects had been observed in animals by feeding them with hydrogenated oils. This had the unfortunate sequel of creating suspicion and anxiety in the minds of consumers. In 1947 the Ministry of Food, Government of India, initiated a series of investigations co-ordinated by a Vanaspathi Research Planning Committee. The investigations have recently been completed and the Committee has submitted its report. These researches have shown that edible oils partially hydrogenated so as to give a product melting at 37°C are not only not harmful but equally nutritious as compared with other sources of edible vegetable fats.

ENERGY METABOLISM

One of the considerations which determines the adequacy of a diet is the energy requirements of the individual. The living animal utilizes the energy contained in food and is absolutely dependent on the latter for its supply in adequate quantities. Fundamental investigations on energy

requirements of human beings had been done in America and Europe. When such work was extended to countries in the tropical and sub tropical regions of the world certain discrepancies were noticed for which explanations were sought in the differences in climate dietary habits physical development and racial origin etc. between the inhabitants of the temperate and tropical regions. Work in India carried out during the last twenty years has provided the necessary information on the energy requirements of Indians which were found to be lower than the Western standards. Although it has not been possible to discover the cause(s) underlying the differences in the rate of energy metabolism referred to above it has been shown that such differences are probably not due to climate dietary habits or physical development as had been suggested. The average standard (energy) metabolism of Indian adults is at the rate of 35.4 calories/sq m /hr for men and 31.5 calories/sq m /hr for women. These values are lower by approximately 10 per cent for men and by 15 per cent for women as compared to certain American standards. The low rate of basal energy expenditure coupled with the smaller body size of Indian adults are the contributory factors in causing our total energy requirements to be lower for the same type of activity than is the case for European and American peoples.

UTILIZATION OF NUTRIENTS AND DAILY REQUIREMENTS

Several metabolic studies on human beings were undertaken in different laboratories to investigate the utilization of proteins fats and minerals. One of the main objects of such studies was to obtain scientific evidence for fixing the daily allowances of essential nutrients for Indian dietaries. The results obtained have formed the basis of the recommendations made by the Nutrition Advisory Committee in 1944 regarding the daily dietary allowances for Indians. In making their recommendations the Committee had taken careful note of the existing dietary practices in India and have translated the recommendations in terms of the common Indian foodstuffs. One effect of the above recommendations has been to provide the Government of India a nutritional yard stick for the formulation of food and agricultural policies in the post war period. On the success of these policies will depend the nutritional future of the Indian population.

VITAMINS

Vitamins are the product of the twentieth century. Their importance in human nutrition came to be realized not more than thirty years ago. Considerable advances have been made in our knowledge concerning their occurrence properties and role in human nutrition. Indian workers have contributed their quota to these advances. Numerous foodstuffs have been analysed for their vitamin content. Pulses have been found to be good sources of the major members of the B family of vitamins. Rich sources of vitamin C and carotene (precursor of vitamin A) were found in some common cheap Indian leafy vegetables such as amaranth coriander curry leaves fenugreek etc. Fruits like mango guava papaya etc proved to be good sources of vitamin C. The pulses on germination develop substantial amounts of vitamin C. Advantage was taken of this last observation in combating scurvy during the 1939-41 famine in Hissar District of Punjab.

DAILY REQUIREMENTS OF CALORIES & SOME ESSENTIAL NUTRIENTS

		Net Calories	Proteins	Fats	Ca (Cal cium)	Fe (Iron)	Vit A I U	Thia mine (Vit B ₁)	Vit. B ₂ com plex	Ascorbic Acid	Vit. D I U
MAN (55 kg or 120 lbs)	Light or sedentary work	2400	g	*	g	mg		mg	‡	mg	{ 400 to 800 400 to 800 30 to 50 and over
	Moderate work	3000	82								
	Very hard work	3600	82								
WOMAN (45 kg or 100 lbs)	Light or sedentary work	2100	67		10	20	3000	10		50	
	Moderate work	2500	67								
	Very hard work	3000	67								
	Pregnancy	2100	101								
	Lactation	2700	112								
CHILD REN	Under 1 year	100/Kg	3.5/Kg								
	1 to 3 years	900	3.5/Kg								
	3 to 5 years	1200	3.5/Kg								
	5 to 7 years	1400	3.0/Kg								
	7 to 9 years	1700	2.5/Kg								
	9 to 12 years	2000									
ADOLESCENTS	12 to 15 years	2400	2.0/Kg		1.0	10	3000	0.5	to	30	
	15 to 21 years	2400									

NB—The estimates of the protein requirements of children and adolescents are given in terms of grammes per kilogram because adequate data about average weight in the various age groups were not available to the Sub-Committee.

Fats must be included in a balanced diet but there is no exact knowledge at present available of the quantity required hence no figures have been included in the Table. Fats possess the advantage of yielding more than twice the energy obtained from carbohydrates or proteins. It is the general experience of nutrition workers that, even in a temperate climate there is a tendency towards a higher consumption of fats in winter than in summer. A liberal consumption of fats can be advocated on the grounds that some of them act as vehicles for fat soluble vitamins and thus may provide these nutrients to the body in appreciable quantities.

The human requirements of riboflavin, nicotinic acid and other members of vitamin B₂ complex have not yet been placed on a fully satisfactory basis and hence are not included in the Table. These vitamins are however essential for human nutrition. A few quantitative estimates of requirements have been made, e.g. from 2.2 to 3.3 mgs of riboflavin and 15 to 23 mgs. of nicotinic acid for adult men. Future research in India and elsewhere should be directed to placing this problem on a firm scientific basis.

Another practical application of vitamin studies in India was the development and growth of shark liver oil industry in recent times. During the war a curtailment in the supplies of cod liver oil was expected and actually did take place. The liver oils of various fish living in Indian coastal waters were intensively investigated and some of them were found to be sources of vitamin A much more potent than the average imported cod liver oil. The livers of saw fish and sharks are particularly rich in vitamin A. Values from 8 000 to 33 000 I U /gram of oil have been reported. It became possible therefore to switch over to the use of shark liver oil as soon as the cod liver oil became scarce. A thriving industry developed which even after the conclusion of hostilities is capable of adequately meeting the demands of hospitals and all others who need vitamin A. Problems of storage of fish liver oils in tropical conditions are also receiving attention. It is necessary to carefully watch the development of this infant industry for it may die out under foreign competition as it once did in 1870. At that time the manufacture and export of shark liver oil suffered from competition of the then newly developed cod fisheries in Europe and America.

During the early stages of World War II dehydrated amla (*Phyllanthus embelica*)—Indian Gooseberry—was used on an extensive scale to supply the vitamin C needs of the Army in India. With the advent of the synthetic product which was cheap to manufacture and available in quantities the manufacture of amla powder was discontinued. It did however meet the need of the moment most effectively.

Apart from the above results of great practical importance the investigations in progress aim at providing more fundamental information on vitamins and their action. Vegetable foodstuffs like green leafy vegetables, carrots, tomatoes, mangoes, etc. are considered to be valuable sources of a yellow pigment β carotene, the most important precursor of vitamin A. β carotene is accompanied in nature by various other carotenoid pigments, not all of which have the same biological activity in terms of vitamin A. These pigments have been estimated and true vitamin A values determined for some fruits and vegetables. This work is of great promise and is bound to give a true appreciation of vitamin A activity of vegetables and fruits. The problem ought to be of great importance for in India a majority of the population depends upon similar foodstuffs for the supply of vitamin A precursor. Of equal importance are the researches dealing with the role of certain dietary constituents on the availability and utilization of vitamins of the B complex and the part played by the intestinal microorganisms in abstracting or providing additional amounts by synthesis of some of these vitamins.

Other researches on vitamins which are of scientific interest have dealt with studies on biosynthesis, absorption, utilization and mode of action of vitamins.

DIET AND NUTRITION SURVEYS

Diet Surveys —An account of diet and nutrition surveys carried out in different parts of India during the last fifteen years has been given in sections dealing with the work done in provinces. A comprehensive review on the subject has been published by the Indian Council of

Medical Research Some general observations regarding the results will be made in the present section

Till 1935 there was very little quantitative information about the Indian diets and dietary habits. It was however generally known that the diets of poor Indians who formed the bulk of the Indian population were defective in more ways than one. This impression had gained support from the earlier work of McCay in Bengal and Uttar Pradesh and of McCarrison at Coonoor. It was necessary however to know the actual defects if only to be able to interpret in more specific terms in the light of newer knowledge of nutrition their effect on the health of the people. Such knowledge would also help in devising steps wherever possible to correct the existing defects.

The new technique of diet surveys was extensively applied in the study of diets since the year 1936. Up to 1942 about 139 surveys had been carried out in different parts of India extending from Travancore to Kashmir. The results were very interesting. The surveys confirmed that cereals formed the mainstay of the Indian diets providing nearly 80 per cent of the energy contained in the whole diet a situation which is not nutritionally desirable and is at variance with sound nutrition principles and practice. Besides the diets were deficient in protective foodstuffs like vegetables, fruits, milk and milk products. The consumption of flesh foods even among those having no religious objection to their use was extremely meagre. From the standpoint of energy requirements the diets were marginal the average being 2 534 calories per day per man value. The average protein consumption per man value was 73 grammes and that of total fat 23 grammes per day.

Recently attempts have been made in a few provinces to evaluate the results of the acute food shortage which was felt for the first time in 1943 and which appears now to have become almost chronic. The results of diet surveys in post war years show that in the villages there has been no gross deviation in the dietary pattern whereas in the urban areas the calorie intake of the low income groups has fallen lower than the pre war average figure and the consumption of protective foodstuffs has decreased further.

Nutrition Surveys —The relation between poor diets and the health of the people was investigated by means of nutrition surveys among the child population. Children are admittedly more susceptible to dietary faults and hence more likely to show clinical evidence of continued malnourishment. Several nutrition surveys were therefore undertaken mostly in conjunction with the diet surveys referred to above. Owing to the fact that criteria of evaluating nutritional status had not been sufficiently well defined before the war and the judgment of the nutritional status had to depend upon the clinical experience of the investigator the only observations in which comparison is possible are those regarding the presence of frank signs of deficiency disease. Bitot's spots, angular stomatitis and phrynoderma were the signs which have been recorded by almost all the workers. Their incidence varied from province to province thus Bitot's spots were the highest (9 per cent) among school children in Travancore and least in Punjab. Angular stomatitis was found to the extent of 18.5 per cent in Orissa where the incidence considerably exceeded that found

in any other province Phrynoderma incidence was less than one per cent in Bengal Assam and Delhi Provinces but in others it varied from 5 to 15 per cent The information on other deficiency diseases is not available

Comparative data collected during the war years and post war period are not available for all the provinces In Orissa the results of two surveys carried out in 1942 and 1945 pointed to a significant decrease in phrynoderma although xerosis and angular stomatitis did not show much variation In Bihar where a much smaller number of children was surveyed in 1947 as compared to that up to 1942 it appears that xerosis and angular stomatitis incidence has increased Data collected in Coonoor on local school children in the years 1935 and 1949 show a marked decrease in angular stomatitis from 8.7 per cent to 1.0 per cent and an equally marked increase in phrynoderma from 8.6 per cent to 20 per cent incidence whereas for Bitot's spots the corresponding figures were 2 per cent and 3.4 per cent respectively It is extremely difficult to draw any broad conclusions applicable over a wide area It is necessary to obtain more detailed information over a wide region to be able to assess the present nutritional status of school children

The Nutrition Advisory Committee of the Indian Council of Medical Research (formerly the Indian Research Fund Association) realized the necessity of evolving uniform methods for the evaluation of nutritional status in India and with that end in view has formulated certain proposals for further study Already work along these lines is in progress in different States and it is hoped that in the near future much material will be collected which will not only give a correct impression of the nutritional state of Indian children but will also test the validity of some of the methods used in the evaluation

NUTRITIONAL DISEASES

In India certain nutritional diseases are endemic such as goitre in the Himalayas and sub Himalayan region beriberi in Northern Circars of Madras State fluorosis in the Ceded Districts of Madras State and lathyrism in Bihar Of these the first two can be classed among deficiency diseases and the latter two as having originated due to ingestion in excess of a nutrient or a poisonous constituent occurring in association with a foodstuff Then again other nutritional diseases occur in sporadic outbreaks Even in common hospital practice cases of nutritional origin present themselves in fairly large numbers Either several of them pass unnoticed or their significance in relation to the nutrition of the general population is not sufficiently recognized Thus infantile beriberi diarrhoea oedema rickets and keratomalacia in children anæmias chronic non-specific diarrhoeas dermatoses nutritional oedema pellagra osteomalacia etc in adults are some of the numerous examples of cases being treated in hospitals but not at present attracting sufficient attention to merit special investigation The fact that mostly the patients coming for treatment show signs of deficiency in which the picture is modified and oftentimes confusing renders it all the more necessary to study such conditions more carefully with a view to treating them adequately and successfully

It is true that information on epidemiology ætiology and clinical features of diseases like goitre beriberi and lathyrism had been collected by the pioneer work of McCarrison Stott Acton Kamath and Raman and others. This information was no doubt of great value in our understanding of these specific diseases but there existed a wide gap in our knowledge regarding those nutritional disorders which could not be referred to one single cause but which resulted from the interaction of more than one deficiency or imbalance of nutrients. These could only be studied by special clinics devoted to the investigations on nutritional disorders.

The Nutrition Research Laboratories established in 1943 a special Nutrition Clinic for the purpose of selecting investigating and treating cases of nutritional disorders. The clinic which worked for four years at the Stanley Hospital Madras was later transferred to Coonoor in 1947 to work in close collaboration with the parent organization. Already a rich harvest of scientific knowledge on some nutritional diseases has been reaped. Such diverse conditions as chronic nonspecific nutritional diarrhoeas nutritional œdema burning feet syndrome skin disorders of nutritional origin etc. have been studied in detail. These studies have added much to our knowledge about the etiology biochemistry pathology and treatment of the above conditions. The work done by the Nutrition Clinic has proved of such significance and utility that a fully equipped clinic has been established by the State Government in Bombay and the organization of another in Madras is under consideration of the Madras Government. There is little doubt that there is room for more such clinics in the rest of the country.

The outbreak of nutritional deficiency diseases in relief camps for displaced persons and the methods used for combating them have already been referred to. Full advantage of this opportunity for investigation on a large scale purposes could not be taken owing to the immensity of numbers involved and the need for urgent assistance. Recently however the Nutrition Department in Bombay State has carried out certain investigations on protein deficiency states and nonspecific diarrhoeas of nutritional origin among the inmates of relief camps. The experience gained in the diagnosis and management of such cases will prove of great value to others interested in the subject. Full details of these investigations are expected to be published shortly.

There are other diseases related directly or indirectly to faulty diet which require investigation in the field as well as the clinic. These are simple goitre lathyrism epidemic dropsy fluorosis etc. Goitre is found to occur in the sub-Himalayan region lathyrism in Bihar eastern Uttar Pradesh and parts of Central India. Epidemic dropsy is associated with the consumption of adulterated or contaminated mustard oil and is found mostly in Bengal Bihar and as far west as the Uttar Pradesh. Whereas simple goitre is due to the deficiency of iodine in soil water and food fluorosis is due to the presence in excess of fluorine in drinking water. Fluorosis is common in Kurnool Nellore and Guntur Districts of Madras State and in the adjoining districts of the Hyderabad State.

A considerable amount of work on goitre has been done in India. What is wanted is an organized trial to test the efficacy of iodized salt in

decreasing the incidence of the condition. Similar trials in other countries have proved highly successful and now should be undertaken in India.

The problems of fluorosis and lathyrism on which some work has been done require urgent attention on the part of public health authorities. They can best be solved in association with nutrition workers. In contrast to the above, the investigations on Epidemic Dropsy have made satisfactory progress. The researches of Lal and his colleagues at the All-India Institute of Hygiene & Public Health, Calcutta, have demonstrated beyond doubt the association of epidemic dropsy with the consumption of mustard oil contaminated with oil of *Argemone mexicana* seeds. Tests have been developed for detecting such contamination, a toxic alkaloid has been isolated from the argemone oil which probably is responsible for epidemic dropsy. It now rests with the public health authorities to take suitable steps for the protection of the population against this disease.

SECTION—IV

FOOD TECHNOLOGY

In India the advances in the science of technology of foods have been few. The reason for this state of affairs is not far to seek. The simple food habits of the people, lack of any appreciable surplus of foodstuffs, inability to purchase processed and refined foods and lack of enterprise can be considered as the main factors for the absence of organized food processing industry in India. Advances in technology and development of industries are interdependent. This is true of all industries. In India one has seen the spectacle of certain industries using methods of production long discarded in other technically advanced countries. Food industry has been no exception. Apart from the sugar and hydrogenated oil industries which have developed considerably during the last twenty years there is hardly any other which can be said to be run on modern scientific lines. There is no doubt that the manufacture of starch biscuits, boiled sweets, fruit preserves and squashes has gained certain ground particularly under the impetus of World War II, but science of food technology has contributed little if any to their development. As a whole however it must be said that food industry has not had any appreciable influence on the food habits of the people. A reference to hydrogenated oil industry has been made in Section III, any description of sugar industry is irrelevant at this juncture. The following description covers only such industries as deal with processing of foodstuffs which even in the unprocessed state form the components of our daily diets. In such cases processing is intended either (a) to improve the foodstuff from the standpoint of appearance, palatability or nutritive value or (b) to preserve the perishable foodstuffs.

Wheat —In India a large portion of wheat is either ground in homes or in small motor driven grinding machines (*chakkis*). There were a few large roller flour mills in the country. These were producing semolina and white flour. The by product was bran which was mainly used as cattle feed. During World War II the manufacture of semolina and flour was prohibited with the effect that roller mills had to remain idle. The grinding mills produce *atta* which is wheat flour of 95 per cent to 98 per cent extraction. The home ground *atta* is also of similar extraction. The coarse bran may or may not be removed before the *atta* is used in making *chappatis*.

In the United Kingdom the extraction rate of flour was raised from 70 per cent to 85 per cent during World War II. It was then found that the retention of a large proportion of phytin in the high extraction flour interfered with the absorption of calcium. This effect was countered by mixing at the source calcium carbonate with the milled flour. In India similar attempts failed for want of any organized large scale milling industry. The *atta* required by the Armed Forces however is being fortified with calcium carbonate.

Rice —A brief account of technical processes to which rice is subjected has been given elsewhere. It will be clear from the description that although the basic information about the nutrient losses due to such processing has been available for some time it has not yet been used with a view

to improving the efficiency of any of the processes which rice undergoes before it reaches the consumer

Milk, Milk Products and Substitutes —There is very little that can be said on this subject. The supply of milk has been inadequate for quite a long time. The producing units are too small and collecting and distributing units too few to enable even pasteurization to be attempted on any scale. The supply of pasteurized safe milk is only possible in military dairies. There exist a few creameries for butter manufacture but they usually waste the skim milk by merely precipitating casein and discarding the whey. Skim milk is being imported into the country and some of it is being used for (a) toning buffalo milk to bring the latter down to the composition resembling cow milk and (b) reconstituting into liquid milk by homogenization with added edible vegetable fat and carotene.

In India a negligible proportion of the population uses butter as such. On the other hand *ghee* which is obtained by boiling away the water contained in butter is extremely popular. In 1940 it was estimated that about 43 per cent of the estimated milk production was diverted for *ghee* manufacture. More recent estimates are not available. In keeping with the agricultural economy of the country it is the small producer who predominates in this industry. Hence it has not been possible to apply any improved methods to the manufacture of the commodity for the same reason it has been difficult to effectively control the quality of the product.

Ghee like milk is also in short supply. During World War II considerable quantities of margarine were manufactured for the use of the Armed Forces. Now the demand is not so great. It is understood however that small quantities are still being produced for local consumption.

The inadequacy of milk has prompted some efforts towards the manufacture of substitutes. Soya bean milk has been produced on pilot plant scale and considerable scientific work has been done at Bangalore which has demonstrated that fortified soya bean milk would prove a good supplement to poor Indian diets. Unfortunately soya bean is not cultivated as a crop in India to any great extent hence the production of soya bean milk on commercial scale has not been possible. Experiments are now in progress for preparing a similar product from groundnut.

Fruits and Vegetables —Canning of fruits and vegetables was an infant industry in India before World War II. During the war its rapid development was found impracticable. The needs of the Armed Forces for the supply of preserved fruits and vegetables was great. Dehydrated vegetables and fruits were produced on a large scale and supplied mainly to the military and some advances were made during the war in this respect. With the end of the war the industry which was filling an emergent need did not make any appreciable progress once the emergency was over. The technical knowledge and skill thus gained have recently been used for the preparation of tapioca and sweet potato flour which are intended to serve as subsidiary foods in the context of present food shortage. Signs are not wanting however which suggest that fruit processing industry in India will soon develop into a major food industry.

The Government and the Universities seem alive to the needs of the country in respect of scientifically trained personnel and the need of research work in food technology. In certain Universities departments for research and training in the subject have been opened and have started functioning. In the Indian Institute of Science Bangalore a food technology section with modern equipment has been established. The Council of Scientific and Industrial Research has established a Central Food Technological Research Institute at Mysore with an extensive programme of work. Other higher technological institutes being planned by the Government of India are also providing for sections on food technology. It cannot be denied however that it will take an appreciable time before these activities in the academic field could influence the development of new and rationalization of old food industries in India.

CONCLUSION

This review of nutrition work in India reveals that a large gap exists between the volume of useful information which has been made available through studies extending over a period of about a third of a century and the application of such information to the improvement of the nutritional status and general well being of the people of the country. The practical application of the knowledge gained through research should mainly be in two directions (a) an increase in food production so as to promote the progressive realisation of an adequate and balanced diet for our people and (b) their education in the new knowledge regarding nutrition in order to enable them to secure the best diet possible within the limits of the resources available to them. The responsibility for the first lies on the Ministries of Food and Agriculture at the Centre and in the States while the task of public education in nutrition should be undertaken mainly by the Education and Health Ministries. It is not the purpose of this review to discuss the reasons for the lag that exists between the knowledge that is available and its utilization by Governments and the people but it is important to draw attention to this lag and to emphasize the need for a concerted effort on the part of all concerned to promote a fuller utilization of science to improve the nutrition of all classes of the population. Certain specific health problems associated with nutrition such as endemic goitre, endemic beriberi, lathyrism and endemic fluorosis have not been dealt with so far and the responsibility for this state of affairs rests on the health administrations of the country.

It may not be out of place to add that with the growing complexity of modern civilized life it is becoming increasingly clear that a successful organization of public welfare can be achieved only through a wide association of technical and scientific personnel with day-to-day administration in order to ensure the fullest possible use of the fruits of scientific research in dealing with the many-sided problems of community life. Today the position is that the scientist and the administrator are working largely isolated from each other. It is deemed essential that not only in the field of nutrition but also in other fields of public endeavour the scientist should be given opportunities to influence administration to an increasing extent so that the solution of the problems relating to the needs of the people may be sought with all the resources that the physical and biological sciences place at our disposal.

SECTION—V

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FOODSTUFFS

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