APPROPRIATE TECHNOLOGIES FOR DEVELOPMENT

Child Nutrition In Developing Countries

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CHILD NUTRITION IN DEVELOPING COUNTRIES

A Handbook for Fieldworkers

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The writing and publication of this handbook has been financed by the

Office of War on Hunger
Agency for International Development
U.S. Department of State
Washington, D.C.

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September 1983

ACKNOWLEDGMENTS

The author is most grateful to the following colleagues for advice and guidance:

DR. M. BEHAR	DR. D. M. BLANKHART	DR. ANNE BURGESS
DR. R. COOK	MISS LILA ENGBERG	MRS. FRANCES ENGEL
DR. C. LEAKEY	DR. J. MAY	DR. M. KING
DR. D. MORLEY	DR. H. A. P. C. OOMEN	DR. D. MCLAREN
MISS E. SIMDLIN	DR. G. J. A. TERRA	MRS. MARJORIE VAN VEEN
DR. G. SAXTON	DR. M. MILNER	

Acknowledgment is made to:

Mr. William Serumaga of the Department of Medical Illustrations, Makerere Medical School, Kampala, for drawing the illustrations and to the following for the kind use of photographs.

The Food and Agriculture Organization for Figs. 2 and 3

The World Health Organization for Figs. 6 and 7

To UNICEF for Figs. 10 and 11

To the Kenya Information Service for Fig. 4

To Dr. I. Schneideman for Figs. 13 and 14

To Miss P. Pollard

First Printing 1968—Financed by the Agency for International Development, U.S. Department of State, and issued as Public Health Service Publication No. 1822

Revised 1969—As a publication of the Office of War on Hunger, Agency for International Development, U.S. Department of State

French Edition 1969—Translated and published by the Regional Technical Aids Center, Paris, Agency for International Development, U.S. Department of State

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INTRODUCTION

This book is intended for the many different groups including those with no technical training in the health field, including Peace Corps Volunteers, who are working in a variety of programs in developing tropical countries. The aims of their projects are often at first sight remote from child nutrition, but experience has shown that their work has often involved them, directly or indirectly, with the problems of malnutrition in children.

In addition, even health workers being trained in the Western world may find themselves confused by differences in infant feeding practices, by the types and severity of malnutrition seen, and, above all, by the apparent lack of relevance, or, at best, difficulty of application, of methods that have seemed so straightforward, obvious, and common-place back home.

The confused worker need not, however, feel so badly. The plight of the child population in tropical developing parts of the world has only recently been widely recognized and made a matter of serious inquiry by modern scientific medicine and public health. Apart from a few pioneers crying in the wilderness, attention to problems of nutrition in young children in developing regions started at the end of World War II, and has only gained momentum in the last decade.

It is now abundantly clear that, while such classical tropical diseases as yellow fever and cholera are very important health problems and blocks to progress, in reality they are of much less significance than childhood malnutrition. Numerically, economically, and socially, malnutrition not only causes a higher rate of immediate sickness, misery, and death, but also leads to a population that may be irreversibly damaged physically, mentally, and psychologically.

Understandably, initial medical emphasis was given to the investigation of the clinical appearance of children with various forms of malnutrition, as well as to laboratory research into changes in biochemistry, and into methods of treatment. Certainly, knowledge is still inadequate in these fields and more research is required. At

the same time, it has become increasingly recognized that, even with present imperfect scientific knowledge, it ought to be possible to deal decisively with the problem of prevention.

Mounting concern with the need to develop effective, economical, and acceptable action programs to deal with the problem of malnutrition in early childhood is indicated by the titles of recent International Nutrition Conferences—"Meeting Protein Requirements" in Washington 1960, "How to Reach the Preschool Child" in Como, Italy 1963, "Preschool Child Malnutrition; Major Deterrent to Progress" in Washington 1964, and "Administrative Problems in Programs to Protect Preschool Children," Hamburg 1966.

At the last of these, the present situation was described as follows: "The need to find *rapidly*, more effective means of improving the nutrition of these children has become even more acute. Evidence of permanent physical impairment due to early malnutrition is already well established, but more recent research points to retardation of the mental development of the young child and the possibility of irreversible damage of vital brain tissue due to malnutrition in early childhood has obvious implications for the future manpower and economic development of the countries in which it occurs, and adds a fearful urgency to the whole problem."

The huge size of the problem and its deleterious effects do, then, appear to be increasingly realized and, more important, the need for greater action in the development of imaginative preventive programs in the field is beginning to receive the priority emphasis and financial backing that it warrants.

The urgency of the situation has been recognized at the highest planning levels in the United States, as exemplified by the call to action by President Lyndon B. Johnson on the occasion of the transmittal to Congress of the Food for Peace Annual Report dated March 31, 1965, and by the statement of Mr. Frank Ellis, Director, Food for Peace, in a memorandum dated March 24, 1965: "It has been firmly established that preschool aged children are most vulnerable to the effects of malnutrition (in some cases suffering irreversible physical and mental retardation); therefore, agencies are urged to give priority attention to the establishment of meaningful programs aimed at attacking malnutrition in this group."

In the most recent directives outlining major activities of both the Agency for International Development (AID) and the Peace Corps, the need to give attention to the nutrition of infants and preschool children has been given high priority.

It is hoped, then, that this handbook will help nontechnical workers to recognize the significance of the problem of malnutrition in young children, and to be able to gear their efforts toward locally appropriate preventive and curative measures.

It is obvious that it is not possible in this book t
concerning scientific aspects of human nutrition. It i
to outline certain general principles and to suggest g
problems of childhood malnutrition exist in Papua
and while the basic needs for foods and nutrients ar
in both places, successful preventive programs could be widely dissimilar, depending, as they do, on the economic, geographic, and social "reality" within which they will have to be applied and developed.

General principles of approach are often valid; universal blanket solutions are a mirage. Each situation requires particularized knowledge, ingenuity, sympathy, and imaginative understanding to envisage a course of action that is relevant to local priorities, within the framework of available resources and, above all, with the community's understanding, support, and participation.

Another variable will plainly be the particular project on which the worker is engaged. This may be directly in the health field, and, in the future, may be specifically concerned with trying to assist in the development of a Preschool Protection Program (P.P.P.), in which the prevention of malnutrition is the dominant theme. Equally, it should be possible to integrate some practical emphasis on methods of combating malnutrition into almost all types of projects in developing countries.

The scene then is set. The past twenty years have delineated the clinical picture, the biochemistry, the causes and the treatment of malnutrition in early childhood. More recently, international recognition has accumulated to emphasize the magnitude of the problem and its gravity as "a prime deterrent to progress." Methods of prevention are theoretically known; their application is desperately needed.

There is no doubt that the next ten years could be envisaged most usefully as the "decade of field application," in which seemingly simple programs, so difficult to carry out in fact, are launched collaboratively by governments and international and voluntary agencies, evaluated, suitably modified, and carried to successful conclusions at the grassroots level of the rural tropical villages and slums, where the majority of the world's children live.

In this decade of field application, there is no doubt that nontechnical field workers, including Peace Corps volunteers, can play a most important role. This book is intended to guide them in the struggle against malnutrition. It does not, and cannot, suggest universal panaceas; but, hopefully, may indicate general tactics, leaving the detailed strategy to the planners of the specific programs, and finally to the ingenuity and adaptability of the worker on the spot.

DERRICK B. JELLIFFE.

chapter i

THE HUMAN SCENE

TO APPRECIATE the always complex and multiple factors responsible for malnutrition in an individual child, or in a community, it is first necessary to have some understanding of the general human scene in what are often called the "developing countries" of the world. This term is, of course, imprecise and plainly applies in varying degree to different countries of the world, or, even to regions within a single country. In the present book, it refers in general to those countries which have lagged behind in the technological, industrial, agrarian, and economic revolutions that have occurred in the Western world in the last 150 years, and whose populations have not been directly involved in the development of the system of thought and logic known as "scientific rationalism." These countries are mostly located in the subtropics and tropics, and they are now making herculean efforts to modernize and to raise their standard of living, so that they are best termed "technically or economically developing."

It is also apparent that all preindustrial societies have their own well established ways of life, and, indeed, some of these have roots in civilizations which antedate those of the Western world by thousands of years. Nevertheless, the human scene in technically developing regions of the world, which include two-thirds of the world's population, usually has certain general features in common, and these need to be recognized and understood, as they not only play a part in the causation of childhood malnutrition, but they also help to determine and limit possible methods of prevention and improvement.

Rural Populations and Increasing Urbanization. In most developing countries, the majority of the population—usually between 60 to 90 percent—are scattered in rural areas, dependent for the most part on subsistence "garden-to-mouth" agriculture, often in villages or homesteads to some degree isolated by poor road communications. At the same time, partly as a response to planned industrialization and partly spontaneously, in all countries there is an increasing move toward urban areas by men, sometimes with their families and sometimes

alone, seeking employment and the excitement of the big city, but only too often finding instead the disappointment and frustration of unemployment and the demoralized life of the slum dweller, with all the consequent nutritional and social problems (p. 57).

Antiquated Agriculture and Inadequate Food Production. Old-fashioned methods of agriculture are usual, and although the tools and methods may be time-hallowed by tradition and are sometimes adapted to local circumstances, agricultural productivity is low, under-mechanized, and usually based on small uneconomic landholdings (p. 44). Food production is, therefore, inefficient and highly dependent on the weather; while the harvest is exposed to much wastage by rodents, insect pests, and molds during storage.

Likewise, the preservation, distribution and marketing of food is also likely to be poorly organized and without benefit of modern technology, thus limiting the range of food distribution from its area of production.

Poverty. The national earning capacity of developing countries is usually low and dependent on agricultural, rather than industrial, production. It is very frequently based on one or more cash crops, such as coffee, rubber, cotton, or cocoa, and subject to the price fluctuations for these commodities on world markets; or, as in the case of rubber, for example, to the development of modern synthetic substitutes.

Low *per caput* incomes plainly limit the range of foods which families can afford to produce, or to buy. Thus, animal protein foods which are, relatively speaking, expensive to produce are little used. They also limit severely the possibilities of investing in supplies and equipment which are needed to increase food production or to improve food storage.

At the same time, the relative expense of a poor man's life deserves emphasis. For example, he can only afford to buy small uneconomical quantities of any commodity at a time, including purchased foods and, in some tropical towns, water.

The national income of highly populated developing countries is often only one twentieth of that of industrialized countries, which means that there will be an understandable competition between the various Ministries or Departments of Government concerned with trying to develop the country for the limited finance available, and especially for restricted foreign exchange. This plainly means that all projects, whether for more hospitals, or for better communications, or for an increased number of boreholes for water, have to be judged, if possible, impartially. Emphasis has to be given to those considered to be priorities for the country's development. Of such, those related to improving the nutrition of young children are extremely important in the long run.

Specifically, a low national income means that little finance will be available for health or other social services. Thus, in developing countries the *per caput* annual health budget may be between U.S. $0.50–1.00, as compared with $30–40 per head per annum in Western industrialized countries.

Lack of Education. Educational problems will also loom large. There is usually a high rate of illiteracy, especially among women. The number of schools is insufficient and a shortage

of school teachers is often a major obstacle to the expansion of the educational system. The availability of all types of technically trained personnel, including those needed to man the health or agricultural services, varies in different parts of the world, but, in general, will also be quite inadequate in both number and quality.

There is no doubt that from the long-term viewpoint, education is a major key to the improvement of the health and nutrition of a country. Educated parents are likely to have an increasing awareness of modern ideas of nutrition, child rearing, and food production, and to realize the economic limitations of trying to rear and educate an over-large family.

Defective Environmental Sanitation. Standards of environmental sanitation, including an easily available, clean water supply and the disposal of excreta and rubbish, are usually defective, with an increased incidence of infections and parasites that are water-borne, spread by flies, or due to fecal contamination of the compound. These will include diarrheal diseases and intestinal worms, both of much significance nutritionally (p. 72).

Inadequate Medical Facilities. Doctors are few—between 1 per 10,000 to 1 per 100,000 population—compared with Western countries in which there may be about 1 per 1,000 population. In addition, there is usually a geographic maldistribution, with a high proportion of the total in cities, and a relatively small number in rural areas.

There is a similar scarcity of nursing and other paramedical personnel, who usually do most of the preventive and curative health work in this type of country. All too often hospital facilities, including beds, are even scarcer for children than for adults, and little attention can be paid to the sheer numerical size of pediatric problems, especially malnutrition. Shortage of beds, drugs, and equipment often mean that health services can of necessity only supply a rough and ready "first-aid" type of treatment.

Nonwestern Culture Patterns. The mass of the population has usually a prescientific philosophy, with motives and drives very different from those of the Western world, and with unfamiliar, but deep-rooted, classifications of disease, food, and all other aspects of life, often much related to magic and ultra-human forces. Women may often be considered to have a low or subservient status—a point of great importance in relation to successful nutrition education.

The local pattern of customs, attitudes, and practices greatly influences, both for better and for worse, the nutrition, diet, and food production of a community, and also modifies the way in which preventive programs can best be developed (p. 68). The scientific mode of thought and logic usually has neither influence nor long-standing historical roots among the majority of the population.

Young Populations. The population structure of most developing countries differs greatly from that seen in the U.S.A. and in Western Europe. In general, there are more children and young adults, and fewer people reaching old age. Thus, about 50 percent of the population will be below 15 years, while 20 percent will be young children below the age of 5 years, compared with about

30 percent and 10 percent for corresponding age-groups in Western countries.

Population Pressure and Food Production. At the same time, and of great consequence nutritionally, despite high mortality in early childhood and a low life expectancy at birth of 30 to 40 years, there is usually a population increase of about 2–3 percent each year. This is due to sustained high fertility and the decreases in mortality that have taken place in recent years, as a result in part of the introduction and acceptance of some aspects of modern preventive and curative medicine, and in some measure to a decrease in warfare at the local level. The consequent population pressure plainly has nutritional significance (p. 55–56). In particular, the high rate of population growth leads to the continual outstripping of food production by the number of mouths to be fed.

The disproportion between numbers of people and land available for food production is notable in India, where 2.2 percent of the world's land area is occupied by 14 percent of the world population.

High Burden of Childhood Disease. The child population is not only a very large one, but also has a high incidence of illness. A visit at any outpatient clinic in a tropical country will show at once that about half of those attending are young children, and this impression is confirmed by the fact that more than 50 percent of the *total mortality at all ages* occurs in early childhood.

The high death rate in early childhood is also shown by the infant mortality rate—that is, the deaths of children occurring in the first year of their life. Rates in developing countries of the world may be as high as ten times those found in industrialized Western countries. Less obvious, and usually unappreciated, is the fact that the death rate of children in the 1–4 year age group—a relatively healthy period in Western countries—may be 40 times as high as those in the U.S.A., largely due to malnutrition and to associated infections and parasites (Figure 1). In general terms, this will mean that approximately half the children born die before they reach their fifth birthday.

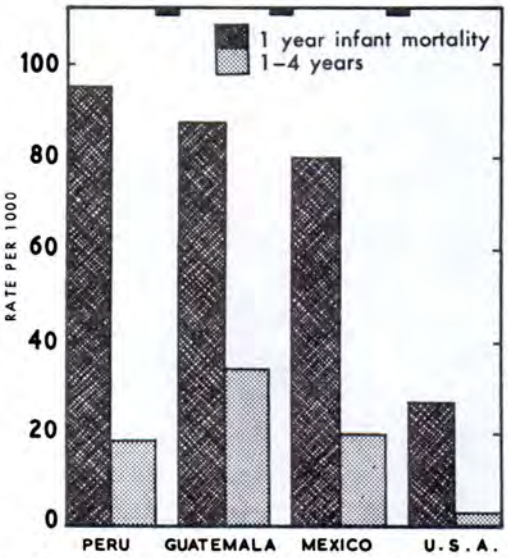

FIGURE 1.—High infant and 1–4 year mortality rates in Peru, Guatemala, and Mexico compared with the U.S.A.

Pattern of Childhood Disease. Despite some differences from one part of the world to another, the general pattern of disease and ill-health in early childhood is broadly similar from region to region in developing countries.

The "Big Three" childhood ailments are usually malnutrition, diarrheal disease, and pneumonia. Following behind these come the remainder of

the "Top-Ten"—tuberculosis, malaria, certain infectious fevers of childhood (notably measles and whooping cough), intestinal worms, accidents, and infections of the newborn. Characteristically, young children in tropical regions are rarely found to be suffering from one disease alone, but from several at one time, each adding to the total cumulative burden of misery and ill-health.

None of the diseases mentioned is "tropical" in the old-fashioned sense—that is, found exclusively in hot tropical regions. Kwashiorkor, one of the severe forms of protein-calorie malnutrition (p. 75), was common in Europe at one time, as was well documented in the Irish Potato Famine of the early 19th century. Malaria can be a scourge in Arctic regions in the summer, and deaths from intestinal roundworm infections were once well known in Britain.

What seems a difference in place is rather a difference in time and development. Urbanizing areas of nineteenth century Europe during the Industrial Revolution had a very high infant mortality rate due to summer diarrhea, malnutrition (including "flour-feeding illness," actually a form of kwashiorkor) (p. 76), and many infectious diseases, all occurring among grim social and hygienic circumstances. The so-called "tropical" pediatrics of 20th century city slums found in some developing countries present a strikingly similar picture.

Moreover, that the tropics, in a climatic sense, are not primarily implicated is shown by the fact that comparable nutritional and health problems are seen in less well-developed communities in cold or temperate regions, including, for example, parts of rural Chile, and among some groups of Eskimos; by the usual good health of the children of the well-to-do, both indigenous and foreign, living in tropical regions; and by the recurrence of similar child health problems, when environmental factors, especially nutrition deteriorate as was the case in Holland in the last months of World War II. Wars, famines and other natural and man-made disasters always have their main nutritional ill-consequences among the vulnerable groups—the young children and pregnant and lactating women.

Preventability of Problems. The common illnesses mentioned are all potentially preventable, including the various forms of childhood malnutrition. Cure alone is economically unsound and illogical, and will in no way prevent the child or others in his family from contracting similar diseases on return to the home environment. It is this preventive approach which has to dominate all realistic child nutrition programs in developing countries.

Molding Factors. Four groups of factors appear to mold the pattern of childhood disease in different parts of the world. These are: the economic, hygienic, and educational levels of development in the community; genetic characteristics; the cultural pattern; and geographic and climatic factors. That certain important diseases are exclusively "tropical" in distribution is not to be denied—for example, some parasitic infections, such as African Sleeping Sickness. Also, all human groups are subject to different inherited diseases. However, there is no doubt that most disease in present-day "tropical pediatrics," including malnutrition,

is principally the result of poverty, technical backwardness, inadequate supplies of nutritious foods, lack of education, and defective hygiene, associated in varying degree with the effect of certain local customs and practices.

Size of Problems. Some of the disease problems mentioned above may be very large, and this is especially the case with childhood malnutrition. Thus, in Kampala, Uganda, 10 percent of all children admitted to the main hospital are suffering from the severe form of protein-calorie malnutrition known as "kwashiorkor" (p. 76); while surveys in the surrounding countryside show at least half of the children under school age are suffering from lesser degrees of this form of malnutrition. In 1958, a countrywide survey in Haiti showed 7 percent of 1-3 year olds to have kwashiorkor.

Only too often the full dimensions and the late consequences of the problem of childhood malnutrition are not appreciated by the administrators and leaders in some parts of the world. The size of the problem, its direct and indirect influence on child mortality, and its late effects on physical and mental development have only recently been appreciated by the medical world. They are particularly unpalatable and difficult for hard pressed politicians in developing countries to accept and face, confronted as they are with a wide range of formidable social and economic problems to be dealt with with limited resources.

Need to Appreciate Background. It is vital for all those working in the field of nutrition to appreciate the background realities in developing regions and the general pattern of childhood disease. Many bacterial and parasitic infections are more easily acquired and have more serious effects in malnourished children. At the same time, much malnutrition results not only from lack of the correct foods, but also the additional burden placed on the child by intercurrent (conditioning) infections (p. 72).

It is in these difficult circumstances that all those working to improve the nutrition of tropical children find themselves enmeshed. Much plainly depends on relatively long-term measures to improve, modify, or expand the economy, the educational system, food production, and the social structure of the particular country.

Important as these long-term objectives obviously are, they cannot be considered here, and the present book is concerned with discussing the causes and recognition of malnutrition in childhood, and with possible measures to improve the nutrition of children available to those working in the field.

The Challenge. The challenge is how to make the benefits of modern scientific knowledge available simply, economically, effectively, acceptably, and persuasively to enable tropical villagers to improve their own standard of health and living, and, in particular, to advise and motivate parents to improve the nutrition of their young children. This accomplishment plainly requires practical and tactful adaptation, with the ultimate aim being always to secure the maximum return in human welfare from minimum expenditure in money and trained personnel.

FURTHER READING [1]

R. E. Brown, *Medical Problems of the Developing Countries*, Science, 153, 271 (1966) (G&T).

D. B. Jelliffe, *Paediatric Practice in Tropical Regions*, Lancet, ii, 229 (1965) (G&T).

M. King (Editor), *Medical Care in Developing Countries*, Oxford University Press, Nairobi (1966) (G&T).

[1] G=Recommended for the general reader. T=Recommended for the technically trained health worker.

chapter ii

THE HUMAN DIET

ALL OVER THE WORLD different human groups have evolved their own diets, based on an immense variety of dishes made out of innumerable mixtures of different foodstuffs. While not appreciated by the people concerned, a satisfactory diet in any part of the world has to contain adequate quantities of specific nutrients to supply energy, to maintain body repair, and to keep the body working normally. In addition, in childhood and pregnancy the diet must be sufficient to cover the extra needs of rapid growth.

The foods making up a diet, after having been eaten, are digested and absorbed from the alimentary canal. Within the body, the nutrients are used for one or more of the activities already mentioned. If excessive quantities of nutrients are taken, they may in some cases be passed out of the body in the urine, as with vitamin C, or may be stored in the body, as with vitamin A in the liver, and with too great an intake of calories, as subcutaneous fat.

BASIC NUTRIENTS

Diets are made up of six basic groups of nutrients—carbohydrates, fats, proteins, minerals, vitamins, and water, together with substances added for flavoring. The body has different needs for these nutrients in health depending upon size, sex, age, degree of activity, and climate.

Nutrient Allowances. Analysis of diets of well-fed, healthy people, and laboratory investigations on experimental animals and human volunteers have led to the suggestion of certain recommended daily nutrient allowances (Appendix I).

These figures are only approximate as there is variation even between healthy individuals, and it is quite possible that communities in various parts of the world may have adapted themselves over long years to higher or lower levels of intake of certain nutrients. The figures given are also aimed

at a safe level and may, therefore, sometimes be too high.

In any case, it will not be possible for the nonnutritionist to calculate dietary intakes, and, for practical purposes, it is more useful to plan diets to insure intakes of certain groups of foods known to be rich in different nutrients.

Needs for Growth. The nutritional needs of young healthy children are particularly great, as would be expected from their rapid rate of growth. In particular, the requirements for protein, calories, and iron are much greater proportionally in young children than in adults. Thus, a 150-pound man needs about 70 grams of protein per day, while a child of one tenth of this weight (e.g. 15 pounds) needs 21 grams of protein, which is almost one third of the adult's requirements.

Pregnant and lactating women also have a very high dietary need for the growth of the fetus and uterus, and because of the nutritional drain of the human milk produced.

Needs During Infections. As well as physiological variations in normal healthy individuals, many bacterial and parasitic infections can affect the body's nutrient requirements. For example, in diarrhea in young children the rapid passage of food through the intestines prevents its full absorption. The presence of numbers of roundworms in the small bowel may lead to food being taken up by these large parasites rather than by the child. Likewise, any fever leads to an increase in the body's needs for protein, as well as resulting in poor appetite and sometimes in vomiting.

Inter-Relationship of Nutrients. The body's needs for different nutrients are related to one another. For example, the requirement for the vitamin thiamine, increases with the intake of carbohydrates. It is this inter-relationship which has led to the concept of the "balanced diet." In other words, not only are certain quantities of the different nutrients required, but for best usage they should be taken together in certain approximate relative proportions.

TYPES OF NUTRIENTS

Full details of the functions of various nutrients, and their sources in various foods can be found in standard textbooks on nutrition—some of which are listed at the end of the chapter. The present section, therefore, only summarizes certain points, especially those that are felt to be relevant to problems of childhood malnutrition in developing tropical countries.

Carbohydrates. The group of nutrients known as carbohydrates consists principally of starches, sugars, and various indigestible substances, such as cellulose. Carbohydrates are the body's main source of energy and heat, and every gram of carbohydrate absorbed into the body provides four units of energy (Calories).

Digestible carbohydrates are broken down by enzymes in the intestinal canal into simple sugars, which are then absorbed into the bloodstream and are used directly as a source of energy; or are stored in the muscles and liver as so-called animal starch (glycogen), which is subsequently reconverted into sugar to deal with the body's requirements for energy. An excessive intake of carbohydrates means that the body is

receiving a surplus of Calories, and these are stored as subcutaneous fat, leading ultimately to overweight and obesity.

Most foods, including meat, fish, and milk, contain some carbohydrates. However, carbohydrates are mostly found in certain classes of vegetable foods, especially *cereals* (grains), such as wheat, rice, corn (maize), and the millets; *root crops*, such as potatoes, yams, cassava, and members of the *banana-plantain* family.

Carbohydrates may also be taken in the diet in the form of naturally occurring sugars, such as those found in milk (lactose), or in fruits and honey (fructose).

Cane sugar (sucrose), extracted from a variety of vegetable sources, especially the sugar cane, beet, and sap of certain palm trees (*jaggery*), plays a part in certain traditional dietaries, and, of course, a large, and often excessive, role in the diet of modern urban communities. Sugar is one form of "naked Calories," that is, Calories with no other nutrients. A high consumption of sugar seems to be one factor responsible for dental caries.

In developing countries in the tropics, predominantly carbohydrate foods are usually the main source of Calories in the diet, with the exception of such unusual groups as some hunting or pastoralist communities. By contrast, in industrialized countries, Calories are less exclusively derived from carbohydrate foods, as the fat intake is higher.

In many tropical regions, the diet may consist to a very large extent of one or more mainly carbohydrate foods, the staples. However, it is important to realize that these predominantly carbohydrate staples also contain protein and other nutrients, although in small quantities. Most tropical peoples also derive the bulk of their protein from their staple food.

In staple foods, the carbohydrate starches are enclosed in granules interspersed between indigestible cellulose. Preparation is sometimes by means of milling to form a flour, and always by thorough cooking to break down the cellulose framework and to cause swelling and bursting of starch granules. In this way the foods are made digestible and the full Calories become available. This is particularly important when preparing foods for young children.

Fats. These may be derived from either plant or animal sources. They are concentrated sources of energy, having more than twice the Calorie content of carbohydrates (9 Calories per gram). Animal fats are present in the livers and fatty parts of animals and fish, the yolks of eggs, and in milk fat and its by-products, such as butter, cream, and *ghee* (clarified butter). Certain animal fats, including egg yolk, liver, and butter, also contain the fat-soluble vitamins A and D.

Vegetable fats are found in the groundnut, the soybean, the olive, the oil palm fruit, all nuts, and the seeds of various plants, including sesame, mustard, and cotton. These oils are often extracted by traditional means and used for cooking. Commercially, some are grown in extensive plantations and the oil used for a variety of purposes, including the manufacture of margarine and soap.

In most developing regions, fats are costly and not widely available, and

so form a very minor ingredient in the diet. Thus, in India only 13 percent of the total Calories of the adult diet are derived from fat, as opposed to 43 percent in the U.S.A.

Proteins. The complex substances known as proteins are essential constituents of all plant and animal cells. Protein molecules are made up of varied combinations of components called amino acids. Over twenty of these amino acids are required by the body, but only eight are "essential" that is, they cannot be manufactured by the human body from other ingredients, so that they have to be present in the food eaten.

The value of a particular food protein in the diet is determined by its amino acid composition (compared with the proteins of egg or breast milk as standards), its known biologic effects in experimental animals, the digestibility of the particular food, and the associated calorie content of the diet, which may have a "protein-sparing" effect (p. 17).

Animal Protein. Proteins may be derived from animal or vegetable sources. Animal proteins are found in meat, fish (including shellfish), eggs, milk(and some of its products, especially cheese, yogurt, and buttermilk), and to a minor extent from other sources, including insects, snails, and so forth. Foods of animal origin not only are rich, concentrated sources of protein, but also all contain the complete range of the eight essential amino acids.

Vegetable Protein. While almost all vegetable foods contain some quantity of protein, the content varies considerably. The richest in protein, usually containing about 20 percent, are the legumes—the various beans, peas, lentils, and the peanut (groundnut). Of these, the best protein source is the soybean (up to 40 percent), although caution has to be exercised in preparing this food owing to its indigestibility (p. 31).

The next best plant sources of protein are the cereal grains. While there is great variation between different types of cereals and many different strains exists, as a group they contain about 10 percent protein.

Plant sources of protein that are often overlooked are dark green leafy vegetables, including tropical equivalents of spinach. These leaves contain about 2–10 percent protein. They are also good sources of other nutrients, including iron, vitamin C, and riboflavin, especially the young leaves. Unfortunately, in many communities of the world, they are often not used as much as they might be, and, indeed, often may be regarded as "poor man's food," with little prestige.

The staple foods poorest in protein are the various root crops, tubers, and plantains, which have a protein content of only 1–2 percent.

As important as the total protein content of vegetable foods is the fact that their proteins do not contain the full range of the eight essential amino acids. For example, the protein of cereal grains, such as corn (maize) is deficient in the essential amino acid, lysine; while the proteins found in legumes, such as the soybean and chick-pea are relatively low in another (methionine). The value of each of these foods is, therefore, enhanced if eaten as cereal-legume mixtures, thereby providing the whole range of essential amino acids.

Expense and Scarcity of Protein Foods. Diets in tropical countries are almost universally deficient in protein,

especially in those of animal origin, a fact which is illustrated by a comparison of the average milk, other animal and vegetable protein intake in Latin American countries with figures from Canada and the U.S.A. The rapidly rising populations in developing countries and the slow increase in agricultural production is tending to widen this "protein gap" still further.

In addition, all over the world, whether in New York or equatorial Africa, protein foods, especially those of animal origin, are more expensive than largely carbohydrate staples. In view of this, the need to use vegetable protein mixtures, if possible with *small* additional quantities of animal protein, is an important principle of village level infant feeding (p. 130). Indeed, many traditional diets in different parts of the world appear to have evolved toward largely vegetable protein mixtures. These are often of a cereal-legume combination, in which the amino acid deficiency of one food is complemented by that of the other ingredient. Examples include the rice and *dhal* (lentil) of India, the beans and corn *tortillas* of Mexico, and various fermented food preparations, such as Japanese *miso* (soybean and rice) and Indian *idli* (black gram and rice).

Functions and Needs of Proteins. Protein is required for repair of the body, the cells of which are constantly being broken down and rebuilt, for the formation of body enzymes, and also for growth. It is for the latter reason that there is a particularly high protein need in infancy and early childhood (Appendix I), when growth is especially rapid.

Carbohydrates as Protein Sparers. It is important to realize that if insufficient carbohydrate foods are present in the diet, protein may be wastefully burned by the body for the production of energy at the rate of four Calories per gram. This becomes of special practical significance in the treatment of kwashiorkor (p. 80), when sufficient Calories in the form of sugar and vegetable oil should be given at the same time as protein.

Vitamins. The group of nutrients known collectively as vitamins are unrelated chemically, but are all essential *in small quantities* for the maintenance of good health. Severe deficiency, leading to depletion of body stores, results in various forms of clinical malnutrition, which can sometimes be recognized by the appearance of certain signs or by the use of appropriate laboratory tests.

However, vitamins are required only in small quantities, so that the mixed diets, made up of a wide range of different foods consumed in most of the U.S.A. and Western Europe, usually supply more than adequate quantities in the diet itself. There is no evidence to suggest that extra amounts of vitamins are beneficial. Undoubtedly, the result of much routine taking of vitamin tablets by well-fed people only leads to the production of an "expensive" urine, as the unnecessary intake is promptly excreted.

Nevertheless, vitamin deficiencies of various types occur in many parts of the world, especially if a diet is taken that is limited to a restricted number of foods. In Britain, the elderly person, living alone and with a poor appetite may subsist on tea and toast, and develop various vitamin deficiencies, especially those of the B complex. Historically, the diet of hardtack and salt

pork which was sometimes eaten for months on end by seamen during the age of sail was almost always guaranteed to lead to a substantial death rate from scurvy (vitamin C deficiency).

In some communities of the world, the basic diet may consist of a very limited range of foods. This limitation may be for economic reasons, or because of local customs, or because the terrain only permits the growing of limited crops, or for a combination of all of these reasons. Difficulties may be aggravated by seasonal variations in food supply, in particular by a "hungry season," which often occurs at the beginning of the rains when crops have been planted, but are not yet ready for harvesting.

As with other forms of malnutrition, vitamin deficiency disease is much more likely to occur in the two nutritionally "vulnerable" groups—young children and pregnant or lactating women. Their need for nutrients is high and their intake is often restricted by various harmful food customs (p. 65).

Another factor to be taken into account in relation to the onset of malnutrition due to vitamin deficiency is the variable degree of storage of different vitamins in the body. In a well-fed individual, vitamin A stores in the liver may suffice for months, even if the diet is lacking in this nutrient, so that clinical deficiency will only be detected after this time has elapsed. By contrast, stores of thiamine last for only a few weeks.

The effects, actions, and interactions of vitamins is a most extensive subject and it will only be possible to touch on a few important points here concerning the relevance of vitamins to the nutrition of tropical children.

Vitamin A. This vitamin can be taken in directly as vitamin A, which is contained only in animal foods, particularly in liver, egg yolk, milk and its products, and liver oil from the cod, halibut, shark and other fish. Alternatively, vitamin A may be synthesized within the body from orange pigment foods, containing the pro-vitamin beta-carotene (vitamin A precursor). Rich sources of carotene include such orange-colored fruits and vegetables as the pawpaw, oil palm fruit, carrots, pumpkins, mangoes, yellow sweet potatoes, and so forth, as well as dark green leafy vegetables, including various tropical equivalents of spinach and cassava leaves.

Foods containing actual vitamin A can be obtained only rarely by the average population of most developing tropical countries, so that the avoidance of deficiency depends in large measure upon ensuring an adequate intake of carotene-containing foods.

Also, tropical infants are much dependent on their mother's diet in this respect, both as regards the stores laid down in the liver in the fetus during pregnancy, and the vitamin A in their mother's breast milk. Both of these may be deficient if the mother's diet has itself been lacking in carotene-containing foods.

Problems may also occur because carotene is not well absorbed from the intestine, especially in children who have diarrhea as is very commonly the case. Storage of vitamin A in the liver may be hampered in young tropical children by various diseases of this organ, which are by no means uncommon.

Vitamin A is principally required for the normal functioning of epi-

thelium (surface cells) of the skin and eye, including the retina. In some parts of the world, vitamin A deficiency is a most common and serious form of malnutrition, which is both preventable and tragic in its consequences, as it may easily lead to permanent blindness (p. 87).

Vitamin B Complex. The three main members of the vitamin B complex or group are thiamine, riboflavin, and niacin.

1. *Thiamine.* Thiamine, which is required for the metabolism of carbohydrate in the body, is widely available in a variety of tropical foods, including cereal grains (mainly in the germ), legumes, green leafy vegetables, fish, milk, and meat. Thiamine is water soluble and easily absorbed. It breaks down at high temperatures.

Severe deficiency of thiamine in young children results in a clinical condition known as infantile beriberi (p. 88). Beriberi is a public health problem of importance mainly in those areas of Asia where over-milled rice forms the mainstay of the diet, with a consequent high intake of carbohydrate and low levels of dietary thiamine. It has been termed "white rice disease."

Thiamine in rice can be reduced not only by overmilling, which removes the germ, but also by over-soaking or cooking with too much water which is subsequently discarded. Parboiling (p. 27) is a method of preparation which preserves the thiamine content.

An insufficient intake of thiamine in the mother's diet is also of great potential harm to the suckling baby, in part because the stores that he will acquire during fetal life will be low, but mainly because the level of thiamine in the mother's milk varies greatly with her diet.

The daily need for thiamine is related to the amount of carbohydrate Calories in the diet, so that feeding with overmilled white rice from the early weeks of life is another factor tending to lead to infantile beriberi (p. 88).

2. *Riboflavin.* This yellow-colored vitamin is also widely distributed, but is in especially high concentration in milk, green vegetables, meat (especially liver), fish, and eggs. In tropical diets, its main sources are usually dark green leafy vegetables, cereal grains, and legumes. Starchy root crops contain only very little.

Lack of riboflavin produces ulcers at the corners of the lips, and a generally red, sore mouth.

3. *Niacin.* This vitamin is found distributed in numerous foods. Rich animal sources include meat, particularly liver, while the best available sources in tropical countries are legumes, including groundnuts, and cereal grains, especially if they are undermilled and still contain the germ.

Corn (maize) is a particularly poor source of niacin, especially if the germ has been removed by overmilling. Clinical malnutrition due to niacin deficiency—pellagra—is thus principally a disease of corn-eating communities.

Vitamin C.—Ascorbic acid (vitamin C) is found in vegetables, especially green leaves, and various fruits, particularly those of the citrus group. There are often especially rich local sources of ascorbic acid such as *acerola* (the Barbados cherry) in the West Indies, the fruit of the baobab tree in Central Africa, and the pawpaw and the guava in many parts of the tropics.

Other sources of ascorbic acid include germinating cereal grains or legumes, whether eaten raw, or cooked, or prepared as local beer.

Human milk is a good source of vitamin C, provided the mother's diet is adequate in this respect. A breast-fed baby therefore needs no other supply of ascorbic acid for the first six months of life.

Ascorbic acid is both water soluble and destroyed by heat. It will, therefore, be lost if vegetables are left soaking for too long or especially if they are overcooked.

Vitamin C plays various roles in the body's metabolism, but is especially required for the formation of the small blood vessels. Severe and prolonged deficiency of ascorbic acid produces scurvy. Because of the walls of the small blood vessels become fragile, hemorrhages occur into the skin and into the gums, which become large, red, and swollen, and bleed easily when touched.

Vitamin D. This vitamin is unique in human nutrition in that it can either be eaten, or synthesized in the skin when the latter is exposed to the ultraviolet light of sunshine.

Dietary vitamin D is found only in certain animal foods, especially fish liver oil, egg yolks, and milk, and its products. Human skin contains a substance which, when irradiated by the utraviolet rays of sunlight, becomes converted to vitamin D, which is then available to the body.

Vitamin D is required for the absorption of calcium from the bowel and for the formation of strong, well calcified bones. Deficiency leads to rickets (p. 90) in children, which is characterized by deformed, soft bones.

It is difficult to give a realistic recommended daily allowance for vitamin D, because in tropical regions little of this nutrient is obtained from the expensive animal foods just mentioned, and is mostly synthesized by the skin. The occurrence of rickets will, therefore, depend on various factors likely to prevent a child from being exposed to sunshine, including over-clothing, the degree of cloudiness, and the avoidance of exposure by parents according to various local customs (p. 90). It is possible that vitamin D is synthesized somewhat less easily by children with darker pigmented skins.

Mineral Salts. A variety of different minerals is required in the diet for the healthy functioning of the human body, including some known as trace elements, which are needed only in extremely minute quantities. The present account will deal only briefly with several more important minerals—iron, calcium, iodine, fluorine, and sodium chloride.

Iron. This is principally required for the formation of the red blood pigment, hemoglobin, which is responsible for carrying of oxygen through the body. The newborn infant relies for his iron needs, in the early months of life, on the stores laid down in his liver during fetal life, again emphasizing the relationship between maternal diet in pregnancy and the infant's subsequent nutrition. This is especially important since both human and cow's milk, the principal foods most likely to be taken during the first months of life, are poor sources of iron.

From at least six months onward, it is important to include iron-containing foods in the child's diet, because his

blood volume is growing as rapidly as his body.

In later childhood, iron needs are much less, but in many tropical countries, requirements may be increased by the continuous loss of small quantities of blood through certain parasites, especially the hookworm, which imbeds itself in the wall of the small intestine and feeds on blood sucked from its host. This continuous loss of blood is thus a cumulative drain not only of iron, but also protein.

Dietary iron comes from both animal and vegetable foods. Meat is a good source, as is such offal as liver, kidneys, and pancreas, but these sources are most unlikely to play a significant part in the diet of tropical children. Another source of potential significance to infants is egg yolk, which is, as a whole, much under-used in infant feeding in developing countries.

Of more practical consequence are dark green leafy vegetables, which are rich in iron; although, as with other vegetables, the content varies with the amount of iron in the soil. Grain cereals are also useful sources. Other factors which affect the amount of iron taken in include the concentration in drinking water and the use of iron cooking pots. The latter can raise the iron content of foods very considerably.

Different iron compounds, however, are absorbed with different degrees of ease. Various intestinal infections and diarrheal diseases, such as are common in children in the tropics, may also further interfere with absorption.

Calcium. This mineral is principally required for the formation of bones and teeth. In addition, a regular intake is required because there is a continual release and excretion of calcium from the skeleton.

The best sources of calcium are human and animal milks and their products, and the bones of small fish. Vegetable foods, especially cereals and particularly millet, provide some calcium. The calcium content of water varies considerably but, in some circumstances, may supply a significant portion of the daily requirements.

The recommended daily allowance of calcium for young children and for school children is given elsewhere (Appendix I). However, this is not always valid. The absorption and utilization of calcium is much bound up with the availability of other nutrients, including vitamin D and phosphorus, and may be impaired by other constituents of the diet. It seems also that some communities may have become adapted to higher or lower intakes.

Iodine. This mineral is required for the normal function of the thyroid gland and, in particular, for the production of its hormone, thyroxine. Deficiency leads to a visible swelling of the thyroid gland (goiter). If large, this can be disfiguring or even cause pressure on the trachea (windpipe).

Iodine is widely distributed in the soil, but is less concentrated inland, especially in high mountainous areas, from which it has been washed out over the centuries by the rain.

The iodine content of vegetables is, therefore, greater away from mountainous areas. Fish and other seafood are rich sources.

Fluorine. This mineral is mostly present in the skeleton and in the teeth. It now seems well established that relatively small quantities protect the teeth from caries.

In some parts of the world the water supply may naturally contain an excessively high content of fluorine, leading to a deposit of this mineral in bones and teeth ("fluorosis"). This can be recognized in school children by the scattered patches of dark brownish mottling on the teeth and, in severe and long lasting cases in adults, by the development of calcification of ligaments, especially those of the back. This leads to a rigidity of the spine and other joints with inability to bend and move.

Various Minerals. The body requires various other minerals in small quantities to carry out its function in a normal way. In particular, in tropical countries where perspiration can often be excessive, sodium and chlorine are required to replace the salt (sodium chloride) lost in the sweat.

In addition, many communities have developed a preference for food which is flavored with salt, either during cooking, added later, or both. So strong is this drive for salt that in ancient times it was actually used as currency in some parts of the world, as witnessed by the present-day word "salary."

In inland areas of Africa and elsewhere, salt caravans were an important part of the local commerce, while various salt-containing earths, or preparations of ashes of plants were used as salt alternatives.

Water. Water is a vital part of all diets. The human body is composed of over 60 percent water, and an adequate daily intake is required to make good the losses in the urine, in the feces, in the moist expired air and in perspiration, both visible and invisible. The turn-over of water is especially great in early childhood, and the infant can easily be precipitated into fatal dehydration by extra loss in the form of diarrhea or vomiting.

Water in the diet may be drunk as such, or it can be taken in various beverages (including milk, tea, and alcoholic drinks). In addition, it is also taken "in disguise" as a part of fruits and in cooked dishes, as in porridges, gruels, and stews. The amount of water required will, therefore, depend on various factors—the local climate, the degree of activity, and on the intake of other water-containing items.

For young children, the *risks* of water must be appreciated. Most sources of drinking water in tropical regions are likely to be contaminated sources of bacterial infection, and so lead to diarrhea from intestinal infection. It is for this reason that, unless indicated by an exceedingly hot, dry climate, it is often best for young babies in tropical communities *not* to be given extra drinking water in the first four to six months of life. It is probable that they can usually obtain adequate water, as well as other nutrients, from their mother's milk. The risk of producing dangerous diarrhea by giving dirty, contaminated water from an unclean utensil is extremely great.

If water is given to babies and young children, attempts should be made to persuade mothers to keep clean water available, to boil it and to feed the infant from a clean utensil. However, for various practical and cultural reasons, mothers are often reluctant to do this. They often do not understand its purpose and perceive very clearly the extra difficulties it will entail, including use of fuel.

In some communities, it is customary to give young children weak tea or various indigenous herbal brews, in-

cluding those called in the West Indies, "bush teas." Some of these have been shown to be harmful to young children and should be avoided. However, some are undoubtedly harmless and may even contain valuable nutrients, including vitamin C. Under these circumstances, it may be possible to suggest using a diluted infusion of a harmless herb, such as the leaves of the orange or soursop trees, as this will ensure that the water given will be boiled in the process of making the infusion.

Flavorings. Various foodstuffs or other substances are used principally for the flavor, coloring or texture that they give to foods. Thus, saffron can be used to give a yellow color to rice. Okra ("ladies' fingers") is widely used because of its viscous thickening properties. Flavoring agents are mostly derived from plant products, which impart distinctive tastes and odors, increase the appetite and stimulate gastric secretion. They thus enliven the bland carbohydrate staples, which comprise the bulk of most tropical diets.

In many countries fermentation is employed in the preparation of foods. Thus, in Japan, *miso* is prepared by the fermentation of a cereal-legume mixture of soybeans and rice. In parts of India, *idli* is made from rice and black gram, and *khanam* from rice and Bengal gram. In other parts of Asia, fermented pastes of fish or shrimp are used. All of these examples not only produce the desired strong flavor, but the fermentation process also digests the protein of the ingredients and increases the amount of B complex present.

Great variations exist in the use of flavoring agents, depending on culturally defined preferences. In tropical regions, extremes can be seen between the bland, saltless steamed plantain of the Baganda of East Africa, taken with unspiced groundnut (peanut) sauce, and the highly flavored *masala* of Indian curries or the chili beans of Mexico.

Extreme flavoring, especially with chili, presents problems in the feeding of young children, because it is necessary to prepare the foods for infants prior to the addition of these irritant substances.

On the whole, most flavoring agents have little direct nutritional value, with the exception of the ascorbic acid in chilies, and the increased digestibility and vitamin B content of fermented products.

Substances used as flavoring agents cover a very wide range and include the following:

1. *Flowers and buds:* capers, cloves, saffron;
2. *Fruits:* tamarind, chili;
3. *Seeds:* caraway, cardamom, pepper, mustard, coriander, cummin, nutmeg;
4. *Barks:* cinnamon;
5. *Roots:* garlic, radish, ginger;
6. *Leaves:* basil.

TYPES OF MALNUTRITION

Three general forms of malnutrition may be recognized: (a) *dietary deficiency*, (b) *dietary excess*, and (c) *dietary imbalance*.

Dietary Deficiency. Various dietary inadequacies may lead to malnutrition. There may be a definite lack of one or more nutrients. The classical example was scurvy, which was so widespread and lethal among the crews of the 18th

Century sailing ships, whose diets were usually almost devoid of vitamin C.

Dietary Excess. Excessive intake of certain nutrients can also lead to forms of malnutrition. In the well-fed industrialized countries, the most widespread example is obesity, which results from a Calorie intake that is in excess of the body's energy expenditure.

With many nutrients, an excessive intake may be stored, and, when the stores are full, the surplus is excreted in the urine. However, a few nutrients are harmful if taken in very large quantities, in particular vitamins A and D. Nevertheless, this is very unusual with actual diets eaten by most human groups, but poisoning by these two vitamins does occur occasionally in children in industrialized countries as a result of the accidental swallowing of large quantities of vitamin concentrate.

Dietary Imbalance. Malnutrition may result from an incorrect balance between various nutrients in the diet. The most important example is one of the severe forms of protein-Calorie malnutrition of early childhood, kwashiorkor (p. 75). In this condition the diet is unbalanced with a low intake of protein, but with a relatively high consumption of carbohydrate Calories.

THE PREPARATION OF FOODS

Foodstuffs not only have to be produced but also stored, preserved, and ultimately prepared for human consumption. Problems of food storage and preservation are considered elsewhere (p. 45). The present account will deal with certain general aspects of food preparation in relation to nutrition.

Preliminary Preparation. While some foods, such as fruits, are eaten raw and others with only little preliminary preparation, many foodstuffs undergo preliminary physical or chemical preparation prior to cooking. At its simplest, this may be considered to include the peeling and cutting up of vegetables into suitably sized pieces. Similarly, the removal of the indigestible husk of cereals and the grinding of grain into flour are parts of the same process, whether carried out by hand in the village or industrially by the large modern mill.

Various communities have developed complex preliminary treatment of foodstuffs designed to improve their flavor, digestibility or to remove harmful substances. The Indonesian food, *tempeh* consists of soybean on which a special fungus has been implanted and allowed to grow, in order to predigest this food. In many countries, the protein-digesting properties of the leaves of the pawpaw tree have been recognized, and meat is sometimes wrapped in them for some hours prior to cooking. Similarly, green unripe pawpaw, which also contains this enzyme, can be added to protein-containing stews. A dried extract of the unripe fruit of the pawpaw is commercially available in Western countries as a meat tenderizer.

In the preparation of cassava, especially certain bitter varieties, it is necessary to remove the poisonous hydrocyanic acid, which is particularly present beneath the peel of the roots. Various methods have been devised by peoples in different parts of the world, often consisting of cutting the root into small pieces, washing, and eventually sun-drying.

Much of this preliminary preparation

of foods is to try to ensure their thorough cooking and subsequent digestibility. This is the ultimate rationale of the de-husking of cereal grains, and of cutting vegetables into small pieces. However, at the same time, wastage may occur, through discarding edible parts of the food, or by loss of water-soluble vitamins as a result of over-soaking, or through cooking for too long in excess water which is then discarded.

Nutritional Aspects of Cooking. The cooking of foods produces chemical and physical changes which improve their digestibility, palatibility, flavor, appearance, and in some cases, their keeping quality also. Thus, cooking causes the swelling of starch granules, which then burst out of their cellulose envelopes, and with meat causes coagulation of muscle protein and conversion of collagen fibres to gelatin. In both instances, digestibility is improved. However, over-cooking may defeat its purpose and actually destroy nutrients, such as the heat-sensitive vitamin C, or make certain amino acids unavailable.

There are many ways of cooking foods, but, in most tropical countries, they are usually restricted for such economic reasons as the cost of fuel and kitchen apparatus, such as pans and ovens, by the range of foods locally available, and by the indigenous culture pattern. The cooking procedures employed will, therefore, be simple in type and limited in scope, and are likely to rely especially on boiling, steaming, or barbecuing on the open embers. Some communities use other less common methods, such as the *umu* (stone-filled cooking pit) of Polynesia, or the plantain leaf packets in which food is steamed in some parts of East Africa.

A detailed knowledge of local methods of food preparation is essential in any program designed to improve infant feeding. It can only be learned by direct observation of foods available in the fields, storage places and markets, and by observing their preparation in the village kitchen itself. Improvements must be based on indigenous foods, and must be planned within the particular culture patern, especially bearing in mind the limitations and restrictions of real life kitchens and traditional cooking practices.

TROPICAL FOODS

The Westerner working in a tropical country will find many unfamiliar foods and therefore all nutritional workers must have a working acquaintance with the more important of these, and must recognize the nutritional qualities and other properties of local foods.

Once again, this should not only be a theoretical knowledge, but should be reinforced by first-hand observation of local foods growing, in the market, being preserved, prepared, and cooked.

It is difficult to classify foodstuffs rationally and the following account is based, in part at least, on practical considerations: (1) Roots, plantains, and so forth, (2) Cereals, (3) Legumes, (4) Vegetables, (5) Fruits, (6) Animals protein foods, (7) Oils and fats, and (8) Miscellaneous.

Roots, Plantains, and so forth. These foods are considered together because they are largely sources of carbohydrate Calories, with a low protein

content (1–2 percent), while also containing much water and fiber. For these reasons regions which use these low protein staples are very likely to show protein-Calorie malnutrition of early childhood.

These foods are particularly difficult for children to eat in nutritionally adequate quantities, because they are both low in protein and also extremely bulky. It is often difficult for a young child even to be able to satisfy his Calorie requirements.

Yams. These tubers are used in many parts of the world, especially in the relatively rainy tropical areas, such as parts of Africa and the New Guinea coast. The protein content of yams is about 2 percent. They are not easy to cultivate and need careful attention. For storage, they need specially prepared "pits" or dry, ventilated yam houses.

Sweet Potato. This root crop has a protein content of between 1–2 percent. Yellow varieties have a relatively high level of the provitamin A, carotene, but the white varieties are used more commonly in tropical regions. Cultivation requires some degree of continuous attention.

Taro (Cocoyams). In parts of Polynesia, some areas in Africa and parts of the Caribbean, taro forms the staple food of the community. In Hawaii, a slightly fermented paste is the ancient staple (*poi*), which is still popular.

Cassava (Manioc). Cassava, is easy to grow, requires little attention and is able to withstand climatic adversity. It has a high yield (7 to 10 tons per acre) and a high Calorie yield per man-hour of work. It can remain "stored" for some years in the ground before harvesting. It has, therefore, been introduced into various parts of the world, including regions of tropical Africa, as a reserve or "famine food." However, because of the high yield and ease of cultivation, its use has spread. This is a matter of considerable concern, because cassava is essentially only a stomach-filling source of carbohydrate Calories, with a protein content of less than 1 percent.

As mentioned earlier, hydrocyanic acid is present beneath the outer coats of the roots and is removed by different traditional methods in various parts of the world. Cassava can be boiled as a vegetable but is often made into a flour, which can be used to produce forms of porridge, unleavened bread, or various fermented preparations.

Often neglected is the fact that cassava leaves, especially the young ones, can be eaten and are an extremely valuable foodstuff, which, if taken together with the cassava root, help to improve the plant's nutritional value.

"Vegetable Fruits." In some parts of the world, notably in areas of East Africa, the *plantain*, a term often applied to varieties of the banana family that are cooked when green and unripe, is the staple food. Again, this is extremely low in protein (1 percent). Many different varieties exist. The plantain can be cooked by boiling, steaming, roasting, or using a flour prepared from dried fruits.

Another "vegetable fruit" is the *bread fruit*, which is a secondary staple in Polynesia and in certain islands in the West Indies. It is usually roasted or boiled.

Miscellaneous. Various other foods are included here not because they are botanically similar, but because they, too, have a very low protein content and

are made up almost entirely of carbohydrate Calories. These include *arrowroot*, which is a flour made from the starch obtained from the roots of a West Indian tuber and *sago* which is prepared from the pith of a variety of palm tree. They are both almost devoid of protein, are almost entirely starch and are disastrous if used for infants without other items of food.

Cereals. The group of foodstuffs known as cereal grains are not only excellent sources of carbohydrate Calories, but also contain significant quantities of protein (about 10 percent), especially as they are consumed in large quantities. They are also good sources of iron and the vitamin B complex. Their protein has a low content of the essential amino acid, lysine.

Cereals are prepared by de-husking and sometimes thereafter by milling. The degree of de-husking and milling is related to the desired characteristics of the end product. The more severe the process of milling the whiter the end product and the greater the loss of nutrients which go with the germ, including especially thiamine. Overmilled white rice, with its low content of thiamine, is sought after in parts of Asia with unfortunate consequences as it tends to lead to the development of thiamine deficiency, beriberi. Similarly, so-called high extraction wheat flour used in the U.S.A. and Western Europe is also depleted of its protein and vitamins by this process. In both Japan and the U.S.A., the thiamine removed from rice and wheat by excessive milling to produce a white end product is later replaced by synthetic thiamine.

After de-husking, cereals may be cooked as such or made into flour and then prepared as pastes, gruels, or bread, or fermented to produce various products, including gruel beers or, if subsequently distilled, alcoholic liquor.

The preparation of cereals for use by young children is comparatively simple. Boiling with water, especially if the flour is employed, will give a smooth, easily digestible paste.

Rice. Rice is the staple food for two thirds of the world's population, including most of Asia. It is becoming more popular, especially for celebrations, in many different areas of the world including parts of Latin America, Africa, and the West Indies.

Many varieties are grown in different parts of the world, including the glutinous rice of northern Thailand, Malaysia, and Viet Nam which, as the name suggests, does not boil to form individual grains but rather forms an adherent, glutinous mass.

Thiamine is contained in some quantities in rice germ. However, it can be very largely removed by overmilling, or by over-soaking or by cooking in too large a volume of water, since thiamine is water soluble. In some communities in India, the rice paddy is soaked and briefly boiled before drying and storing. This process, parboiling, is nutritionally valuable as it causes thiamine to diffuse into the substance of the grain.

Rice is most usually cooked by boiling, so as to leave individual grains. It is important not to use more water than is necessary. Rice is easily digestible by young children, and especially soft and suitable preparations can be prepared in the form of pastes or gruels from soft boiled rice or from rice flour.

Corn (Maize). This crop, which came originally from South America has been taken by man to many parts

of the world. It has a high yield per acre, but nutritionally corn has the disadvantage of being not only low in the amino acid, lysine, as are all other cereal grains, but also being deficient in the B vitamin, niacin, and another amino acid, tryptophan, from which the body is capable of synthesizing niacin. It is for this reason that niacin deficiency, pellagra, occurs almost exclusively in areas of the world where corn is the major food.

Corn may be eaten on the cob after boiling or barbecuing. It may be milled at home or commercially to varying degrees of extraction, producing corn flour, the staple food of many African communities. Unfortunately, the preparation of preferred white flour includes overmilling and often repeated washing with water which removes protein.

In the Mayan cultures of Central America, a particularly valuable method of preparing corn has been employed for centuries. In this method, corn is initially treated for some time with lime before being cooked as *tortillas*. This has the advantage of enriching the grain with calcium and improving the amino acid value and available niacin.

All over the world attempts to produce higher yielding and better quality foods are under way and it may be mentioned that outstanding success appears to have been achieved with corn—the so-called "opaque 2" variety—which has been shown to have 150 percent more lysine, the limiting amino acid, than the usual varieties.

Millets. Numerous species and varieties, particularly finger millet, bulrush millet, and sorghum, can be included under this general heading. All have the advantage of being relatively resistant to drought and can be stored for years after harvesting. However, they require considerable care in cultivation, especially with regard to scaring off animals and birds when the grain is ripening. In addition, the small, rather tough grains of these crops require much time-consuming pounding or milling in their preparation. This is often carried out in the village and is a considerable burden for the housewife; occasionally, millet flour is avaliable commercially. Because of difficulties in cultivation and preparation, the millets are tending to be grown less, and to be replaced by nutritionally inferior crops, such as cassava and maize.

The grain itself is usually too indigestible to be eaten boiled. Dishes are commonly prepared from the flour, in the form of gruels or so-called "bread," looking like thick mashed potatoes. In Africa various fermented millet products are eaten or drunk in the form of alcoholic gruel-beer.

Wheat. Wheat is a major staple in parts of the Eastern Mediterranean, in West Pakistan and Northern India, and in regions of China. It is usually used as a flour, as in the preparation of unleavened bread pancakes (*chapatis*) or Chinese noodles. In Lebanon an interesting wheat preparation of great nutritional value is prepared in the form of *burghul*. In this product, the wheat is parboiled so that the thiamine is diffused throughout the grain, the same as with parboiled rice.

The flour prepared after milling is often mixed with locally produced dried sour milk. The resulting wheat-sour milk powder is known as *kishkeh*, and is a valuable food for young children.

Wheat bread is spreading as a prestige, convenience food in tropical urban areas. It is often superior to the local staple, as in parts of West Africa where cassava is the main local food. In some parts of the world, protein enrichment of bread has been attempted with soy flour, yeast, lysine or fish flour.

Legumes, Nuts, and Oilseeds. In general this group is not only a good source of Calories, but is also the principal plant source of protein.

Legumes. Legumes as a group contain about 20 percent protein, except for the particularly protein-rich soybean which contains up to 40 percent. However, the protein in legumes is somewhat deficient in the essential acid, methionine, which is the limiting amino acid. Legumes are also sources of the B complex and iron. Their vitamin content, including vitamin C can be substantially increased by allowing them to germinate and sprout before cooking.

Legumes are of especial importance when eaten together with the staple food. This was also the case in medieval Europe when pea flour was used with wheat in the preparation of bread for the poor.

There are at least 70 varieties of legumes. The problem of their identification is often difficult, since many sub-varieties often look different. Also, common names in different languages, including English, often further confuse the issue.

Legume crops are extremely important not only nutritionally but also agriculturally since they have the property of taking nitrogen from the atmosphere and fixing it in the soil.

Legumes are compact and take up little space but require careful storing, otherwise a high percentage of the yield can be lost as a result of pests including rodents and insects, particularly weevils.

With protein shortage a major difficulty, and with protein-Calorie malnutrition of early childhood (PCM) (p. 75) the principal public health problem in worldwide nutrition, legumes can be expected to play an increasing part in the dietary prevention, and even the treatment of PCM.

The use of legumes for infant feeding is limited by their relative indigestibility. Only small quantities should be given initally, although the amount can be gradually increased. It is important to ensure that legumes are as thoroughly cooked as possible, by such simple means as removing the skins through soaking prior to boiling or by straining after cooking. Often it is useful to start with a basic mixture of four parts of staple (preferably a cereal grain) to one part of legume and then to gradually increase the proportion of the latter.

Possibly because of the known association of large quantities of ill-cooked legumes with lack of digestibility and loose stools, there are many taboos and restrictions in different parts of the world on their use for young children.

Most legumes are usually boiled whole, although various flours may be prepared from them which can be cooked with water to produce a soup or gruel or made into a variety of thin dry pancakes. In India, the term *dhal* is applied to a variety of different legumes which are dried, passed through a wide sieve, and then given several treatments with a stone grinding apparatus which removes the skin and

splits the legume in two. The dried, split end product is ultimately boiled to form a thin paste.

It is not possible to consider all varities of legumes here. *Wherever work is being carried out, it is necessary to discover the most easily available and economical varieties of legume to buy, their protein composition, their alleged digestibility, their cultivation characteristics as regards yield and resistance to disease and climate, and local attitudes toward their use for feeding young children.*

Brief notes follow on certain legumes because of their particular significance:

1. *Kidney bean* (*French bean, Haricot bean, Navy bean*), (*Phaseolus vulgaris*). This is one of the most widespread of all legumes, although its physical appearance varies from one variety to another. It has a high protein content and, because it is frequently easily available, it deserves to be included more than it is at present in village-level infant food recipes. It is usually prepared by boiling and experience has shown that it is important that the skin be removed before giving the bean to the child to eat. This can be carried out before boiling (when it can be accomplished by soaking overnight or scalding), or after cooking has been completed.

2. *Chick-pea* (*Cicer arietinum*). This legume deserves special mention because after cooking it can be mashed easily to produce a very smooth and digestible paste. Wherever it is available, it should be seriously considered as a possible high-protein vegetable food for incorporation into infant mixtures, both in the village kitchen and when prepared commercially.

3. *Groundnuts* (*Peanuts*). This crop has the advantage of not only possessing a high protein content but also, because of its 40 percent fat, being rich in Calories. The groundnut is also a good source of the vitamin B complex.

In villages, the groundnut may be eaten raw or after roasting. For culinary purposes, it is often pounded into a powder and then used in pastes, sauces, stews, soups, or milky drinks. If roasted and passed through a mincer, a thick peanut butter-like preparation will be produced, which is often relished by infants.

Groundnuts are grown commercially mainly for their oil. After this has been extracted, the groundnut presscake is usually sold for animal feeding, but it represents a largely untapped potential source of groundnut flour which, after further refining, may then be used for child feeding either by itself or incorporated into a variety of commercially prepared high-protein infant foods (p. 140).

Unfortunately, the situation has been complicated by the discovery that groundnuts harvested in hot, moist climates grow a fungus (*Aspergillus flavus*) which produces a highly toxic, water-soluble substance, aflatoxin. This material is poisonous to various animal species, especially their young. When, for example, contaminated groundnuts were used as the main source of the diet of young turkey chicks, there was an appreciable mortality from liver damage.

Although no clear case of aflatoxin poisoning has ever been described in human beings, it is necessary to exercise more caution before urging the increased use of groundnut flour in the preparation of infant foods. Current information shows that if groundnuts

are dried to a low moisture content after harvesting, aflatoxin is not formed. Many countries are considering legislation to ensure that groundnuts must be free from aflatoxin.

4. *Soybean.* This legume is particularly high in protein (up to 40 percent), and has a better amino acid composition than other legumes. It also has a high fat content (up to 20 percent). It grows widely in different parts of the world and is cultivated on a large scale commercially for its oil. Currently, the presscake is used variously for animal foodstuff, although its potential for infant feeding after suitable preparation is considerable.

The importance of the soybean in the diets of some communities is so considerable that it has been termed the "Chinese cow." The soybean has the disadvantage of being difficult to introduce to a community not experienced in its preparation and value. This is because it has a characteristic and to some persons an unpleasant flavor and smell as well as a protein-digesting enzyme inhibitor which interferes with digestion. Soaking for 24 hours helps to remove the taste.

In communities where the soybean has been employed traditionally for hundreds or thousands of years, special technics have been developed to destroy this enzyme inhibitor and make the bean fully digestible. Thus, in Indonesia *tahu* (a soft, white cottage cheese-like soybean curd) and *tempeh* (thin slices of fungus-digested soybean) are widely used and are easily digestible, even by young children. Similarly, in Japan *miso* (a fermented rice and soybean preparation) and *ketjap* (a fermented preparation of rice and wheat) are important items of food.

The soybean may also be eaten in many other ways. A defatted flour can be added to cassava meal or wheat bread as a protein reinforcement. A soybean milk was used in ancient China and has now been prepared commercially in some parts of the world, although its value is limited by the fact that it usually costs as much as animal milk. Also, soybean sauce is a familiar item in Chinese cooking, where sprouted soybeans are also used.

Nuts. Although not widespread, and not likely to figure to any great extent in methods of improving the diet of young children, nuts are important sources of protein and are also high in Calories because of their fat content. Thus, in parts of tropical South America the Brazil nut is used.

Also, in various coastal parts of the tropics the coconut is extremely valuable, not only for the copra (dried flesh), which is sold commercially for its oil content but also because the fresh coconut flesh can be used for infant feeding. In its immature, soft, gelatinous form, this can be eaten as such or mixed into porridges. The use of coconut presscake after the oil has been extracted is receiving attention as a potential source of high-protein infant food, although it has the disadvantage of a high fiber content.

In some tropical regions, the cashew nut is commonly grown. This may be used as a high-protein, high-fat addition to children's diets. This nut is unique in that it grows attached to an apple-like fruit, which not only is edible when cooked, but also is a good source of vitamin C.

Oilseeds. In addition to the groundnut, the soybean, and the coconut, a variety of seeds of different plants are

cultivated largely, if not exclusively, for the oil which may be extracted from them, either in the village or commercially on a large scale. These include the seeds of sesame, sunflower, cotton, and mustard.

Some of these seeds are already used in some localities as traditional foods, as with the whole sesame seed in the eastern Mediterranean. Also, the seeds of the melon and the sunflower are eaten in some parts of the world as a snack, much as peanuts are used in the U.S.A. Both of the seeds are high in protein.

Cotton is principally grown for its fiber. After the removal of the fiber, the oil is extracted from the seeds, leaving cottonseed presscake, which at present is largely used for animal feed or fertilizer. Much work is going on all around the world in attempts to devise economical methods of processing high-protein cottonseed flour for human feeding from the presscake. A major problem is that most varieties of cottonseed contain a poisonous substance (gossypol), which has to be removed before the flour becomes safe to eat.

Vegetables. It is difficult to define exactly what is meant by the word "vegetable," as this useful expression is employed by different people to cover a variety of foodstuffs. As a whole, however, vegetables are usually eaten to give flavor, variety, and sometimes necessary roughage to a diet. Nutritionally, they are usually rather high in water and, conversely, low in both protein and carbohydrate Calories. However they often contain substantial amounts of carotene, vitamin C, and minerals; while their limited proteins may supplement those of the staple foods.

Some vegetables are used fresh, although some can be stored or even dried. Some are eaten raw, although more often they are cooked, frequently by boiling or steaming.

It is convenient to consider vegetables not with botanical precision, but in approximate relation to the parts of the plant eaten, that is, roots, stalks, fruits, flowers, and leaves.

1. *Roots.* These comprise certain root crops which cannot be considered as staples. They usually contain less than 10 percent carbohydrate and include carrots and turnips.

2. *Stalks.* In tropical regions, these will include such items as bamboo shoots, young ferns, and the palm cabbage (the heart or growing center of the palm tree).

3. *Fruits.* A wide variety of different items may be classified as "vegetable fruits." Two of these, namely the plantain and the breadfruit, can better be regarded as staple foods. Other vegetable fruits include the large family of pumpkins and gourds, the tomato and allied species, and the avocado pear. The gourd family is important as a source of carotene. The avocado pear, which grows widely in many tropical countries, possesses a soft, easily mashed, digestible, and high-oil flesh which can be incorporated very easily into the food of young children without cooking.

4. *Flowers.* While it is not customary to think in terms of consuming flowers, the cauliflower is eaten in the temperate zone, and in the tropics, various flowers, including those of the banana, may form a minor part of the diet.

5. *Leaves.* Green leafy vegetables are eaten, both raw and cooked, in very

many parts of the world. Thus, in the Western world lettuce, cress, cabbage, and mustard and turnip greens are widely consumed. In the recent past, a wide variety of "wayside herbs" were eaten, especially by the less well-to-do.

In tropical regions, it is the *dark green leafy vegetables* that are particularly valuable and, at the same time, very often much underused, partly because they may be regarded as low prestige food of the poor. Many of these dark green leafy vegetables are to be found in a semiwild state and grow very easily with minimum attention in household or school vegetable gardens, or in the compound.

Dark green leafy vegetables, especially young leaves, are valuable nutritionally. They not only contain important quantities of carotene (provitamin A), vitamin C and the B complex, calcium and iron, but also have a significant protein content, the composition of which complements that of cereal grains and tubers. Thus, young cassava leaves contain 7 percent protein and so-called tropical spinach (species of amaranthus) contains 4 percent. In addition, green bean pods, which may be eaten as vegetables, contain 2 percent protein.

There is a wide variety of these edible dark green leafy vegetables available in most tropical countries, including the leaves of the sweetpotato, various beans, and peas, okra, cocoyams, hibiscus, pumpkins, and baobab. It is important that these should be used, especially as there are in some parts of the world indications that they may be superseded by vegetables such as the cabbage, which has more status but is nutritionally inferior.

If possible, young leaves should be plucked, although old leaves can be used if they are cooked rather longer. If need be, they can be dried, powdered, and stored for subsequent use.

Increased attention has recently been given to the possible use of cassava leaves, as the cultivation of this nutritionally poor staple is spreading. The nutritional value of the plant may be considerably increased if the leaves are also eaten, either by the occasional plucking of some of the newer ones or by using all the leaves when the root is finally dug out for consumption.

Dark green leafy vegetables may be shredded, chopped, or pounded in a mortar and subsequently mixed with other foods intended for young children. Alternatively, preserved powdered leaves may be used.

Fruits. Once again this is a general word that is very difficult to define with precision. Possibly the best definition is "a cultivated or wild product with a sweet soft flesh, pleasantly edible when ripe in the raw state."

Nutritionally, fruits are important principally as sources of vitamin C and, in some cases, of the orange-pigmented vitamin A precursor, carotene. Otherwise they are composed principally of water, cellulose, and some fruit sugars. They have the advantage of not requiring cooking, if eaten ripe.

It is important to appreciate that there are many tropical fruits which are extremely good sources of vitamin C and often much more easily accessible locally and more economical than the citrus fruits which are usually thought of in the Western world. Thus, in various tropical regions of the world, the following may be considered—guava, Indian gooseberry, fruit of the

baobab tree, fruit of the cashew nut, and, as a very rich source, the Barbados cherry (*acerola*).

The following fruits may be mentioned particularly:

Papaya (*Pawpaw*). This fruit is very widely distributed in the tropics and frequently is not used nearly enough especially for young children. Various food attitudes and taboos may be partly responsible. The dark yellow, orange, or red sweet edible pulp of the fruit is rich in vitamin C and carotene. It is soft, pleasant flavored, easily mashed, and can be fed to young children without cooking.

Mangoes. The dark yellow or orange flesh of the mango is particularly rich in carotene and vitamin C. Also, especially in the larger varieties, it can be a source of Calories for school children.

Bananas. Although mainly of value for its Calories, the sweet banana also contains small quantities of carotene and vitamin C. The advantage of the sweet banana is that when fully ripe, as judged by the appearance of brown spots on the skin, the fruit pulp will have become soft, easily mashed, digestible and sweet, as the starch granules will have been converted into sugar. It can, therefore, be used immediately for young infants without cooking and can be mashed and mixed with other foods with a higher protein content.

Dates. The fruits of the date palm are more often used when dried and, as in the desert regions of North Africa, may be an important, easily transportable, and a preserved source not only of Calories but also, to some extent, of protein (2–4 percent).

A wide variety of other familiar and more exotic fruits may be used in a particular region, both cultivated and collected wild. These may include pineapple, Cape gooseberry, cactus fruits, a variety of citrus fruits, various types of soursops, and so forth. Local sources should be sought for in any region.

Animal Protein. Animal protein foods are everywhere the most expensive and difficult to obtain, and they are often used only for celebrations and as prestige items. All over the world large numbers of food attitudes, taboos, and prejudices, often of a restricted nature, are associated with the use of animal protein foods. These often are directed at women and young children and tend to limit their intake of animal protein.

Animal proteins contain all of the eight essential amino acids in abundance. If available, even in small quantities, they are best used together with vegetable foods, preferably with a combination of a legume and a cereal staple. In this way, the nutritional value of the plant protein foods can be enriched as the amino acids in which they are deficient can be made good from the rich surplus in the animal protein.

The question of the absolute need for animal protein in the human diet, especially for young children, has not yet been conclusively determined. Most so-called vegetarians usually take some form of animal protein food, particularly milk or its products. It has been shown, however, that young children grow adequately on vegetable protein mixtures and that even severe types of protein-Calorie malutrition, marasmus and kwashiorkor, can be cured by vegetable protein mixtures alone, although recovery is slower than when animal proteins are given.

The present view is that vegetable protein mixtures will form the mainstay of infant feeding in most developing tropical countries, but that the addition of at least small quantities of animal protein to these diets should be the aim, wherever possible.

Meat. With the exception of certain hunter and pastoralist groups, animal meat plays an extremely limited part in the diet of tropical peoples. It is usually reserved for celebrations or special occasions, when most of it will go to adults, especially to male elders. Young children will rarely receive meat and even when it is available it is usually tough and often ill-cooked, so that its preparation for infants poses problems. Simple, locally appropriate methods of chopping, shredding, or grating meat, either before or preferably after cooking, have to be devised to make meat palatable for infants.

Meat is a source not only of protein but also of the B vitamins and of iron. A variety of different meats may be eaten by, or prohibited to, different communities in the world (p. 62). These include such items unfamiliar to the Westerner as dog, newborn rat, kangaroo, monkey, snake, and hyena. Although unfamiliar and culturally difficult to appreciate, the meat of these creatures is not much different nutritionally from that of domesticated animals. In addition, in many communities insects form a part of the local dietary, often seasonally. In various parts of the world these include snails, locusts, grasshoppers, lake flies, various caterpillars, and flying ants. While insect eating is strange to the Westerner, it must be remembered that the secretion of one insect, the bee is widely relished as honey.

Blood. In a few communities, notably in Africa, blood is used and is obtained from cattle by puncturing a vein in the neck and "bleeding" off a quantity, which can then be drunk as such, or allowed to clot and mixed with other foods, or which can be dried to form a powder.

Milk. Man being a mammal, he rears his offspring with milk. However, man alone among other mammals, has introduced the milk of other animals in the diet of his young. The composition of the milk of different mammals varies considerably. Some, like the seal's, the camel's and the reindeer's are rich in fat; others contain more protein than some. However, all contain protein, milk sugar, fat, calcium, and vitamins, both of the fat- and water-soluble kinds. All milks are poor in iron. The concentration of these major ingredients also varies considerably from one species to another. As a result of the selective processes of evolution, each species produces the milk whose composition is optimal for its young. In other words, cow's milk is the specific food for growing calves and human milk is the best food for human infants. Cow's milk can only be regarded as second best and artificial in the nutrition of human infants.

1. *Human Breast Milk.* This valuable and traditional source of clean, digestible, specially adapted, high quality protein baby food is very frequently overlooked, possibly because it is not commonly sold on the market! Its amino acid composition is such that it has been used as a reference standard of protein excellence. However, like all other milks, it is low in iron. While its protein content is relatively unaffected by inadequate maternal nutrition, its content of water soluble vitamins (thi-

amine and vitamin C) can become deficient if the lactating mother's diet is low in these nutrients. Also, if the mother's diet is deficient, the output of breast milk may be diminished, especially in late lactation. Eventually the nutritional drain will be felt by the mother herself in the form of maternal depletion.

While breast feeding is desirable in any part of the world, it is of particular importance in developing tropical regions in terms of nutrition, economy, and sanitation.

2. *Animal Milks.* Animal milks used in various parts of the world, both in the general diet and as foods for young children, include the milk of the buffalo, ass, sheep, goat, llama, reindeer, and yak, but cow's milk is by far the most commonly employed. Its composition is different from human milk: it contains two to three times as much protein, the same quantity of fat, and half as much milk sugar. The protein of cow's milk is relatively indigestible; however, it can be modified to suit the needs of human babies in the first three months of life by diluting it with water to decrease its relative protein content, by boiling it to make the protein more digestible, and by adding sugar to it to increase the caloric content.

Two points concerning cow's milk require special emphasis, as they are often not adequately understood by Westerners. First, cow's milk is expensive when bought on the market in developing countries. Because of its price, it will be given in highly diluted form. Second, because of environmental conditions described in Chapter 1, and because of the addition of unclean water, it is most likely to lead to infective diarrheas. In brief, in relation to the prevention of protein-Calorie malnutrition, cow's milk, in whatever form, should not be regarded as a competitor with breast milk in the early months of life but as an important, although not irreplaceable, protein-weaning food.

In the foreseeable future, adequate sources of animal milk cannot conceivably be available for the majority of young children living in tropical developing regions; therefore, alternative protein-rich foods of animal and vegetable origin will have to be employed, especially legumes. These should be chosen in conformity with local resources and the local cultural pattern.

3. *Commercial Milk Products.* Very large numbers of different brands of processed milk are prepared by commercial companies, although only four types are commonly available: full cream and skimmed, dried powdered milks, evaporated milk, and condensed milk. Their use in infant feeding is discussed later (p. 133–134).

4. *Village Milk Products.* Various peoples in different parts of the world have developed techniques for preserving milk, especially in times of relative surpluses. Most of these processes are based on planned microbial souring of milk. Various preparations may be used, including acid milk, yogurt-like products, and cheeses. In Lebanon, for instance, there is a flour which is composed of a mixture of milled, parboiled wheat, and dried sour milk (*kishkeh*). In many areas of the eastern Mediterranean and elsewhere, various forms of cottage cheese are available and can be incorporated in infant food mixtures.

There is evidence that some of these preparations are not only valuable be-

cause of their keeping qualities but also because they are more digestible and perhaps less susceptible to infection with harmful baceria. Thus, *amasi*, the sour milk of South Africa, has been shown to be somewhat resistant to the growth of tuberculosis bacilli. Wherever these preparations exist, their use in infant feeding should be considered.

Eggs. Although these are widely distributed throughout the world, they are not generally used for young children. Often they may be considered rather as a form of "cash crop"; while in many cultures strong food prejudices concerning the use of eggs for infants are to be found. In parts of India they are considered to be too "hot," and in parts of eastern Nigeria, they are believed to cause baldness in infants. This is a pity, because not only are eggs a rich source of protein with such a full and well-balanced range of essential amino acids that they are used as a protein reference standard, but also the yolk contains iron, vitamins A and D, the B complex, and fat. They are also easily digestible and can be mixed with other foods in many ways.

Eggs are also compact units which can be easily used in infant feeding. In addition, like milk, they provide animal protein without the necessity of slaughter thus avoiding the economic loss involved in killing an animal or the religious taboo against killing living creatures which obtains in some parts of the world.

Chicken's eggs are most commonly used and those of free ranging tropical village birds may be half the size of those from well-fed fowls. In addition, the eggs of other birds may be widely eaten in some communities, especially duck's eggs in some parts of Asia.

Eggs may be cooked in a variety of ways, some of which, including boiling and scrambling, are especially suitable for young children. Alternatively, if culturally acceptable, raw chicken's egg may be beaten into the infant's food.

Fish. Fish and other sea products remain a major unexploited natural reservoir of animal protein food in the world. They are valuable nutritionally, not only for their high protein content, but also because they contain vitamin B complex, vitamins A and D, calcium, and iodine. Fish also have the advantage of being small compared, for example, with the large carcasses of animals, such as cattle or swine.

In addition to fish as such, a wide variety of other sea products, such as shellfish, crustaceans, and seaweeds, are eaten in some parts of the world and could be consumed more widely.

The principal problems limiting the wider use of fish include difficulties of preservation and transportation, cost in relation to local purchasing power and, in some parts of the world, cultural food prejudices.

Canning and refrigeration of fish usually put the price well beyond the reach of the average family in tropical regions. However, traditional methods of drying, salting, or smoking may exist and deserve further investigation to see how their effectiveness and the quality of the end product can be improved. Commercially, the possible use of fish to produce fish flour which could be used, either alone or as a component of a manufactured infant food, is receiving much attention.

The increased production of fish at the village level is of great practical importance. Better use should be made

of nylon nets and motorized canoes, and encouragement should be given to the development of fish ponds or fish culture in wet rice fields.

Fish ponds have been in traditional use for many hundreds of years in various parts of the world, including China and medieval Europe. Recent emphasis has been given to the development of fish ponds by governments and the Food and Agriculture Organization of the United Nations (FAO). Their use is by no means without problems. Several species of fish need to be introduced at one time, as otherwise very large numbers of small fish of one species may result. The pond has to be cared for and organic vegetable material, such as cut grass, has to be added at appropriate intervals. The risk of breeding malarial mosquitoes and the spread of bilharzia has to be borne in mind. Nevertheless, with due care fish ponds can represent a valuable contribution to village protein resources, especially since they bring fish near to rural homes. In some communities these ponds can also be used for rearing ducks and growing various water vegetables.

Oils and Fats. Many animal and vegetable foods contain fat or oil. In addition, various so-called "naked fats" may be taken in the dietary as oils.

Fats are relatively expensive everywhere but owing to their high caloric value they represent "compact Calories" which may be important for children whose diet otherwise consists of bulky carbohydrate foods of low calorie density.

Animal fat is present in meat, egg yolk, milk and its products, and the flesh of certain fish. Extracted animal fats include butter *ghee* (clarified butter), lard, and some forms of margarine. Fats derived from milk are sources of vitamins A and D.

By contrast, vegetable fats contain no vitamin A or D. These include oils obtained from the groundnut, sesame, mustard seed, and cottonseed, coconut, and oil palm fruit. The last is of particular interest because of its extremely high content of carotene, the precursor of vitamin A. Other fats derived from plants, include vegetable *ghee* and vegetable margarine.

Miscellaneous. Many foods are eaten in various parts of the world which do not easily fall into the categories already outlined.

Sugar. Most communities eat sugar in some form or another, whether as naturally occurring honey or sugarcane, or as prepared in the village as *jaggery,* or as commercial crystalline cane sugar. Sugar, especially in its refined form, represents only naked Calories since it contains no other nutrients.

In industrialized countries, the sugar intake is undoubtedly too high and, in part, is responsible for the high incidence of dental caries and obesity. The same trend is also beginning to occur in some developing countries.

In some communities, diluted sugarwater is given alone for prolonged periods to sick infants, with resulting marasmus.

Alcoholic Drinks. Most, but by no means all, communities prepare their own alcoholic drinks. In some places, these are prepared from fermented grains, and take the form of thick alcoholic gruel-like preparations. In parts of Africa, these are still widely drunk and apart from a source of Calories, also contain vitamin C and vitamins of the B complex.

Similarly, alcoholic drinks may be prepared by the fermentation of milk, or honey, or the sap of various palm trees (palm toddy), including the coconut, date, and palmira.

In addition, many groups of people prepare high-alcohol liquors by distillation. These include rice wine, *waragi* in East Africa and white rum in the West Indies. Nutritionally, these products, in common with similar imported alcoholic spirits, are sources of energy alone (7 Calories per gram).

As anywhere in the world, the main nutritional consequence of alcohol, as far as young children are concerned, is social in that if the parents spend excessively on alcohol, then the children are likely to be neglected and insufficient money may be left to purchase adequate food.

Caffeine Drinks. Beverages containing the mild cerebral stimulant caffeine, are used in many parts of the world, including, tea, coffee, and *maté*.

Nutritionally, these may be of little consequence but supply needed variety in taste and refreshment. However, in some parts there is a tendency for a high percentage of limited budgets to be spent on tea or coffee or for mothers to try to feed their young children on tea with little or no milk with disastrous results as the child is thus starved and likely to develop marasmus.

Agriculturally and economically, the production of these caffeine crops is extremely important since in many regions they may be a significant national and family source of cash income.

Seaweeds and Fungi. In some nations with a marine coastline, notably Japan, seaweeds of various sorts are consumed. They are especially important for their iodine content.

Likewise, a wide range of different types of fungi are eaten in various parts of the world. Although not making a major contribution to any dietary, it may be noted that fungi contain a small quantity of protein and of the vitamin B complex.

TROPICAL DIETS

Although many different dietary patterns exist in different parts of the world, a certain general similarity can be found in many regions, especially among the less well-to-do.

For economic, geographic, or cultural reasons, diets tend to be based on a limited number of foodstuffs, cooked in what to the outsider is a monotonously limited range of different dishes. The main bulk of the diet will be composed of one or more carbohydrate staples which will be eaten, very often with smaller quantities of mixtures of various vegetables, relishes, or sauces. Nutritionally, the diet of many peoples in developing tropical countries is much bound up with the major staple which is the main source not only of Calories, but also of protein and other nutrients. This dominance is often emphasized by the use of the same word in the vernacular both for the staple and for "food" in general.

Not infrequently, only a limited range of the potentially edible local foodstuffs will, in fact, be eaten. In particular, there is often underuse of various semiwild dark green leafy vegetables and certain fruits, such as the pawpaw and various berries.

Because they are based on one or more staples, tropical diets tend not only

to be principally composed of carbohydrate Calories, but also to be relatively bulky.

VALUE OF DIETS

Methods of Assessment. There are various methods of trying to assess the value of human diets. In more sophisticated literate communities, questionnaires may be issued to householders. In developing countries, however, if detailed accurate information is required, it is usually necessary to carry out dietary surveys by means of home visits, during which the amount of food used and cooked for the family can be recorded. Problems with this method are numerous, both at the social level—in gaining acceptability and in knowing whether the diet on the days chosen adequately represents the normal range of food taken by the family—and at the technical level—in estimating the nutrient loss occurring during preparation and cooking, in taking into account foods eaten out of the house, and in allowing for seasonal variation in the food pattern.

Dietary assessment is particularly difficult with young children. This should be a period of a gradual transition, when new foods are introduced gradually in variable, but increasing, quantities. At the same time, the young child will also often be receiving breast milk in quantities which are difficult to measure.

Detailed dietary assessment will only be possible for the non-nutritionist with supervision. However, approximate clues may be obtained by observing food preparations and meals, especially noting which items are given to young children.

It is useful to obtain approximate qualitative information concerning feeding practices in the early years of life. This can be carried out by means of a questionnaire, particularly related to the preparation, or otherwise, of special protein-rich dishes for young children. Local household utensils of known size can be used with the questionnaire when mothers are interviewed, in order to assess approximate quantities.

For young children, the questionnaire should cover in particular the following aspects related to the usual limiting factor, protein intake:

1. *Breast-feeding:* still carried on or not; complete or partial, i.e., night only;
2. *Carbohydrate foods:* types (e.g., part of adult foods, or specially prepared gruels or pastes); quantities; times;
3. *Protein foods—animal milk:* type (e.g., fresh or boiled liquid from cow, goat, and so forth, sour milk products); tinned—powdered, condensed, or evaporated; quantities (daily and monthly); cost; number, approximate timing and volume, dilution, and other ingredients (e.g., sugar) in feeds; method of feeding (e.g., bottle, cup, and spoon, indigenous feeding vessel, and so forth);
4. *Other animal proteins:* types (e.g., eggs, fish, meat, etc.); quantity; frequency;
5. *Vegetable protein foods:* types (e.g., legumes, green leafy vegetables); quantity; frequency; method of cooking.

The questionnaire should be tried out first and then can be used on a sample group of mothers. It should aim at ascertaining only the foods taken currently, that is, in the past 1–7 days.

Its construction will be guided by background knowledge of available local foods.

In this simplified, rapid technic, the mother is first asked to say spontaneously what the child has eaten in the past 1–7 days. Following this, she is questioned as to how many times a day each item is being eaten and in what approximate quantities, using household measures (e.g., cups, spoons, gourds, and so forth). The information obtained is recorded as given by the mother, e.g., rice, two tablespoonfuls, twice a day.

When the mother has given her spontaneous answers, questions are put systematically on the use of other foods, and, in the event of an affirmative answer, on the number of times daily and approximate quantities.

This questioning should be done quickly because too much interrogation and cross-checking leave both the mother and the interviewer confused.

The information may be entered in columns ruled for each of the local foods likely to be used for young children. The frequency of use of different foods can be calculated for each three-month group for the first two years of life and for six-month age groups thereafter, and expressed as the average number of times eaten per week in each group. Approximate quantities taken can also be calculated for each group.

Results of such a simple questionnaire can give rough qualitative information on the foods given to young children and those that are not sufficiently used. It can form the basis for relevant advice on improvement of infant feeding using locally available foods.

Calculation of Food Values. Once quantities of foods used by the child have been determined, it is possible to calculate the total intake of Calories, protein, and other nutrients by reference to appropriate tables which give the detailed composition of various foodstuffs. Difficulties may occur with variations in the composition of foods from one region to another.

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chapter iii

IMPROVING FOOD SUPPLIES AND POPULATION PRESSURE

Food production, distribution, and marketing within a country are directly related to the feasibility of achieving adequate nutrition. Therefore, any program aimed at improving the nutrition of children must be made not only within the framework of the present range and availability of foods in the particular region but must take into account changes that may occur at the present and in the future. It must also, as far as possible, consider methods of improving food production and utilization, both at the national and local levels.

PROBLEMS OF FOOD PRODUCTION IN DEVELOPING REGIONS

The effectiveness of methods of food production depends on many interacting factors, including the soil, the climate and rainfall, the level of health and vigor of the community, the customs and social organization of the people, local crops, and indigenous pests and diseases of plants and animals.

While modern methods of food production are being introduced increasingly into limited areas, for the most part agriculture, rearing of livestock, and fisheries are dependent on methods that are in a sense traditional and time-tested, but which, at the same time, are by modern standards inefficient and unproductive. To understand this, it is necessary to consider briefly the methods employed, including problems of available labor, land ownership, and soil characteristics, as well as customary methods of storage, preservation, and marketing of food.

Labor Force and Equipment. In most tropical countries, methods of food production will be essentially "labor-intensive"—that is, relying on human labor rather than on machines. Traditionally, the labor force is made up of the family, the clan, or the people of the same village. Much of the hard work is often the duty of women, especially in Africa. Methods are usu-

ally based on the use of limited crude equipment, such as the hoe and entail a large expenditure of energy and effort for a small return. The daily round of digging, grinding, pounding, and carrying heavy loads involves a tremendous expenditure of time and energy.

Additionally, the physical energy of a chronically malnourished, diseased, and parasite-ridden community is reduced, leading in turn to the vicious circle of defective food production and continuing malnutrition.

Often only simple methods of ploughing and irrigation will be available. There may be an inadequate realization of the need to rest the soil or rotate crops, except perhaps by means of clearing new cultivation areas each year by so-called "slash and burn" methods. In fact, "farming may be mired in Babylonian technology."

Large-scale mechanized agriculture can undoubtedly play a major role in increasing food production in some parts of the world, perhaps using machines, such as tractors, hired from cooperatives. Often, a more realistic approach than the use of expensive, difficult to repair, elaborate machines may be the introduction of minor improvements ("intermediate technology"), such as an ox plough, or relatively simple mechanization, as, for example, the introduction of a manually operated thresher, a mechanical walker tractor, or a groundnut digger. This type of approach also has the advantage of maintaining employment.

An advantage of mechanized farming in parts of Africa is that it is a man's job, as opposed to traditional cultivation which is usually a woman's task. The new allocation of duties may permit women to spend more time on other things, including the care and feeding of their children.

A further problem with regard to the production of food is that in some countries the labor force is itself being reduced by the movement of men to towns in search of more lucrative and supposedly exciting employment. Not only may this migration deplete the rural labor force, but also, at the same time, it adds to the numbers of town dwellers needing to be fed by the rural population.

In many parts of the world, much greater use could be made of village gardens, which with very little change could often produce much more food which would be immediately available to the family.

Land Ownership. In most tropical regions, the question of land ownership greatly complicates the problem of modifying methods of food production. In some regions, ancient feudal systems may still persist. In other parts of the world, various complex systems of land ownership and inheritance are based on family ties and clan rights. Often land is split into very small portions, and a family may own several small areas situated far apart. Farming under such conditions is inconvenient, difficult, and uneconomical.

For large-scale food production using modern mechanized methods, some form of land consolidation is desirable as a part of a sound agricultural policy based on the rational and economic use of land. However, with the worldwide deep emotional attachment of peasant people to the land and with current complicated systems of ownership, necessary reforms cannot be brought about easily or speedily.

In addition to consolidation of land into large and economically sound holdings, in some tropical countries it may be possible to reclaim new land by settlement, by clearing bush or forest, by draining swamp lands, by introducing irrigation systems, or, in parts of Africa, by the eradication of the tsetse fly, the carrier of sleeping sickness.

Soil and Climate. In tropical countries, the soil is often shallow and leached of the minerals contained in the organic humus that are needed to make it fertile and productive, partly because of the heavy rainfall and soil erosion. In some places, land is overused agriculturally, or by overgrazing. Livestock may be kept in too large numbers for their prestige value rather than for their food potential. Likewise, available animal manure may not be used as fertilizer, as in India where cattle dung is employed principally for fuel. Other fertilizers, including compost and chemicals, are also underused.

Agriculture everywhere depends on the climate but in developing tropical countries this dependency for survival is often nearly absolute. In India, widespread food shortage or even famine is at the mercy of the annual monsoon. In some tropical countries, rainfall may be too abundant, leading to soil erosion, or too scarce, leading to aridity, which may be further increased by overgrazing.

Seeds and Stock. Variation in quality, including nutritional value, already exists between different strains of a particular crop, and the popularization of the best variety can be of great value. In addition, modern developments in seed genetics and stock breeding have already led to great improvements in yields and quality. It is increasingly possible to develop strains that are adapted to special needs, such as being resistant to particular climates and diseases, bringing a higher over-all yield, possessing improved nutrient content, or being unattractive to insects, rodents, or bird pests.

However, experience has clearly shown that careful testing of community acceptability of these new varieties is as important as their scientifically proved values. They must possess the appearance, taste, and cooking properties that are acceptable to the people.

Considerable attention has also been given by stock breeders in recent years to trying to develop strains of cattle and other animals which have a high yield, are adapted to a tropical climate and available fodder, and resistant to local diseases, such as trypanosomiasis in Africa.

Food Protection and Storage. (figs. 2 and 3) Much loss of food can occur while it is still growing, as a result of the ravages of rats and birds and, in some places, monkeys, porcupines, and other creatures.

In most places it is necessary to store food harvested to last until after the next cultivation season. With present methods, there is frequently a very considerable wastage, so that in India it has been estimated that about one third of the food harvested and stored in traditional granaries is destroyed by insect pests, rodents, and molds. This worsens the seasonal shortage likely to occur prior to the next harvest—the "hungry season"—when both fresh foods and stored staples are likely to be in short supply and less nutritionally

FIGURE 2.—Traditional raised rice granary (Madagascar).

desirable famine crops are used, especially cassava.

In some places, farmers recognize that this loss is likely to occur and, unfortunately, sell most of their harvest at once. This means that they need to buy the same foods for their own consumption from shops later in the season at much higher prices.

The provision of insect-, rodent-, and mold-proof granaries would increase the availability of foodstuffs immensely. These granaries can sometimes be cheaply made concrete communal stores; while, at village level, considerable improvement is frequently possible by means of such relatively uncomplicated methods as trying to ensure that grain and legumes are stored dry in sealed rat-proofed, mud-brick granaries that are raised off the ground and protected by inexpensive insecticides that are not toxic to man.

Food Preservation, Distribution, and Marketing. The distribution of foods is frequently restricted by poor communications, difficulties in transporting crops and other foods, defective means of preservation, and inadequate and economically unattractive marketing opportunities. For example, for all these reasons, fish is available for only a very limited distance around the great lakes of Africa.

Village-level methods of food preservation are based on making the particular material less liable to bacterial invasion and decomposition. Canning and bottling are too expensive and sophisticated for most families in developing countries.

Drying is the method most commonly employed, using either the sun or fire. Drying can be used for certain vegetables, including okras and peppers, for some fruits, such as dates, apricots, and figs, for meat cut into thin strips (*biltong, charqui, jerkey*) (Fig. 4), for small fish (Fig. 5) and shrimp, for some mushrooms and other fungi, for edible insects, such as grasshoppers and termites, or for various green leaves (which are then sometimes pounded and stored as a powder).

Smoking, salting (or brining) or spicing (e.g., with red pepper) may also be employed, and several processes may be used together to reinforce one another, as when fish is salted and then dried in the fire-smoke for prolonged periods. In addition to salt, various other substances and spices may be used as preservatives, especially vinegar, as in Korean pickled vegetables (*kim chee*).

FIGURE 3.—Traditional granaries (Togo, West Africa).

Controlled bacteriological change may be induced and can lead to short or long-term preservation, as with *fermented dishes*, such as Japanese *miso* (soybeans and rice) or Indian *idli* (black gram and rice), or with *sour milk products*, such as curd or dried cheese.

There is a great need for practical research into ways of applying modern scientific knowledge for the improvement of these ancient village practices.

Another nutritional aspect of marketing is that certain foods which could best be eaten by the family are sold as "cash crops." These may include such valuable foodstuffs as eggs, salad vegetables, and milk which may be sold and the cash obtained used to buy carbohydrate foods or household goods. However, this may be helpful if farmers can be encouraged to grow enough of these foods to enable them to sell some while retaining some for family consumption. Rural prosperity and improved nutrition can both be related to marketable food surpluses.

While many rural communities continue to be subsistence farmers growing their own foods, in most areas some

FIGURE 4.—Sun-dried strips of beef (North Kenya).

form of traditional market continues. This marketplace often acts as a focal point for the community where produce can be brought for sale or barter and where information and news can be exchanged. Traditional markets are also extremely important as sites for nutrition education activities (Figures 6 and 7).

Minor improvements in transport can be most valuable to the farmer economically and to the community nutritionally. Simple modifications and strengthening of bicycles can permit greater loads to be carried increased distances to market.

More recently, small village shops selling a simple range of goods have become a feature of many tropical communities. Undoubtedly they are playing a part in spreading goods to remote regions, including such commodities as kerosene, antimalarials, and agricultural implements. At the same time, the foods they sell very frequently tend to be what are in many tropical circumstances nutritionally undesirable or even luxuries, such as tea, sugar, and expensive, inappropriate tinned foods. It is to be hoped that in the future village shops may act increasingly as outlets for the low-cost, high-protein foods that are being developed in various countries of the world.

Cash Crops and Food Crops. A key problem in many present day communities in the tropics is to try to develop a balance in their cultivation between a locally-grown, nutritious diet intended for the family or village itself and cash crops, such as coffee, cotton, and cocoa, which are the main or sole source of cash income for the family for taxes, school fees, and household goods, and the chief source of foreign exchange for the nation.

However, it is increasingly apparent that nutritious food "crops," such as beans and eggs, can also be important as cash earners if grown in larger quantities.

Finance and Incentive to Change. Many peasant farmers in developing tropical regions are unremittingly bound down by chronic poverty and indebtedness. The development of government assisted cooperatives, crop insurance schemes, and bank and credit systems may enable the cultivator to obtain loans of money and credit in the form of insecticides, improved strains of seeds, and equipment which can enable him to start on the road to modest prosperity.

FIGURE 5.—Sun-dried, smoked fish on sticks (Uganda).

Incentives to increase production and to change to new crops are also needed. These may be supplied by governmental assurance of a market with a guaranteed remuneration per acre cultivated, or by import restrictions on foods that are producible within a country.

SELECTED FOODS

Vegetable Protein Foods. The production of foods in most tropical countries is usually dominated by one or more local starchy staples, such as rice, corn, or yams, upon which the population relies for the majority of its Calories and, indeed, for much of the rest of the nutrients of its diet, including protein. A top priority must therefore always be the increased production of improved quality staple.

The production of protein foods, both of vegetable and of animal origin, is usually deficient, sometimes because

FIGURE 6.—Traditional market (Mali, West Africa), showing mixed beans in foreground.

FIGURE 7.—Traditional floating market on canals (Bangkok, Thailand).

of difficulty of producing these foods, but more usually because their nutritional value is not appreciated. In particular, pulses or legumes very frequently are not produced in nearly the quantities that are desirable or feasible. Many different varieties exist and efforts are obviously needed, both on a national and on an individual cultivation basis, to increase their production. *Legumes are, and in the future will become increasingly, the world's mainstay as regards protein nutrition.*

In some countries, it would be most desirable if some inducement to their increased cultivation could be developed, possibly by governmental assurance of a local market for a certain percentage of the yield.

Legumes may be eaten fresh at the time of harvest or, more usually, dried and stored, when special care has to be taken to prevent their infestation with weevils and other insects.

Particular emphasis needs to be given to solving problems of increased

production of aflatoxin-free groundnuts (p. 30) and of using the presscake obtained after the extraction of oil from soybeans (p. 31) and cottonseed (p. 32) to prepare high-protein flours suitable for infant feeding.

Animal Protein Foods. There is a great need to increase the production of animal protein foods in tropical countries, except for certain favored groups, such as fishermen, pastoralists, and, in rare places, hunters. At the same time, the production of animal protein foods is often not the most biologically efficient or economical way of using available land. Problems related to local geography and climate, such as scarcity of water and fodder, and the disease pattern may make animal husbandry difficult.

Milk. Increased dairying is rightly regarded as an important aspect of animal protein production which has special relevance to young children. However, as has been noted elsewhere, animal milk, although an extremely valuable food, especially for young children, is by no means necessary as evidenced by the fact that many communities have reared their children successfully without this food—for example, the Chinese and the Polynesians.

Often with international assistance, various tropical countries have been making great efforts to increase their milk production, both from cows and from buffaloes. With small peasant stock raisers, it is necessary to introduce some system of rural milk collection, using robust, simple equipment, and to devise some method of transporting the pooled mixture to a processing center. This should, in turn, be followed by factory pasteurization, inexpensive bottling, and economical distribution and sale. Preferably, there should be some system for ensuring that at least a part of the end product reaches the young children who need it most.

Most indigenous tropical cattle yield very little milk, and to increase production to an economic level it is necessary either to introduce such high yield exotic breeds as Channel Island types or Fresians, or to develop hybrids between exotic and local species. In both cases, it is usually necessary to take special care with disease protection by means of immunization and tick control, and to ensure the animals an adequate diet and water supply. Plainly, this is difficult for an uneducated farmer to realize or, indeed, to put into practice, without some form of subsidy or inducement from the government. However, in some parts of the world, as in Uganda, a small but increasing percentage of "Progressive Farmers" are rearing cattle with all these precautions and finding it most profitable to do so, thus providing the financial motive for others to follow their example.

In some places, it may be possible to produce a relatively inexpensive "toned" milk, made up of locally produced fresh milk mixed with inexpensive imported dried skimmed milk. In particular, this has been tried with success in Bombay, India, where high-fat buffalo milk (7–9 percent) has been mixed with imported low-fat dried milk, with a resultant mixture rather similar to cow's milk.

Meat. Increased meat production may be possible in some regions, by means of improved breeds and by better protection against disease. Equally im-

portant in some places is the need to make use of animals, especially cattle, which at present are not eaten for various cultural reasons and which in fact act as competitors with human beings for the limited food available, or overstock and overgraze the available land. Thus, in India it is forbidden, for religious reasons, for the Hindu population to eat beef or, indeed, to kill these sacred beasts, which are permitted to wander the streets uncared for and often diseased.

Likewise, in many traditional African communities, small stunted cattle are kept as symbols of wealth and prestige and for use as the bride price. Usually the health and general condition of the animals is of less importance than their number, although some cattle-keeping people pay great attention to certain nutritionally irrelevant aspects of their appearance, such as the curve of the horns and the color pattern of the skin. When cattle are kept, they are usually milked, but give a low yield which is most often reserved for the elders of the community. Animals are often slaughtered only on special occasions, such as feast days.

In certain favored tropical regions, ranching schemes may be practicable, while, in some parts of Africa, attempts have been made to obtain meat on a continuing commercial basis by game-cropping, either in extensive fenced-in areas, or in natural circumstances as with hippos in East African rivers.

In most tropical villages, chickens are to be found, although usually living a "free-run" existence on the rubbish and insects to be found in the compound. These birds are small, with little meat and with a low yield of undersized eggs. Their mortality from small animal predators and from accidents is great.

Chicken is eaten in most parts of the world, although in some parts of Africa, both chicken and eggs are still taboo to traditionally brought-up women, as they are believed to produce infertility.

Despite the existence of a variety of worldwide and tropical fowl diseases, chicken rearing on both a medium and large scale is being carried out increasingly in some tropical regions. However, even with the use of the cheapest local materials and labor for building deep-litter pens, a considerable amount of care, expense for feeding material and large numbers of birds are required before it can become reasonably profitable on a commercial basis.

Alternatively, a compromise can be employed for the small farmer, for example, by devising an inexpensive chicken run and a protected raised roost, by feeding the birds with leftover peelings and food waste and by introducing a better breed of cock.

The rearing of a variety of other small animals as food can be attempted in the right circumstances, provided they are acceptable to the local cultural pattern. In various parts of the world, these may include pigs, goats, rabbits, guinea pigs, and agoutis.

Eggs. In many parts of the world, eggs are particularly underused as food, especially for infants. Frequently this is because they are considered as a "cash crop" to be sold at the local market. In addition, however, many cultures have traditional beliefs that prevent their being eaten by young children (p. 64).

Fish. Basic and applied research is being carried out on improved methods of fishing appropriate to particular

tropical communities. For example, strong nylon nets can be made available at relatively low cost and loans can be supplied to purchase outboard motors. Often, a major problem is preservation and distribution; and if this could be improved, the incentive to obtain larger catches would obviously increase greatly.

In some parts of the world special fish preparations are much prized as foods, as with the fermented, predigested fish and shrimp pastes of parts of Asia. Investigations aimed at improving the nutritional value and increased yield are plainly of importance.

Vegetables and Fruits. As a generalization, it may be said that vegetables and fruits are not grown or eaten as much as they might be, especially dark green leafy vegetables. The production of these foods could very often be increased easily by the development of improved home gardens or school gardens.

New Sources of Food. Intensive research into new sources may be expected to play a role in the world food scene in the future.

Synthetic Amino Acids and Vitamins. The economical synthesis of certain essential amino acids, notably lysine, has suggested the possibility of reinforcing cereal flour with this limiting amino acid (p. 2). Cost and practicability make this approach unlikely for most tropical communities.

The use of synthetic vitamins, especially thiamine, to reinforce overmilled rice and wheat flour has been in effect for decades in limited areas of the world.

Plankton. These small sea organisms can be harvested, concentrated, and added to livestock rations as a high protein source.

Microbial Protein. Recent research has shown that microbial protein may be grown on petroleum. The end result appears to have promise at least as animal feed.

Food Yeast. Highly nutritious food yeast can be easily grown in molasses. Its use as a protein additive for various commercially prepared infant foods is being explored.

Leaf Protein. Methods have been devised to extract protein from various types of leaves and the resulting dark green powder has been employed experimentally in the feeding of young children.

However, it must be stressed that, with the exception of oil seed residues which are not at present much used for human food, the solution to the world food problem lies principally in the direction of augmented production and impoved quality of traditional, orthodox food sources.

PROBLEMS OF MODERN CHANGE

Two problems of extreme importance to food production and to the nutrition of populations as a whole, and especially to young children, have merged in the past few decades, particularly since World War II. These are (a) a rapid population increase, and (b) urbanization. Almost all countries have been affected, although to very different degrees.

Population Increase. Tradition-oriented people all over the world desire to have large families, as an expression of virility for the men, of fertility for the women, as a source of

strength to the clan, group, or tribe, as a work force, as a source of insurance in old age, and, in some places, as a source of wealth, either from bride price or doweries. In addition, politicians tend to equate numbers with power.

Over the centuries, communities have become accustomed to a high child wastage, often with over half the children born dying before adolescence. A high birth rate was required to compensate for child wastage. However, with the introduction and acceptance of at least some aspects of modern methods of medicine and public health, and with the establishment in most places of some degree of law and order the death rate in childhood, although still extremely high, has decreased greatly. In fact, death control has occurred without parallel fertility control. As a result, the population has increased ever more steeply, so that the present world population of about three billion is expected to reach seven billion by 2000 A.D.

Population Pressure and Food Needs. There is a widening gap between the growing world population and available food supplies. Of especial seriousness is the fear that the most rapid increase in population has occurred in the parts of the world where food production has lagged, that is, in developing tropical regions. This is especially striking in some Latin American and Asian countries who were food exporters some years ago, but who now have to supplement their own production with imports and whose food production is increasingly inadequate even as regards Calories. The situation is plainly precarious with food supply dependent to a great extent on the import of foodstuffs from elsewhere and extremely vulnerable to natural hazards, such as droughts or floods or man-made disasters, such as wars and civil strife.

In many other regions, food inadequacy is particularly related to protein, resulting in a poorly balanced national diet.

Population Pressure and Arable Land. Administrators in many countries do not seem to appreciate that with the present geometrical progression in their population increase, they too may meet the extreme problems of the more over-crowded Asian countries in the coming decades, unless appropriate action is taken *now*. Thus, even in the apparently underpopulated areas of East Africa, it has been shown that, by the year 2000 A.D., the population density in Kenya in relation to useable land, will approximate that of India today.

Population Pressure and Social Services. Another nutritional and health consequence of an over-rapid increase in population is that the hard-won advances in "development," both economic and social, constantly lag behind the extra numbers of people expecting to share in these advances. General and health education through schools are important methods of nutritional improvement; with a too rapid increase in child population, the building of adequate numbers of schools will never catch up with the number of children. The result is a growing number of uneducated young people unable to find jobs.

Child-Spacing and Malnutrition. An often ill-appreciated, but highly important, aspect of over-large families is related to child-spacing. If children are

born at too close an interval, severe nutritional consequences occur, both for the mother and for her offspring. Many tropical women marry young and commence child bearing before they have completed their own growth. Thereafter, their life may be one of continuous reproductive nutritional drain, as one pregnancy and prolonged lactation is followed by another. In mothers, this cumulative "maternal depletion" may sometimes manifest itself as a definite deficiency of a certain nutrient (as for example iron-deficiency anemia), or alternatively may lead to general malnutrition, with weight loss, thin muscles, and subcutaneous fat, and with premature aging and death.

If children are born with too short an interval between them, this may lead to the newborn baby himself being underweight and with less than adequate stores acquired from an already nutritionally depleted mother. Also in tropical village circumstances, both prolonged breast feeding and close and careful attention by the mother are desirable for the child's nutrition and health.

The ideal gap between children is probably between two to three years because, if children are born in rapid sequence, the period of breast feeding and of close maternal care is too short and the possibility of the infant developing protein-Calorie malnutrition (p. 75) is greatly increased. Many communities had traditional customs which ensured child spacing.

Family Planning and Nutritional Needs. Family planning is required nutritionally *both* to achieve child-spacing and to control the "population explosion." Recent changes in opinion in many parts of the world and new technological advances have made this type of approach a practical possibility although it is still fraught with many cultural, religious, and political misunderstandings and difficulties. In particular, the use of the plastic intrauterine device (I.U.D.) has revolutionized the approach to family planning, as it is a method which is inexpensive, often culturally acceptable, practical, simple and, once inserted, does not entail any alteration in customary sexual behavior.

The move toward family planning has increasingly involved greater areas of the world, although there are still many countries or regions where this approach is unacceptable and the dangers of over-population are either not appreciated, or are thought to be amenable to increased food production, to technological advance, and to raised standards of living leading to reductions of family size. The inescapable conclusion is that increased food production and family planning are complementary and that *both* are urgently needed.

Many countries now have family planning projects, often on a vast scale as part of official government policy, e.g., India, Pakistan, Egypt, Tunisia, and so forth. Still more have small-scale family planning associations or activities which are increasingly supplying the demand of the well-to-do and middle classes (the trend-setters of the future), although they have no direct, open support from governmental authorities, largely for political reasons since they may be misconstrued as sinister attempts at genocide or at restricting the "power" of a particular group, community, or nation.

Urbanization. Many tropical countries are in the relatively early stages of

industrialization and, indeed the newer problems of the present and the dominant problems of the future are in many cases bound up with the partly planned, but mostly haphazard urbanization that is occurring in the same way as happened in the Industrial Revolution in Europe in the early 19th century.

People, and especially men, come to the towns to seek work, where it seems to them that more modern, prestigious and lucrative opportunities exist than in the rural areas. As anywhere, they are also attracted by the bright lights, excitement, and bustle of town life. All too often, only a few can obtain gainful employment and reasonable low-cost housing, so that the majority may find themselves living the "detribalized" lives of discontented, underprivileged, unemployed slum dwellers, with immense potential for social unrest.

Family Instability. Under these circumstances, the traditional customs and restrictions of the home community are abandoned, often with a rise in temporary marital liaisons, illegitimacy, venereal disease, alcoholism, broken families, and abandoned children. The last is particularly striking in certain African cities, since in traditional society children born out of wedlock are usually absorbed into the clan or tribal structure, whereas in towns the neglected or abandoned undernourished young child is nowadays becoming an increasingly serious problem.

Nutritionally Relevant Infections. As regards nutritionally important infections (p. 72), in some ways the town child is at an advantage. For example, malaria and certain types of parasites will usually be much less of a problem. However, as a result of the overcrowding, some infections of nutritional consequence, particularly tuberculosis, whooping cough, and diarrhea, can often occur more commonly than they do in rural areas.

Changing Food Habits. Most directly relevant to the nutrition of children will be the change in food habits that can occur as a result of moving from a rural traditional way of life to an urban situation, where the family concerned will depend, in major part, upon a cash economy—that is, upon food bought rather than the food grown through home cultivation. This situation poses problems of budgeting for inexperienced "new townsmen," exposed to many understandable temptations to spend their limited resources wastefully.

Often the main foods that have been customary in the home area, including even the staple, may not be easily transportable and hence may not be found to any large extent in shops in towns. For example, millet-eaters migrating to towns do not usually find this cereal available to them and often have to move over to less nutritionally desirable, cheap, easily storable staples available in the stores, including cassava or maize (corn) flours. In general, there is also often a tendency to use convenient, refined, less nutritious foods, including white overmilled flour, sugar, tea, and carbonated beverages. However, the people do have an opportunity for wider exposure to nutrition education, which should be made available to them, and are often closer to limited health services.

Another point of considerable importance is that many rural people make use to a very considerable extent of a variety of different foods of vege-

table, and occasionally of animal, origin which occur wild or semiwild in the countryside. These may include various green vegetables, fruits, berries, eggs, and, in some communities, honey and insects. These are no longer available in towns.

Of particular importance as far as the feeding of young children is concerned, is the fact that urbanization seems to be paralleled by a harmful trend away from breast feeding toward artificial feeding with cow's milk, often using a feeding bottle.

In addition, rural mothers exposed to the advertising of the towns are extremely likely to buy not only impossibly expensive milk preparations but also a variety of costly largely carbohydrate tinned foods, which are economically beyond their reach, nutritionally of low value, and a misuse of their limited budget.

FOOD AID

In the past decades, very large quantities of food from agriculturally highly productive countries have been used as "food aid" for developing regions. The vast majority of this has come from surplus foods produced in the U.S.A., as, for example, the low fat (dried skimmed) milk distributed by UNICEF, CARE, and the Catholic Relief Service, and the foods distributed by the Food for Peace Program.

These have been used on a very large scale and have been of much value in trying to deal with actual malnutrition through supplementary feeding programs, as with dried skimmed milk for the therapy and rehabilitation of young children with varying degrees of protein-Calorie malnutrition.

In addition, the use of dried skimmed milk has helped increase attendance at child health services, has drawn attention to the problem of childhood malnutrition and has, in some places, stimulated the local production of low-cost, high-protein foods suitable for young children.

The disadvantages of this approach are that it was geared to the use of surpluses that were not necessarily the most suitable foods for the area and that it could discourage local production.

The situation has changed radically in the last few years and the previously huge food reserves in the U.S.A. have decreased greatly, mainly because of massive food aid to avert famine in India but also because new markets have developed.

War on Hunger Program. In view of recent developments, the policy of the U.S. War on Hunger Program is to try *to deploy more specifically needed food aid to deal with defined nutritional problems, especially those of young children and, at the same time, to assist in the development of indigenous food production.*

With this in mind, farmers in the U.S.A. will be induced to grow specific foods that are required for the problems of particular regions, expanding cultivation to use previously idle land.

These foods will be related to actual nutritional problems and will, therefore, frequently be the animal or vegetable protein foods, such as dried skimmed milk or legumes, especially the soybean, produced to combat protein-Calorie malnutrition of early childhood.

Lastly, and most importantly, food aid will, as the name suggests, be geared to stimulating food production

within a country instead of producing the negative effect it has often exerted on agriculture in the past.

World Food Program. In a similar way, this multilateral U.N. program is principally designed to assist with food aid from a variety of participant countries in the support of technically sound and feasible projects intended to improve a country's economic development and especially its own food production. Thus, in the building of a dam designed to increase land irrigation, as well as produce power, part of the salaries of the labor force may be made available in the form of food. This enables food production to be increased and, at the same time, mobilizes manpower and provides employment.

Other projects covered by the World Food Program include subsidizing educational development through school feeding, direct preschool child feeding schemes, and assistance in the development of locally produced high-protein foods for young children. In the last category, sorghum (a millet-like cereal) flour has been made available in Senegal for incorporation into a processed infant food which is being manufactured there. It is hoped that this initial reduction in cost of the product will enable it to be launched more easily and that local sorghum flour will be used subsequently.

FUTURE DEVELOPMENTS IN FOOD PRODUCTION

Realization of the Situation. The world population is increasing twice as fast as the increase in food production, and the gap is especially marked in developing tropical regions. The threat of extensive major food shortages, or even mass famines, is a real possibility for large areas of the world in which all age groups would be involved, although young children would be the principal sufferers.

Over-all Policies. There is in many countries an awakening awareness of this problem, especially in light of the current lack of food surpluses from the U.S.A. The message seems clear. *A sound food production policy based on the nutritional needs of the country, coupled with some sort of locally acceptable family planning program, is what is required.*

These programs rank even higher in urgency than educational development or the extension of all but the simplest health services. Of course, they are not as attractive politically as such prestige items as national airlines or grandiose public buildings, and they require the support of technical advisers and workers if they are to gain acceptance.

The aim should be an increased, diversified national food production, using both large scale and domestic level approaches, with special relation to vegetable protein foods, and with the object of improving the family diet with particular reference to young children.

A balanced approach is needed between measures designed to improve a country's wealth—that is, its economic development—by means of industrialization and the cultivation of cash crops on the one hand, and those measures to increase food production by agriculture, animal husbandry, and fisheries on the other. However, in most countries there has, in the past, been an over-emphasis on industrialization and cash crops. In the context of the

world in the near future, it may well be possible to appear to be developing the economy of a country favorably and still be short of food.

That an increased national food production is needed for full insurance against national food shortage is emphasized in a recent speech by President Ayub Khan of Pakistan when he said: "The time has arrived when the world cannot produce food for us and after some further time it will not be able to supply us with food even for gold. We have to feed ourselves."

Blocks to Increased Food Production. It is now recognized that blocks to vastly increased world food production are neither technical nor even "natural," that is, related to geography or climate, but that limitations are rather due to economic, social, and cultural factors.

Improvement appears mainly to require education and motivation of governments and ultimately of the farmers themselves. More efficient marketing systems are particularly needed, thus supplying both incentives to the food producer and also lowering the price for consumers.

The Field Worker and Food Production. In addition to wider issues related to national policy, much improvement in food production can be achieved at village level by the use of high yield seeds and fertilizers (including manure, compost, or mulching), by pest control (especially with insecticides in stored grains and legumes), and by the increased cultivation of protein foods (as with legumes and dark green leafy vegetables in home gardens, or with fish ponds). In these important, small-scale activities, the field worker may be strategically situated to help introduce and popularize new or modified ideas in collaboration with the local agricultural extension services, village clubs, and other organizations.

FURTHER READING [1]

C. J. GAMBLE and A. F. GUTTMACHER, *A challenge to health workers of every nation*, Family Planning, (1966) (G&T).

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A. T. MOSHER, *Getting Agriculture Moving*, Agriculture Development Council, Inc., New York (1966) (G&T).

Time Magazine, "The struggle to end hunger," Time Essay, August 12, 1966. p. 42 (G).

H. D. TINDALL, *Fruit and Vegetables in West Africa*, FAO, Rome, (1965) (G&T).

[1] G = Recommended for the general reader. T = Recommended for the technically trained health worker.

chapter iv

CUSTOM AND FOOD

Each of the many different communities of mankind has its own pattern of behavior, customs, and beliefs, which together are termed its "culture." This complex set of attitudes and ways of life are by no means inherent; they are learned after birth by instruction from parents and others, but mostly by means of subconscious imitation of the behavior of the family and other members of the community. By the time later childhood and adulthood have been reached, the individual has been conditioned to accept the ways of his particular group as the correct and proper way to behave, and, indeed, often to regard other culture patterns as bizarre and absurd, if not positively harmful.

In fact, all different cultures, whether in a tropical village or in a highly urbanized and technologically sophisticated community, contain some practices and customs which are beneficial to the health and nutrition of the group, and some which are harmful. No culture has a monoply of wisdom or absurdity. *For a worker from a Western, industrialized society, it is absolutely necessary to realize the existence of this "cultural relativity," especially the universality of scientifically unsound behavior.*

The conditioned responses and behavior of a community which make up its culture are particularly important in relation to food and eating practices, and to methods of food production. An understanding of some of these variables is imperative, if cross-cultural misunderstandings and clashes are to be avoided or minimized.

CULTURAL FACTORS AND CHILD NUTRITION

All the aspects of a culture are interrelated and interact one with another, so that an understanding of the leadership structure, kinship systems, life goals and values is helpful in trying to understand local health and nutrition problems, and in carrying out a preventive program.

Two "nonnutritional" cross-cultural problems often of importance in nutrition work may be mentioned as examples:

1. *Specimen collection,* which may be misunderstood and resisted through fear that the blood or urine may be used for occult purposes, or that its loss may weaken the donors;

2. *Difficulties with names and numbers,* which arise when the culture forbids that one's own name or that of one's husband or child, or the number of children in the family, should be mentioned before strangers, or when names are changed for various reasons.

Nevertheless, there are certain customs that are more obviously and directly relevant to child nutrition and feeding. Certain of these can now be considered.

Food Classifications. These are often of great complexity and usually the result of numerous interlocking historical, social, and economic factors that have influenced the culture pattern.

These subconscious classifications comprise one of the most deep-rooted aspects of all culture patterns. They are learned by imitation in early childhood and are notoriously difficult to modify or change.

The food classifications employed usually have no relation to scientific divisions (e.g. protein, vitamins, and so forth). They seem complicated to the outsider, but appear natural, normal, and correct to the particular community. It is most unusual for there to be any recognition of the relationship between the type or quality of diet eaten and health or disease due to malnutrition. In fact, trying to convince people of this concept is basic to much nutrition education, and is particularly difficult to achieve, because evidence of the benefits of a good diet are not quickly produced.

Basically no human group eats all the potentially edible material available to it, but arbitrarily classifies these items into food and nonfood (fig. 8). Thus, in the U.S.A., dog, although a good source of animal protein, is categorized as nonfood. Certain hunting groups in remoter Tanzania, hard pressed as they are for food, do not eat fish, even if it is available to them. Also, the categorization into food and nonfood may be on a ritual or religious basis, as with the avoidance of beef by Hindus, and of pork by Muslims.

Cultural Super-Foods. In all communities, one or more items have become the cultural super-food. The characteristics of cultural super-foods are that they are usually, but not always, the dominant staple and main source of Calories. Their production and preparation occupy a major part of the community's work time, both agriculturally and domestically. If the cultural super-food is a grain, its preferred preparation is usually overmilled and as white as possible (e.g., wheat or corn flour, rice).

Because of their importance for the survival of the particular community, they often have semi-divine status, being interwoven into local religion, mythology, and history. They have profound emotional value to the group concerned and tend to dominate the local dietary so much that often a vernacular word for "food" is the same as for the staple.

Examples of cultural super-foods include rice in most of Southeast Asia, *matoke* (steamed plantain) in Buganda, corn (maize) in Central America, and wheat in Northern Europe.

FIGURE 8.—Food and nonfood. Blood being drained from jugular vein of cow (Karamoja, Uganda).

The nutritional importance of the cultural super-food is that it will usually also be the main source of protein and other nutrients as well as Calories, and will be the food which mothers will over-value and will tend to feed their young children on preferentially. People with a relatively high-protein cultural super-food, such as one of the millets, are at an automatic, base-line advantage with regard to infant feeding and are likely to avoid kwashiorkor, compared with those eating a predominantly low-protein staple, such as plantain or cassava.

Prestige Foods. All cultures have prestige or status foods, which are mainly reserved for important occasions or for the illustrious of the community. Examples include chicken in

Africa, various special milk deserts in parts of India, camel hump in some traditional Arab groups, and the pig in New Guinea. Equally, in the U.S.A., a nutritionally equivalent quantity of steak would certainly have greater prestige than a corresponding quantity of cheese.

Examination suggests that, even in so-called vegetarian societies, prestige foods are usually protein, frequently of animal origin, often a milk product. They are usually difficult to obtain, so that they are expensive.

Body-Image Foods. Many cultures have their own body-image that includes their own culturally defined concepts concerning the workings of the body and its physiology, which are totally different from modern scientific views. These ideas may be systematized as with the ancient Hindu classification of body physiology into *doshas* (humors), especially "heat" and "cold," or the similar systems found in Latin America and the Eastern Mediterranean.

The importance of these classifications is that both foods and illnesses are usually categorized in this way, so that the diet permitted may be of considerable influence in both health and disease, in relation to its supposed influence on the body. For example, in Bengal diarrhea is classified as a "hot" illness and, to the village mother, it is plainly dangerous to feed her child with milk, even during recovery, as this is also classified in this system as being "hot."

Relics of ancient classifications exist in industrialized countries. For example, the Galenic humoral concept of illness may influence modern food intake. One reason that spleen is not eaten to any extent in Britain is that, by this classification, it is traditionally the prime seat of "melancholic humor."

Sympathetic Magic Foods. All over the world some foods are eaten or avoided, at least in part, because of subconsciously assumed "sympathetic magic" properties. That is, it is felt that the appearance or original function of the food may affect the eater. Thus, in Gujerat the convoluted walnut is regarded as a brain-food; while underdone steak—symbolically representing vigor, energy and masculinity—was used for training university athletes in Europe until recently.

Physiological Group Foods. Special foods are often reserved for, or forbidden to, certain physiological groups, including males (especially elders), women (particularly when pregnant, after delivery, or lactating), and children (most importantly in the early years of life). For example, in Malaysia fish is the most available source of animal protein locally, but is still sometimes thought to be unsuitable for children in the early years of life because of its alleged capacity to produce intestinal worms.

There may also be foods considered to be particularly suitable for young children. Sometimes they may be soft and easily fed to infants, including squash, sweet banana or arrowroot paste, but otherwise nutritionally inferior. Occasionally, high protein foods are considered especially appropriate, as bone marrow in Northern Tanzania.

General dietary restrictions for women are quite common, as with eggs, chicken, mutton, and certain types of fish in East Africa, and with pork in Polynesian Hawaii.

In Burma and elsewhere, the mother's diet may be restricted during pregnancy, in an attempt to have a small baby and an easy delivery. These practices mean that the fetus receives inadequate stores of nutrients from the mother.

As restrictive dietary practices often apply to women, especially in pregnancy, they may be in worse nutritional condition than men. In addition, the tropical mother is often in a continuous state of production; if she is not producing a baby, she is lactating. In many cultures, it is also customary for her to continue her normal hard physical work in the garden or in collecting wood and water.

Nutritional Significance of Food Classifications. Affluent societies with an abundant supply of foods, covering a wide range, can, as it were, "afford" the idiosyncrasy of scientifically absurd food restrictions. In Western Europe, the taboo on protein-rich grasshoppers or dogs (prized foods in parts of Africa) is not important. A parallel avoidance of fish for young children in Malaysia may be disastrous.

Examination of the food classifications briefly presented here suggest that they often have a significance in public health nutrition in developing regions. In general, they are often related to protein foods, especially those of animal origin. While they may be nutritionally beneficial, they more often tend to restrict or limit the use of available foods ("cultural blocks"). They are often aimed at mothers and young children. They can have, therefore, a direct and important relevance in contributing to the dietary causation of malnutrition in these vulnerable groups.

New Customs. At all times in history, cultures are always undergoing a slow process of change. However, in recent decades the speed of modern communications has increasingly brought traditional non-Western societies in contact with both the science and the cultural assumptions—two very different aspects—of Western, technologically developed communities. This has led to obvious and rapid changes in some customary forms of behavior usually related to convenience or status, as, for example, the use of Western style clothes for men, the bicycle and other wheeled transport, and the telephone.

In the field of child nutrition, many traditional practices have remained unchanged. However, especially in towns, there has been an unfortunate tendency for unsophisticated, less well-to-do mothers to try to follow certain types of Western practice, in particular the use of bottle feeding.

Other problems of infant feeding in towns (p. 58) include adapting to a money economy, unavailability of some customary staples, and the use of nutritionally valueless dilute tea or carbonated beverages (which often cost more than milk).

Child Rearing Practices. Local methods of bringing up children must be known, including the pattern of infant feeding (Appendix II), how the child is separated from the breast (i.e., whether suddenly or slowly, whether the infant is sent away, and so forth), the way children are disciplined, ceremonies at different stages of life (*rites de passage*), and the community's ideas about the relative importance of girls or boys.

Various rites may be significant nutritionally, as with the rice-feeding

ceremony of Hindu infancy, before which rice may not be given to the baby.

Customs in relation to child spacing are important both as regards the likelihood of a baby being breast-fed, and as regards the health and nutrition of the mother. Some communities forbid sexual intercourse for parents until a child has reached one year or more.

Ideas about Illness. Parents will usually have quite different ideas as to what they believe to cause disease in their babies (i.e., evil spirits, witchcraft, ritually incorrect behavior, eating forbidden food, and so forth), and it is important to know what is in their minds.

Local concepts of the causation, cure, and prevention of disease are often complex. Illnesses, especially diarrhea, are often treated by dietary changes, mainly of a restrictive nature, as well as with herbals and appropriate magical ritual.

The advanced, and therefore more obvious, forms of malnutrition are often recognized and classified by uneducated indigenous peoples. The terms used usually refer descriptively to some striking feature, or to the presumed causation. For example, the Luganda word *obwosi,* synonymous with "kwashiorkor", "disease of the displaced child" indicates astute insight into the social background, but reveals no understanding of the actual dietary causation.

Food Preparation. The traditional methods of food preparation are plainly of great practical importance, as far as the feeding of young children is concerned. Foods may be cooked by boiling, by steaming, by barbecuing, or a variety of other different methods. The cooking utensils may be of various types, but are often very limited in range and number. The type of stove or fire used and the availability of fuel are also relevant, as are village methods of measurement, as, for example, the types of spoons, bowls, bottles, gourds, or other containers.

Numerous customs may influence practices in food preparation; for instance, in traditional Hawaiian society, the man did the cooking, but had to cook food for himself and his wife in two entirely separate pits.

It is necessary to know whether food is cooked in pots, in leaf packets or in various other types of containers. The appearance, consistency, flavor or lack of it, color, and temperature may greatly influence acceptability of food. To some people it is highly important that cooked food should be hot, whereas the temperature is quite immaterial to other groups. In the Highlands of New Guinea no liquid foods are used at all, a practice which must be taken into consideration in attempts at providing protein supplements for the young child.

Obviously the methods by which attempts are made to prevent malnutrition through nutrition education will need to be kept within the framework of local home economics and the realities of the kitchen.

Meal Patterns. In some communities, it is usual to have only one or two meals daily, which means that the nutritional needs of young children are particularly difficult to meet, unless extra meals are arranged for them. In much of the world there is little appreciation of the special needs of children.

Also, the method of eating and the intrafamilial distribution of food may be of relevance. If, as is often the case, the family eat together and use their fingers rather than cutlery, then young children are often at a considerable disadvantage. Not only are the more nutritious foods given preferentially to the older males, but the small child is inexperienced and less adroit at feeding himself and often tends to get the carbohydrate staple rather than the protein-rich sauce or relish, which is often somewhat liquid. In some cultures forced hand feeding of young children by the so-called "swallow or suffocate" method can lead to aspiration pneumonia.

Many practices encountered in developing countries will seem rather ridiculous unless certain patterns in Western culture are considered. In the 1955 edition of a standard American book on etiquette, there is a chapter titled "Foods That are Sometimes Difficult," referring to certain foods that can be eaten by hand without offending one's host or neighbors and certain foods which must be eaten only with the aid of various utensils. The fact that these are classified under the heading of etiquette in no way makes them different from equally absurd and arbitrary customs elsewhere.

The prechewing of food is practiced by numerous communities in various parts of the world, including the Hadza of Northern Tanzania, some Eskimos, and various Polynesian groups.

The order in which various members of the family eat at meal time is important because sometimes the adults, particularly the father, may eat first and receive the more desirable portions of food, leaving little for the children.

Another important point with regard to meal preparation is the realization that the tropical mother's day is extremely busy and full. She will have many chores occupying her from dawn to dusk, including collecting wood, carrying water, and, in some communities, cultivating the fields. Under these circumstances, suggestions concerning the use of local foods for young children, or the attempted introduction of new processed foods, are not likely to be followed if they impose much extra burden on an already crowded and over-full day.

Food Production. As is understandable in view of its importance to survival, traditional agricultural practices are everywhere much bound up with rites and customs, so that attempts to change may be extremely difficult and likely to meet with opposition or, at least, with lack of enthusiasm.

The planting, harvesting and storing of the cultural super-food is particularly likely to be the occasion for ceremonies and rites of fertility. Phases of agriculture are also likely to be related to the calendar.

Disasters to food crops, such as drought or locust swarms, may be equated with the influence of ultrahuman forces, often especially with witchcraft. Specialists may exist for specific problems, in Africa particularly rainmakers.

Animal husbandry may be much influenced by the particular symbolism of certain animals in some communities. In New Guinea, the pig is important for status and not eaten except rarely at large-scale, nutritionally wasteful feasts. In much of Africa, especially among pastoralists, cattle represent wealth, prestige, and bride-price. In rural

Burma, chickens and eggs were traditionally reserved for divination rites.

Pattern of Authority in the Family. Of great importance to practical nutrition education is to discover which member of the family is responsible for the final word on the choice of diet for the young child, and also for the control of the family purse and decisions as to management in illness. Very often this may be the father, although, in communities with extended families, the grandmother or the mother-in-law may be at least responsible for decisions as to what food the young child should be given and when.

IMPORTANCE OF CULTURAL FACTORS

All those working outside their own culture pattern, especially when in direct contact with communities, must have a clear understanding of cultural relativity, and realize that all their own practices and customs may not be logical and ideal anywhere, and particularly that they may not be appropriate outside their own community. For example, in the Western world, it is now realized that strictly regulated "by the clock" breast feeding is incorrect, and that a more permissive attitude toward timing—such as is practiced naturally by traditional village mothers is more likely to suit the nutritional needs of the baby and lead to psychological rapport between the nursing couple.

An understanding of the local pattern of customs and beliefs is important from several points of view.

Disease Patterns. Firstly, a knowledge of cultural practices may help to explain, in part, why a certain pattern of illness occurs. Thus, in India, tetanus of the newborn is common in some areas because dung, a product of the sacred cow, is used as a dressing on the umbilical cord. In Buganda, kwashiorkor is partly related to the overvaluation of the plantain—the local cultural super-food—in the diet of young children.

Effectiveness of Health Education. Secondly, much improvement in the field of nutrition is sought through health education—that is, by attempts to persuade people to modify their present dietary behavior. This is particularly difficult to do in the field of food and nutrition, but can be best approached with most chance of success by working within the frame of reference of local ideas.

In fact, it is a classical mistake to assume that the parents concerned have no ideas on food and infant feeding themselves, and that all that is required is to make available to them modern factual knowledge. Methods of trying to persuade parents to change feeding practices are considered elsewhere (pp. 95–114).

Acceptability of New Infant Foods. In many parts of the world, attempts are being made to introduce low-cost, high-protein infant foods. It is possible to plan economical, acceptable, and nutritionally desirable food supplements for young children only if the product, and nutrition education relating to it, are suited to the indigenous culture.

Establishing of Rapport With People. Lastly, but importantly, a sympathetic understanding of local ways and attitudes is helpful to the foreigner in ensuring his acceptability by

the local community and by establishing a friendly rapport with them.

APPROACHES TO CULTURAL VARIATION

It is vital to become as familiar as possible with the local culture pattern. This can be attempted by the reading of appropriate general, anthropological, and nutritional books or papers concerning the particular region, and must form an important part of the general preparation for anyone about to work overseas.

Discussion with, and questioning of, apparently well-informed, modern-educated local people and foreigners long resident in the country are often helpful, although the bias of the particular informant has to be borne in mind.

If it is realized that differences in practices and customs are certain to be found, a great deal can be learned by unobstrusive observation and, when sufficient rapport has been achieved, by friendly inquiry.

CATEGORIES OF CUSTOM

It is often possible to classify customs roughly into four groups according to their apparent effect on health and nutrition.

Beneficial Customs. These are customs which appear to benefit the health and nutrition of children, although they may be very different from Western practices. For example, prolonged breast feeding (p. 120) up to two years or so is a beneficial practice in most of the tropics, especially in areas of Africa where no cattle exist because of sleeping sickness, and no alternative sources of good quality protein are available.

Likewise, practices which favor the early introduction of animal protein foods for young children are also beneficial, such as the use of bone marrow among the Hadza of Northern Tanzania.

Beneficial customs should be actively adopted into nutrition education. By these means it seems likely that the confidence of the group may be obtained, and subsequent suggestions on customs regarded as harmful may more likely be heeded.

Unimportant Customs. Certain practices may appear strange and unnecessary to an observer reared in the U.S.A., as, for example, avoiding giving double-bananas to pregnant women in case twins are produced, or using special meat from the nose of the hyena to help blind children to move around better.

If, however, they are of no significance one way or another to the health and nutrition of the child, *they should be left well alone.*

Customs of Uncertain Effectiveness. Sometimes customs will be found which appear to have both beneficial and harmful effects, so that it is difficult to say how they should be classified. For example, in some African communities, various clays or earths are fed to children. Without analysis, it is impossible to be certain of their value or otherwise.

With customs in the uncertain group, *further observation and investigation is required before undertaking any action.*

Harmful Customs. In all cultures there are practices which are harmful from the point of view of health and nutrition. In Western countries, the excessive use of sugar and over-refined flour is undoubtedly in part responsible for the high incidence of dental caries.

In various tropical countries, the following practices may be mentioned as being harmful nutritionally—the prolonged starvation of children with diarrhea, the restriction of protein foods for pregnant women, and an under-usage of eggs for young children, because they are too "hot" or lead to baldness or for other cultural reasons.

Health education is often largely concerned with the last category—that is, with harmful customs. Suggested methods for use in trying to deal with deleterious feeding practices are given elsewhere.

It is absolutely essential *to try to convince parents of the need to modify the particular practices*—that is, to motivate them to want to learn how to change (p. 96). Without motivation, improvement is not likely.

Occasionally, it may be possible to plan infant feeding so that it is nutritionally correct *and* is acceptable in the local culture pattern. Thus, milk, which is "hot," will not be given by a Bengali mother to her child recovering from a "hot" illness, such as diarrhea. However, she will be very ready to give home-made acidified milk, which she categorizes as "cold," thereby achieving the same nutritional goal.

FURTHER READING [1]

D. B. Jelliffe, *Infant Nutrition in the Subtropics and Tropics,* WHO Monograph No. 29, Geneva, (1955) (G&T).

——— *Culture, Social Change and Infant Feeding,* Amer. J. Clin. Nutr. 10, 19, (1962) (G&T).

B. D. Paul (Edit.) *Health, Culture and Community,* Russell Sage Foundation, New York, (1955) (G&T).

M. Read, *Culture, Health and Disease,* Tavistock Publications, London, (1966) (G&T).

[1] G=Recommended for the general reader. T=Recommended for the technically trained health worker.

chapter v

MALNUTRITION IN CHILDHOOD

CAUSES OF MALNUTRITION

The causation of all forms of malnutrition, from marasmus (p. 82) to obesity, is always complex, and this is certainly so with malnutrition in young children in developing tropical regions. This realization is fundamental because, in different parts of the world, the same type of malnutrition may occur with very different causative factors responsible. It is plainly necessary to know the detailed causes of malnutrition in a particular region, because without this knowledge it is not possible to plan and to carry out a preventive program relevant to local circumstances.

Three main groups of causative factors will be considered here: (1) dietary inadequacy, (2) infections, and (3) socio-cultural factors.

Dietary Inadequacy. In tropical children, malnutrition is often in large part directly due to dietary inadequacy, whether this be a lack of nutrients or an imbalance. However, at the same time, "pure" dietary malnutrition is the exception, and other precipitating causes, such as infections, are usually also present.

An inadequate diet may itself be due to a variety of causes:

1. Poverty may put various foods beyond the budget of the family, and this is especially the case with regard to expensive animal protein.

2. Certain foods may not be available in adequate amounts in a community because of poor production, sometimes because of an unsuitable climate or soil, or defective food distribution or marketing.

3. There is usually a lack of knowledge of the best foods for different age groups, and especially the special dietary needs of young children, such as the high requirement for protein during this phase of rapid growth. Without exposure to modern knowledge, it is impossible for an intelligent but illiterate and uneducated individual to have any awareness of modern nutritional concepts.

4. Lastly, what may be termed "wrong knowledge" may be nutritionally significant. This may form part of the traditional local culture pattern (p. 61) or may be a recent importation

into the community. For example, in Bengal a study was carried out which showed that, although kwashiorkor was most usually mainly due to poverty, there were, in fact, a range of locally available protein foods which were not being given to the child for a variety of different cultural reasons ("cultural blocks").

Infections. Much work has been carried out recently on the interaction between nutrition and infections. It has been shown that many infections occur more easily, persist longer, and have a much higher mortality rate in malnourished children; while infectious diseases also play an important role in the initiation of malnutrition itself.

Many infections are characterized by poor appetite, and sometimes by vomiting and diarrhea. Apart from this, it has been shown that during even minor infections the body's need for protein and other nutrients increases. Also, in some communities the diet during infections may be severely restricted, or the child starved, as a misguided part of treatment.

Infections are of particular importance in the production of malnutrition, especially marasmus, kwashiorkor, and vitamin A deficiency, because during the early years of life, they have little immunity, while infections are extremely common, repeated, and often occur together.

Particularly important in the causation of kwashiorkor and other forms of malnutrition are measles, whooping cough, infectious diarrhea, and tuberculosis. In some places, especially in West Africa, measles is particularly serious in this regard. Whooping cough can also be of importance, especially because of the vomiting, which often follows the "whoop" at the end of the characteristic bout of coughing.

Infections with various parasites also may have nutritional relevance. In some countries, young children are continually exposed to malaria during early childhood, and apart from the general effects of any fever, the millions of malarial parasites throughout the child's body also affect the nutrition directly, as they too have needs for various nutrients which are derived from the host child. Also of importance can be heavy infections with various intestinal parasites, especially with roundworms and hookworms.

Socio-cultural Factors. Various socio-cultural factors can play a part in the causation of malnutrition.

Separation from the Breast. The method of separation from the breast is often very relevant—particularly how and when this is carried out. In different communities, this may be at various ages, with different degrees of abruptness or gradualness. Sometimes substitutes may be given in the form of food delicacies, and sometimes there may be actual geographic separation from the mother when the young child is sent to stay with a relative.

There is no doubt, especially in some parts of Africa, that the sudden separation of the child, who previously had been in close contact with the mother both day and night, can lead to psychologic illness. The "maternal deprivation" that results may be characterized in the child by poor appetite and vomiting, which are of obvious importance nutritionally, as is the loss of the breast milk.

Length of Breast Feeding. The length of breast feeding is also a socio-cultural factor of significance as, apart from

anything else, breast milk often represents one of the few sources of good quality animal protein. In most traditional societies (including the Western world until very recently), breast feeding is carried on for at least two years or until the next pregnancy or the next child has been born. All over the world nowadays there is a tendency toward a shorter period of breast feeding than previously. In the tropics, this has as yet affected mainly town dwellers, and the majority of rural people usually breast feed in the traditional way.

Food Preparation and Meal Pattern. The local pattern of eating obviously has significance as far as satisfactory infant feeding is concerned and consequently in the prevention of malnutrition. These patterns will include the methods of cooking, the number and times of meals, and the priorities of distribution of different types of foods within the family.

Mother-Child Interdependence. Indigenous practices with regard to child spacing are of much nutritional relevance. Children born too close together deplete the mother nutritionally and also are more liable to malnutrition themselves, because they have a relatively short period of breast feeding and the mother is not able to care for them herself for sufficient time.

Tropical children are usually very close to their mothers most of the time, receiving continual care, protection, and affection. This close contact between mother and child leads to great psychological dependence of the young child on his mother.

Also, the stores of nutrients obtained from the mother in the last three months of pregnancy are important to the growing infant. After birth, breast milk represents an economical, safe, high-protein food requiring no kitchen preparation and carefully adjusted to the young child's digestion and needs. As discussed elsewhere (p. 124), breast feeding alone is all that is required for the first 4 to 6 months, while the additional supplement of protein supplied by prolonged breast feeding of 1 to 2 years can be of significance nutritionally.

While this book is concerned with the nutrition of children, it is obvious that this is much related to the nutrition, health, and survival of the mother herself. The mother needs a generous diet based on local, usually largely vegetable foods, containing adequate protein, minerals, and vitamins, both during pregnancy and lactation. She also needs a reasonable period of rest and nutritional recuperation between pregnancies.

MALNUTRITION IN PRESCHOOL CHILDREN

When considering malnutrition in children, it is useful to differentiate two age groups—preschool children,[1] i.e. infants and 1- to 4-year olds, and school children, as they have very different problems. The present account deals with the most important forms of malnutrition found in developing regions so that, for example, obesity is not mentioned. The causation, diagnosis, simple treatment, and main approaches to prevention are considered for each of these conditions.

[1] The term "preschool child" is defined in different ways by various authorities. In the present account it refers to *all children up to their fifth birthday.*

Rapid growth is a fundamental characteristic of a healthy, well-fed young child, and the growth curves seen so commonly in young children in many tropical countries are revealing, as they indicate the type of circumstances which can easily lead to the development of malnutrition.

Growth curves in less well-to-do children in many tropical communities often show four stages:

Birth to 6 Months. Birth weights of tropical babies are usually somewhat below the standards considered to be "normal" in Western countries. Reasons for this may vary from one region to another but include maternal malnutrition and overwork during pregnancy, malarial infection of the placenta, inadequate prenatal care, and inherited (genetic) differences in diverse human groups. However, it is probable that genetic differences are less important than previously considered, as the birth weight of the babies of well-fed, upper socio-economic groups corresponds much more closely with Western standards.

If the infant is breast-fed as is, fortunately, still the case in most rural tropical communities, weight gain is usually very good during the first 4 to 6 months of life, as he is receiving an abundant supply of protein and Calories from his mother's milk and has his own stores acquired during pregnancy to rely upon. During this early period, the weight gain may be superior to that of bottle-fed Western babies, and it is no exaggeration to say that in some communities an individual may never be better nourished throughout life as at the age of 4 to 6 months.

6 to 12 Months. During the second 6 months of life, breast feeding is usually continued, but the quantity is no longer sufficient for the larger infant; additional foods given to him will all too often consist of insufficient quantities of carbohydrate pastes and gruels with little in the way of protein or vitamin-rich foods. Also, at this time the infant will be losing the immunity which was passed to him across the placenta from his mother and will begin to be susceptible to various infections.

Usually, therefore, during the second 6 months the growth curve is less good than in the early months of life; although, if breast-fed, severe malnutrition is usually not seen. However, if lactation fails, nutritional marasmus is likely to develop.

1 to 3 Years. The next phase of growth is undoubtedly the most dangerous, often especially the second year. Breast feeding may or may not be continued during some or all of this time, but the amount of protein supplied in this way is small. The diet during this period will all too frequently be largely composed of rather ill-cooked, indigestible vegetable foods often predominantly carbohydrate in nature. The protein content of the diet will be low, while at the same time the child will be involved in a continuous succession of bacterial, viral, and parasitic infections. Also, this is often a time of considerable emotional upset during adjustment from babyhood to childhood proper.

It is during this transitional period that in many areas the growth curve becomes seriously abnormal. Weight may continue to increase very slowly, or the curve may remain almost flat during some or all of this period. In some children, the weight may actually decrease during this period so that it

is by no means unusual to see a child of 18 months who has reverted to his original weight when 6 months old.

Failure of weight gain is the earliest sign of malnutrition and may herald decline into the severe forms—marasmus and kwashiorkor.

Over Three Years. After the age of three years, the young child has frequently acquired a certain degree of resistance to various infections and is able to obtain and digest a wider range of the family diet. Under these circumstances, although he may remain below standard weight and height for years, he starts growing slowly.

However, in the event of famine, war, or complete family breakdown, such as may occur with refugees, malnutrition may be seen in older children or even in adults.

While the ultimate impact of lesser degrees of protein-Calorie malnutrition on physical development in later life requires further study, there is no doubt that the short stature and underweight physique of some communities is the result of childhood malnutrition together with continued inadequate nutrition thereafter. Long-term effects include possible mental retardation and narrowed pelves, which in women lead to difficulties in childbirth.

Protein-Calorie Malnutrition (PCM) of Early Childhood. Studies in the last decade have clearly shown that the most important form of malnutrition in developing tropical countries is what is termed "protein-Calorie malnutrition of early childhood" (PCM). This can occur with several different clinical appearances, as will be described below, and in many parts of the world is so prevalent as to be the primary public health problem, often affecting in some degree over half the young child population.

The term PCM is, in fact, a collective term and refers to a variety of different clinical forms of malnutrition. These can be best visualized in the form of a triangle, which is intended to show that there is a gradation between the normal, healthy, well-fed child at the apex of the triangle and severe PCM at its base. In between, mild and moderate degrees occur. Two types of severe PCM—nutritional marasmus and kwashiorkor—can be easily recognized.

The term PCM is used for this group of conditions because *all of them are due to a diet low in protein but with different levels of intake of carbohydrate Calories.* The name also draws attention to the fact that Calories *are* important in the diet of the young child and also in the treatment of PCM. The rather vague label "early childhood" is deliberate, because PCM has a slightly different age incidence in various parts of the world, although always having its main occurrence in the early years of life.

PCM has recently been shown to have long-term consequences among survivors which are of a greater importance than previously realized. Not only do the severe forms of PCM have a high mortality, and the lesser degrees make children more susceptible to infections, but also they may result in physical stunting and permanent brain damage. Therefore, all possible means for preventing this condition must be brought into action.

KWASHIORKOR. The word "kwashiorkor" was introduced to medical literature by Dr. Ciccly Williams in the early 1930's. It is from the Ga language

of West Africa and means "disease that occurs when displaced from the breast by another child." It is interesting that other African languages have names for the same condition which also referred to this association. However, although as noted earlier, kwashiorkor often does occur after weaning from the breast, it can also develop months after separation from the breast.

Causation. Kwashiorkor is one of the severe forms of PCM. It is due to a diet which is very low in protein, especially animal protein, but one which contains Calories in the form of carbohydrates. In other words, it is *not* starvation, but is due to an unbalanced diet. While it can occur at a wide range of different ages from infancy even up to adult life, it is usually most common during the third growth period mentioned above—that is from 1 to 3 years.

During this period, the child has high needs for protein for growth, and yet is often receiving an indigestible, bulky, largely carbohydrate diet, and is still further nutritionally burdened by many common, often multiple infections, including measles, malaria, and infective diarrhea. As noted earlier, psychological factors also often play a part, especially if the child has been abruptly separated from the mother's breast.

Kwashiorkor is, then, a disease principally due to an unbalanced, largely carbohydrate diet, but is always in part caused by infections and parasites, which make still worse the basic dietary nutritional inadequacy.

The detailed factors causing kwashiorkor may vary considerably from one part of the world to another. Thus, in one part of Uganda hookworm infection is very common in young children and, as these intestinal worms drain protein-rich blood from the small intestine, it can lead not only to anemia, but can be an additional factor leading to kwashiorkor. By contrast, in another part of the same country, the roundworm is a very common intestinal parasite, and in heavy infections, several hundred of these large worms may assist in the development of malnutrition as a result of their absorbing food from the intestinal contents.

Diagnosis. (Figures 9 and 10) The clinical appearance of kwashiorkor varies in different parts of the world, both because of the genetic characteristics of different human groups and also because the detailed causation of the condition varies as regards diet, associated infections, etc. The signs found in kwashiorkor can be conveniently divided into three groups: (1) always present, (2) usually present, and (3) occasionally present.

1. *Signs Always Present.* Four signs are always present in children with kwashiorkor: *edema* (swelling of the feet, ankles, and elsewhere), *growth failure* (especially a low weight for age), *psychological change* (misery, poor appetite), and *weak, wasted muscles,* with *some overlying subcutaneous fat.*

Edema is the cardinal sign of kwashiorkor. It is usually obvious on inspection and commences on the feet and lower legs. Other parts of the body, including the back and hands, may be affected.

In mild cases it can be demonstrated by pressing firmly with one finger on the ankles or on the upper surface of the foot for three seconds, when a definite pit will be produced. The edema is partly the result of the low protein content of the diet, which leads to defec-

FIGURE 9.—Kwashiorkor in two-year old Ugandan child, showing edema, misery, wasted muscles (with fat present) and growth failure, together with slight hair changes and a marked "flaky paint" rash.

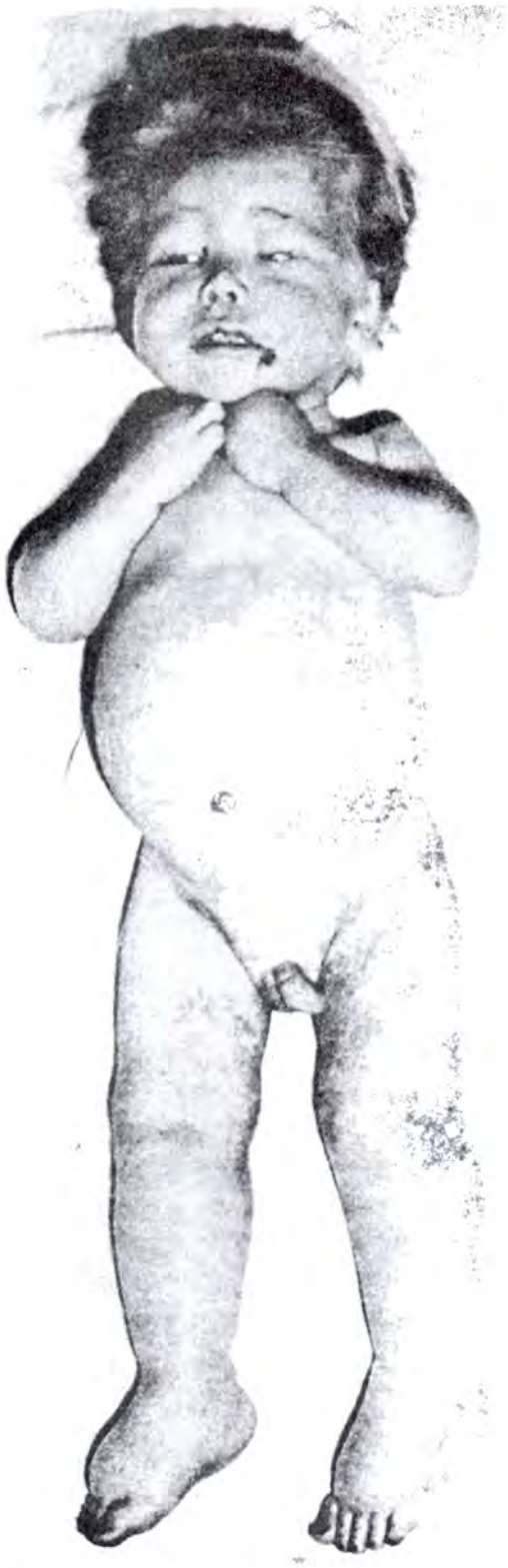

FIGURE 10.—Kwashiorkor in Guatemalan child, showing edema, misery, wasted muscles (with fat present) and growth failure.

tive production of plasma by the body with subsequent leakage of fluid from the small blood vessels.

The growth retardation, which is a characteristic feature of kwashiorkor, is to some extent masked by the water-logging effect of the edema. In fact, a truer picture of the degree of underweight can better be judged after some days on treatment, when, as the edema disappears, the weight at first decreases before commencing to gain as the child starts to grow again.

Children with kwashiorkor are notably *miserable, apathetic, withdrawn, immobile* and *with little interest. They* also have *a poor appetite.* Various factors may be responsible for this, including the psychologic upset produced as a result of separation from the breast. Also, actual changes in the brain, both biochemical and anatomical, may be in part responsible. During recovery, the child's return of interest in his surroundings is an excellent indication of progress.

Muscle is the body's principal store of protein and is used up by the child developing kwashiorkor as emergency rations of this nutrient. The *thin, wasted muscles* can easily be seen, especially in the upper arm and in the neck, where they may be so reduced that the child is unable to hold up his head. By contrast, there will usually be *a layer of subcutaneous fat* present, which reflects the child's intake of carbohydrate Calories.

2. *Signs Usually Present.* Although *not* required for diagnosis, various *hair and skin changes, anemia,* and *loose stools* are usually present in children with kwashiorkor. Characteristically, the *hair is light in color, silky in*

texture, straight, sparse in distribution, and only loosely attached to its roots, so that it can be plucked out easily. Obviously, assessment of hair changes will depend upon the normal appearance for the particular genetic group. Plainly, a standard for Swedish children will be different from that for Indonesian infants.

Hair abnormalities in kwashiorkor can vary considerably, especially with regard to color change. If kwashiorkor develops suddenly, the hair may be completely normal. Also, abnormal light colored hair can be seen in young children in the "kwashiorkor age group" who are plainly not suffering from this condition. However, this usually occurs in communities where children's diets are protein-poor and predominantly carbohydrate, and some of these children may probably represent lesser degrees of PCM.

Especially in darker complexioned children, there may be a parallel lightening in color of the skin itself, which is often particularly noticeable on the face. Both lightening in color of the hair and skin are probably mainly due to deficiency of certain amino acids.

Another feature usually but not always present is anemia—that is, an inadequate production of red blood cells. This may be due to a variety of causes including the low protein content of the diet together with lack of other substances required for the formation of blood, especially iron. In many communities, there may also be other conditions likely to aggravate any dietary anemia present, including malaria and hookworm disease.

Some degree of loose stools is usually present in kwashiorkor. This may sometimes be due in part to an infective diarrhea, caused by bacteria swallowed by the child, but may be due to a reduction in the body's enzymes, as these require protein for their production. Low levels of intestinal enzymes lead to inadequate digestion of food and the passing of loose or semi-solid stools.

3. *Signs Occasionally Present.* A wide variety of other signs may be present in children with kwashiorkor, including a *flaky paint rash* (Fig 9), an *enlarged liver, ulcers* and *open sores* on the skin, and sometimes the features of *associated deficiency of various vitamins,* such as vitamin A.

Treatment. Severe cases of kwashiorkor should be admitted to a hospital for treatment, if at all possible, as even there the mortality may be up to 30 percent. They need special biochemical investigations and other tests to exclude less obvious infections and to guide more detailed treatment. In general, treatment should include dietary therapy and nutrition education of the mother.

1. *Dietary Therapy.* The main essential in the treatment of kwashiorkor is to keep the child warm and to supply what has been lacking from his diet—that is, protein—in a form that he can take and easily digest, together with an adequate supply of Calories.

Usually a milk formula is used, frequently based on dried skimmed milk (low-fat milk), as this is economical and sometimes available either from UNICEF or some other organization, or commercially from shops or stores. Alternatively, suitable formulas for treatment can be prepared from fresh cow's milk, full cream dried milk, or evaporated milk.

Extra Calories should be added to all these milk formulas to prevent the protein being burnt as Calories by adding cane sugar and, *in the case of dried skimmed milk*, preferably by adding *both* sugar and a digestible, edible vegetable oil. The dried ingredients—that is, the milk powder and the sugar—are mixed first in a bowl or plastic pail. The vegetable oil, which may be sesame, cottonseed, or other edible oil, is then stirred in slowly and thoroughly with a wooden spoon. Finally, the cooled boiled water is mixed in to make up the final liquid diet. If there is a refrigerator in the hospital, it is useful to make up the total quantity for the day at one time. This will often be 40 fluid ounces (1,100 cc).

The following simple but effective formulas may be used:

a. Dried skimmed milk powder 20 level teaspoons[2] (10 level dessert spoons), sugar 4 level teaspoons, edible oil 6 level teaspoons, to 20 fluid ounces (550 cc) of boiled water;

b. Full cream milk powder 20 level teaspoons (10 level dessert spoons), sugar 4 level teaspoons, to 20 fluid ounces of boiled water;

c. Boiled liquid cow's milk 20 fluid ounces with sugar 4 level teaspoons;

d. Reconstituted evaporated milk (1 part milk, 2 parts boiled water), with sugar 4 level teaspoons added to 20 fluid ounces.

These mixtures can often be prepared more simply by the use of locally available measures (e.g. tins) of known size.

[2] The volume of teaspoons varies, but these formulas refer to those of 5–6 cc volume. One dessert spoon has twice this volume (approximately 10–12 cc).

The daily dosage of any of these milk formulas can be calculated approximately by multiplying weight in lbs. by 2½ which gives the 24-hour total in fluid ounces. In the hospital this will often be best administered through an *intragastric plastic polyethylene tube*, either as a milk drip, or by giving calculated feeds by syringe down the tube at 2–3 hourly intervals.

If it is absolutely impossible to admit a child with kwashiorkor to a hospital, treatment should be tried using one of the milk formulas suggested in the total quantity advised, but divided into eight small feeds given at two-hour intervals throughout the day, from 6 a.m. to 10 p.m. This method requires much patience and can be very time-consuming as a result of the child's apathy and lack of interest in food. It can be attempted with supervision in the child's home, or in a feeding center, or a nutrition rehabilitation center.

As soon as the child shows signs of improvement as evidenced by disease in edema, by a general improvement in alertness, and by returning appetite, other foods should be introduced into the diet in addition to the milk formula.

These additions should be based on the range of foodstuffs available in the particular region. The aim should be to give as wide, as mixed, and as economical a diet as possible, with special emphasis on digestible protein foods both of animal and vegetable origin, as well as those known to be rich in vitamins and minerals. If vitamin A deficiency is common in the area, a vitamin concentrate or fish liver oil should be included in the early treatment of all cases.

2. *Nutrition Education*. The recovery of a child with kwashiorkor as a result

of correct diet is not only of therapeutic value, but also of educational value, as in many tropical hospitals mothers, fathers, or other relatives accompany their children into the wards or visit frequently.

In areas where kwashiorkor is common, group discussions and demonstrations should be carried out in the wards with, if possible, the mothers assisting in preparing and cooking the right dishes and in feeding them to their children. The changing appearance of the improving child is, in fact, a "visual teaching aid" for the group (p. 99).

It must be stressed again, however, that kwashiorkor cases require hospital treatment if at all possible. Medical supervision is needed to deal with complicated cases, to diagnose correctly, and to treat effectively the often multiple infections present and associated vitamin or mineral deficiencies which the child often has at the same time.

Prevention. There are four main principles in the prevention of kwashiorkor: (1) a high-protein diet in the early years of childhood, (2) the prevention of infections, (3) adequate child spacing, and (4) the early recognition and management of mild and moderate PCM.

1. *High Protein Diet in Early Childhood.* Basically in most tropical circumstances, a high-protein diet can best be obtained from breast feeding and by the optimal possible use of available animal and vegetable protein foods whether produced locally, available commercially in stores, or issued in a supplementary feeding program (p. 141). In addition, the roots of successful infant feeding must be recognized as being in large measure related to an adequate maternal diet during pregnancy and lactation.

2. *Prevention of Infections.* Various measures can be attempted from the public health point of view to minimize the burden of infections to which tropical children are continuously exposed. These measures include immunization against whooping cough, tuberculosis, and measles; the routine use of antimalarials; health education aimed at measures to decrease the incidence of infective diarrhea, including the encouragement of breast feeding, the use of clean foods and feeding utensils, and the boiling of water; and malarial suppression in areas where this infection is common.

3. *Adequate Child Spacing.* Kwashiorkor often follows the sudden stopping of breast feeding because the mother is pregnant again. In order to prevent this from happening, mothers should be taught how to postpone their next pregnancy until a nursing infant is slowly weaned and eating independently. Furthermore, if they do become pregnant, they need not stop nursing suddenly, but should be taught to do so gradually while eating more protein themselves because of the extra drain on them.

4. *Recognition and Management of Early Cases.* Kwashiorkor is one advanced, severe form of PCM, and it should be the aim of any health service to recognize earlier stages of the condition and to take prompt preventive measures at this time. The recognition of early PCM is considered later (p. 84).

NUTRITIONAL MARASMUS. The word marasmus is derived from the Greek language and has been used for years

as a medical term for the severely wasted, underweight young child.

Causation. Marasmus differs from kwashiorkor in several respects. It is the other severe form of PCM, but is due to a diet which is low *both* in protein and in Calories. It is, in fact, the result of starvation.

The condition occurs commonly in the first year of life (early marasmus) when it is most often the result of a failure of breast feeding and unsuccessful attempts to rear the baby on very dilute, infected bottle feeds (p. 119). Unfortunately, marasmus is on the increase in many countries, especially in towns, and in many parts of the world is much more common than kwashiorkor.

Late marasmus can occur at any age, including adulthood, from near starvation. In particular, it can develop in the second year of life in children who are subsisting on breast feeding alone without the necessary other foods (Figure 11).

Once again, the basic dietary inadequacy is made worse by various associated infections, and children with this condition may well be suffering from tuberculosis, infective diarrhea, and oral thrush (a fungus infection of the mouth shown by the presence of little white patches scattered over the inside of the cheek and gums).

Diagnosis. The signs of marasmus may be considered in two groups: (1) always present, and (2) occasionally present.

1. *Signs Always Present.* Marasmus is always characterized by *extreme growth failure,* so that the body weight will only be 60 percent or less of what

FIGURE 11.—Late nutritional marasmus in two-year old child, showing very wasted muscles and fat, and severe underweight (Guatemala).

would be expected for a child of that age. Secondly, there will be a *very marked wasting of the child's muscles and also his subcutaneous fat.* This contrasts with kwashiorkor, and is due to the fact that the marasmic child has been living on his own body stores of both protein and Calories.

Again, by contrast with kwashiorkor, marasmic infants are usually more vigorous and tend to have a better appetite; their hair is relatively normal; and there is no edema. In marasmus, the face is thin, wizened, and has a "little old man" or skull appearance compared to the often rounded "moon-face" of kwashiorkor. Also, the head seems very large in contrast with the thin, wasted body (Figure 12).

2. *Signs Occasionally Present.* A variety of other features may sometimes be present, including those due to associated lack of vitamins, anemia, and diarrhea, sometimes with signs of dehydration (drying up of the body).

Treatment. Cases of severe marasmus should be admitted to a hospital, and even here their response to treatment is often extremely slow, much more so than with kwashiorkor. Basically, the treatment is the same as for kwashiorkor—that is, with one of the milk formulas already described, in order to supply protein and Calories (p. 80). However, in view of the extreme underweight of the infant, it is better to try to increase the total quantity of feeds as soon as practicable and to base the calculation of the daily quantity on *expected* rather than actual weight.

Hospital admission is particularly required for investigations to exclude the possibility of tuberculosis and to treat diarrhea. Thrush, if present, can

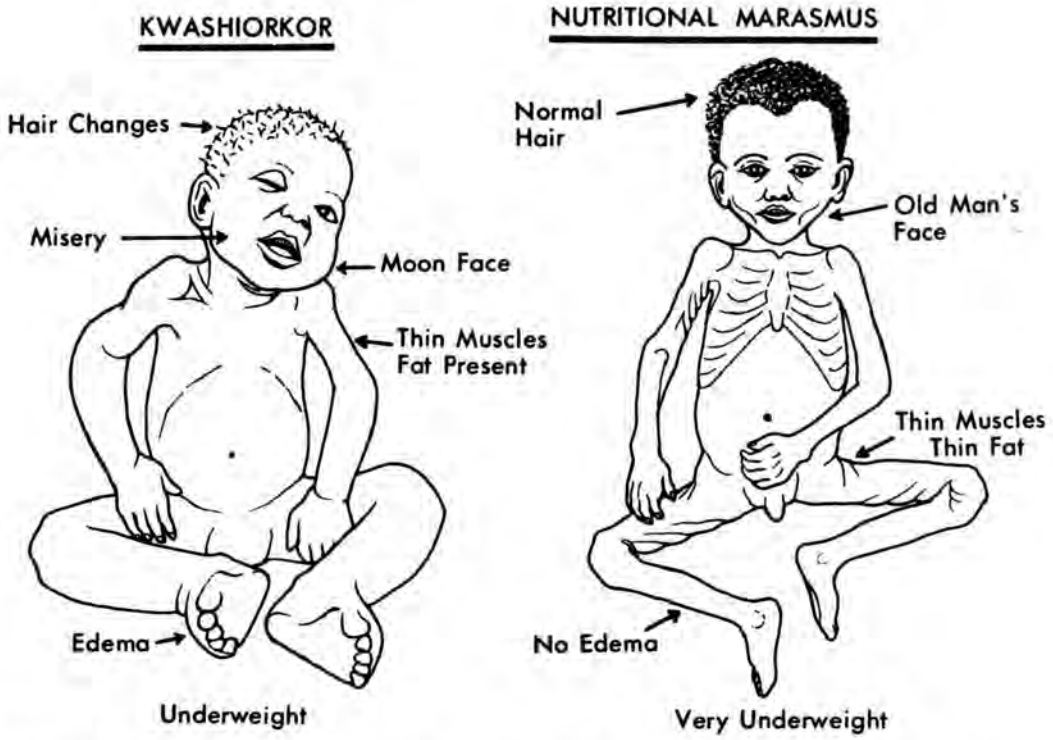

FIGURE 12.—Clinical features of two main severe forms of PCM—kwashiorkor and marasmus—contrasted diagramatically.

be simply and inexpensively treated by painting the inside of the mouth three times daily with 1 percent gentian violet.

Prevention. Prevention is based on the same principles as have been mentioned for kwashiorkor, but with special reference to the first year of life—that is, (a) a high-protein diet, (b) the prevention of infections, and (c) the early recognition and management of mild and moderate PCM.

In practice, for the majority of tropical children this will mean (1) breast feeding, (2) the avoidance of artificial feeding, (3) the introduction of other foods only when required nutritionally (e.g., 4–6 months of age), (4) the prevention of tuberculosis by BCC immunization, and (5) the avoidance of infective diarrhea by breast feeding, by boiling drinking water, and by using clean foods and feeding utensils.

If artificial feeding is absolutely necessary, particularly if the mother is dead, a cup and spoon or a feeding cup are preferable to a feeding bottle, as the latter is particularly likely to become contaminated and a major source of infection. If, however, a relative insists on using a feeding bottle, then advice must be given her as to how she can attempt to minimize the risks of infection.

MILD-MODERATE PCM. For every case of severe PCM, whether marasmus or kwashiorkor, there are many hundreds of thousands of young children suffering from the earlier stages of mild to moderate PCM. Plainly, it is necessary to try *to detect cases in the early stages* and *by suitable advice and management to prevent them from ever reaching a severe degree.*

Diagnosis. The detection of mild to moderate PCM is by no means easy. The clinical signs are variable and inconstant. Biochemical tests are being developed but are still under trial and, in addition, will not be available to most workers in the field away from major laboratory services.

The earliest sign of PCM of early childhood is *growth failure*, and this is best detected by a low weight or a failure to gain weight normally.

The careful weighing of young children is the most important method of recognizing PCM in its early stages.

Useful information may sometimes be gained by a single weighing, but serial measurements at intervals are always preferable as they give a continuing picture of the individual child's progress or otherwise.

In tropical communities, two problems have to be faced when trying to assess the significance of children's weights. Firstly, the question of *locally appropriate standards of comparison* has to be considered. Standards may occasionally be available from measurements made on healthy, well-fed children of the local elite. Usually, they are not, and the standards given in the present book are those collected in Boston in the 1930's (Appendix III). Although they may not always be genetically appropriate, they are convenient and widely used. Also, present evidence suggests that really well-fed children of different ethnic groups are more similar in weight than previously appreciated.

Secondly, a major difficulty in many tropical communities is that of *age assessment.* Precise ages are not usually known, as they have little significance in most traditional societies. This poses an obvious problem, as weights in young children have to be compared with standards for the appropriate age.

Attempts must be made to see if documentary evidence of birthdate is available, or if the mother in fact does not know the age but can recall the actual day or month of birth. Alternatively, a calendar of local events can be constructed from which the child's birthdate can be approximately pinpointed.

The stage of dental eruption may also be helpful at least in giving a lower limit, especially as this seems to be little affected by malnutrition. However, as is well known, there is much variation in the appearance of teeth even in healthy, well-fed children (Table 1).

A simple approximation can be used where the age in months is calculated by adding six to the number of teeth present.

If only a *single weighing* is possible, this can be compared with standards for age given in tabular form in Appendix III, or as a graph (p. 156). Both representations show the "standard" (or average for well-nourished children) and levels for 80 percent and 60 percent of this standard.

If the weight is below 60 percent or if edema is present, hospitalization is indicated if possible. If the weight is between 80 percent and 60 percent, the child should be seen frequently (preferably at least fortnightly), and the mother should be given careful advice on locally practicable infant feeding, issued with dried skimmed milk or other protein food supplement, and also, if practicable, the child should be followed up by means of home visiting.

If the weight is between 80 to 100 percent of the standard, the mother should be given advice on infant feeding, and weighing continued in the future at monthly intervals.

Serial weighings should always be the aim, and results can best be plotted on weight graphs, if such are available. By this means, failure to grow can be detected early by a falling or stationary weight curve for the particular child. If weight graphs are not available, levels of "inadequate weight gain" may be used (Table 2).

Both an abnormal weight curve or an inadequate weight gain should alert the observer to deteriorating nutrition and the need for careful advice on infant feeding, for more frequent supervision and for the issue of supplementary protein food if available.

In many tropical circumstances, it may be impossible to obtain the *exact* age, although in surveys dental second year may be defined as children with

Table 1.—AVERAGE ERUPTION TIME OF FIRST TEETH [1]

Tooth	*Lower Jaw*	*Upper Jaw*
Central incisor [a]	6 months	7½ months.
Outer incisor [a]	7 months	9 months.
Canine	16 months	18 months.
First molar [b]	12 months	14 months.
Second molar [b]	20 months	24 months.

[1] Reproduced by permission from Massler & Schour (1944).
[a] Incisors range ±2 months.
[b] Molars range ±4 months.

Table 2.—INADEQUATE WEIGHT GAINS DURING THE FIRST TWO YEARS OF LIFE

Age (months)	*Minimum Length of Observation (months)*	*Inadequate Weight Gain*
0– 6	1	½ lb (226 g) per month.
7–12	2	1 lb (453 g) per 2 months.
12–24	4	1 lb (453 g) per 4 months.

between 6–18 teeth. Under these circumstances, a rough assessment of early PCM may be attempted by two means. Firstly, serial weighings at intervals may be feasible when "inadequate weight gain" (Table 2) may suggest commencing malnutrition.

In addition, the measurement of the arm circumference, taken with a tape measure halfway between the elbow and the point of the shoulder, may be useful. This is much reduced in severe PCM and also appears to be affected in lesser degrees of malnutrition. It is especially useful in the second year of life when, in normal children, the arm circumference remains more or less constant (16 cm) throughout the whole of this year. The reason for this is that the components of the arm are changing with the fat of infancy being replaced by the muscle of the toddler, but with the overall circumference remaining about the same.

To detect early PCM if the age is not known exactly, the arm circumference of children in the second year of life may be compared with various percentages below standard (16 cm): 90 percent, 14.4 cm; 80 percent, 12.8 cm; 70 percent, 11.2 cm; 60 percent, 9.6 cm. Experience suggests that children with measurements below 80 percent of standard (12.8 cm) require supplementary feeding if practicable.

Prevention. The main aspects of the prevention of all degrees of PCM have been mentioned when discussing kwashiorkor and marasmus (pp. 81–84) and will be elaborated later (p. 150).

Treatment. The management of mild and moderate PCM is considered later (p. 141).

Vitamin Deficiencies. The present brief account can cover only certain major aspects of the commoner vitamin deficiency diseases, especially those which are public health problems in various parts of the world.

VITAMIN A DEFICIENCY. Avitaminosis A is seen occasionally in young children in all tropical regions, but is a common and important condition in certain regions including parts of India, Indonesia, and the eastern Mediterranean countries.

Causation. The condition is caused by a very low intake of vitamin A, both as the vitamin itself and in the form of the orange-pigmented foods containing carotene, the precursor of vitamin A (p. 18). It is particularly likely to occur in children whose mothers are on a diet poor in vitamin A and who have, in consequence, transferred only a small quantity to the fetus during pregnancy, and whose breast milk is also poor in this nutrient.

Severe avitaminosis A may accompany kwashiorkor. It is also notoriously associated with ill-advised attempts to rear babies on formulas of dried or

condensed *skimmed* milk which are lacking in this fat-soluble vitamin. Severe vitamin A deficiency is predominantly a problem of the early years of life.

Diagnosis. Vitamin A is required for the normal functioning of certain epithelial cells of the body. Deficiency may produce "night blindness," but this is extremely difficult to detect in the young children, who are principally affected with severe degrees of this condition. In addition, various forms of dry and roughened skin may sometimes be associated with lack of vitamin A.

However, the main effects of vitamin A deficiency are on the eye. The conjunctiva becomes dry and brownish instead of glistening and moist. Sometimes a silver or white superficial, roughly triangular patch appears on the conjunctiva of one or both eyes (Bitot's spots). This may be followed by a dryness and cloudiness of the cornea which in turn may lead to a softening of the cornea and a rupture of the eyeball. Both eyes are usually affected, but often to different degrees.

Treatment. Young children with a dry conjunctiva should be referred for medical attention or, if this is not available easily, should be treated with vitamin A (6,000 international units daily by mouth for 2 weeks). This can be in the form of vitamin concentrate or fish liver oil (cod liver oil contains about 2,000 I.U. of vitamin A per teaspoon; shark liver oil, 1,000 I.U. of vitamin A per teaspoon). At the same time, health education should be undertaken to persuade parents to widen the child's diet to include locally available carotene-containing foods.

If cloudiness, bulging, or rupture of the cornea have occurred, this should be regarded as a medical emergency and the child should immediately be given 100,000—20,000 international units of vitamin A intramuscularly or by mouth as drops on the back of the tongue. Thereafter, treatment should be continued with a daily dose of 25,000 I.U. vitamin A by mouth for 5 days, together with a high-protein diet and a course of antibiotics, probably penicillin or sulfonamides, as infection of the eyeball is likely to have occurred through the weakened cornea.

In areas where vitamin A deficiency is common, 25,000 units should be given by mouth to all children following measles or diarrhea.

Prevention. The prevention of avitaminosis A of early childhood should commence in pregnancy when the mother's diet should contain a generous quantity of this nutrient or, more usually, of carotene-containing foods (p. 18). This will ensure adequate fetal stores. This diet should also be encouraged during breast feeding.

In areas of the world where severe vitamin deficiency is common in young children, the fetal stores may be raised by giving women a single dose of 300,000 I.U. by mouth in the later months of pregnancy.

During infancy the baby should be breast-fed, and after 4 to 6 months of age, when a mixed diet is introduced, this should contain local sources of vitamin A, such as fish and animal liver, and egg yolk, and of carotene, including dark green leaves and a wide range of orange-pigment fruits and vegetables (p. 18). The pawpaw is often widely available and a rather little-used food for young children. It is a valuable source of vitamin A precursor and, being soft and easily mashed, is suitable for young children.

If an area is known to be one of high risk for vitamin A deficiency in young children, it may be useful and practicable to introduce a special supplement of vitamin A during the period of greater incidence—that is, from 6 months of life until 2 years. This can be in the form of cod liver oil (1 teaspoon a day), or red palm oil, or shark liver oil (2 teaspoons a day).

Alternatively, if the risk is considered great and it is felt unlikely that daily supplementation will be followed by mothers, and if no form of house supervision can be divised, a single depot dose of 100,000 international units of vitamin A may be given by mouth or by intramuscular injection, which may last the child for several months and can be repeated thereafter.

If the child is artificially fed with full cream cow's milk, then no supplementation with vitamin A is required. Dried skim milk is not recommended for the feeding of young infants below 6 to 12 months of age. However, circumstances may be such that this is the only form of milk available; when it will have to be used, it should be reinforced with Calories in the form of sugar (p. 15), and also should be accompanied by vitamin A administration, either as daily fish liver oil or red palm oil, or an intramuscular injection, which lasts for several months.

THIAMINE DEFICIENCY. Deficiency of thiamine (vitamin B_1) produces a disease known as beriberi. This occurs in older children in the same form as in adults. In addition, a particular and often fatal form of the condition occurs in babies and is known as "infantile beriberi."

Causation. Severe thiamine deficiency is almost confined to those parts of the world where overmilled rice forms the main part of the diet. In particular, it is a problem in extensive areas of Southeast Asia. Uniquely, infantile beriberi is due to dietary inadequacy *in the mother,* both during pregnancy and particularly during breast feeding, leading respectively to poor stores of this nutrient in the fetus and more importantly to a very low breast milk thiamine content.

Diagnosis. Babies developing infantile beriberi usually appear plump and well-nourished and, indeed, have been receiving adequate protein and Calories from their mother's breast milk. They are usually aged between 5 to 7 months. The illness often comes on suddenly with soundless crying (aphonia), convulsions, and signs of heart failure, such as blueness of the lips and rapid breathing. Many other illnesses in young children can produce much the same picture, a fact which makes beriberi difficult for trained doctors to diagnose. However, in areas where infantile beriberi is common, it is quite justifiable to give emergency treatment on the basis of this diagnosis, provided it does not interfere with their speedy attendance for medical advice.

Treatment. Infantile beriberi should be treated as an emergency with an intravenous or intramuscular injection or an oral dose of 50 mg of thiamine, followed by 10 mg of thiamine daily for 14 days. Health education of the parents is required to persuade them to introduce thiamine-containing foods into the baby's diet. The child should be sent for medical advice and will probably be admitted to a hospital.

If thiamine is not available, any available thiamine-containing multivitamin preparation may be used, or

any local preparation known to be high in this nutrient, such as yeast, or *tiki-tiki* (a fresh extract of rice bran), or a soup of green gram.

While the baby is being treated, the mother should be given thiamine by mouth (20 mg a day) for 4 weeks.

Prevention. The prevention of infantile beriberi lies essentially in improving the diet for the mother in pregnancy and lactation.

Theoretically, this may be achieved in a variety of different ways. The overmilled rice, which may be much preferred from the cultural point of view, can be combined with a wider general diet, especially including vegetables and legumes. In some circumstances, it may be preferable and easier to make available to mothers either thiamine (20 mg daily) or a local source of this vitamin, such as *tiki-tiki*, which they can take during this period.

Basically, the problem of beriberi, both in adults and babies, lies with the overuse of white rice as the main bulk of the diet. The situation may be improved, as mentioned before, by widening the diet or, alternatively, by trying to ensure that rice is undermilled or commercially enriched with thiamine or parboiled.

Finally, as soon as the infant is introduced to mixed foods, care should be taken to see that these contain local sources of thiamine.

VITAMIN C DEFICIENCY. Deficiency of vitamin C in young children is referred to as infantile scurvy. It usually occurs in the first two years of life, most often between 6 to 18 months of age.

Causation. Vitamin C deficiency is rarely seen in the breast-fed because the mother's diet usually supplies an adequate quantity of ascorbic acid in her milk. However, when, as is unfortunately increasingly the case, babies are reared on a cow's milk formula based on either fresh boiled, or powdered, or evaporated milk, the condition is likely to develop unless an additional source of ascorbic acid is also given. This is because vitamin C is destroyed by heat, as occurs with the boiling of fresh milk (which is required to kill bacteria), and also in the processing of preparing powdered and evaporated milks. However, it may be noted that some brands of commercially prepared milk add vitamin C to their products.

Diagnosis. Infantile scurvy has a different appearance from that of the classical picture in adults. For example, red, swollen, bleeding gums are only found if teeth are actually present.

The characteristic features of infantile scurvy are produced by hemorrhages in various parts of the body, especially under the covering (periosteum) of the bones. This leads to the picture of an irritable, anemic infant with a tender limb or limbs, which may be thought to be paralyzed because he is unwilling to move them because of the pain.

Treatment. Hospitalization is required, especially as there are many other diagnoses which give a similar type of clinical appearance. Treatment in medically proven cases will then be with large doses of ascorbic acid given by mouth (250 mg four times daily for 7 days).

Health education is required to persuade parents to include vitamin C-rich foods in the child's diet.

Prevention. The most natural prevention for infantile scurvy is undoubtedly breast feeding, provided the lactating mother's diet contains vitamin

C-rich foods. Again, after 4 to 6 months, when the diet is widened, it is important to see that these also include sources of ascorbic acid, such as vegetables, fruits, and germinating pulses.

It must be stressed that for the *breast-fed infant* there is no need for any vitamin C supplementation in the first 4 to 6 months of life. Infantile scurvy is extremely rare in the breast-fed, and, what is more, *the danger of introducing fruit juices* from various unclean sources very much outweighs any doubtful advantage, as they pose a considerable risk in terms of infective diarrhea.

In artificially fed infants, however, it *is* necessary to introduce a source of vitamin C into their diet, unless the particular milk preparation used has been already enriched by the manufacturer. In these children, vitamin C may be given in the form of a locally available fruit juice or as ascorbic acid tablets, and should be continued until the child is having a full, mixed diet. It will be noted that orange juice, while a good source of ascorbic acid, possesses no special or magic properties, and the best, cheapest, most easily available fruit juice with a high vitamin C content should be used in preference (p. 16). It may be more convenient and economical, and with less danger of introducing infective diarrhea, to make use of ascorbic acid tablets (30 mg per day).

VITAMIN D DEFICIENCY. Most dietary vitamin D is contained in expensive animal foods such as dairy products (p. 15), so that, for the majority of tropical children, the vitamin D intake is in no way related to the diet, but entirely proportional to the degree of exposure of the skin to the ultraviolet light of sunshine.

Causation. Vitamin D deficiency (rickets) occurs most easily in cloudy, temperate zones with little sunlight and with cold weather which requires considerable clothing and keeps children indoors. However, at the present time, there is relatively little rickets in these regions because of a fairly wide awareness of the problem and because many foods, including milks, are often reinforced with vitamin D. By contrast and paradoxically, rickets is common in certain subtropical and tropical countries. In some towns, housing may be so close together that little sunshine can penetrate into the dark courtyards. In other places, infants may purposely be kept covered by their mothers when they are outside, sometimes to avoid "the evil eye" and sometimes to prevent darkening the skin.

Diagnosis. Vitamin D is required to assist the absorption of calcium and to ensure the formation of normal strong bones. In rickets, walking is delayed, while the eruption of the first set of teeth will also be later than usual. The skull is larger than normal, and the back is bowed. The long bones may be bent or bowed, and there is a thickened prominence at the ends of the bones, especially noticeable at the wrist.

Treatment. Unless in a part of the world where the condition is well recognized, it is usually necessary to carry out further investigations on the child by way of X-rays of the wrist and biochemical tests of the blood.

Severe cases of rickets are treated *under medical supervision* by large doses of vitamin D. This can be given orally as a concentrate or as fish liver oil, in a dose of about 2,000 I.U. daily

for 1 to 3 months. Alternatively, a single intramuscular dose of 100,000–300,000 I.U. of synthetic vitamin D may be given, which lasts for 3 months.

Mild or suspected cases can be given smaller doses of vitamin D (1,000 units per day) for 1 to 3 months together with exposure to the sunshine for the whole body for at least one hour in the morning or afternoon.

Fish liver oils are frequently available and may often be used for the treatment or prevention of rickets—1 teaspoon of cod liver oil contains about 350 I.U. of vitamin D, and shark liver oil, 100 I.U.

Prevention. In tropical countries, the best way of ensuring an adequate availability of vitamin D is by exposing children to the sunshine, and this is emphasized by the absence of rickets in most rural *tropical communities.*

However, in some areas, such as Ethiopia, the practice of covering up young children when they are outside the house is deeply held in the local culture, and health education to persuade parents to allow their children to be exposed to sunlight is difficult to put over effectively.

In high risk areas, it may sometimes be desirable and sometimes feasible to issue vitamin D as a supplement for young children, either in the form of fish liver oil or of actual vitamin. This should be continued from 6 months to 2 years at a dose of 400 I.U. per day. Alternatively, in areas of high risk, it may only be practicable to give children a single intramuscular depot of 300,000 units of vitamin D, which will last them for 6 months. This will only be done under medical supervision.

In urban communities, possible enrichment of foods must be taken into account, including margarine, vegetable fats, and milk, including dried skimmed milk.

IRON DEFICIENCY. Iron is needed to make hemoglobin, the oxygen carrying pigment of the red blood cells. An inadequate intake of this mineral leads to an iron deficiency anemia in which there is a defective production of red blood cells owing to lack of this essential ingredient.

Causation. Poor stores of iron may be acquired during pregnancy from a mother who is herself deficient in iron, as can occur for various reasons, including a too rapid succession of pregnancies.

This is particularly important, as all milks, including human and cow's, contain negligible iron, so that the infant who has a high iron need during this time of rapid growth and increasing blood volume, has to rely to a very considerable extent on the stores in his own liver.

From the age of 4 to 6 months onwards, the child's body stores are largely exhausted, so that it is important to ensure that the diet the child receives in the second six months of life contains local foods which are rich sources of this nutrient, including green vegetables and egg yolks.

Anemia is extremely common in tropical children but, it must be noted, is often due to several causes at one and the same time. Thus, there may often be a coincident nutritional iron deficiency together with hookworm infection, further draining blood from the child, and also with malaria infection. Investigation with suitable blood tests is indicated whenever practicable.

Diagnosis. The main sign of anemia, whether due to iron or from other

causes, is a pallor of the tongue and conjunctiva because of the dilute blood circulating in the child's small blood vessels. If anemia is prolonged and severe, the child will be tired, listless, and eventually breathless.

Iron deficiency anemia due to dietary causes occurs most commonly from 6 to 18 months of age, and may even occur in children who are receiving sufficient protein, Calories, and vitamins, but who are on an almost exclusively milk diet. However, iron deficiency anemia, also associated with the intestinal blood drain of hookworm infection, can occur at any age in childhood or adult life.

Treatment. Medical advice is needed, as various blood tests should be carried out to pinpoint the exact cause of the anemia. Hospitalization is required for severe cases of anemia, as blood transfusion may be indicated.

In moderate anemia, treatment will be with iron given by mouth or occasionally by intramuscular injection. Oral iron, usually as either tablets or a mixture of ferrous sulphate, is extremely cheap. A dosage of 120 mg three times a day can be used for young children, and 0.1 g three times daily for school children.

At the same time as giving iron medicinally, health education should be carried out to persuade mothers to give children locally available foods which are good sources of this mineral.

In many parts of the world where hookworm infection is an important cause of iron deficiency anemia, the stool will have to be examined microscopically for eggs of this parasite, and, if present, the child will have to be treated.

Prevention. As iron deficiency in infancy often begins with insufficient fetal stores, attention should be given to the mother's diet in pregnancy, especially the use of dark green leafy vegetables. Clinical examination for anemia and preferably routine hemoglobin checks should be made during pregnancy, especially at 6 months and later. If anemia is found, ferrous sulphate tablets (1 tablet of 0.1. g three times daily) should be given for the rest of pregnancy, although, ideally, anemia should be investigated thoroughly. However, this may not be possible in many tropical circumstances because of lack of available laboratory services.

In some regions where iron deficiency is extremely common, it may be advisable to give ferrous sulphate tablets (1 tablet daily) throughout pregnancy to less well-fed women from the lower socio-economic groups. In some areas where iron deficiency in the diet is even more frequent, it may be possible as a public health nutrition approach to the problem to enrich the staple food with iron. This is, however, only practicable if the staple is in the form of a flour and is prepared centrally or at a limited number of mills.

An important minor, but not insignificant, method of increasing iron stores in the newborn baby is to ensure that the umbilical cord is not cut at once, but only after a few minutes, when blood from the placenta will have had an opportunity of draining into the baby. This extra volume is not required as blood, but, when broken down by the baby's body, will increase his iron stores.

The iron stores will be used up by the age of 4 to 6 months, so that it

is important to ensure that the mixed diet introduced from this time onwards includes all available sources of iron, particularly dark green leafy vegetables and eggs.

MALNUTRITION IN SCHOOL-AGE CHILDREN

Unless the local availability of food is very poor, school-age children do not usually have the severe problems found in the early years of life, and there is little mortality in this group from malnutrition. By this age, children will usually be eating most of the adult foods and will have become, to some extent at least, immune to many important infections and parasites. Also, at least in rural areas, school children may have available to them a selection of wild foods from the bush, including berries, insects, and eggs.

Nevertheless, school children in tropical regions very frequently show some degree of malnutrition. They are often underweight and below standard height, which may, in part, be due to failure to catch up following some degree of protein-Calorie malnutrition in early childhood. Evidence of poor current intakes of protein and Calories may be indicated by thin limbs with only slight subcutaneous fat and poorly developed musculature.

Anemia may be present in some degree, as judged by a pale tongue and conjunctiva. This may, in part, be due to iron deficiency sometimes associated with hookworm infection, although the causation is often complicated by other conditions, including malaria. Various specific signs of dietary inadequacy may be found—for example, the enlarged thyroid (goiter) due to iodine deficiency (p. 17), the cracks and sores at the corners of the mouth that can result from an inadequate intake of riboflavin (p. 17), and the dark, scaly areas of skin that occur in niacin deficiency (pellagra) (p. 19).

The teeth may show signs of dietary abnormality. An excessively high intake of fluorine in the drinking water leads in school children to characteristic brownish mottling of the teeth (fluorosis); while communities who have moved toward the more refined foodstuffs of a Western-type diet, especially containing sugar, flour, and sweetened, carbonated beverages, and who, at the same time, have little in the way of dental services, will show a high incidence of dental cavities as the result of untreated caries.

Growth and nutritional status of school-age children can be assessed by taking weights and heights and comparing them with standard weight-for-height-for-age tables. Alternatively, especially if ages are not known, serial measurements may be made. As an approximation, it may be noted that between 5 to 10 years of age, the weight increases by 10 percent and the height by 5 cm (2 inches) annually.

Although there is a low incidence of severe or killing malnutrition in this age group, nutrition work aimed at school children is important because:

1. In order to derive optimum benefit from the school experience, children must have an adequate dietary intake. Many children walk long distances to school with little or no breakfast and with nothing available for lunch. Under these circumstances, they are often tired, unattentive, and apathetic. Some form of school meal, therefore, must be regarded as an important measure

in improving the value of a nation's educational system.

2. Although school children have passed through many of the infections and parasitic diseases that cause such havoc in early childhood, nevertheless, they are still growing, although less fast, and the danger of certain infections is still considerable, especially tuberculosis.

3. Lastly, and very importantly, school children represent a highly significant "target group" for health education, even though only a percentage of children of this age are, in fact, attending school. Their school experience is one of learning, and they are more amenable to new ideas concerning food and health than older people. Also, they will be parents themselves and responsible for young children in the very near future. School children must, therefore, be regarded as a priority group for nutrition education for the coming generation.

FURTHER READING [1]

D. B. JELLIFFE, *The Assessment of the Nutritional Status of the Community*, WHO Monograph, Geneva (1966) (T).

N. C. TROWELL, J. N. P. DAVIES, and R. F. A. DEAN, *Kwashiorkor*, Edward Arnold, London (1954) (T).

[1] G=Recommended for the general reader. T=Recommended for technically trained staff.

chapter vi

NUTRITION EDUCATION

Education lies at the core of all attempts to improve the nutrition of individuals and of communities. It is, however, much easier to talk about than to carry out effectively.

Nutrition education is concerned with trying to persuade people to modify their way of life with a view to improving their health and nutrition by the better use of available resources, both traditional and modern, and both man-made and natural. It is much more than the mere supplying of information and basically is concerned with trying to convince people with different cultural concepts of food and disease and to motivate them to want to make the changes suggested. It is a difficult process and much remains to be learned concerning the best ways to undertake effective nutrition education. It is a fact that in this "age of mass persuasion," nutrition education is still neither as efficient nor as scientifically-based as desirable.

Patterns of behavior are always in the slow process of change, and modern nutrition education is concerned with guiding people more *rapidly* toward minimal beneficial modification in their traditional way of life.

The expression "nutrition education" is used here to cover aspects of health education concerned with trying to improve, directly or indirectly, the nutrition of an individual or a community. The modifications in behavior that are often the aim of nutrition education, as, for example, with food habits, child rearing, or agricultural practices, are difficult to effect, as these aspects of life tend to be particularly deeply woven into the culture pattern of communities and often are resistant to change.

Although poverty is often an important causative factor in childhood malnutrition, frequently a considerable proportion of the malnutrition seen could be avoided, if local food resources were used to a better purpose by parents.

Nutrition education is one of the most important methods of combating malnutrition. It should be carried out at every opportunity by all members of staff and should be incorporated into all types of health, agricultural, and community development work and into

other extension activities related to village or home improvement.

It is no exaggeration to say that the most important global target for nutrition education is to persuade tropical parents to feed their children in the early years of life as well as is possible with local foods produced in greater quantities in the village.

THE PURPOSE OF NUTRITION EDUCATION

Until recently nutrition education was largely concerned with instruction of the "do this because I tell you it is good" or "father-knows-best" type. It was often immensely boring, full of exhortations and admonitions. It was often neither suited to local conditions, nor carried out with any realization that communities have their own well-defined classifications of food, causes of disease, and so forth.

Sometimes this old-style didactic nutrition education must have produced beneficial results, especially if presented by a sympathetic, respected, and prestigeful person. More usually, a main result may have been the feeling of "doing something in a good cause" evoked in the would-be health educator, but often, in fact, with little idea of the effectiveness or otherwise of the session.

Problems with this type of nutrition education are firstly, that the ideas presented are too often unrelated to local concepts of disease causation, food classification, or other aspects of the indigenous culture; secondly, that learning is less likely with an audience in a passive, noninvolved state; thirdly, and most importantly, it is now realized that for health education to be effective it is necessary to involve people in planning and to motivate them to want to change, rather than merely to offer them advice. In fact, persuasion, to be successful, consists of imparting information, of changing attitudes, and finally of altering behavior.

To change habits, people must acquire knowledge in such a way that new beliefs and attitudes result. It is important to create the desire for change. There are three criteria for successful motivation of the individual to change his behavior:

1. He must be aware that there is a problem for him;
2. He must know that this problem has serious consequences and that these are important to him;
3. He must believe that there is a practical solution to the problem.

The process begins with understanding, followed by the winning of confidence and the introduction of incentives. The ideas suggested must be suited to the local situation and aim at improving traditional methods.

Learning is influenced not only by the student wanting to learn, but by the *educator*. He should have a sense of vocation, a respect for the people being taught as well as a knowledge of how to teach. He should be aware of the various influences, such as prestige, personal experience, and repetition of ideas which form the basis of habits. He must know the people, their problems, and what they want to know, and he must understand how poverty and ignorance, long-established, deep-seated customs, inertia, and superstition can offer resistance to change of habits. He must appreciate that before people change they must want to change and that this desire involves believing that the new way will lead to desired goals and that it is physically and economically possible.

BACKGROUND INFORMATION NEEDED

Before the planning of any health education, it is imperative to have as much background information as possible. Areas of importance will include:

Locally Available Foods. These will include those available from the family cultivation and from the shops, coupled with knowledge as to their prices and probable seasonal variations in availability. Of principal significance will be the protein foods, including those from vegetable sources, but particularly those of animal origin, as these are most needed, in shortest supply and most expensive.

Local Pattern of Food Production, including village level preservation and storage.

Local Culture Pattern. The message the educator is trying to transmit to the villager must be viewed as an interaction between what the educator wants to say and what the village already knows, thinks, believes, and does about the particular matter. It is important, therefore, to know the customs and beliefs in regard to foods, especially "cultural blocks" that prevent the use of foods that are, in fact, available. Other traditional feeding habits are frequently of relevance, including the numbers of meals daily, and the order of feeding within a family.

Similarly, ideas concerning causation of disease, and various aspects of general child rearing may have nutritional overtones, as with the sudden geographic separation from the breast, practiced in parts of East Africa. In addition, attitudes to family size and child spacing must be known.

Local Home Economics. The type of kitchen, the cooking methods and utensils, the fuel, the use (or otherwise) of measures of weight, or volume, will all be relevant and will indicate the range and complexity of the dishes that may be feasible for "village level" infant feeding, as with the amount of money available.

Local Status and Activity of Women. The type of work customarily expected of women will plainly determine whether mothers can care for their toddlers adequately themselves or have to leave them at home in the care of siblings or elderly women. Also of great importance is the degree of independence women possess in relation to trying "new" methods of child rearing and especially the spending of household money. The holders of power and authority in the house (e.g., the grandmother or father) may also be of importance.

COMMUNITY NUTRITIONAL DIAGNOSIS

The preliminary background information, collected by discussion, observation, or perhaps by a special survey, will enable a community nutritional diagnosis to be made which can be considered under three headings: (1) Pattern of Malnutrition, (2) Causes of Malnutrition, and (3) Educational Diagnosis.

Pattern of Malnutrition. The collected data will show the commonness of various types of malnutrition, to-

gether with their age incidence, geographic distribution, and seasonal variation.

Causes of Malnutrition. These will vary from region to region and nutrition education will, therefore, have to be modified to suit the particular area. Of the various "burdens" which go to produce a breakdown into malnutrition, the following social, economic, cultural, and disease factors always require consideration:

Dietary. Poverty (or actual unavailability of protein foods), and/or lack of knowledge, and/or "wrong" knowledge (e.g., food prejudices), and/or defective food production and storage.

Infective. Whooping cough, measles, diarrhea, tuberculosis, and so forth.

Parasitic. Intestinal worms (heavy burdens of the roundworm or hookworm).

Psycho-social. Sudden separation from the breast (especially if the child is sent away from home), family instability (emotional, economic, and social), and illegitimacy.

Educational Diagnosis. Information is also needed not only on local ideas concerning foods and malnutrition but also on the literacy of the community, the usual channels of communication (that is, the way ideas diffuse), and the natural or informal leaders and probable "influentials" likely to be most effective in promoting or supporting change in a community, or who may themselves be "trend-setters."

PLANNING

Any program of nutrition education should, if possible, be based on this type of preliminary community diagnosis, after which planning, within the framework of available staff and finance, can take the following logical steps:

1. *Problem.* What is the nutritional priority (or priorities)?
2. *Nutritional Objectives.* What should be done about these?
3. *Educational Objectives.* What should be done about these?
4. *Content of Program.* What should this consist of?
5. *Method.* How should this be put over?
6. *Educators.* Who should carry it out and how should they be trained?
7. *Evaluation.* How should the success or otherwise be assessed?

Health education programs can fail for one or many reasons. They may be unrelated to practical and economic considerations. They may not be in sympathy with local beliefs and attitudes. They may not be based on modern ideas of learning behavior. They may neither pretest the methods nor evaluate their effectiveness. They may not appreciate the value of programs based on needs actually appreciated by the villagers themselves, rather than on scientifically valid, but unappreciated, interests imposed by well-meaning outsiders.

COMPONENTS OF NUTRITION EDUCATION

Old style health education was based on the idea that the community itself

had no ideas on the subject, and was merely waiting to receive new facts in order to act on them and achieve better health. By contrast, modern nutrition educational activities can be considered to have the following components:

Nutrition Information. As with old-style methods, information has to be supplied in the process of nutrition education. Facts should, however, always be few in number, simple, stripped of unnecessary cultural frills from the demonstrators' own community, and scientifically correct.

The presentation of facts to a group is certainly of importance, but is only one component of nutrition education.

Nutrition Demonstration. There is no doubt that the best way of both teaching people and also trying to convince them is to use actual live materials. This may not always be possible. However, whenever feasible, actual situations and real material should be used for demonstrations, e.g., methods of preparing suitable weaning foods. Mothers are familiar with the ingredients used and more likely to follow advice if they are involved in the preparation, cooking, and feeding of their children on the spot.

Probably the most effective type of demonstration is that involving only a small number of mothers or parents, with ample opportunity for participation and questions. This type of group discussion-demonstration (p. 174) is not only valuable as a method of nutrition education but also enables the giver to have a "feedback" of information from his audience.

Nutrition Conviction. A basic problem with much direct nutrition education is that the concept of a relationship between certain foods and growth, health, and disease is entirely absent. To motivate mothers to want to follow the suggestions made in the course of nutrition education, it is plainly important to be able to convince them that the advice given is sound and correct. This is particularly difficult to do when most communities have their own concepts of the causes of common and identifiable forms of malnutrition, such as marasmus and kwashiorkor. Conviction is also difficult to ensure, as both the onset and recovery from almost all forms of malnutrition are rather slow, undramatic, and a time-consuming process.

The best method of convincing parents that malnutrition is due to an incorrect diet is by demonstrating a cure with food, preferably alone. Thus, in hospitals and nutrition rehabilitation centers (p. 186), where kwashiorkor is a major problem, the response of a mother's child, and other children in the ward, to dietary treatment is valuable and convincing (Figs. 13 and 14). Even so, the mother may find it difficult to believe that the recovery is related to the better diet the child has been receiving and may be more inclined to think of cure being effected by various other "mystical" hospital procedures, such as injections, temperature taking, X-rays, and so forth. Under some circumstances, photographs of children on admission and on discharge may help.

Nonnutritional Motivation. The commercial advertiser does not sell his goods on their quality alone but also incorporates other motivations, including status, sex appeal, convenience, and economy.

FIGURE 13.—Nutritional conviction. Two-year old child with marasmus on admission to the Nutrition Rehabilitation Unit, Kampala

While nutrition education should always be concerned with the demonstration of actual nutritional advantages, there is also every reason to try to incorporate nonnutritional motivation as well. For example, posters encouraging women to breast feed should show a well dressed mother in surroundings that are of status value locally. A newly produced low-cost high-protein infant food should not be introduced as a food for the poor, but rather for the whole social spectrum, especially for the well-to-do. In areas

FIGURE 14.—Nutritional conviction. Same child after six weeks of high protein diet based on local foods

where modern education is highly valued and competitively limited, it may be best to stress "*proteini*" as a brain food. Breast feeding may also be appealing if its economy is stressed.

In the past, spontaneous changes in food habits have almost always resulted from nonnutritional motivation. Present methods should learn from past history.

Felt Needs. Inquiry always shows that mothers in developing countries, as with people anywhere, have certain "felt needs"—that is, things that they themselves really want to do or to learn about. These should be incorporated into nutrition education activities wherever practicable. They often take the form of sewing (especially using a machine) or learning English.

However, although paid much lip-service, "felt needs" are not often considered. By discovering what the community, including the mothers want, in relation to any topic, it becomes easier to equate health education to local anxieties and hence to have a better chance of achieving results. It is often a question of reconciling the villagers' wants with scientific nutritional needs.

Entertainment. Not only should the whole presentation be as lively and stimulating as possible, but it is often practicable to include some activity directly intended to entertain. This may in some communities be covered by the actual presentation itself, especially, for example, if slides are used in a community little used to this type of visual aid.

In addition, it may be helpful to include some minor diversions, such as the playing of records or reading or recitation from some popular book, such as the Ramayana in India.

GROUPS FOR NUTRITION EDUCATION

In general, health education may be directed toward three different sized groups:

Large Groups. In developing tropical countries, these can be reached, to a varying extent, through mass media—the press and television, and the radio.

In largely illiterate communities, the press may have comparatively little impact, especially among women. However, in some parts of the world, it is not uncommon for there to be some literate person in the house who may read a newspaper to other members of the household. There is considerable evidence in many developing regions that newspapers are read by many more than the individual who made the purchase.

Television has great potential as a medium of general and health education at schools. It is, however, an expensive development often commenced for prestige purposes. It usually mainly reaches the well-to-do of the community, except if community viewing sets are available. It may nevertheless have the advantage of making the elite aware of problems within their own country.

The disadvantages are:

1. The audience is "noncaptive."
2. Advice is given in a rather impersonal way.
3. One cannot see the reaction of one's audience as they are consuming information; therefore, one is unable to make on-the-spot alterations.

4. The families who can afford to own the receivers of mass communications tend to be those families who need help least.

Small Groups. This is probably the most effective way of putting over nutrition education. Examples include groups of mothers, or preferably parents, at community development clubs, in hospital wards, in Young Child Clinics, and so forth. Under these circumstances, face-to-face direct demonstrations and group discussions (p. 112) are more convincing; and, because the audience is involved as participants and in discussion, learning is more likely. The obvious disadvantage is that only small numbers can be reached at one time.

Individuals or Families. Nutrition education should form part of the counseling of parents, of sick children in hospital, or at any other time or place, such as during home visiting. Key figures and influentials in the community are particularly important "targets."

The use of radio has spread immensely in recent years in tropical regions, especially since the introduction of cheap transitorized sets. Many communities may have radios in the market place or coffee shops. For economically underprivileged countries with widely scattered populations, radio represents the most valuable type of mass media. Nutrition education may be given in special programs, or incidentally as slogans, jingles, or incorporated in drama.

These channels provide an important means of transmiting health instruction and motivating changes toward higher living standards. The advantages of mass media over more conventional methods of health education are:

1. A large number of people can be reached at relatively little cost.

2. The method of instruction is easy to control.

3. It probably reaches the most influential member of the household.

4. Information in the press or on the air tends to have a special kind of authority.

5. The audience can be motivated to desire certain changes by careful insertion of ideas into programs of entertainment.

SPECIAL GROUPS FOR NUTRITION EDUCATION

Politicians and Administrators. Most usually, fund-controlling politicians and administrators in tropical countries are but little aware of the dimensions of malnutrition as a public health problem. One case of yellow fever, very rightly, acts as an effective stimulus to dramatic action, while thousands of young children dying yearly of protein-calorie malnutrition may make little impact and sometimes is not even known.

Parents of the Present. Understandably, it is toward this group that health education concerning the prevention of childhood malnutrition is usually principally directed, via health centers, community development activities, village clubs, and so forth.

In tropical communities, there is much need to direct nutrition education activities toward fathers, who often control the household purse, and toward other members of the family (such as the grandmother or mother-in-law), who may have a considerable say in the

method of child rearing actually carried out.

A detailed discussion of how to plan a family budget in terms of local income and costs can be very helpful. In the course of this, the worker can come to realize the hard facts which underlie the low consumption of protein foods. At the same time, he can go on to point out ways in which protein can be produced economically, the advantages of savings accounts, or the savings that can be effected through family planning.

An important but often neglected channel through which health education can reach this group at a probably receptive time is the hospital itself. The fact that mothers, and sometimes fathers, are admitted with their infants in many tropical hospitals represents an often underexploited opportunity; and, if practicable, under these circumstances each children's unit should have facilities for simple, practical health education activities, especially of the group demonstration type.

Parents of the Future. That school-age children are the parents of tomorrow is a truism that is even more correct in many tropical communities where marriage is relatively early. Nutrition education should form part of the activities of all youth clubs, including Young Farmers Clubs; while the gustatory and visual aid of an inexpensive, but nutritious school lunch based on local foods, can be important at this relatively receptive stage of life.

A nutrition education program for schools needs careful and imaginative planning not only for the school children themselves, but also for teachers in training.

Advertisers. In the present "age of mass persuasion," it is readily apparent that commercial advertising is having an increasing impact on family life in tropical regions, especially in urban areas. Much of this appears to be excellent and, indeed, is helping to encourage parents to more healthful and modern ways of living.

However, at the same time a great deal of advertising, especially of inherently excellent but overly expensive infant foods, has been transported *en bloc* from affluent countries, in which totally different cultural, educational, and economic circumstances are found. In particular, the ill-considered advertising of high-priced tinned milks for infant feeding is to be deplored.

While these food products are usually of good quality and have been well tried in child rearing in prosperous educated groups in various parts of the world, for the majority in most tropical countries they are impossibly expensive so that only homeopathic doses can be afforded. At the same time, they dissuade mothers from breast feeding and create the image of bottle feeding with artificial formulas as a status symbol of progress and emancipation. Whereas, in the educational and environmental circumstances of the tropical village or urban slum, the ill-cleaned bottle and its rubber teat supply a most dilute solution of milk and a concentrated suspension of bacteria, with resulting diarrhea and marasmus.

The health educator has two courses open to him in relation to such commercial advertising which, on mature consideration, he knows to be harmful in this respect. Firstly, he may orient his own health education toward neutralizing the unwitting ill-health education

that is being generated. This is what is usually done but represents, as far as finance and organization are concerned, an unequal contest between the heavyweight of commercial advertising and the flyweight of health education.

As a second alternative more logical, but of immense difficulty, is the need to "health educate" commercial infant food firms operating in tropical countries. At the present they are causing a considerable amount of harm when, in fact, by basing their policy on the actual facts of the situation, they could produce great benefit. At the core of the problem must be the realization that the main need for tropical countries for young children is not a milk preparation to be reconstituted as a liquid and misfed from an infected bottle in competition with breast milk, but rather a cheap, inexpensively packaged protein infant food, preferably in a powder form, to be used either as an additive mixed with locally available foods or prepared as a gruel or in a paste form.

SITES FOR NUTRITION EDUCATION

Clubs and Other Small Groups. Nutrition education is very commonly, and perhaps most effectively, carried out in the various clinics and clubs for mothers, parents, or young people that are organized in the village by community development, extension agencies, religious bodies, and so forth. It is the best site for the use of group discussion demonstrations.

Homes. A variety of different people, including public health nurses, sanitarians, and various extension workers, carry out home visiting as a part of their activities, and should use this opportunity for nutrition education which can then be related to the actual home circumstances. However, staff available for home visiting are always in very short supply; while problems of distance between scattered dwellings and the small, but significant, expense of travel also tend to restrict this type of activity. Workers living in rural communities have the opportunity of carrying out nutritional improvement programs based in part on home visiting.

The teaching of nutrition in the home is by no means simple, as it requires careful background knowledge of the community and of the particular family. The establishing of confidence and rapport is important. Home visiting must always be with the approval and understanding of local leaders and the families concerned, and should be within the framework of customary practice, especially in relation to acceptability of male (or female) visitors.

During initial visits, care should be taken not to hurry matters and attention should rather be given to discovering the interests of the family and especially the mother. Visits should be planned for a convenient time of the day in relation to the mother's household duties.

Useful "points of entry" may be made after a mother has returned home from having a baby in a maternity center, or after a child has been cured at a clinic. However, many other opportunities will present themselves, and the worker living in a rural area may be in an especially useful position to undertake informal, casual, friendly home visits.

Nutrition education in the home also requires quick thinking and adaptability as the visitor will have to use situa-

tions as they develop and relate to questions that the family itself raises. It can never be a "set-piece."

With a background knowledge of the local situation and having established rapport with the family, nutrition education may be undertaken. This should be simple, limited in scope, and clear-cut, preferably only trying to get over one idea during each visit. The topics to be covered should be related to priorities and should be carefully defined and planned. At the same time, they should be capable of modification in the light of questions and of the mother's interest. Real life situations should be used as found in the garden, the food stores, and the kitchen.

The content of the nutrition education should link up with and conform with teaching given elsewhere. A record of what has been discussed on each visit should be kept, as this will assist with continuity.

Schools. These are particularly important sites for health education. School children may be expected to be less fixed in their food habits than adults, and the learning of new ideas about food will fit into the concepts of schools being "places of change."

Health education should be incorporated into the syllabuses of all schools. This may be included as separate classes or sessions, or may be woven into courses of science, nature study, health science, and so forth. The revision of many syllabuses for school children in many parts of the world is long overdue. Too frequently, these have been imported from elsewhere without sufficient modification. Examples should always be from the local scene and a nutrition education message included, wherever possible.

This need often appears to be difficult for Western-trained educators to appreciate, largely because much that needs to be included in basic nutrition education in tropical schools will have been learned at home in cultures of industrialized Western countries.

As well as modification in syllabuses, there is also a need for suitable adjustment in examinations to ensure that nutrition is given due prominence. Plainly, this means that teachers must themselves be aware of local health and nutrition problems and their prevention and include correct emphasis in their teaching. Undoubtedly, the most important places to inject ideas concerning nutrition education into the educational system of a country are the teacher training colleges.

Nutrition education at schools should consist of much more than planned lessons. Learning is more likely to be achieved as a result of habit acquired by repeated observation and participation. Again, the practical behavior and example of the teachers will be important. The involvement of pupils in the growing of locally suitable, nutritious foods in a school garden (p. 166), and the provision of school meals can be of value as forms of practical nutrition education.

Effective nutrition education in schools may in some circumstances be carried home and affect or, at least, stimulate parents and others in the household. However, its main significance is that the school children themselves will shortly become parents with responsibilities for rearing and feeding their own offspring.

Hospitals. Wards and out-patients of hospitals are frequently regarded as being exclusively concerned with curative

work. This should not be the case and planned nutrition education should be incorporated into all possible health work. In many children's wards in tropical countries, mothers come in with their infants and young children. This is a valuable custom because it reassures the child, encourages the mother to carry out some of the nursing in understaffed wards, and permits the continuation of breast feeding.

Also, it offers an opportunity for nutrition education not only by individual counseling but also by means of small group discussion demonstrations, at a time when, if their children are recovering, mothers may perhaps be likely to be receptive to new ideas. In addition to the children's wards, the outpatient clinics, prenatal clinics, newborn and premature units, and so forth, should be included.

Every mother being delivered in a maternity center or hospital today should be offered the knowledge of how she can postpone her next pregnancy until the newborn infant has been gradually weaned. In this way, many cases of PCM can be prevented.

In planning tropical children's hospitals, accommodations and other facilities for mothers must be considered, as well as a suitable area in which to carry out demonstrations and a simple practice kitchen in which mothers can participate in the preparation of dishes. In some places, a low-cost model house may be built adjacent to the ward, if possible with a demonstration garden, growing highly nutritious foods, such as good quality legumes and dark green leafy vegetables, with a compost heap, improved village-level food stores, and seeds and insecticide on sale at reduced rates.

Wherever possible, hospital nutrition education should be linked up with other parallel activities in the neighborhood, such as may be occurring in farm institutes and village clubs.

As well as planned health education sessions, the general activities of the ward may be expected to influence in some degree the ideas and subsequent behavior of mothers. It is, therefore, obviously important to ensure that what is taught is actually practiced. For example, the foods served to both mothers and young children should conform, as far as economically possible, with the teaching mothers have received, and should be used as visual aids for demonstrations on how best to use local diets for young children.

The special value of nutrition rehabilitation centers in health education is discussed later.

TEACHING AIDS

Various teaching aids may be used in nutrition education. All, it must be stressed, are merely "aids" to complement the teacher's own efforts.

Aids should aim at being attractive, simple, short, stimulating, and factually correct. They should refer to "us"—that is, the local community—as regards appearance, dress, foods, and customs. They should always be "pretested" on the "consumer" before general use. They should, wherever possible, lead to audience participation.

Audiovisual Aids. Different audiovisual aids may be appropriate and feasible for different situations, topics, sites, and groups. They should always draw attention to the problem, suggest improvements, and, if possible, motivate people to want to change. When

considering the desirability of preparing particular audiovisual aids, the following must be considered: (1) type and level of nutrition education planned, (2) the proposed audience, (3) the site, and (4) the aim and purpose. Training in the practical use of visual aids is most important and often overlooked.

Real Life Situations. While a wide variety of visual or audiovisual aids can be used, there is little doubt that a real life situation, using actual material, is the most vivid teaching aid, most likely to be understood and most certain to produce a lasting impression. Thus, the most effective visual aids to demonstrate improved infant feeding to tropical mothers are the actual foods, cooking pots, and other kitchen paraphernalia to which they are thoroughly accustomed and with which they work each day. They should be involved in preparing and cooking the foods and in subsequently feeding them to their own children at the time.

Educational situations include a model school vegetable garden, producing a high yield of beans, or the living visual aid of a child actually gaining in weight while recovering from kwashiorkor, or an improved village level kitchen. Demonstrations by *visual comparison* should be the aim.

The most outstanding visual aid is a mother who has been convinced of the value of, say, the need for protein foods for young children. She should be given a major role in nutrition education of her fellow villagers.

It is also well to remember that "ill-health education" can unwittingly be carried out, as by having calendar posters advertising inappropriate infants' foods hanging in child clinics, or the distribution of largely carbohydrate diets to hospital patients, or the use of bottle feeding of young children in pediatric wards.

Visual Aids. A variety of visual aids of different levels of complexity can be employed.

Posters. Posters are very widely used in most countries. Their effectiveness is usually unknown but often may be either slight or unexpected. Village people who have been brought up without becoming accustomed to the conventions that even simple drawings contain, such as perspective, shadow, and relative sizes, may completely misinterpret what is shown them. A sewing machine may be perceived as a loaf of bread: shading to show highlights on a face may be thought to be leprosy.

Also, the local cultural significance of different types of clothes, colors, postures, and ways of depicting people and scenes will certainly affect the way posters are perceived.

For these reasons, posters, and, indeed, all visual aids are best produced in the particular region, rather than using material imported from elsewhere. However, both will often have to be used, but, in either case, it is vital to pretest the material before using it widely.

Posters have the advantages of cheapness and, at least in theory, of reaching large numbers of viewers. However, there is no feedback and too often they only "decorate" a wall.

Posters should, as far as possible, have a single, straight-forward message which "speaks for itself" (Figure 15). Any text should be minimal, clear, and serve to further clarify the point already

AMABEERE GEGAKIRA ECCUPA

FIGURE 15.—Straightforward understandable poster, with few words and one obvious message. ("Breast feed; don't bottle feed").

made visually. Posters may also be used as well as charts in talks and demonstrations.

Animated Visual Aids. Various animated visual aids may be used to enliven and make demonstrations more vivid. Whatever animated visual aid is used should tell a clear, straightforward, simple story. These include such simple devices as flannel graphs, flip charts, and flash cards or more complex methods ranging from puppets and plays to series of color slides, film strips, films, and television programs.

With less sophisticated audiences there is a danger that interest, at least for initial "exposures," may be more focused on the novel gadget than the message. Also, problems of cost, electricity supply, projection facilities, and maintenance have to be borne in mind.

At the less "animated" end of the scale, the flannelgraph and the series of color slides deserve special mention. They can be cheaply prepared with local relevance and can be used in demonstrations at a pace adjusted to the particular audience.

An economical homemade flannelgraph can be improvised with cutout illustrations stuck on sandpaper and a blanket.

Written Material. Visual aids incorporating written material plainly have a limited value in largely illiterate communities, although, even here, the written word often has a certain prestige ("ego boosters"), and it is possible that a member of the household may be able to read it to the mother.

There is often a great shortage of simple reading material in the vernacular, so that it may be possible to produce simple stencilled booklets, texts, brochures, or pamphlets with the dual purpose of satisfying the need for more reading material and also for introducing nutrition education into the community.

It is often useful to prepare a simple, single-page handout sheet in the vernacular by the mimeograph process. It should be limited to one subject, such as "How to Prepare a Protein Mixture for Young Children," or "What Every Man Should Know About Family Planning."

In all instances, the language must be simple and clear and the message "pretested" on the group for whom it is intended. Semantic problems are very likely. If no word exists for a certain concept, a new one may have to be introduced, as with *germsi* or *proteini*. Also, a single word may be used for a range of different variants. For example, there is one Luganda word for "worms," including earthworm, roundworm, etc.

Auditory Aids. In addition to television and radio, nutrition education may sometimes be possible by means of prerecorded talks or slogans, or by music or songs played by tape recorder, or with a live band. The usefulness of this is mainly limited to certain crowded situations where no other approach is practicable, as in hospital outpatient clinics or markets.

NUTRITION EDUCATION TOPICS

Priority topics will need to be selected. These will vary from place to place and will be indicated (1) by local forms of malnutrition, conditioning infections, food production problems, and environmental factors; (2) by the selection of conditions for which health edu-

cation can be demonstrated clearly and convincingly; and (3) by the villagers' own felt needs.

Nutrition education in the widest sense should be designed to improve the diet of the whole family with specific reference to young children. It should also encompass methods of improving village food production, storage, and preservation, as well as the prevention of infections and of customs that have important nutritional significance.

Relevant topics cover many aspects of life. Local priorities will have to be selected from the following or from other topics not included here:

Dietary Topics. Points of emphasis will vary with the local pattern of childhood malnutrition. Special topics may be required in some regions. For example, the use of red palm oil for young children may need inclusion, if vitamin A deficiency is common (p. 86), or the feeding of thiamine-rich foods in areas where infantile beriberi occurs (p. 88).

However, in all developing countries, a major emphasis will be on the prevention of different forms of protein-Calorie malnutrition (p. 75). With this in mind, the following topics will usually need emphasis:

Diet for Pregnant and Lactating Mother. Emphasis will be given to available sources of protein, vitamins, and iron, especially the best use of legumes and dark green leafy vegetables.

Value of Breast Feeding. This should be started as soon as culturally acceptable after birth, given permissively—that is, whenever the baby indicates hunger, alone for 4–6 months, and continued for 1–2 years. If pregnancy occurs, breast feeding should be *continued* for the first three months and the infant weaned slowly over the last six weeks of this period. The economy, prestige, and moderness of breast feeding require stress.

Dangers of Bottle Feeding. The dangers of infection and the high cost should be emphasized. Methods of preparing artificial feeds for use, preferably with a feeding cup or cup and spoon, are best demonstrated individually for those cases where it is really required (e.g., twins or orphans).

Types of Foods. Different methods may be employed and the most appropriate for the sophistication and problems of a particular community will have to be selected.

Sometimes it may be practicable to classify into three groups—"body-building foods" (proteins), "energy foods" (carbohydrates), and "protective foods" (vitamin rich fruits and vegetables). From this basis, the idea of a complete or balanced diet may be developed.

In other communities, there is little current evidence of vitamin deficiency, so that advice on infant feeding may best be concentrated on the protein-foods needed to make the child grow well, to make him more intelligent at school, and to prevent kwashiorkor.

Another practical approach may be to emphasize that the child needs some of four foods each day—staple, legume, dark green leafy vegetable (*or* orange-pigment vegetable or fruit), and, if possible, animal protein. These should preferably be given as mixtures of all four foods.

Prevention of Protein-Calorie Malnutrition. Mothers can be taught to recognize the early and late signs of PCM, especially failure to gain weight. The dangers of the weaning period need

stress as well as the protective value of protein foods and the need to prevent infectious diseases.

Weaning Foods. These should be commenced at 4–6 months, depending upon the lactation ability of the mothers in the region. The following require stress—the type of food; its preparation, cooking, and serving; quantities; and timing. They should aim at supplying as much protein as possible often as "multimixes" (p. 130).

Harmful Foods. This should be concerned with trying to persuade parents to avoid spending money on such nonnutritious or highly expensive items as carbonated drinks, patent infant foods, and so forth.

Use of Protein Supplements. Various protein foods suitable for young children may be available in shops or be issued free or preferably sold at low cost by the health services. These include dried skimmed milk and, in Central America, "Incaparina." Their correct use can be an important topic in nutrition education.

Food Production. The topics to be covered may include:

1. Introduction or increased cultivation of beans, dark green leaves, other vegetables, fruit bushes, and trees;
2. Animal protein production, such as poultry or rabbits or the use of fish ponds;
3. Improved village level food preservation and storage, including the use of insecticides;
4. Control of soil erosion;
5. Increasing soil fertility, especially by the use of a compost heap.

Miscellaneous Topics. Various miscellaneous topics may require highlighting in health education, especially when they are of nutritional importance in a locality. Again, these will vary from place to place but will often include the following:

1. Purpose and value of health services, including hospitals, prenatal clinics, family planning clinics, children's clinics, and so forth.
2. Bacterial cause of infectious diseases;
3. Immunization against some infectious diseases;
4. Prevention and early management of diarrhea;
5. Cause and effects of common intestinal worms;
6. Emotional problems of too sudden stopping of breast feeding;
7. Cause and prevention of malaria;
8. Importance of cleanliness—personal (including bathing young children), feeding utensils, house;
9. Improvement of village housing, including kitchen, latrine, water supply, and household water storage;
10. Avoidance of harmful local customs (e.g., purgation or starvation in diarrhea);
11. Advantages of child spacing, including cheap, simple methods;
12. Budgeting, including food priorities, use of markets, and ways to augment mother's income.

GROUP DISCUSSION—DEMONSTRATIONS

Principles. The most effective form of nutrition education is undoubtedly by means of a demonstration, given in a lively, stimulating way with full use of visual aids, especially of actual live materials, such as foodstuffs, combined with group discussion and as much audience participation as possible.

This method caters for only a limited small group of up to 20 persons but, if skillfully handled by an experienced discussion leader, can lead to much greater interest and involvement by the people concerned, as evidenced by questions and answers. It also gives the demonstrator an opportunity to gauge the interest and to some extent the effectiveness of the demonstration, as the questions also act to some extent as a "feedback."

The principles involved are of practical importance. Firstly, they are usually best carried out by someone of the particular community, speaking the vernacular fluently. They should be given by someone of suitable status. For example, many village mothers find it difficult to take advice on prenatal care from a young unmarried girl. It may sometimes be profitable for foreign staff to participate in a joint demonstration as this may add prestige.

Also, under some circumstances it may be very valuable to enlist the assistance and participation of a village mother, or leader, who has already been exposed previously to the same demonstration, and preferably has become convinced of the desirability of the particular change.

The atmosphere should be informal, intimate, and relaxed. Seating should be comfortable and as is customary in the particular community, possibly therefore on mats or on the grass. A schoolroom atmosphere with someone lecturing from behind a raised table to a group of mothers seated on the ground in the near distance should be avoided.

The seating, lighting, and acoustics should enable the demonstration to be watched easily; while external distractions should be avoided. Local materials should always be used as, for example, clay cooking pots in some parts of the world rather than aluminum. If new ideas are introduced, these should be within the economic reach of the particular group.

Demonstrations should be planned to last for a relatively short time, possibly 15–20 minutes but ample time should be available to permit an indefinite period of discussion and decision making.

The demonstrations should be carefully thought out, planned beforehand, and rehearsed, with regard to their content, sequence, and visual aids.

Planning a Group Discussion-Demonstration. The planning of a group discussion-demonstration can be considered under the following headings:

1. Aim(s) of Demonstration
2. Socio-Economic Factors Responsible
3. Cultural Attitudes[1] ("Blocks" and "Links")
4. Presentation

a. General—logical, realistic, step-by-step development of theme;

b. Visual Aids—To inform, to sustain interest, to convince, to change.

In the presentation of a group discussion it is often possible and useful to use analogies well-known to villagers; for example, comparing plant seeds with bacteria-spreading disease, or a drooping wilting plant with a dehydrated child. However, these may quite often be over-imaginative, and need to be pretested to determine local response.

[1] Some aspects of the local culture pattern may tend to make nutrition education more difficult ("cultural blocks"), while other factors may be helpful ("cultural links"). The former should be avoided, if possible; the latter should be incorporated.

A sequence used in planning a demonstration in East Africa is given in Appendix IV.

It is also valuable for a group discussion-demonstration to start by finding out *all* that the group already knows about the particular subject and to finish by the group deciding what they are going to do when they return home with their new knowledge.

EVALUATION

A much neglected aspect of health education is its evaluation—that is, assessment of its effectiveness or otherwise. This is, of course, difficult to do because of problems of measuring changes in attitude and behavior.

Evaluation should be (but rarely is) considered at an early stage of a program. It can be carried out by one or more of the following methods:

1. a questionnaire showing change in knowledge;
2. a change in behavior by parents (e.g., infant feeding, food storage, and so forth);
3. the effect on the neighbors;
4. the long-term alteration in incidence of the particular condition at which prevention is aimed (e.g., less marasmus seen, or better weight curves at Young Child Clinics).

The close contact that field workers may have with families in rural villages or in urban slum areas may give opportunities for estimating the effectiveness of nutrition education by informal direct observation as to whether what has been advised is, in fact, actually carried out or not.

FURTHER READING [1]

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[1] G=Recommended for the general reader. T=Recommended for the technically trained health worker.

chapter vii

COMBATING MALNUTRITION

All aspects of modern "development" are aimed at raising the standard of living and hence, it is hoped, the nutritional plane of the family and the community. A better-educated population may be expected to have more modern knowledge of health and nutrition and also, through the medium of the printed word, to be accessible to information, both on general topics and on health, nutrition, and food production.

Improvement in the economic level of a country by means of industrialization, or modernized, diversified agriculture, or preferably both of these, will lead to an increased national revenue with more money available to families for purchasing food and with bigger budgets for government to spend on necessary further development projects, including schools, food production schemes, and health and other social services.

Increased food production is required all over the world because it is often increasingly insufficient in quantity and even more so in quality, especially as regards "protective foods," particularly those containing protein. How this is to be achieved will obviously depend upon the particular region. Large-scale farming, entailing some form of land consolidation, seems inevitable if modern methods of high-yield agriculture are to be introduced with the best use of mechanization, fertilizers, and pest control.

Improved communications are also of obvious benefit to the nutrition of a country, enabling foods, especially the more perishable type, to travel longer distances to market.

Lastly, to ensure increased agricultural development it is necessary to persuade farmers to use modern technology and to make available supplies and equipment (usually implying some form of credit system), to organize assured markets for their produce and above all to introduce locally meaningful incentives for higher production.

At the same time, at the village level much can be done to improve food production by the introduction of simple but effective modifications of traditional methods of growing, storing, preserving, and preparing essential food.

This book is focused almost entirely on the grave nutritional problems of

young children. At the same time, there is no doubt of the desirability of improving the diet of the whole family.

Not only are they all frequently in need—the father as the supporter of the group and the mother as the child-bearer—but also because a more generous and balanced family diet will, to at least some extent, lead to improvement in the foods available to young children. This is especially so when it is realized that the "weaning foods" of many communities are not especially prepared for young children but are portions of the adult diet.

AMONG PRESCHOOL CHILDREN

Young children of preschool age are the main group suffering from malnutrition; hence, the principal target for nutrition work.

Information Needed. Before an appropriate program to combat malnutrition in young children can be planned, it is necessary to try to obtain preliminary information. This is needed to know where to apply the program, to what age groups, for the prevention of what types of malnutrition, and lastly, if possible, to have statistical information on the size of the problem, so that the effects of any measures taken may be assessed later.

Magnitude and Distribution of the Problem. Information is needed concerning the types of malnutrition present in a community, the size of the problem, and its geographic distribution. Some statistics may be available from the health services, especially hospitals and health centers; and, although these may be all that is available, their usefulness is limited because they represent only the percentage of really sick children who have been admitted to hospital. They are, therefore, biased by such factors as the particular population's belief in the effectiveness of modern medicine, by local communication problems, and by the number of hospital beds. They can, however, give a rough idea of the nutritional problems likely to be found in a particular region.

The incidence of malnutrition in the community itself may be assessed by a survey to examine children of the vulnerable age group. This may be done by a small, simply equipped team or may be much more elaborate with a large group carrying out a wide range of laboratory tests.

The number of examinations and tests carried out will plainly vary, both with the size and complexity of the investigating team and with the objective of the survey. Investigations may include: (1) examination for clinical signs of malnutrition, appropriate biochemical tests and anthropometry (body measurements), (2) studies of dietary intake, either by questionnaire or by direct measurements of food during home visits, and (3) assessment of the factors responsible for malnutrition in the particular community, including conditioning infections (p. 72), food production, and so forth.

Cross-Sectional Surveys. The advantage of short "cross-sectional" surveys is that they are relatively speedy and can give insight into the approximate size of nutritional problems in the locality. They have the distadvantage that they give information only for the particular time of the year during which the survey was undertaken, although this may be compensated for by repeating during each season. Also, they give

little knowledge concerning the incidence of more acute illnesses, such as infantile beriberi (p. 19), although some information on these conditions can be obtained from records at the districts' hospitals and health centers.

Longitudinal Surveys. A better idea of the full impact of malnutrition on a community can more appropriately be obtained by a "longitudinal study," by which the young children in a particular community can be observed over a period of time, preferably several years. To carry out this type of study scientifically is, however, obviously time-consuming and expensive in terms of money and personnel. Also, a problem with this type of project is that the presence of the investigating team will to some extent affect the situation, especially as humanitarian considerations will mean that treatment will have to be made available for sick children.

Especially if ages can be estimated with some certainty, a simple "cross-sectional" survey may be carried out on all children in the community up to their fifth birthday by weighing, by measuring their arm circumferences (p. 76), and by inspecting for kwashiorkor, as judged by the presence of edema (p. 76).

Results for the survey can then be expressed as follows:

(1) percent with severe PCM (children with kwashiorkor *plus* those with 60 percent of weight-for-age or less) in the whole group, and in each year (e.g., 0–1 years, 1–2 years, and so forth);

(2) percent with moderate PCM (children with weight-for-age between 80–60 percent of standard) in whole group, and in each year;

(3) percent with arm circumference in different 10 percent levels below standard (p. 76), especially in 1–2 year olds.

In addition, workers living in rural villages can obtain useful longitudinal data in their area, especially if an initial census has been carried out, including the general incidence of different forms of malnutrition each year, the family prevalence and the mortality rates in infancy and 1–4 year olds.

Causative Factors. As stressed earlier (p. 75), malnutrition, especially in the preschool child, is always a complex matter with many different factors responsible. If a preventive program is to be carried out realistically, effectively, and economically, it is necessary to ascertain the various causative factors responsible in the particular community and to select those that appear both to be priorities and also to be most likely to be amenable to simple preventive measures.

Reasons for Dietary Lack. The questions that have to be answered are the relative responsibility of poverty, lack of availability or production of foods, inadequate knowledge by the parents, and the existence of harmful cultural beliefs. Sometimes one of these may be dominant, although, quite often, several may play a part.

Infections and Socio-Cultural Factors. In addition, the locally important conditioning infections (p. 72) and socio-cultural factors (p. 72) must be known. If severe protein-Calorie malnutrition is principally due to poverty, lack of availability of protein foods and a high incidence of measles, then the preventive program most suitable will be very different from a community in which kwashiorkor occurs because cultural attitudes prevent the young

child from being fed available protein foods and where severe roundworm infection is common and important as a conditioning factor.

Some of this information may already be obtainable from nutritionists, pediatricians, and others working in this field. If not, approximate information can sometimes be gathered by the field worker by direct observation of feeding practices in the community, of customs with regard to child rearing, and of obvious clinical conditioning infections, such as whooping cough and measles.

Background Information. In most regions of the world, there are often a large number of different ethnic, religious, dietary, and socioeconomic subgroups all with their own nutritional problems. However, for practical purposes, there are usually *two main groups in the present day tropics as far as the feeding of young children is concerned,* although, of course, many fall between these two extremes.

The first, the "privileged," consists of a usually small, well-to-do minority of whatever ethnic group, who have a house with an adequate kitchen with running water, storage space, and even occasionally refrigeration facilities, who earn sufficient money to be able to buy usually high-priced protein foods, such as milk, in sufficient amounts for their young children, and who have received enough modern education to be able to understand and carry out practices, based on quantities and dilutions and especially appreciate the need for cleanliness. Infant feeding for this group can, with minor modifications for local customary practices and available foods, follow standard methods employed in North America and Europe.

The second group, the "underprivileged," who make up the vast majority, either live in villages or in scattered homesteads in rural areas, or have flocked to the "septic fringe" slums, or, if more fortunate, to low-rent urban housing estates. This group often has little or no modern education, very little spending money, dirty, fly-ridden kitchens with few cooking pots, limited fuel and storage facilities, and an inadequate water supply. This is the group whose children develop malnutrition, especially PCM (p. 73), and who require priority attention with regard to practical and practicable advice on infant feeding. Even here important subdivisions will be found, as, for example, those with land and those without, and also those who rapidly accept new ideas and those who are more conservative traditionalists.

Before planning the best form of infant feeding for a particular community within local resources, it is necessary to have as much background information as possible. Areas of importance will include:

1. Local Methods of Child Feeding
2. Local Pattern of Malnutrition
3. Local Pattern of Childhood Disease
4. Local Culture Pattern
5. Local Status and Activity of Women
6. Locally Available Foods
7. Local Home Economics

Approaches to the Problem. The improvement of the nutrition of young children is plainly a highly complicated

affair and has to be planned for the particular circumstances in a community. However, a program often includes one or, more usually, several of the following overlapping approaches:

1. *IMPROVED FEEDING OF YOUNG CHILDREN*
2. *EARLY RECOGNITION OF LESS SEVERE MALNUTRITION AND SUPPLEMENTARY FEEDING*
3. *PREVENTION AND MANAGEMENT OF CONDITIONING INFECTIONS*
4. *IMPROVED TREATMENT OF SEVERE MALNUTRITION*
5. *IMPROVED VILLAGE-LEVEL FOOD PRODUCTION*
6. *CHILD SPACING*
7. *PROGRAMS*

1. Improved Feeding of Young Children.

The most natural way to feed a young baby is with human milk, and it is only in the last few decades in the Western world when various forms of canned milk have become widely available and within the economic reach of the vast majority that bottle feeding with cow's milk formulas has increased to its present dominance.

Advantages of Breast Feeding. In all parts of the world, breast feeding has certain advantages. The composition of human milk has been adapted for the human infant over thousands of years. It contains protective substances (antibodies) against certain infantile diseases, while the close and natural contact between mother and newborn assist in the development of beneficial emotional links between mother and child.

Breast milk has a different composition from that of cow's milk (p. 36). It is possible to "humanize" cow's milk to approximate the same gross composition of breast milk; but, although infants can plainly digest cow's milk formulas and grow well on them, the precise constituents of breast milk cannot be mimicked.

Breast milk can, in general, be regarded as *supplying by itself a nutritionally adequate diet for children up to 4 to 6 months of age. It is uncontaminated, easily available and requires no culinary preparation. It is economical,* if the mother is receiving an adequate diet, especially containing vegetable protein foods.

Problems of Artificial Feeding. Conversely, there are many problems with the alternative to breast feeding, that is, artificial feeding with animal milk, often using a feeding bottle. For the average mother in tropical circumstances, artificial feeding is extremely difficult to carry out successfully.

Firstly, the cost of cow's milk (even if this is available) is usually prohibitive. For example, in Uganda, it has been calculated that to feed a three-month old baby with adequate quantities of full cream powdered milk would take about one third of a laborer's basic wage.

Secondly, both in rural villages and in slum areas, the low level of home hygiene makes the clean preparation of feeds and their storage almost impossible. Water may be brought from a nearby pond or spring. Feeds are liable to be contaminated by dust or insects. Limited fuel may make frequent preparation of feeds very difficult.

Thirdly, most tropical mothers will not have been reared in a "mathematical" atmosphere, such as is customary in the Western world and may have had little or no schooling. They will, there-

fore, often find difficulty in following instructions as to the mixing of different types of feeds. As discussed, the results of artificial feeding for the majority in tropical countries are usually most unsatisfactory. Very dilute feeds are usually given in a dirty contaminated bottle, so that the result is a starved, marasmic baby with infective diarrhea.

Traditional Breast Feeding. In more traditional communities, including the U.S.A. and Europe until quite recently, breast feeding was universally carried out, for the most part uneventfully and permissively—that is, with feeds given at irregular intervals during both day and night whenever the child indicated he was ready. This is still the case in most rural areas in tropical countries but, as mentioned elsewhere (p. 123), the situation is changing for the worse in town and periurban areas.

In various communities, different customs prevail concerning the use and choice of wet nurses, the "testing" of the suitability of breast milk for a particular baby, and herbal medicines designed to increase the flow.

Traditionally, breast feeding is carried on for what would nowadays be regarded as a prolonged period—that is, up to one to three years, or most often, until the next pregnancy. This pattern is still common in many rural tropical communities although many different minor variations of practice are to be found. It has been shown in many parts of the world that the protein content of the breast milk of "late lactating" women is of a normal value (1 percent). The volume produced in the second year of lactation, even in poorly nourished women, is significant although small, often being about 10 fluid ounces (250 cc).

Another phenomenon in many traditionally breast feeding communities is that of induced lactation. In this, the baby of a mother who has died in childbirth is given to a non-lactating female relative to rear. The infant is put to the breast very frequently and a variety of different herbal medicines may be used, and probably have mainly a psychological effect. After a few days of this, lactation is induced, although the quantity of milk produced is usually insufficient alone, and the baby will often have to be given some other food, usually in the form of a gruel. Induced lactation comes about as a result of what is called the prolactin reflex (p. 122).

Increasing Lactation Failure. There is increasing evidence from all parts of the world that the trend away from breast feeding toward artificial bottle feeding with cow's milk formulas is occurring increasingly, not only among the educated elite, but also among the general population in tropical towns and in adjacent periurban areas. The consequences of this disastrous trend seem clear. It is certain that there will be an increasing incidence of nutritional marasmus and infective diarrhea due to the over-dilute contaminated feeds given. At the same time, infantile scurvy, due to lack of ascorbic acid, will be seen more frequently (p. 89), and, if cheap dried skimmed milk is used for bottle feeds, as is very likely to be the case, then severe vitamin A deficiency may occur, with the eye signs mentioned elsewhere (p. 87), including possible blindness.

From another point of view entirely, a widespread failure of lactation in a

tropical country could have much wider economic and agricultural consequences, because, if breast milk is no longer widely available, plainly an alternate, easily digestible source of protein suitable for babies, probably a form of cow's milk, would have to be produced or imported.

Lactation failure can occur in women with severe maternal malnutrition or advanced illness. However, it is surprising how satisfactorily poorly nourished and far from well women appear to be able to lactate in traditional communities.

Also, failure to breast feed can be due to a feeble baby, such as in prematurity or cerebral birth damage, or to mechanical difficulties in feeding, as with a cleft palate or abnormally shaped nipples.

The two commonest causes of lactation failure are in no way related to the nutrition or physical health in the mother or baby. Rather, economic, cultural, psychological, and social factors associated with the process of urbanization and sophistication seem to be responsible.

One form of lactation failure is more obviously and directly linked to economic and cultural circumstances. This is in the mother in the tropical town who goes out to work in some employment where breast feeding is not permissible because of the unfortunate modern Western convention concerning "modesty." Sometimes partial breast feeding may be attempted during the night, but this usually soon ceases.

More important and more common are the increasing numbers of urban tropical mothers who change to bottle feeding in preference to breast feeding because they believe this is the modern method, or because "there wasn't enough milk" or "the milk didn't suit the baby."

The sequence here is that an uninformed, inexperienced, anxious mother puts the baby to her breast. Here he obtains some milk, but, because of anxiety inhibiting the let-down reflex, he is unsatisfied, cries, and sucks at the nipple vigorously. The dissatisfied baby, the sore nipples, and the somewhat congested breast mean that the mother will approach subsequent feedings with even more apprehension. The end result of this cycle is usually that the baby is taken off the breast and given bottle feeds.

Mothers in the lower socio-economic group in urban tropical circumstances have probably been brought up in a breast feeding environment, but have also been exposed to two other types of behavior-molding experience.

First, they will be aware of the practice among upper socio-economic group women of successfully bottle feeding their babies, and they will tend to want to imitate them, because they will believe this to be a status symbol and the modern method.

Secondly, mothers under these circumstances will have been increasingly exposed to advertising by milk companies. Even for illiterate women, posters in the shops and the pictorial advertisements in the newspapers make their message clear. It is not, it must be stressed, that the milk products concerned are poor quality. It is, rather, that the content of the advertisement is inappropriate in tropical circumstances in that it further impels mothers to abandon breast feeding, when there is no practical possibility of their being able to carry out bottle feeding at all

adequately for financial, hygienic, and educational reasons.

Reflexes and Breast Feeding. To understand the mechanism at work, it is necessary to realize that successful breast feeding depends upon a set of subconscious reflexes, possessed both by the baby and by the mother.

(a) *Baby.* The healthy, mature newborn possesses both sucking and swallowing reflexes, which permit him to squeeze out and to swallow milk from his mother's breast.

(b) *Mother.* The mother's reflexes also need to be understood, and, in view of the importance of breast feeding in infant feeding in developing regions, the basic physiology has to be examined briefly.

Prolactin Reflex. When the baby takes the breast, two maternal reflexes are brought into play. The first of these is the prolactin reflex, in which the stimulation of the nipple by the feeding infant sends impulses up nervous pathways to the anterior part of the pituitary gland, which liberates a hormone, prolactin, into the bloodstream, which, in turn, passes back to the breast and is responsible for the secretion of milk.

Let-down Reflex. The sucking on the breast by the newborn infant also sends impulses to the posterior part of the pituitary, which releases a substance known as pituitrin into the bloodstream. This passes back to the breast and acts on small muscle cells surrounding the milk producing ducts in the breast. This concerted muscular action forces the milk down into the terminal milk ducts —the so-called "let-down" reflex, or the "milk-ejection" reflex. By this means, the breast is emptied more completely and the baby is enabled to have a full and satisfactory feed.

However, the let-down reflex is a psychosomatic reflex—that is to say it has a psychologic component as well as a somatic or bodily aspect resulting from stimulation of the nipple by the sucking baby. In practice, this means that anxiety can interfere with and inhibit the let-down reflex, while tranquil confidence can enhance it.

Examples of psychologic interference with the let-down reflex are commonplace. For example, there is the woman who is successfully breast feeding her baby, but whose milk "dries up" after sudden news of a family tragedy. Also, farmers are well aware that an unfamiliar milker produces a lower yield from a particular cow, again because of the anxiety produced in the animal interfering with the let-down of milk.

Let-down Reflex in the Village Mother. The traditional village mother approaches breast feeding with no anxiety and with no easily accessible alternative. She will have been surrounded by lactating relatives and neighbors during her own childhood and will regard the whole process as commonplace and normal. She will also be used to handling young children and will subconsciously have learned a great deal of the technique of breast feeding by observation of relatives.

In most cultures, if the baby is mature and vigorous, he will be put to the breast at once after delivery, or after at most a short delay after birth, while neither the mother nor child will be in a sedated condition. The outcome will almost always be an uninhibited let-down reflex and contented baby, breast feeding permissively.

Let-down Reflex in Western Women. By contrast, a young woman in Western society may never have seen an infant breast-fed. Her knowledge of the process may be colored by stories of difficulties and complications, while safe, economical, convenient alternatives are at hand. Likewise, the modern tendency to regard the female breast almost exclusively as a symbol of sex may also make her less inclined to "risk losing her figure." Also, it must be admitted that many of the doctors and nurses in the U.S.A. and Europe appear to have little knowledge of the advantages of breast feeding and almost routinely start on artificial bottle feeds.

In many cases, Western mothers may not breast feed at all, either because they believe that bottle feeding is the modern method or because of the need for them to go out to work. However, just as commonly the mother attempts to breast feed, but is unsuccessful, usually because "there was not enough milk" or "the milk didn't suit the baby."

Reversal of Present Trend. The move away from breast feeding toward attempted bottle feeding continues to increase in tropical regions and represents a real problem both for the present and still more for the future. Methods of attempting to reverse this trend are difficult to formulate.

If, however, the pattern of infant feeding has already altered with bottle feeding on the increase, then the following approaches may be feasible:

(a) *Raise the Status of Breast Feeding.* Bottle feeding is spreading largely because mothers feel that this gives them both status and modernness. To counteract this, status may be given to breast feeding by involving prominent local ladies in the community in the health education program (e.g. the President's wife), or by stressing the recent move toward breast feeding by an increasing number of well-educated American ladies. The latter group, known as the La Leche League (LLL), produce a monthly bulletin which can be very useful in this regard, showing, as it does, a modern group of women in an affluent society who believe that breast feeding is worthwhile achieving.

(b) *Control of Unsuitable Advertising.* There is little doubt that much advertising in tropical countries is of great value health educationally and assists in improving the level of living of populations. Equally, there is much advertising, particularly in the field of infant nutrition, that is highly inappropriate and, indeed, dangerous. The desirability and the feasibility of censoring inappropriate advertisements in the press, radio, stores, and TV has been often suggested, but is extremely difficult to put into practice. Government agencies usually control the radio and TV, and require the income from advertisers, while examination of advertisements would require some form of censor board, and neither staff nor finance would be available for this.

Nevertheless, this type of approach certainly deserves further consideration, as, at the moment, the toll of death from marasmus and infective diarrhea in tropical infants as a result of artificial feeding is probably greater than that due to cancer of the lung resulting from cigarette smoking, for which legislation to modify advertising has been introduced in some Western countries.

(c) *Health Education.* If breast feeding is proceeding normally in a

community, no health education at all is required, except perhaps in relation to dangers of artificial feeding. In fact, under these circumstances, the more attention that is drawn to the process of breast feeding, the greater the likelihood of the development of anxiety and doubt in place of previous untroubled confidence.

By contrast, in areas where breast feeding is on the decline, health education may be directed toward this subject, particularly for school children and for mothers during the pre-natal period. For the latter group, undoubtedly the best health education and instruction can be given with the assistance of the woman who is already successfully breast feeding her baby.

(d) *Legislation.* For working mothers in towns, the possibility of legislation deserves consideration, perhaps by providing nurseries (créches) at factories, or even "lactation bonuses" for mothers while breast feeding their babies for 4 to 6 months.

Principles of Breast Feeding for Tropical Mothers. A working hypothesis with regard to breast feeding for mothers in tropical regions can be based on the following six principles:

Breast Feed Alone for 4 to 6 Months. Breast milk is the mainstay of *protein nutrition for the first 4 to 6 months of life and is usually all that is needed for this period.*

It is also the cheapest, cleanest, most easily available and digestible source of protein. Any other additional food considered during this early period must be either really nutritionally necessary or of great cultural significance, and its alleged advantages have to be weighed against the considerable risks of producing infective diarrhea with unclean food, water, or feeding utensils. For example, there is no need for orange juice or other source of ascorbic acid for breast-fed tropical infants, among whom scurvy is virtually unknown.

Successful breast feeding can be judged by a contented, well-formed, active baby, who is gaining weight satisfactorily.

There are few absolute reasons for not breast feeding, notably very severe maternal illness or mental derangement (at least temporarily), and absence of the mother, if the baby has been deserted.

Maternal pulmonary tuberculosis or leprosy are no longer regarded as contra-indications, provided measures are taken to prevent infection occurring, including the prophylactic use of appropriate antibiotics for the baby.

Introduce Supplements to Breast Milk from 4 to 6 Months. After the first 4 to 6 months, breast milk is never nutritionally adequate alone ("breast starvation"), and the child always requires additional food as well.

Semi-solids need to be introduced, based especially on protein foods available (p. 149), so that the diet includes all items of the adult diet at least by the time the child is 1 year old. Kwashiorkor occurs most commonly in the second year of life. Its dietary prevention should commence in the second six months of the first year.

Breast Feed for 1 to 2 Years. So called "late lactation" (e.g. up to 1 to 2 years or more) was usual in the Western world until the comparatively recent "milk revolution," with its improved dairying and milk conservation.

In late lactation, the breast milk of poorly fed tropical mothers has a low normal protein content, although the

yield is rather low. However, the nutritional drain on the mother is cumulative with successive pregnancies and protracted lactation, and emphasizes further the need for attention being given to the mother's diet in pregnancy and during breast feeding.

However, at the same time, lactation prolonged for 1 to 2 years, depending upon local cultural acceptability, represents a significant partial protein preventive against the development of kwashiorkor. It must always be regarded as a small, but valuable, *protein supplement to a mixed diet based on all available local foods.*

Feed the Pregnant and Lactating Mother. Attempts must be made to persuade mothers to feed themselves better on locally available foods, especially rich sources of protein, such as legumes and dark green leafy vegetables, during pregnancy and prolonged lactation.

Avoid Advice on the Technique of Breast Feeding. The world's experts on practical breast feeding are unsophisticated village mothers, among whom it is carried on as naturally as are such similar physiologic events as swallowing in other parts of the world. Conscious, planned "technique" with regard to nipple preparation, positioning of the baby, regularity of feeds, fully emptying the breast, burping, and so on is usually minimal or non-existent. Success is based on subconscious imitation of female relatives observed in childhood, and the unruffled, unthinking normality of the whole process, in which doubts or hopes as to success or failure figure not at all.

Advice on the technique of breast feeding should, therefore, only be offered if some definitely harmful practice is being used in the traditional method.

Artificial Feeding is Dangerous. As has been stressed, bottle feeding with cow's milk formulas is increasingly becoming the competitor of breast feeding, especially in tropical towns. The standard pediatric textbook arguments concerning the relative merits of human and cow's milk are entirely secondary and academic as far as infant feeding of the underprivileged in tropical regions is concerned.

Basically, with few exceptions, the majority of tropical mothers have neither the money, nor the education, nor the kitchen facilities, so that bottle feeding means the giving of an over-dilute, contaminated mixture, low in nutrients, and high in bacteria, with the resultant combination of infective diarrhea and nutritional marasmus.

Weaning [1] *Diets and Local Foods.* A basic problem in infant feeding anywhere in the world, especially in the difficult circumstances found in developing tropical regions, is to introduce a nutritious, digestible "weaning" diet, containing sufficient quantities of protein, calories, vitamins, and minerals, during the so-called "transitional period" between the time a baby receives adequate nourishment on breast milk alone, and the time when he is receiving a fair share of the full range of the adult diet.

Weaning in the Western World. In industrialized countries in North America

[1] The term "weaning" (Anglo-Saxon *wenian*, to accustom) is used with various different meanings, including "accustoming to foods other than milk" and "the stopping of breast feeding." It is here used in the former sense to refer to the gradual process of introducing other foods than milk, whether human or cow's.

and Europe, the weaning process is not usually very difficult. The initial period of feeding with breast or cow's milk is supplemented by a wide range of other foods introduced gradually. These may be home-cooked or, more likely, obtained in convenient, pre-cooked portions prepared in small cans or glass containers.

Weaning foods in the Western world are, therefore, often based on vegetable purees, soft egg dishes, minced meats, mashed fish, and so forth. In all cases, the new semi-solid foods introduced will be fed with the continuation of the use of cow's milk.

At least by the time the child is 1 year old, he will be having almost the full range of the adult diet, although with the food suitably cut up into small pieces.

Traditional Weaning. It has been noted (p. 39) that many traditional, customary diets include a relatively limited range of foods, usually based on rather coarse, bulky vegetable foods, and especially on one or more staples.

It is usual, therefore, that the "transitional diet" given to young children in tropical circumstances consists of the softer portions of the adult diet, very frequently largely carbohydrate foods, sometimes made into pastes or gruels.

The process of introducing semi-solids is often abrupt, and on to relatively indigestible, coarse vegetable foods of low nutritional value. Diarrhea is likely from infection introduced by unclean utensils, and from poor digestion of the foods taken, leading to defective absorption. The process may also be complicated by the psychologic upset of the associated sudden separation from the breast, and by innumerable general infections.

It is, unfortunately, unusual for even the full range of the still limited foods that comprise the adult diet to be used for infant feeding. Likewise, the preparation of special dishes for young children is uncommon. The need for young children to have more frequent meals than adults is often not appreciated.

There is no doubt at all that much could be done to improve infant feeding in many tropical countries, if the present range of foods available and already used by the adults, could be prepared suitably and fed to young children for at least four meals a day from the second six months of life on.

Time to Introduce Semi-Solids. There is much controversy with regard to this timing in the Western world and elsewhere. For example, there are extreme schools of thought which suggest that young children should be given semi-solid foods from a few weeks old.

(a) *Relation to Growth and Nutrition.* The matter has to be judged rationally in relation to the particular circumstances of the tropical child. Firstly, as has been noted elsewhere (p. 56), exclusively breast-fed infants usually grow extremely well during the first 4 to 6 months of life, show little in the way of malnutrition of any sort, and are highly susceptible to diarrheal disease from contaminated food, dirty water, and unclean utensils. Breast milk, together with the stores the infant has acquired from his mother while in the uterus, are together more than adequate for this early period of life, *without the addition of other foods.*

(b) *Relation to Development.* The fact that teeth erupt in the baby from about six months and the mouth's movements become coordinated to be able to deal with semi-solids suggest that this

is physiologically the time when foods other than breast milk are required.

(c) *Relation to Diarrhea Prevention.* Lastly, and very importantly, in tropical circumstances whether in rural areas or in towns, the risk of introducing bacteria to the young child, and hence intestinal infection resulting in diarrhea, with its great risk in the early months of life, have to be taken into account.

Breast milk is clean and uncontaminated. As soon as other foods are introduced, whether these are cow's milk or semi-solids, the risk of infective weanling diarrhea increases greatly. It does, therefore, seem important from this point of view to introduce foods other than breast milk only when the child really needs them.

Food prepared for young children should be well cooked, fed with clean feeding utensils, and stored after preparation to avoid contamination from flies and other insects, and dirt. Before feeding children, mothers should be encouraged to wash their hands, and should only give clean, preferably boiled water to their children to drink.

(d) *Variation with Breast Feeding Ability.* It is probably unwise to generalize too widely, as the ability to breast feed does appear to be less good in some tropical communities in certain parts of the world. Possibly the best way to judge the correct time to introduce semi-solid foods is in relation to the customary growth, as evidenced by weight curves seen in the particular region. Usually, these will be excellent for the first six months, but, in some places, the slowing of weight gain may commence earlier than this, indicating the need for somewhat earlier introduction of semi-solid foods, possibly as early as four months.

Types of Weaning Foods. The types of foods most suitable for feeding to infants during the weaning period will depend very much on whether it is thought practicable to cook separate dishes, which are preferable for young children, or whether it will be necessary to use foods already prepared for adults.

Gradual Change. The process is initiated by offering small quantities of semi-solid food once daily. Thereafter, the quantities are increased, the range of food taken is widened, the numbers of daily feedings increased, and the consistency of the dishes used is thickened, until solids are being eaten.

The weaning process should be a gradual one in any part of the world and should aim at a change from milk to a wider diet, consisting of milk together with a full range of other foods available. In a Western sense, it often means the changeover, or accustoming period, from cow's milk to a mixed diet, including cow's milk. In most traditional tropical circumstances, it can be regarded as a change from breast milk to a mixed diet, in which breast milk is continued up to 1 to 2 years.

This phase of child feeding has well been described as "a danger period," because the child has to become accustomed to the taking and digesting of these new foods and, at the same time, is susceptible to the various infections of the intestinal canal that are likely to be introduced in unclean foods and utensils.

In tropical regions, infant feeding will almost always have to be based on the fact that animal protein, including milk from the cow or other mammal, will be uncommon and expensive, and

consequently can play only a very limited part in the diet of the young child.

First Semi-Solid Food. In many communities, the initial food given to young children will consist of one of the local largely carbohydrate staple foods, sometimes as cooked for adults or sometimes prepared specially for the child, either as a paste or gruel or mash. There need not be any objection to this, provided the carbohydrate food is enriched thereafter with other items from the local diet with a high content of protein, vitamins, and iron.

Suitable soft foods include gruels of semolina (the *sugi* of India), corn flour (the *ugali* of the Swahili-speaking world), taro (the *poi* of Polynesian Hawaii), or rice (the soft boiled *nasitim* of Indonesia).

Various soft, "natural convenience foods" can be fed to young children, if freshly prepared in a clean fashion—the ripe sweet banana, the papaya, the avocado and the immature coconut jelly. All can serve as a base into which protein foods can be mixed.

Frequency of Feeds. The young child's capacity is small, so that it is best to try to use less bulky foods for children, particularly compact sources of Calories and protein, and, at the same time, to offer four feeds daily, in the form of hot meals or cold snacks. This is often easier to do if a separate preparation is made for the young child and preferably served before the adult's meal.

Village-Level Weaning Foods.

(a) *Characteristics.* The characteristics of the weaning process are the same anywhere. Firstly, the food preparation used should be soft, easily masticable, digestible, not too bulky, clean, non-irritant, culturally acceptable, made of locally available foods, economical, and nutritious, with special reference to protein.

Almost universal problems in the tropics are the uncommonness and expense of animal protein, the comparative costliness and relative indigestibility of legumes, and, sometimes, the bulky, high water and cellulose content of the staple.

(b) *Aims.* In view of the commonness of protein-Calorie malnutrition of early childhood (p. 73), the main aim is to introduce a soft, digestible diet containing adequate protein and Calories, based on indigenous foodstuffs and on the local kitchen potential, which should, when possible, be taken together with the small, but important, amount of breast milk from the mother, which should continue during and after the weaning process, if culturally acceptable.

However, although protein is the prime concern in most parts of the world during the weaning period, it is also necessary to ensure that the child's transitional diet should contain naturally occurring vitamins and minerals, especially vitamin A and its precursor, carotene (p. 15), and iron (p. 15). In tropical circumstances, this may be done by introducing egg yolk and liver, whenever practicable, and dark green leafy vegetables and yellow pigment fruits and vegetables into the diet.

Also, in some communities, special problems may have to be considered. Thus, for example, in regions where severe vitamin A deficiency is common (p. 86), particular attention must be given to the introduction of rich sources of carotene, such as red palm oil or of vitamin A, such as egg yolk, liver, or fish liver oil.

(c) *Composition of Weaning Foods*

(i) *The Staple.* The main source of Calories in a weaning food will be the local staple. If alternative staples are available in the particular community, the most nutritious should be used, with special regard to the protein content. In particular, if culturally acceptable, a cereal grain should be employed in preference to a tuber.

An often under-appreciated problem may be that if the staple is a tuber or plantain, it will itself be bulky, high in water and fiber, and a poor source even of Calories, especially with a child's small capacity.

It may, therefore, be necessary to consider the feasibility of adding "compact Calories" to dishes. In West Africa, this has been carried out with red palm oil, and in East Africa, with other vegetable oils (p. 174), and with sugar. Another source of ready-to-eat, easily mashable "compact Calories" is the avocado pear.

(ii) *Legumes.* Protein will almost certainly have to be derived mainly from legumes. Selection will depend on local availability and cost, properties as regards cooking and apparent digestibility, cultural attitudes, and suitability for young children, as well as the protein content.

Because of their undoubted poor digestibility, it is important to see that legumes are well cooked and carefully prepared. For example, the skins should be removed from dried red beans (*Phaseolus vulgaris*) before cooking by soaking or scalding, or after cooking by sieving. As noted earlier (p. 31), particular care is needed with the soybean.

(iii) *Animal Protein.* In almost all places, animal protein will be in very short supply, so that it is important to use it most advantageously.

Firstly, attempts should be made to incorporate portions of all available animal protein into the weaning food. These may include protein foods widely used in the Western world, such as eggs, fish, meat, and cow's milk, but other more unfamiliar sources should be considered, such as acid milk preparations, village cheeses, duck's eggs, fermented shrimp paste, edible insects, and so forth.

Secondly, if possible, the available animal protein should be given throughout the day and eaten in small amounts intermixed with as many meals as possible.

(iv) *Dark Green Leafy Vegetables.* These are often much too little used by

Table 3.—APPROXIMATE PROTEIN CONTENT AND AMINO ACID DEFICIENCY OF MAIN CATEGORIES OF VEGETABLE FOODS USED IN MULTIMIXES

Type of Food	*Protein (approx. percent)*	*Amino Acid Deficiency*
Tuber-plantain [1]	1–2	Lacking in Lysine.
Cereal grain	±10	
Legumes [2]	±20	Lacking in Methionine.
Dark green leafy vegetable [3]	4–10	

[1] Dried: 3 percent.
[2] Soybeans: 40 percent.
[3] Dried: 30 percent.

tropical communities, especially for infant feeding. They represent an excellent source of carotene, vitamin C, and iron, the B complex, as well as protein, whose amino acid composition complements that of staple foods.

(d) *Principle of Multimixes.* Most communities have by age-long experiment come to use foods in mixtures, so that their nutrients complement one another.

In fact, an important generalization in relation to human diets is that the wider the range of foods included and the greater the variety the less the likelihood of nutritional deficiency.

The best way of planning a nutritious, village-level weaning food is as a mixture of ingredients, designed to complement and mutually reinforce one another, in particular to ensure an intake of the full range of eight essential amino acids at the particular meal.

With this principle in mind, three types of mixtures can be considered. All are built around the staple, with addition of one, two, or three other foods—double mixes, triple mixes, and quadrimixes. Recipes from different parts of the world are given in Appendix V.

(i) *Double Mixes.* These consist of the local staple (preferably a cereal grain, if more than one staple is used by the community), together with the most suitable legume, or animal protein, or dark green leafy vegetable.

The staple : legume double mix can commence with 4 : 1 proportions, followed by a gradual increase in the legume, until a 2 : 1 mixture is used.

Nutritionally, the essential amino acid deficient in the staple, lysine, is supplied by the legume, which is itself lacking in methionine, available from the staple.

Traditional double mixes sometimes used for infant feeding in different parts of the world include sweetpotatoes-red beans (Ruanda), and rice-soybeans (Indonesia).

Alternatively, the staple can be directly reinforced with an animal protein with its abundant surplus of essential amino acids. Examples include various cereal porridges with added egg or milk. Less satisfactorily, the staple can be mixed with dark green leafy vegetables.

(ii) *Triple Mixes.* Sometimes it may be possible, if only for an occasional preparation, to reinforce a "double mix" of staple and legume with *small*

Table 4.—VILLAGE-LEVEL MULTIMIXES

	Ingredients
Double Mix	Staple + legume.
	(or)
	Staple + animal protein.[1]
	(or)
	Staple + dark green leafy vegetable (DGLV).
Triple Mix	Staple + legume + animal protein.
	(or)
	Staple + legume + DGLV.
	(or)
	Staple + DGLV + animal protein.
Quadrimix	Staple + legume + DGLV + animal protein.

[1] Mixtures with animal protein preferable in all mixes.

amounts of animal protein, thereby converting it into a "triple mix." This approach ensures that the child will be receiving Calories, while the surplus essential amino acids (p. 16) from the animal protein food will be available to complement and reinforce still further the essential amino acids of the vegetable protein mixture.

Typical examples of triple mixes used for infant feeding include plantain, pounded groundnuts and egg in Buganda, East Africa, and a mixture made of soft boiled rice, Bengal gram (chickpea) and milk in Bengal, India.

Alternatively, triple mixes may be prepared from a mixture of staple, dark green leafy vegetable (or orange-pigment vegetable), and a small quantity of animal protein; *or* from staple legume and dark green leafy vegetable.

(iii) *Quadrimixes.* If local food resources and cooking practices permit, the staple-legume-animal protein "triple mix" can be converted into a "quadrimix" by adding small quantities of dark green leafy vegetables (or orange-pigment vegetables), both of which are sources of vitamins A and C. Of the two, the dark green leafy vegetables are preferable because of their content of protein and iron.

The various weaning food mixes suggested are increasingly nutritionally desirable the greater the number of ingredients. In other words, quadrimix recipes are ideal, followed by triple mixes and with double mixes as next best. Planning of mixtures should, therefore, be aimed at using the largest number of these ingredients, especially small quantities of animal protein but one should be prepared to use vegetable protein double mixes, if need be.

Typical recipes of multimixes are given later (Appendix V). Suitable mixtures based on local foods and cooking methods can often be devised by practical observation and by trying out suitable recipes oneself in an actual village kitchen.

(e) *The Three Plank Protein Bridge.* In this consideration of weaning food mixtures, adequate stress needs to be given to the fact that breast feeding, continued at the same time as the food mentioned, is supplying a further small amount of protein of good biological value.

As protein is the critical need in feeding young children in developing tropical regions, the concept of the "Three Plank Protein Bridge" has the value of simplification and emphasizes the need for the use of *all protein sources,* represented pictorially by the three "planks" *of prolonged breast feeding,* and mixtures of *animal and vegetable protein foods,* if the child is to bridge the nutritional divide, between the age of 6 months and 2–3 years, without developing kwashiorkor.

(f) *Quantities.* A most difficult aspect of feeding during the weaning or transitional period is that it is a gradual process of "accustoming," with increasing numbers of feeds made up principally of semisolids and with increasing quantities of food taken. It is, therefore, difficult to suggest amounts required for this period of change.

Nevertheless, it is necessary to try to give guidance in regard to quantity of foods to be used in preparing infant recipes. This is usually best undertaken by approximate "domestic" advice—that is to say "use one handful of beans" each day, or to make use of locally

available measure, such as bowls or gourds. This can most usefully be taught by means of demonstration.

A further problem is that with limited resources the mother can obviously not afford to prepare over-large, wasteful quantities. The best that can often be done is to have approximate recipes based on the needs for the second six months of life, and then the second year of life.

(g) *Preparation.* The preparation of suitably cooked, soft, digestible high protein mixtures poses problems in ill-equipped village kitchens, and always takes time.

Preliminary soaking and skinning of legumes may be required. The final product needs to be made into a suitable masticable consistency by mashing with a fork or spoon, by pounding or crushing with a pestle and mortar, by sieving or straining, or by grating.

The difficulties in carrying out these seemingly simple procedures in village kitchens must be appreciated. Suggestions have to be as simple and convenient as possible, based on personal experience.

Supplementary weaning mixtures should, if possible, be cooked separately for young children, as this means that a special nutritious preparation for young children can be made and served, without the child having to take his (usually low) place in the priorities of intra-familial food distribution.

As dishes of this kind usually need special preparation, small cheap cooking pots with lids may be required, and it may be necessary to make these available at low cost at Young Child Clinics (p. 172). If, as is often the case, cooking is only possible once or twice daily, thought should be given to suitable preparations which can be fed to children safely between cooking periods, if warmed up or if cold. The use of cold dishes, such as bean cakes, may play a significant part in some cultures.

If special dishes prepared separately for the young child are not culturally or domestically practicable, weaning food mixtures can be prepared from the adult diet, by removing suitable portions and mixing them together to form multimixes.

Ingenuity may be required. For example, in some communities ingredients will have to be used before the final very hot spices are added. In others, methods of softening the locally prepared unleavened bread, such as *tortillas* or *chapatis*, will have to be considered. In others, a larger helping of thicker protein-containing sauce must be reserved for the young child.

It may be valuable to make a small spoon easily and cheaply available at Young Child Clinics (p. 172), if this is not customary in the community, as this may ensure a much greater intake of food than if an inexperienced young child tries to eat semi-solids with his fingers.

Artificial Feeding. Breast feeding is fortunately still the normal manner of feeding young babies in most rural tropical communities, although decreasing in urban situations.

However, anywhere in the world circumstances may arise when breast feeding is impossible, as, for example, if the mother dies in childbirth or becomes mentally deranged.

In some societies these emergency situations may be dealt with by ac-

cepted cultural technics, whereby a wet-nurse may be hired, or another lactating relative will breast feed the orphaned child. Alternatively, lactation may be induced in a selected female in the extended family, largely by putting the baby to the breast frequently, resulting in prolactin production (p. 122) and, hence, secretion of breast milk.

If the mother is not available to breast feed and if there is no cultural method of dealing with the situation, the child will have to be reared artificially—that is, by feeding with some form of modified mammal milk, usually cow's milk. The dangers of this have already been stressed (p. 36) and, in many tropical lower socio-economic circumstances, chances of success are slight. The result is only too likely to be a development of nutritional marasmus from over-dilute feeds, and associated infective diarrhea from the use of contaminated foods given in unclean utensils.

(a) *Type of Milk.* Numerous different animal milks may be used for feeding young babies from birth onwards. These include the milk of the cow, buffalo, reindeer, and many others. Most usually cow's milk is employed, either fresh or in one of its processed, tinned forms. The latter include powdered milk, evaporated milk and condensed milk.

Essentially, cow's milk contains about 2–3 times the content of protein, especially relatively indigestible casein, the same amount of fat, and about half as much milk sugar (lactose) as is found in breast milk.

Fresh Cow's Milk. This has to be *boiled,* both to kill harmful bacteria, *and* because the heat makes the cow's milk protein more digestible.

Unless from a reliable source, fresh liquid cow's milk is often a rather uncertain, dangerous fluid, as, in many tropical countries, it is likely to be contaminated, diluted and adulterated.

Dried Powdered Milk. Dried or powdered milks are made in innumerably different forms by large numbers of companies. Some are prepared for particular purposes, such as for children who are allergic. However, there are really little important differences between these milk preparations, apart from their fortification with various vitamins and minerals, despite the manufacturers' claims. Most hospitals in the U.S.A. use simple formulas based on evaporated milk; while in Britain in World War II only one preparation of full cream dried powdered milk was available, and the health and nutrition of young children improved.

Full Cream Powdered Milk. If dried powdered milk is to be used for the hazardous process of artificial feeding in tropical circumstances, then the cheapest reputable brand of full cream dried milk that is available locally should be employed.

Powdered milk has the advantage of being compact, light in weight and hence, easily transportable. It is also sterile until the tin is opened, when it soon becomes contaminated.

Cow's milk can be approximately reconstituted by adding 1 rounded teaspoonful (with a volume of about 5–6 c.c.) of full cream powdered milk to 1 ounce of boiled water.

This method is very approximate, as the compactness of different brands of dried milks varies. However, the need for simplicity in preparation of these milk mixtures cannot be over-stressed. The likelihood of their being carried

out incorrectly in the home by the mother on her return is extremely great. Therefore, the technic of preparation should be as basic as possible.

Dried Skimmed Milk. Dried skimmed milk is available in stores in some parts of the tropics and certainly has been used all over the tropics as a result of UNICEF supplies being made available.

Dried skimmed milk should not usually be used for artificial feeding of young babies. It is low in calories and, much more important, it has had removed from it the essential fat soluble vitamins, especially the vitamin A required to protect the eye. However, recent shipments of dried skimmed milk from UNICEF have been reinforced by both vitamins A and D.

However, if no other form of milk is available, dried skimmed milk may have to be used for infant feeding in the first months of life. It should be reconstituted for young babies using one level teaspoonful of powdered dried skimmed milk to each ounce of boiled water, and with 1 level teaspoon of sugar to each feeding. In addition, unless it has already been reinforced, vitamin A should also be given to the child, either in the form of vitamin concentrate, red palm oil, fish liver oil, or, possibly, long acting intramuscular injection.

Dried skimmed milk is best used, not as a reconstituted liquid for the feeding of young babies, but rather as a protein additive mixed with food as a powder during the weaning period (p. 72), or in the preparation of a formula for the treatment of kwashiorkor or morasmus.

Evaporated Milk. Evaporated milk is widely used in the U.S.A., and may be found on sale in a number of tropical countries. It can be used very conveniently and easily for infant feeding, and is sterile until opened. It is, however, costly and rather bulky and difficult to transport.

Full strength cow's milk may be reconstituted from it by adding 1 part of evaporated milk to 1 part of water.

Condensed Milk. This type of milk preparation is not only highly concentrated, but also has had very large amounts of sugar added (30–40 percent). This has the great advantage that, in tropical climates, the opened tin can remain unrefrigerated for days without souring.

Condensed milk is not at all suitable for the feeding of young children. Firstly, it is often made of low-fat, skimmed milk, with the great risk of development of vitamin A deficiency, also, its high sugar content unbalances the diet towards the carbohydrate end of the scale; while the extreme sweetness often tends to make mothers "stretch" the milk by the addition of water, so that it becomes a very thin homeopathic solution indeed.

If no other milk is available, condensed milk may have to be used (p. 36). Again, if prepared from skimmed milk, other sources of vitamin A will have to be given.

(b) *Economics of Animal Milk.* All forms of cow's milk are usually relatively scarce and expensive in tropical regions. It is for this reason that mothers will be tempted to try to use less costly dried skimmed milk. It is important to know the price range of various commercial types of milk available in the shops in the particular region.

What is needed is to know and use the cheapest reliable form of locally

available full cream cow's milk, whether fresh, or powdered, or evaporated.

It still will be unlikely that most mothers will be able to afford to artificially feed their young babies on even the cheapest brand, so that, if artificial feeding is really required, it may be necessary to supply milk free or to subsidize the feeding process, as by purchasing tinned milk by the crate and selling at cost.

(c) *Modification of Cow's Milk.* All forms of cow's milk need to be modified for use by young babies in the first three months of life, by slight dilution and the adding of sugar.

Modification of fresh cow's milk for babies under 3 months can be carried out by (1) diluting with water (2 parts of boiled milk : 1 part boiled water); (2) adding sugar (1 level teaspoonful of household sugar to each feeding).

Suitable approximate dilution of full cream powdered milk can be achieved by adding 1 level teaspoon to 1 fluid ounce of boiled water, and with evaporated milk by adding one part milk to 3 parts of boiled water. Sugar should be added to both.

After 3 months of age, boiled cow's milk can be given undiluted with added sugar. Full cream powdered milk can be used at the strength of 1 heaped teaspoon to 1 fluid ounce of boiled water, and evaporated milk can be diluted 1 : 2 with boiled water. Sugar should be added to both.

Many other animal milks are customarily used in different parts of the world, and can be employed in much the same way as has been suggested for fresh liquid cow's milk. Even buffalo milk, which has a much higher fat content (9%), can be diluted and reinforced with sugar in the same manner.

(d) ***Daily Milk Requirements.*** The appetites of babies and their nutritional needs vary from one to another. However, as a rough guide, *young infants in the first six months of life need approximately 2½ ounces per lb. body weight per day of modified cow's milk* (p. 119), prepared from either fresh liquid milk, or powdered milk, or evaporated milk. It is then possible to calculate the child's approximate daily needs by knowing his weight.

Number and Timing of Feedings. Ideally, in artificial feeding, as in "natural feeding" on the breast, the baby should be allowed to develop his own rhythm of feeding and sleeping. However, usually this will settle into an approximate pattern of 3–4 hourly feedings.

Volume per Feeding. For practical purposes, the total calculated quantity of milk needed for the whole day can be divided into five parts, and one fifth of the total offered to the child at approximately 4 hourly intervals (6 a.m., 10 a.m., 2 p.m., 6 p.m., and 10 p.m.).

Alternatively, if five feedings are given daily at a calculated total volume of 2½ fluid ounces per lb. body weight, then *the volume for each feeding (in fluid ounces) can be rapidly calculated by dividing the child's weight in lbs. by two.*

Practical Application in the Village. The successful practical application of these principles is very difficult in village circumstances.

Firstly, the volume of each feeding (in fluid ounces) is calculated by halving the child's body weight in pounds. The container, such as a cup, and teaspoon available to the relative should be brought for inspection, and

Table 5.—SIMPLIFIED USE OF COW'S MILK AND ITS PREPARATIONS IN THE FEEDING OF BABIES UP TO THREE MONTHS OF AGE

	Fresh Cow's Milk	*Full Cream Powdered Milk*	*Evaporated Milk*
Dilution.....	2 parts boiled milk + 1 part boiled water.	1 level teaspoon milk powder + 1 fluid ounce boiled water.	1 part evaporated milk + 2 parts boiled water.
Add sugar.....	1 level teaspoonful household sugar per feeding.		
Calculate Daily Volume	2½ fluid ounces per lb. body weight per day.		
Calculate Volume per Feed.	One-fifth of daily total at each of five feedings at 4 hourly intervals.		

Table 6.—SIMPLIFIED USE OF COW'S MILK AND ITS PREPARATIONS IN THE FEEDING OF INFANTS OVER THREE MONTHS OF AGE

	Fresh Cow's Milk	*Full Cream Powdered Milk*	*Evaporated Milk*
Dilution.....	Undiluted boiled milk.	1 rounded teaspoon milk + 1 fluid ounce boiled water.	1 part evaporated milk + 1 part boiled water.
Add Sugar.....	1 level teaspoonful household sugar per feeding.		
Calculate Daily Volume.	2½ fluid ounces per lb. body weight per day.		
Calculate Volume per Feeding.	One-fifth of daily total at each of five feedings at 4 hourly intervals.		

should then be used for practical demonstration.

Depending upon the type of milk preparation available, the relative who will be responsible for feeding the baby should be shown how much milk, boiled water and sugar to use for each feeding.

For example, an 8 lb. baby of 1 month will need 4 fluid ounces of formula at each of five hourly feeds.

If full cream powered milk is available, the relative should be shown how much 4 fluid ounces are in the cup (probably about half full), how to measure out 4 level teaspoons of full cream powdered milk and 1 level teaspoonful of sugar, and how to mix them together for each food.

The demonstration should be followed by the relative carrying out the

procedure. Cleanliness of the feeding utensils will also be stressed. If practicable, follow-up should be carried out by home visits.

(e) *Method of Feeding.* In Western countries, artificially fed babies are usually given cow's milk formula with one or other variety of feeding bottle. In good hygienic circumstances, this is a harmless procedure.

In tropical suroundings, the problem of contamination of the feed is always great and is made even more so by the use of the feeding bottle, which is narrow-necked and difficult to clean.

The feeding bottles seen in many countries amply emphasize the part they play in the development of diarrheal disease. They are, only too often, covered with dirt and mold, and with filthy, cracked and encrusted rubber or plastic nipples.

If, then, artificial feeding with cow's milk formulas has to be undertaken, the question of the best method of giving the feeding is very important.

Feeding Bottles. In some circumstances, it may be possible carefully to instruct and to demonstrate to mothers how bottles should be cleaned and sterilized, and to follow this up with supervision by means of home visiting. If available, widenecked bottles are preferable. Two methods can be used—boiling or sterilization with hypochlorite solution (Appendix X).

Consideration of the time required to prepare five feedings daily with one bottle, limited fuel, unclean water and lack of refrigeration make the likelihood, or, indeed, practicability, of home sterilization of bottles most improbable.

Other Methods. Only too often, it is virtually impossible to ensure the cleanliness of bottles for artificial feeding in tropical home circumstances. Many workers, therefore, prefer to advise the feeding of cow's milk to young children not by the bottle, but by means of a feeding cup (Figure 16) or with cup and spoon. Both of these are much longer to use.

(f) *Acid Milks.* Acidification of milk can be used to reduce the risks of bacterial contamination leading to infective diarrhea. After adequate acidification unrefrigerated milk keeps without souring for about 24 hours.

This can be accomplished by adding 1 teaspoonful of 85 per cent lactic acid (U.S.P.), or 1 teaspoonful of white vinegar (4 percent) to 16 fluid ounces of milk formula. Fresh lemon juice can also be used.

(g) *Vitamins and Artificial Feeding.* The ascorbic acid of cow's milk is destroyed during the boiling of liquid milk, or in the processing of dried

FIGURE 16.—Plastic feeding cup, easier to keep clean than feeding bottle.

evaporated products. Vitamin C should, therefore, be added to the diet from one month of age, either in the form of clean fruit juice (prepared from the best local source of vitamin C), or as ascorbic acid tablets (30 mg each day), which are often cheap and with no risk of causing infective diarrhea p. 145). This should be continued until the child is on a mixed diet which includes ascorbic acid-containing foods.

In tropical countries, extra vitamin D is not required, unless special local environmental or cultural factors prevent the infant from being adequately exposed to sunshine.

If any skimmed milk preparation has to be used for the feeding of young infants, vitamin A *must* be added to the diet.

(h) *Supplementary Foods and Artificial Feeding.* As artificial feeding with cow's milk in tropical communities at once introduces the risk of infection of the alimentary canal, and as it is not likely to be carried out adequately—that is, with sufficient amounts of milk of adequate strength—it is sometimes desirable under these circumstances to introduce the transitional diet rather earlier than has been suggested for breast-fed babies. These foods may be commenced from about four months onwards.

Use of Commercially Processed High Protein Foods.

Much malnutrition in early childhood is due to the incorrect, or insufficient, usage of foods already available locally in the village and thus can best be tackled by means of nutrition education.

However, in an increasing number of parts of the world especially in towns, people are already spending some of their money, even if they have but little of it, on advertised goods. These include infant foods, which may be quite inappropriate, both nutritionally and as regards the budgets of tropical families. One reason for the development of a low-cost, high-protein food for young children is to cater to this trend towards goods bought from the store, especially for the increasing segment of the population living in urban regions on a cash economy.

Also, in some parts of the world, no suitable foods may be available at the village level for infant feeding, or there may be great difficulties in preparing these foods for young children. Again, a commercially processed product may be valuable in filling this gap.

Scientific Considerations. Nutritionally, a suitable food for young children would have to be high in protein and, if possible, reinforced with vitamins and iron. It may be produced as a complete food—that is, containing carbohydrate calories as well and intended as a balanced intake of nutrient. Or it may be intended as a protein additive—that is, as a food which can be added to, and mixed with, foods already available in the local dietary.

The food would usually be particularly aimed at the problems of early childhood, especially the transitional or weaning period.

Socio-Cultural Considerations. A processed food would have to be acceptable in the local culture pattern with regard to flavor, appearance, cooking properties and palatability.

Also, in many places, it may be best to have a high-protein food which is capable of being used by the *whole family*, but with special emphasis for the young child.

Work in different parts of the world has also shown that the status of the product is extremely important. If possible, the food should be introduced as a high-protein food for use by all economic groups, and, to start with, it need not be particularly inexpensive. It should sell through the supermarkets as well as village stores. Ultimately, it will be possible to reduce the price of this food, which by this time should have established itself in the eyes of the villager not as a "poor man's food," but as a modern food eaten by the well-to-do.

Likewise, it is usually important to have the product considered as a food, not as a medicine. This can be best achieved if it is actually in the form of an existing local food (e.g. noodles reinforced with fish flour in Chile).

Also with the extremely limited kitchen facilities in the tropics and also with the very full and hard day's work that village mothers customarily have, an easy-to-prepare, preferably precooked, convenience food may be even more important than in the U.S.A., provided it is culturally acceptable. The "dosage" required for each child should be clear, and easy for the mother to understand and follow.

Economic Considerations. A high-protein food intended principally for young children should be cheap and, if possible, based on ingredients grown locally and processed in the country or region concerned. If possible, it should help the economic development and the employment situation in the country, introducing a new crop or increasing an established crop not previously exploited.

Ideally, the food should be made in part from some source not at present used for human food (e.g. cottonseed presscake). It should also store well, and be cheap and convenient to transport, both in bulk and at village-level.

Above all, the food should be economically and commercially viable, so that manufacturers will be able to make at least a modest profit. This may be helped by making the product a family food, thereby increasing the likelihood of sales.

Commercially Processed Protein Foods. These foods may be made of (a) animal protein, (b) vegetable proteins, or (c) animal-vegetable protein mixtures.

Animal Protein. These will be for use as protein additives and include dried skimmed milk, meat powder and fish flour.

Dried skimmed milk has been widely available from UNICEF or from other agencies (p. 191). However, in only a very few tropical parts of the world, such as East Africa, is dairying increasing sufficiently so that limited quantities of locally produced dried skimmed milk are available in the markets and shops already.

Also, it is obvious that meat powder will not be available very widely. However, again in East Africa, a pilot meat powder project has been successfully started in part of Kenya, using scrub cattle in remote rural areas which are slaughtered in field abattoirs and which would have no commercial value as butcher's meat, if driven long distances to market.

Fish flour has been prepared commercially in many parts of the world (p. 371), including certain developing countries, notably Morocco and Chile. The main difficulties are ensuring a

uniform product and also carrying out the process economically. Fish flour and fish protein concentrate have been used as additives in infant feeding in various parts of the world.

Vegetable Proteins. A tremendous amount of research is under way in different parts of the world into the better usage of sources of vegetable protein that have long formed part of the human diet, and also into the processing of relatively new sources, particularly the protein from oilseeds, including the presscake from the soybean, cottonseed and groundnut.

Geneticists are breeding new varieties, and food technologists are devising and testing more appropriate processing with a view to improving the nutritive value, lowering the cost, increasing the safety, and producing an end-result which is convenient and of acceptable taste.

Modern technology can now produce protein isolates from oilseeds; while the feasibility of reinforcing legume protein with synthetic methionine, their limiting amino acid, has been demonstrated.

Various soybean preparations, treated to increase their digestibility and reinforced with vitamins, have been tried out on a large scale for the feeding of young children and school children. The advantage of this treated soybean is that it is high in protein (up to 40 percent) and is economical in that up to the present it has been a by-product of the soy oil industry.

Soy protein concentrate (75 percent) can now be prepared; while a new process can produce a digestible full-fat flour, which, because of its high calorie content, promises to be very useful.

An interesting recent technological development has been the dehydration of *tempeh*, a well-tried traditional Indonesian soy preparation.

Vegetable Protein Mixtures. It is possible to prepare an all vegetable protein infant food, composed of a balanced mixture of two or more different vegetable proteins. The classical example is "Incaparina," developed by the Institute of Nutrition of Central America and Panama, and composed of whole corn flour, whole sorghum flour, cottonseed flour, torula yeast, calcium carbonate and vitamin A. This is sold in a powder form, in economical and convenient packets. It is easily cooked, and can be readily made up by mothers into a porridge or gruel-like food, similar to the *atole* which is the customary preparation for young children in much of Central America.

Another vegetable protein mixture is Indian Multi-Purpose Food, which is made up of 3 parts of low fat groundnut flour and 1 part of Bengal gram (Chick-pea) flour.

Animal-Vegetable Protein Mixtures. A number of low-cost, high-protein infant foods are based on a mixture of animal and vegetable proteins. Thus, in Nigera, "Arlac" is available. It is composed of groundnut flour, with 25 percent of dried skimmed milk. In Senegal, a mixture containing sorghum and groundnut flours, sugar and dried skimmed milk is under trial.

A successful product is "Pronutro," which is produced in South Africa from dried skimmed milk, whole soy and groundnut flours, wheat germ, powdered bone meal, iron, iodized salt, the vitamin B complex and sugar.

Development of Protein Foods for Young Children. This is a seemingly

simple matter, but, in fact, it is highly complex. Much endeavor and thought has been given to this matter in different parts of the world, under the guidance of various international agencies.

Initially, nutritional testing of suitable mixtures has to be carried out biochemically, followed by investigations on experimental animals, and, ultimately, by assessing effectiveness in curing malnourished children and in producing normal growth in well infants.

An investigation has to be carried out into the economic feasibility of using the suggested ingredients, including their availability in the country, their seasonal variation in price, and other aspects, which require the knowledge of an agricultural economist.

Acceptability trials have also to be carried out to see if the food is culturally acceptable—that is, whether it will be used by mothers and will fit into their traditional concepts of infant feeding and methods of cooking.

Finally, however, the success of a particular protein food for young children depends on its commercial success. Again, this is a complicated matter to assess beforehand, and depends on marketing research and ultimately on prolonged trial. It cannot be undertaken without the active participation of experienced food manufacturers who know the problems of the particular region and, preferably, already have a sales network available there.

It is apparent that the development of a low-cost, high-protein food for young children can only be achieved with the pooled knowledge of a variety of experts, including the biochemist, the pediatric nutritionist, the agriculturist, the food technologist, governmental authorities, international and bilateral agencies, and, above all else, commercial food manufacturers, with their knowledge of marketing, advertising and merchandising.

Current schemes of "food aid" by Food for Peace and the World Food Program are geared to stimulating local interest in the development of high-protein foods for young children on a commercial basis.

2. Early Recognition of Less Severe Malnutrition and Supplementary Feeding.

The early recognition of mild and moderate degrees of PCM of early childhood can best be accomplished by regular health supervision at monthly intervals at Young Child Clinics (p. 155). The practical operation of these clinics is given later.

The main objective method for the early recognition of less severe PCM is by *regular weighing at intervals to detect growth failure.* Methods of evaluating the adequacy of weight gain are given earlier (p. 84), when the importance of plotting the weights on a weight graph on the Young Child Clinic card (p. 155) was stressed.

Supplementary Feeding Programs. These aim to close the gap between the food actually available and what is needed in terms of adequate nutrition. At the same time, they are aimed additionally at teaching parents better nutritional habits and in calculating a desire for a more mixed and varied diet.

Supplementary foods may be issued widely on an entirely preventive basis, because a particular nutrient is known to be commonly deficient in the com-

munity, *or* more usually be issued to selected individuals showing evidence of early malnutrition, especially children with PCM.

The foods issued will obviously depend on the particular nutritional problem, and may be imported on a free or subsidized basis (e.g. dried skimmed milk), or may be locally produced (e.g. "Incaparina").

Supplementary feeding programs may be based on the issue of foods or supplements for mothers to take with them to prepare for their children at home. Alternatively, the supplement may be taken as such on the spot, either at a Young Child Clinic or in the home, or in the form of a meal which may be prepared and fed at a variety of places, including schools (p. 184), nutrition rehabilitation units (p. 186) or at special child feeding centers in the community.

(a) *Calorie Sources.* In situations of famine or other natural or manmade disasters, the distribution of food may be required purely to avert starvation. This will often largely be in the form of calorific carbohydrate foods, as, for example, with the distribution of maize (corn) flour in areas of Africa during exceptional drought conditions. These foods may also be accompanied by limited quantities of protein-rich supplements, in which case it is important to see that adequate shares of these should go to the more vulnerable segments of the community, especially young children.

(b) *Vitamin Supplements.* In tropical regions, the mass issue of multivitamin tablets is to be avoided. These are not usually priorities and tend to divert attention and finance from more important nutrients, especially protein.

However, in some areas, as has been noted, certain specific vitamin deficiencies may be highly important, and indeed may reach the dimensions of public health problems. Under these circumstances, it may be desirable to issue appropriate vitamin supplements to selected groups at risk.

For example, in areas where vitamin A deficiency is a common cause of blindness in young children (p. 87), naturally-occurring sources of vitamin A may be issued, especially red palm oil or fish liver oil. If children are difficult to reach, it may be considered practicable to give them vitamin A by mouth or by intramuscular injection, which will last for several months.

Likewise, where rickets is an important childhood disease, it may be considered desirable to issue this vitamin as a supplement to all children from 6 months to 2 years of age in the form of vitamin concentrate, or as naturally occurring vitamin D in fish liver oil. Once again, a long-acting intramuscular injection of vitamin D way be an alternative approach.

If infantile beriberi is a problem (p. 19), thiamine can be administered to pregnant and lactating mothers, either in the form of the vitamin itself (20 mg/day) or as a naturally occurring source, such as *tiki tiki* (fresh extract of rice bran), or gram soup.

An additional supplement that must be mentioned is that of iron, which may be required by pregnant mothers in some parts of the world where iron deficiency anemia is common. This can sometimes be usefully issued in the form of inexpensive ferrous sulphate tablets (one 0.1 g tablet per day during the last three months of pregnancy).

It may be noted that in some circumstances the supplement should be given as a *medicine* rather than as a food. In the Western world this was the case with cod liver oil which was widely used to prevent rickets, as well as with medicinal iron to prevent iron deficiency in pregnancy. In Indonesia, this has been found to be an acceptable approach with the use of red palm oil in the prevention of vitamin A deficiency.

(c) *Protein Supplements.* These may be issued free or at a subsidized low cost through the health service, community development clubs or other channels. Although the various foods already mentioned (p. 112) may be included in this category, such as soy preparations and fish flour, in practice low-fat (dried skimmed) milk is widely used and an understanding of its optimal use is highly important as is the use of more recently introduced CSM (p. 181).

However, it seems certain that dried skimmed milk will be much less available in tropical countries in the near future, and may then have to be reserved for treatment of severe PCM (p. 73). Under these circumstances, the most appropriate alternative protein supplement must be decided on for moderate PCM, and a policy worked out by health and nutrition authorities for issue and practical usage.

Ultimately, it is hoped that this may be a locally produced low-cost, high-protein food. Until such are available, it may be necessary to issue available vegetable protein sources, such as, for example, groundnuts, either whole or as flour, or various legumes.

Dried Skimmed Milk (DSM) or Non-Fat Dried Milk (NFDM). The use of dried skimmed milk has had much influence on the nutritional scene as far as young children are concerned in tropical developing regions in the last decade or so. It is, therefore, important to understand its sources, advantages and disadvantages, and best usage.

Sources of DSM. The majority of the DSM used in tropical regions is derived from the U.S.A. where its production has, to some extent, been related to the production of the butter and cream industry. It has been supplied by the U.S.A. in extremely large quantities through CARE, Catholic Relief Service, AID and UNICEF.

Much of the DSM reaching developing countries has done so under the aegis of UNICEF, who is responsible for its transport as far as the port or border town in the particular country. Thereafter, the storage and distribution is the responsibility of the Government concerned. Both of these often pose extremely difficult problems, owing to lack of storage space, insufficient staff to supervise adequate distribution, and shortage of transport and fuel to carry this out. Nevertheless, UNICEF quite rightly insists on a reasonable degree of efficiency and accountability in this regard.

Packaging. The packaging of DSM has changed over the years. Currently, it is most usually available in large reinforced cardboard boxes containing 54 lbs., with individual smaller boxes of 4½ lbs. each inside individual plastic polythene bags.

UNICEF dried skimmed milk is now reinforced with both vitamins A and D (p. 21) to make good the fat soluble vitamins that have been removed during the manufacturing process.

Usage and Method of Issue. The correct use of DSM also poses a number of problems. Ideally, it might be

best for the reconstituted liquid milk to be drunk by the child on the spot, thereby ensuring that it is not misused. This is, however, rarely possible owing, amongst other things, to distances involved and difficulties incident to children's attendance; also, uncertainty with regard to the child's appetite. This method may occasionally be of value in some village circumstances, where supplementary feeding centers may be set up.

More usually DSM is issued in its powder form. Instructions may be given to reconstitute this as a liquid milk, but there is no doubt that it is better to use this high-protein powder as an additive—that is, mixed with the child's other foods.

DSM has often been misused—for example, sold to village stores or used in parents' tea. Various methods have been suggested to prevent this, such as issuing it mixed with groundnut flour or by adding a pinch of gentian violet powder to each 4½ pound container.

(d) *Selective Issue.* Unless under famine or other very serious nutritional circumstances, DSM or other protein supplement should be issued to vulnerable groups on a selective basis. Its too universal use means that the issuing site becomes a food distribution point alone, with the staff's limited time taken up with this alone and with too little of its attention devoted to other important matters, especially to nutrition education.

The selection of priority children to receive dried skimmed milk will depend upon local circumstances and also upon the amount of DSM available. In malnourished women with inadequate lactation, it may be more suitable to issue DSM to the woman herself to improve the output of her breast milk, rather than to attempt the hazardous addition of reconstituted liquid DSM fed to the young child with all the problems of infective diarrhea that are likely to occur.

Priorities. In many tropical circumstances, DSM can be best allocated according to the following priorities:

(i) Severe PCM (kwashiorkor and marasmus) top priority with DSM reconstituted as liquid and fed to the child, preferably in hospital, when reinforced with calories in the form of sugar and, if possible, vegetable oil (p. 129);

(ii) Moderate PCM—with weight for age between 80 to 60 percent of standard, or with failure to gain weight (p. 173) or with arm circumference measurements below 80 percent standard (p. 86), to be advised on the best high-protein diet, based on local foods, together with DSM issued as a powder for mixing in with diet for 1–3 months, with follow-up and serial weighings fortnightly.

The criteria will obviously have to be adjusted to the commonness, or otherwise, of PCM in the area. Also, with certain decreasing availability of DSM in tropical countries in the coming year, it is probable that more stringent selection will be required.

Practical Use of DSM. A simple method of reconstituting DSM with sugar and, if possible, oil is given elsewhere for the treatment of severe PCM (p. 80).

When DSM is used for the supplementary feed of moderate PCM, a mother should be advised to add *five level teaspoons* (each with a volume of 5–6 c.c.) *to the child's feeds three times daily.*

If this type of instruction is given, a full 4½ lb. polythene bag of DSM, as issued by UNICEF at the moment, will last the child for approximately 4 weeks. However, it is often desirable to issue milk for a shorter period than this, as if large quantities are given out they may become contaminated or, regrettably, be misused as, for example, sold or used in the adult's tea. It may then be thought preferably to issue smaller quantities. This is best done by arranging for the DSM to be repackaged in suitable sized (often 1 lb.) paper or preferably polythene bags for issue to mothers. If the DSM is issued in paper bags or tins supplied by the mothers the likelihood of it becoming hard and lumpy, or contaminated is very considerable. Undoubtedly the best way to issue the DSM is in polythene bags closed with an elastic band, although, of course, the cost of these has to be considered.

Dried skimmed milk is an extremely valuable commodity in dealing with the problem of PCM in young children in developing tropical countries. It is the basis of economical treatment of severe cases (p. 73), and is also an excellent protein supplement for the rehabilitation of young children with moderate PCM. It also has the advantage of attracting mothers to attend Young Child Clinics and, hopefully, may draw the attention of a country's politicians and administrators to the problem of protein shortage.

It is, however, by no means a long-term solution to the problem, and, *it must always be combined with nutrition education as to the best use of local foods, and must always be paralleled by attempts within the country itself to produce a suitable protein supplement to take the place of DSM, when, as is probable in the near future, it is no longer available.*

3. Prevention and Management of Conditioning Infections

Infections of various sorts have great nutritional consequence (p. 72), and, in trying to combat malnutrition in young children, it is of importance to try to prevent or minimize the effects of bacterial, viral and parasitic infections.

This can be attempted in three ways, all of which approaches are required: (a) specific prevention of infectious diseases, (b) recognition and management of common childhood illnesses, and (c) improved environmental sanitation.

Specific Prevention, Infectious Diseases. Many infectious of nutritional importance may be prevented by means of immunization, including measles, whooping cough and tuberculosis.

(a) *Infectious Diarrhea.* Diarrhea in early childhood is most often due to bacterial infection of the alimentary canal. Its commonness can be reduced by breast feeding in early infancy, by cleanliness with regard to feeding utensils and food, and by the use of clean, boiled water for drinking.

(b) *Worms.* Intestinal worms, especially the roundworm and the hookworm, also add their nutritional burden to the young child, especially if present in large numbers. The prevention of these parasites is largely concerned with trying to ensure the disposal of feces in well-constructed latrines.

(c) *Malaria.* In areas where malaria is highly prevalent, it is justifiable to try to issue antimalarials to young chil-

Table 7. SUMMARY OF IMMUNIZATION PROCEDURES FOR YOUNG CHILDREN IN RELATION TO NUTRITIONAL CONDITIONING INFECTIONS AND OTHER IMPORTANT INFECTIONS

Disease	*Vaccine*	*Storage*			*Method*	*Lowest*	*Interval*
		Main	*Transport*	*Dose*			
(1) NUTRITIONAL CONDITIONING INFECTIONS							
Whooping Cough, Tetanus, and Diphtheria.	"Triple Vaccine."	Lower part of refrigerator.	Cold Boxes with gel bags (or) large thermos.	0.5 cc on 3 occasions.	Intramuscular injection (outer side of thigh).	1 mo.....	1–3 months.
Tuberculosis B.C.G.	.....	"	" (Protect from light).	Once.....	Intradermal injection.	Birth.....	—
Measles.....	Live Vaccine...	"	"	Once.....	Subcutaneous or intradermal..	9 months.....	—
(2) OTHER IMPORTANT INFECTIONS							
Smallpox.....	Calf Lymph....	"	"	Once.....	Multiple pressure method.	Birth.....	—
Poliomyelitis	Oral.....	"	"	3 drops orally on 3 occasions.	By mouth.....	1 month.....	1–3 months.

dren during the special danger period from 6 months to 2 years.

There is the obvious risk that by so doing there may be an interference with the development of natural immunity, but this method has the advantage that it postpones the child's main struggle for co-existence with the malarial parasite until after the age of greatest nutritional strain.

The use of antimalarials during this period is especially worthwhile if there is some other indication, as, for example, if the child is already showing some degree of PCM, as judged by failure to gain weight (p. 72). The best drug to use will vary with different communities, depending upon the drug sensitivity of the local species of malarial parasite. "Daraprim" (pyrimethamine) ½ tablet (12 mg) once weekly is often suitable, especially as it is relatively tasteless. Chloroquine ½ tablet (75 mg) once weekly may be used instead.

Alternatively, some workers advise the issue of one tablet (25 mg) of "Daraprim" monthly, to be taken when attending the Young Child Clinic.

Recognition and Management of Common Childhood Illnesses. A major part of the prevention of the nutritional ill-consequences of childhood infections is their recognition at an early stage, and their correct management and treatment before they have become too advanced.

The importance of a good diet during and following infections requires stress, especially as in some communities it is customary to limit food intake drastically during childhood illness.

While obviously the recognition of the early stages of some conditions requires prolonged experience and medical training, some of the relevant commoner childhood infections mentioned can be detected quite easily.

Their recognition, based on certain elementary symptoms and signs, and their simple management are given in Tables 8 and 9. If the management of these conditions is to form part of the particular program, appropriate instructions will have to be given to field workers prior to going overseas, later reinforced by practical demonstration and supervised experience in the country in which the program is being developed.

Training should include how to carry out a head-to-foot examination of children and the recognition of the following physical signs—anemia (moderate and severe), conjunctivitis, dehydration (depressed fontanelle, inelastic skin, sunken eyes), edema, ear discharge, fever, hair changes (light colored, sparse, straight, silky), measles rash, rapid respiration, scabies rash, spleen enlargement and the whoop of whooping cough.

Improved Environmental Sanitation. Much improvement in infectious disease of nutritional consequence could be expected as a result of improved hygiene in the village, leading to clean food, clean water and a clean home.

In most countries, one or more governmental agency is concerned with village improvement, often the Community Development Department. Plainly, advice is required as to the regional policy and as to methods found to be suitable in the area. These are usually available in booklet form, and will include improvements to:

(a) The homestead, both in con-

struction of the walls, roof and windows, and in interior furnishings, such as corner cupboards, mosquito nets, and so forth;

(b) The outbuildings, especially the kitchen (stove, food storage), the bath place, the latrine, and so forth;

(c) The compound (e.g. rubbish disposal, mosquito breeding, rats, flies);

(d) The water supply (e.g. protected spring, storage pots, home-made filter);

(e) The market place;

(f) The roads;

(g) The community center.

Table 8.—RECOGNITION AND SIMPLE MANAGEMENT OF EARLY CASES OF SOME COMMON CHILDHOOD ILLNESSES [1]

Condition	*Recognition*	*Management*
Pneumonia	Fever Cough Rapid breathing	Penicillin course, or Sulfadimidine course
Measles	Fever Cough Red eyes Fine rash	Sulfadimidine course Protein supplement (e.g. DSM) Advice on feeding
Whooping Cough	Cough (with whoop) Fever	
Diarrhea	Loose watery stools Dehydration (sunken eyes and and fontanelle, inelastic skin)	Large quantities of sugar-saline by mouth (Table 9) Do not stop milk feeds
Clinical Malaria	Fever No rash or rapid breathing	Chloroquine course
Roundworm	Worm passed in stool or vomited	Piperazine
Accidents	Kerosene swallowing	Do not wash out stomach Penicillin Hospital
	Burn or scald	Cover with clean cloth Penicillin Hospital
Anemia	Weakness Pale "red" of eyes (conjunctiva)	Iron course Chloroquine course Treat hookworm
Scabies	Itchy rash between fingers and elsewhere	Application of benzyl benzoate emulsion or tetmasal soap for family
Conjunctivities	Red eyes with discharge	Apply tetracycline ointment three times daily
Ear discharge	—	Soak discharge from outer end of ear canal with thin stick or applicator twice daily. Instill boric and spirit ear drops

[1] To be considered if neither health service nor microscope available nearby, and if included in training. Failure to respond indicates need for further adivce.

Table 9.—BASIC DRUG DOSAGE FOR TROPICAL VILLAGE CHILDREN

Drug	*Dosage*
Penicillin course	*Single* dose—1.2 million units benethamine penicillin by intramuscular injection. (or) *Daily* dose—400,000 units of procaine penicillin for 5 days by intramuscular injection.
Sulphathiazole course	1–2 tablets 6 hourly for 5 days (1 tablet=0.5 gm)
Sugar-saline for dehydration [1] (½ teaspoon salt, 6 teaspoons sugar to 20 fluid ounces boiled water)	*EXTRA* to milk feeds: 10 lb. weight—40 fluid ounces/day 20 lb. weight—60 " " " 30 lb. weight—80 " " "
Chloroquine course	½–1 tablet daily for three days (1 tablet=150 mg)
Piperazine	Single dose 2–4 gm by mouth

[1] Demonstrate to mother how to feed child with a few spoonsful at a time between feedings. Arrange for mother to commence to give sugar-saline for 1 hour or so under supervision.

4. Improved Treatment of Severe Malnutrition

In countries where severe malnutrition in the preschool child is common, it is obvious that adequate treatment facilities for these severely afflicted children should be a priority. This is necessary not only on humanitarian grounds, but, in addition, because it is important to demonstrate a convincing ability to cure, if it is hoped to be able to persuade parents with nutrition education aimed at prevention. The educational aspect of efficient treatment cannot be overestimated.

Methods. Treatment of severe PCM is outlined elsewhere (p. 79). It is essentially based on the feeding of a high-protein, high-calorie diet, given in the form of approximately calculated quantities of a milk formula (p. 80), followed by the introduction of high-protein foods from the local diet.

The after-care of PCM by correct feeding at home is just as important as the cure of the disease itself. Vigorous health education is therefore essential, and for this to be effective, the same foods that the mother is to give at home must be prepared in the wards. She must be shown how to prepare both the specially cooked dishes and how to improve the average family diet. While in the hospital the mother should not only see them prepared but help to prepare them herself—"If I do it, I know."

It may be possible for the mother to help to grow the foods that have been used to cure her child in the hospital. If it is desirable to introduce new strains of such crops as legumes into the area, she should be given the seeds to take home with her. The purpose of a hospital garden is to make this kind of nutrition education realistic.

Sites. Treatment of severe cases is best undertaken in the hospital ward, but may have to be carried out in the outpatient clinics attached to hospitals, health centers or mobile units, or in "nutrition rehabilitation units," or in the home itself.

The Field Worker and Treatment. Adequate curative services imply that the politicians and administrators of a country must be aware that the problem

of childhood malnutrition exists and they will, therefore, be willing to divert some of the limited finances to these services. This awareness is not always present, so that suitable modest buildings, food supplements and, above all, appropriately trained staff may not be available in sufficient quantities.

Under different circumstances in various parts of the world, the worker may find himself treating children with PCM, or, if health services are nearby, in assisting in treatment carried out in them.

Nutrition Rehabilitation Units. The concept of the Nutrition Rehabilitation Unit has been developed recently as an approach to both treatment and to nutrition education. Such units may be practicable and helpful in some parts of the world.

For a Nutrition Rehabilitation Unit, a building is required, preferably of cheap, easily available local materials and often contructed by "self-help" or community development endeavor, in which young children suffering from malnutrition may be rehabilitated by means of nutritious diets based on local foods for the most part prepared and cooked by the mothers themselves with customary cooking methods. This, it is felt, has the double advantage of returning the child to a near normal nutritional state and, even more importantly, acts as a profound educational experience for the mother herself.

Various forms of Nutrition Rehabilitation Units have been developed in different parts of the world. In some, mothers stay in residence with their children for several weeks at a time (Appendix VIII). In others, children are left during the daytime only, with one or two of the mothers in charge of the cooking of food and feeding of the children.

If Nutrition Rehabilitation Units are built of cheap materials, employ limited junior staff and helpers from the village, and use basic kitchen equipment and economical local foods, they may contribute significantly to the low-cost treatment of malnutrition and also to nutrition education in the community.

Such units should not cater to more than a small number of children, probably not more than 20 in all, and, whenever possible, they should be under supervision by health staff, because of the risk of intercurrent infection in these young children. In some places, it may be possible for a field worker to initiate or to supervise the development of a Nutrition Rehabilitation Unit.

Whenever feasible, the units should also incorporate other aspects of nutrition education and village improvement, such as a demonstration garden, an improved kitchen, and so forth.

5. Increased Village-Level Food Production

Much malnutrition in childhood could be prevented by increased village-level food production, storage and preservation. This can be put into effect through school gardens, cooperative efforts, and in home gardens or farms, often in cooperation with various types of Youth Clubs.

The Home Garden and Its Potential. The home garden forms a natural and important segment of an agricultural subsistence economy, as from it can be obtained the supplementary nutrients, notably the vitamins and iron, that are usually lacking in the staple diet.

Gardens adjacent to the house often have a rich fertile soil, and a considerable variety of plants can be grown conveniently near the kitchen with little labor. They are often semi-wild and are easy to propagate.

These mixed gardens are particularly suited for such leafy vegetables as varieties of tropical spinach, for such "fruit vegetables" as tomatoes, eggplants, okras, and red peppers, and for such fruit and leaf vegetables as gourds and pumpkins.

So-called "permanent crops" can also give a continuing yield for years, including various fruit trees, such as citrus, the papaya, and the banana, as well as the coconut, the red oil palm and the pineapple.

A principal aim should always be to use local plants, which are resistant to disease and adapted to the soil and climate, rather than imported plants, such as the cabbage or cauliflower, which are also often less nutritious.

Increased yields of locally suitable legumes should also be an important objective, both in gardens and particularly between field crops. The aim should be to ensure adequate year-round supplies, particularly for the diet of the young child.

Increasing Agricultural Productivity. This is a very wide subject and the field worker, can, of course, in no way be expected to be an expert or authority. However, there are certain areas of great importance on which information can be sought from agricultural extension workers in the country, concerning the best practical advice for the village circumstances. Some practical reference books are suggested at the end of the chapter.

Major topics will include:

(a) *Soil Fertility.* Much can be done to augment agricultural productivity by increasing the soil fertility, either with appropriate chemical fertilizer, or, more logically, by ensuring rotation of crops and fallow periods, and with the use of organic manure in the form of animal dung, compost, or green manure. In particular, a knowledge of the best local method of preparing a compost heap is often of real practical value.

(b) *Seed Selection.* In some countries, the agricultural extension services are in the process of trying to popularize new varieties of seeds, which may have a higher yield, or be disease or pest resistant. The field worker may assist in trying to introduce "starter" supplies of these new varieties of seeds and to demonstrate their value.

(c) *Soil Erosion.* The prevention of soil erosion may be achieved in some cases by relatively simple means, including ridging, crop rotation, hedging, and so forth.

(d) *Maintenance of Crops.* The yield of a particular crop is related to how well it is maintained, that is how it is irrigated, weeded, and kept free of pests and diseases.

(e) *Storage.* As noted several times (p. 45), an extremely high wastage of crops occurs after storage due to the depredations of rats, molds, and insects.

Sometimes indigenous storage granaries may be improved simply. Rat proofing may be assisted by ensuring that they are tightly closed with no holes, and preferably raised on legs. Molds are less likely to be widespread if the grain or legume is dry before storing; while insects may be kept at

bay by mixing in suitable insecticides that are nontoxic to man.

(f) *Marketing.* New ideas concerning marketing may be possible, and advice on "farm arithmetic" concerning, for example, yields and accounts may be welcome in some places.

Cash Crops. Although there is little doubt that in many countries cash crops are over-emphasized at the expense of food crops, at the same time is is important to have an outline knowledge of the cultivation of the area's cash crops which may include cotton, coffee, cocoa, tea, and so forth.

By appreciating the basic problems and by knowing the usually straightforward advice given by agricultural extension workers to increase the yield of cash crops (e.g. by spraying cotton with appropriate insecticide), it is likely that assistance and ideas concerning other matters may more likely be followed.

Animal Protein Production. Methods may be available, but not appreciated by villages, for the improvement of existing livestock, as, for example, by immunization of cattle.

In addition, in some areas it may be sound animal husbandry policy to introduce and popularize new sources of animal protein or improved methods of production. These may include:

(a) *Pig rearing.* If culturally acceptable, swine can be an economical and efficient way of producing animal protein.

(b) *Poultry.* Chickens are often kept in the tropics on "free range". While not often possible for the peasant farmer to be able to afford to introduce the "deep litter system", especially on a large enough scale to make a profit, it is frequently practicable to increase the egg yield with "restricted range" rearing, using a simply constructed poultry pen, with advice on feeding and disease prevention.

(c) *Fishponds.* Fish culture represents one of the best ways to make animal protein available to populations living inland. This may exploit existing water areas, such as ponds or flooded rice fields, but in many areas is carried out in specially dug fish ponds, preferably using marginal, agriculturally unproductive land.

In countries where fish ponds are being developed, advice on the best local methods of construction, stocking, feeding and cropping will be available from the fisheries authorities.

(d) *Various small animals,* including rabbits and guinea pigs.

Applied Nutrition Programs. Various governments in different parts of the world have undertaken Applied Nutrition Programs, with the assistance of FAO, WHO, and UNICEF.

They are a practical approach to the increased production of better quality foods at the village level, thus ensuring that families, especially young children, enjoy a more varied and nutritious diet than previously.

Activities center on gardens at schools, in the homes, or those run cooperatively by the community, and aim at the improved production of vegetables (especially legumes), fruits, and animal protein, in the shape of poultry (and eggs), small animals and fish.

Programs are intended to interest and to be of educational value for various groups, including those in authority, school children and the villagers themselves. They are also combined with nutrition education activities intended to encourage and ensure greater consumption of the foods produced, especially by young children.

In addition, Applied Nutrition Programs include training activities for those involved, such as courses and in-service training for technical personnel, school teachers, club leaders and voluntary workers.

6. *Child Spacing*

Plainly the problem posed by the population explosion varies in urgency in different countries, depending on the availability of arable land and on the efficiency of food production. However, of recent years in the developing parts of the world as a whole, despite some increase in total food production, the food production per head has declined. Also as a rule, high human fertility characterizes the developing countries. The result is that the rapid growth of population is constantly outstripping economic growth, and, because of this, is always ahead of the development of social services and employment opportunities.

Rising Expectations. Unless the birth rates in many developing countries can be reduced, standards of living of those populations which depend on economic development, food production and available social services, cannot begin to rise in the way intended by national planners and hoped for by the common man.

Family Decision. The decision to try to limit family size and space pregnancies has to be made by *both* the parents themselves. They are not likely to appeciate the national or world problem, and even if they do, they are not likely to be motivated by this knowledge.

At the family level, much more persuasive are the obvious problems posed by too many mouths to be fed on food from a small cultivation, or the school fees to be paid with a limited income.

Methods. These will have to be cheap, culturally and religiously acceptable to both parents, without serious side-effects, and involve little change in customary sexual behavior. At present, the plastic intro-uterine device (IUD), in one of its various forms, seems most widely suitable.

Trend-Setters. Experience has shown that the first group to indicate a practical interest in family planning is often the well-to-do urban elite, and, although this affects the main problem not at all, their importance as trend-setters for the particular community or country is likely to influence future developments.

Sites for Family Planning Activities. The question of introducing family planning services has to be approached with great care and diplomacy in relation to existing cultural, religious and political attitudes by the authorities and by the people themselves.

While these services often commence at separate clinics frequently run by voluntary organizations in towns, it is most desirable to include them as a part of maternal and child health services, such as pre-natal and Young Child Clinics.

The practicability of suggesting family planning will obviously depend on local circumstances. However, the field worker should be aware of the arguments for and against family planning, especially those relating to child nutrition. *Whether anything further is feasible will have to be decided by the supervisors of the particular project.*

It may, for example, be possible to talk unobtrusively about problems of an over-large family and to know where to refer those interested, if, indeed,

such a clinic is available. Simple devices, such as the condom, and creams, such as spermicidal preparations, are usually available in the local shops in towns. These do not require a doctor's prescription, as "the pill" does, or skilled personnel to insert, as the IUD does. Often the most important first step is simply to point out to parents the advantages of using these locally available supplies.

Finally, it should be pointed out that for the individual family, infant lives saved through improved nutrition, immunization and healthier environments make it desirable to space future pregnancies. The same number of children will survive to enter school as before family planning and the other health advances were introduced. The advantage is reduced wastage of human resources as maternal, infant and child deaths.

7. *Programs*

The concept of the Preschool Protection Program (P.P.P.) was introduced in 1963, when the wide range of activities that could be included was outlined, ranging from health supervision of young children to such important over-all aspects as raising the economic level of communities and the improving of agricultural production with due regard to the nutritional needs of the population, especially young children.

In the future, it is envisaged that many nutrition projects organized by field workers, including Peace Corps Volunteers, will in effect, be Preschool Protection Programs [1] developed as a major part of village improvement schemes, often initiated in a limited area, and adapted to the availability of existing health and extension services.

Aims. Six main methods of combating childhood malnutrition have already been suggested with nutrition education, running through all of these activities: (a) improved feeding of young children, (b) early recognition of less severe malnutrition and supplementary feeding, (c) prevention and management of conditioning infections, (d) improvement of treatment for malnourished children, (e) increased village-level food production, and (f) child spacing.

Some or all of these methods can be incorporated in a P.P.P. The aspects to be included or emphasized in a specific program will depend on the area's problems and needs, on existing services and other circumstances.

Reaching the Preschool Child. The problem essentially is how to *reach* a significant percentage of the preschool age population, and their parents, both in remote rural areas and in urban slums, with a program designed to improve the health, welfare, and standard of living of families, with special reference to the nutrition of young children.

In the rural circumstances often found, this implies in practice taking the program to the village, either by means of mobile services, or, preferably by having field workers living in rural areas.

It is apparent that when field workers are living near to villages or developing areas of towns, they will be in an excellent situation to try to initiate, develop, or assist in a Preschool Protection Program, together with the village

[1] Medical aspects of these programs have been termed "Young Child Health Services" or "Under-Fives Health Services."

people themselves and, if possible, with national coworkers.

Sites of Activity. A P.P.P. may include activities in several, or all, of the following places—a health center, a nutrition rehabilitation unit, a day care center, a Young Child Clinic, a hospital, village extension activities, religious meetings, clubs, formal and informal meeting places (such as markets), homes, and, very likely on the worker's doorstep, or at any other opportunity.

It is possible that the area of operation will be far away from the main services, so that, while ensuring liaison and contact for technical supervision, advice, consultation, and referral, a P.P.P. may have to be planned to be carried out entirely by national and foreign nonhealth trained staff, together with the villagers themselves.

(a) *Young Child Clinics.* The basis of much practical work directed at combating malnutrition in young children is by means of health supervision, which permits preventive measures to be put into practice, as with nutrition education and immunization, infectious diseases to be recognized and treated, and malnutrition to be detected at an early stage by examination and regular weighing, so that appropriate measures can be taken.

Health supervision is based on the regular observation of young children, usually at monthly intervals.

Sometimes this can be carried out, at least in part, by home visiting. More usually, health supervision entails attendance of the mother and child at some form of Young Child Clinic (Y.C.C.).

Depending on the distribution of houses in the particular region, one or more Y.C.C.'s may have to be developed by the field worker to serve the area. Sometimes one may be adequate, but if dwellings are widely scattered or if the area covered is large, Y.C.C.'s may have to be held at several locations on different days of the week, in the form of mobile clinics serving nearby settlements.

Site. The physical structure of these clinics is unimportant, provided they are adjacent to the people concerned, acceptable to them and relatively weatherproof, as regards rain and tropical sun. They can, therefore, be carried out in the open air, under a tree, in a school house, in a hut lent by the village or anywhere else.

Functions. Wherever they may be, their function will be a combination of prevention and curative work, including, therefore, examination (particularly weighing), early treatment, supplementary feeding, immunization, prevention of important infectious diseases and, above all else, nutrition education. In all cases, it is of the greatest importance to ensure, however, that the preventive aspects of the clinic should always be the main priority, constantly before the eyes of the organizers of the clinic as their principal aim and concern.

Sequence and "Lines of Flow." Young Child Clinics should be organized to run in a certain sequence from one "station" to the next, often in the following order: (a) registration, (b) weighing, (c) nutrition education by group discussion-demonstration, (d) examination and counseling, (e) immunization (if feasible), (f) issue of food supplement and/or medicine (if required.)

If facilities exist for simple laboratory tests, as may occasionally be the case, a separate "station" should be set up for this purpose.

Registration. Many different systems of records can be used. It is usually helpful to have a book kept at the clinic in which the names of those attending can be recorded on each occasion, together with a *brief* note of any procedure, advice or decision on management (e.g. home visiting required).

At the same time, experience has suggested that a Young Child Clinic card, often kept by the mother, can form the best record of weight, immunization, antimalarial drugs, diet, nutrition and illness.

One type of Y.C.C. card is used in Uganda. On the front page, social identification data are recorded, while space is available for recording information concerning immunizations and the issue of antimalarial drugs.

The inner pages are divided into three columns for recording the date, the weight and a blank column for brief notes on feeding, results of examination, and advice given.

When unfolded the card contains a graph, on which the child's weight can be plotted. Three curves are marked on this—the "standard" (100 percent), and 80 percent and 60 percent of this standard. Children's weights may be compared with these levels and appropriate action taken. Also serial measurements can be made to see if growth is occurring satisfactorily or not (p. 85).

In some circumstances, these cards can be issued to mothers in a plastic container and can act as permanent, readily available health records, which can be available if children attend a distant hospital or health center.

Cards may be lost, but, if their importance is understood by mothers in relation to continuing care of their children, they are often kept conscientiously.

These cards also have considerable educational value, as regards health and nutrition, especially the weight records, which sometimes unsophisticated mothers seem able to appreciate.

Weighing. Weighing, especially serially is the most important method of detecting early protein-Calorie malnutrition of early childhood (p. 84), and also can be valuable nutrition education for the mother, provided she is kept informed.

The scales employed must be sturdy, inexpensive, easily transportable, and accurate to within the limits required, usually to 0.1 kg or 4 oz. When in use, the machine must be checked twice daily through the complete range of weights envisaged by the use of objects of known weight available for this purpose. The scales should be corrected in the light of the tests, or, less satisfactorily, allowance made in the results.

Beam, or lever, balance scales are preferable, as they are less likely to be inaccurate if carefully looked after. Their accuracy depends, however, on the integrity of their knife-edge balancing part or fulcrum.

Beam balance scales are usually of the familiar type supplied by UNICEF for young children, measuring up to 16 kg (35 lb) with increments of 100 g (approximately 4 oz or the platform type for adults or older children. Both are rather heavy to transport and can become mechanically inaccurate after jolting on a rough road journey. The

use of a locking device or wedging the moving parts before journeys is advisable. They must be used on a firm, non-tilted surface, and checked before use.

Technique. Young children should be weighed nude. If bells or heavy charms are worn, as in some rural communities, they should be removed, if permissible and practicable. Otherwise due allowance should be made for their weight.

With careful attention to technique, relatively passive infants can be weighed on most scales. The problem is more difficult with larger, more active 1–4 years olds. With apprehensive young children in rural tropical surroundings, it may sometimes be best to use an adult platform beam-balance scale to weigh the mother alone, and then weigh her carrying her child. The advantage of this method is that the child is calmed by the mother, so that time is saved and accurate recordings can be made. The disadvantage is that two weights have to be recorded and subtracted, so that the risk of clerical error is increased.

The accurate weighing of young children is by no means easy, and should only be carried out by a trained person under supervision, using carefully checked scales.

Standards of Reference. Weight measurements can best be compared with locally prepared standards (p. 84), if such exist. More usually, general standards of reference have to be used (e.g. the Harvard Standards for young children, as shown in Appendix III.

Nutrition Education. The Y.C.C. is an excellent site for nutrition education, especially using well planned group discussion demonstrations (p. 112). A model garden and house adjacent to the clinic can be valuable visual aids.

Examination and Counselling. Children attending the Y.C.C. should be examined nude for certain basic, predefined signs of malnutrition and relevant infections.

The history taken from the mother should inquire principally into the child's diet. If the interview mainly emphasizes illness, the preventive objective of the clinic may be lost sight of.

Counselling to individual mothers concerning their children's health, diet and need for supplementary food, immunization or medicine is an important educational aspect of the clinic, which overlaps to other waiting mothers, who will be listening.

Immunization. This will depend on the immunization activities in the particular program, and on the methods used.

Details of equipment cannot be given here, but will include appropriate syringes, needles, cooling apparatus for the vaccines, and so forth. A synopsis of commonly used technics is given earlier (Table: 7).

Food Supplements and Medical Treatment. Supplies of food supplements should be available for issue to selected children who require them. This may take the form of dried skimmed milk or other protein supplement, or source of some other nutrient, such as iron (as ferrous sulphate), thiamine, red palm oil, fish liver oil, and so forth.

The quantity and method of distribution must be planned beforehand and can often be made easier by prepackaging suitable quantities.

Food supplements may be appreciated more if a nominal charge is made.

Also the sale of small, cheap, subsidized saucepans and a teaspoon may be most helpful in the preparation and feeding of semisolid foods designed especially for young children.

The drugs available for simple treatment will depend on local problems and needs, and on the program policy.

The following is a simple and economicai basic list of drugs, which may be suitable in some circumstances:

Eye Infections: small tubes of sulfacetamide (10%) and tetracycline (1%) eye ointments.

Skin Disease: gentian violet (1%) aqueous solution; benzyl benzoate emulsion; benzoic acid ointment.

Ear Infections: boric and spirit ear drops.

Various Infections: (including pneumonia) benethamine (long-acting) penicillin (1.2 million units); sulfadimidine tablets; small quantity chloramphenicol capsules.

Malaria: chloroquine tablets, daraprim tablets.

Intestinal Worms: Piperazine tablets, bephenium packets (or tetrachlorethylene)

Miscellaneous: dressings, bandages, and so forth.

Paper is needed to wrap up the tablets. Squares of newspaper can be prepared beforehand, or small inexpensive envelopes purchased. A packet of wooden tongue depressors should be available for dispensing ointment, together with a supply of small bottles and boxes.

If any drugs are to be issued, the dosage schedule and method of administration will have to be learned (p. 146).

(*b*) *Planning a P.P.P.*

Selection of Area. The selection of the area within a country for a particular P.P.P. will best be decided upon by national authorities and governmental technical services, together with the organizers and planners of the program. In practice, the area selected will depend on many factors, including the nutritional needs and problems, and the backing, cooperation and enthusiasm of local leaders.

Community Diagnosis. The program should always be based on the maximum use of available information concerning the locality, including: the types of malnutrition most prevalent; the causation of malnutrition in the district; the local pattern of infant feeding; existing foods and their cost and availability; methods of food production, preparation and preservation, cooking practices; and the existing services, formal and informal, in the district which are already trying to work towards village improvement and, more specifically, the betterment of the nutrition of young children. These may include government extension agencies, village clubs, religious groups, and so forth. Relevant aspects of the local culture pattern (p. 61), including social organization and community leadership, are also obviously important; as is the pattern of housing, e.g. whether in villages or in more scattered homesteads or settlements.

In addition to information obtained by prior inquiry and from the available literature, it is important, if practicable, for the field worker to carry out a survey of the community to be covered by the P.P.P.

The scope of the survey will vary with local circumstances and details should be carefully worked out previously in consultation with technical experts. In particular, advice will be needed on the type of forms to be used, the data to be collected, and methods of coding results. Statistical guidance as to the selection of a random sample of the population will also be required.

This type of preliminary inquiry should be carried out by the field worker and national colleagues, together with the local leaders. It should be preceded by the definition of a selected area as the "intensive area" of the project, which should be mapped, especially to show the boundaries and the position of dwellings.

If acceptable to the particular community, collection of data should then be made by home visiting of all dwellings in the intensive area, or, if the number is too great, by visiting only those that have been statistically selected at random.

The data to be collected must be carefully defined and will vary from program to program. The following types of information will often be required:

Basic census data—family details (including geneology, age, sex, marital status, educational levels), amount of land and its use, type of house (construction, roof, rooms and their use and accommodation, kitchen) water supply, and so forth.

Incidence of Malnutrition—children with signs of malnutrition, measurements of young children (weight and arm circumference) compared with standards.

Conditions responsible for malnutrition—pattern of infant feeding, and so forth.

Analysis of the data obtained, together with information already available, will enable a tentative community diagnosis to be made. This will help to identify problems and their causation, and will suggest priority aims for the program and methods most likely to be useful.

In addition to assisting in program planning, baseline data will have been obtained which can later be used for evaluation.

Priority Aims and Methods. While general improvement of village life is the over-all aim, more limited specific technical goals will have to be defined for the particular project in relation to the nutritional problems of young children.

These aims should be related to the actual causes of childhood malnutrition in the area, to the felt needs of the community, and, to some extent, to objectives which can be achieved convincingly.

These priority aims need to be carefully defined and understood by everyone working in the project.

Thus, in some Southeast Asian villages, priority aims may be related to the prevention of vitamin A deficiency, by distribution of red palm oil to children in clinics and by home visiting, by the popularization of the production of carotene containing foods in home gardens, by trying to incorporate more practical nutrition education in schools, and so forth.

The type of service for the particular community also has to be decided on, as well as the methods to be used.

The program may for example, be initiated by the development of a Young Child Clinic, with an associated demonstration vegetable garden and a

nutrition rehabilitation unit. However, many combinations of the six different approaches to combating childhood malnutrition are possible (p. 119), and the most suitable components for the area have to be selected.

Both the aims and the methods suggested will have to be tentative and flexible, and the plan of campaign devised must have built into it methods of evaluating what is being done (p. 114). As a result of this feedback, modification and adjustment of future developments must be possible, especially in light of the worker's experience of the real needs and fields of opportunity in the village itself.

Team Structure and Organization. The scope and methods used in a particular program will also be related to the structure and organization of the team concerned.

This will vary from place to place, and is likely to evolve as experience of child nutrition programs staffed by nonhealth trained personnel accumulates.

Teams may be of varied size—from a single field worker to a coordinated group of twenty or more.

Thus, a large team for a P.P.P. might consist of 20–40 generalist nonhealth trained field workers, with 1–2 technical supervisors, one of whom could best be a medical nutritionist—that is, a physician, preferably with experience in nutritional problems of tropical children. The area of operation might have the generalists located in pairs at the center of an appropriate zone, each pair with a defined intensive area in which they would work initially.

The national members of the team also would vary with the circumstances in different countries. In a large team, a pair of field workers might work with two nationals—one of whom might be a junior member of the health service (e.g., a health assistant), and the other a national volunteer.

Apart from official personnel in a project, there are always to be found people in villages who show special interest and initiative. They are of the greatest importance to the development of a P.P.P. Not only can their help be enlisted in the organization and running of various activities, including Young Child Clinics, but they are also invaluable in stimulating local interest in the community, as with the forming of clubs, and by initiating self-help activities, such as the construction of a simple building made of local materials for a clinic or a nutrition rehabilitation unit.

Also, the training of suitable people who work closely in the village with the field worker means that there will be an extra network of people, both informed about the methods and objectives of the project and also capable of carrying out at least some aspects of the work. In particular, if the area covered is somewhat spread out, it may be feasiable to have one or two villagers trained practically and helping in outlying parts of the area, not only while the field worker is there, but also between visits.

Technical supervision and advice should be available locally from the government extension agents and representatives of the health service, and, in some circumstances, from the supervisor of the whole P.P.P. team, who would spend some of his time "on circuit."

While the field worker is most definitely *not* a multipurpose expert, he

can and should aim at being a multipurpose extension worker, assisting government and voluntary extension services in carrying ideas to villages—bridging the gaps between modern scientific knowledge and rural needs, and also between governmental plans and rural suspicions.

Also, the field worker may, by enthusiasm, hard work, and capacity to get things done, help to invigorate extension services, add prestige to the work of his national colleagues, and assist in raising the status of village life, which seems so important if the drain of population from rural areas to towns is to be halted.

A field worker can have special advantages in relation to the development of P.P.P. as a component of an overall plan for improvement of rural life. He may often be in intimate social contact with the people themselves, without the obvious geographic, economic and linguistic gaps that usually separate tropical villagers from foreigners.

However, in addition, the field worker needs the right psychologic approach to village people:

> . . . appreciating them and their way of life, their gifts and skills; not seeking to bring things to people so much as seeking to increase the people's ability to get them for themselves; passing on skills in a kindly and humble manner, instead of condescendingly and patronizingly; giving the people a sense of belonging to something bigger than themselves; focussing public attention on them and their progress; above all, being a living example of the new kind of life.

If accepted by the people, the field worker is in an important position of trust, in which by lending a hand rather than by offering advice, he may be able to initiate the necessary ferment of change from within by helping people to realize that new ways are possible, which will enable them to achieve a healthier, better and more profitable life within the framework of their traditional village background.

In other words, the field worker should have a catalytic function between the villagers' felt needs and the often unappreciated potential that exists for improvement through inexpensive, unelaborate mutual help programs.

Training. In addition to training in the local language and knowledge of the cultural and historical background, the technical content of the training of generalist field workers in a P.P.P. will obviously have to be specifically tailor-made for a particular program.

The general content will cover information encompassed by the present publication. In addition, a limited number of special technical skills will be required—as, for example, the best method of improving a local village kitchen, or the prevention of soil erosion, or the recognition and simple therapy of the main conditioning infections, or of immunizing children against whooping cough. Which of these are taught as priorities will depend upon the tentative program drawn up by the project organizers.

Training Program. If practicable, a training program should be devised for the individual project. Part can be carried out in the U.S.A. (or country from which the field worker may be coming), and part in the host country.

In the U.S.A. The following will have to be covered, as far as general principles are concerned, together with examples relevant to the particular project:

(1) Basic nutrition (main facts concerning types of food, dietary re-

quirements and vulnerable groups);

(2) Causation, prevention, treatment and recognition of early and late forms of major types of malnutrition, especially methods of detecting less severe PCM by serial weighing;

(3) Custom, diet and food production;

(4) Infectious diseases and their control (including immunization, recognition and simple treatment of limited childhood illnesses, and village improvement of environmental sanitation by means of better water supply and effective excreta disposal;

(5) Food production at the village level, including cultivation of legumes, dark green leafy vegetables, fruits, and so forth, raising of poultry, development of fish ponds;

(6) Local dietary pattern including cost, availability of foods and customary methods of infant feeding;

(7) Principles of nutrition education;

(8) Methods of combating malnutrition, through health services, extension agencies, community development and by village self-help schemes.

(9) Community diagnosis and program evaluation, by analysis of data from censuses, and so forth.

The type of training envisaged requires a multidisciplinary approach with teachers from different fields involved. Wherever possible, it is very valuable to include instructors from the host country and also American teachers with personal experience of the country in which the program is to operate.

Inevitably, the technical training for a P.P.P. organized within the U.S.A. will be largely theoretic, although as many visual aids (e.g. color slides, movies, and so forth) as possible should be employed. The main aims should be to ensure that the background to the problems of childhood malnutrition is outlined and the *principles* of a Preschool Protection Program understood.

In the Host Country. By contrast, training in the host country should have a minimum of classroom lectures and seminars, and should be mostly practical—in other words, training by doing, with the classroom, the community, and the textbook, real life.

The coverage will again include the range of subjects mentioned earlier (p. 110), although this can best be undertaken by visits and inservice activities in the following places:

Health Services. To recognize the appearance of children with various forms and degrees of malnutrition, with the clinical features of important infectious diseases and with the methods employed in the treatment and prevention of these, to become familiar with the running of the local health services, their staffing and methods.

Markets and Shops. To see at firsthand the range of foods available in local markets and small shops, and to note the cost of these and their availability.

Cultivation Sites. To see the types of foods grown, the methods of agriculture and animal husbandry, including irrigation, rotation of crops, fertilization, storage, preservation, and so forth.

Kitchens and Homes. To see local methods of food preparation, including type of stove, fuel, cooking pots, types of measure used, and so forth;

to observe the family meal and the way food is served, apportioned, and eaten.

Local Extension Services. To know the local organizations and other units which are involved in trying to improve village life in general and in particular food production and methods of feeding young children and mothers, undertaken both in the headquarters of the various organizations concerned, but even more importantly by visiting and seeing what is going on and how various ideas are working out in practice in rural circumstances; to learn specifically the suggested practical methods advised by extension services to improve the village, food production, recipes for infant foods, and so forth; to learn what assistance is available from government to villagers, which they may not be aware of (e.g. credit schemes, assistance with latrine construction, and so forth).

Practice. Depending upon details of the program a variety of technical procedures will need not only to be known in theory, but *practiced repeatedly in field circumstances using actual equipment.* These may include some of the following:

(1) *Recognition of malnutrition*—by signs, by weighing.

(2) *Recording*—using Young Child Clinic card for weight graphing, recording immunizations and antimalarials given, noting present infant diet and appearance as regards health, nutrition and infection.

(3) *Basic Treatment*—including recognition of clinical features of main infections, details of basic treatment, and technique of intramuscular injections (if to be included).

(4) *Immunization Procedures*—depending upon range of immunizations to be included (if any).

(5) *Issue of Food Supplements*—how much per child, in what package, to be used in what way.

(6) *Weaning Foods*—actual practical preparation, using quantities suggested, cooked in traditional kitchen.

(7) *Methods of Improved Food Production*—selected techniques depending on local priorities and using methods advised by government extension services (e.g. compost heap, spaced planting of beans in rows, use of insecticide in traditional granary, and so forth).

(8) *Methods of Village Improvement*—selected procedures suggested by government extension services and related to local needs (e.g. safer "smokeless" kitchen, protected spring, and so forth).

(9) *Nutrition Education*—group discussion demonstrations, with visual aids, on priority topics.

Again depending upon the program, practical training needs to be carried out using the services to be developed, which may include one or more of the following—a Young Child Clinic, home visiting, a nutrition rehabilitation center. The use of a pilot project or trial area is desirable for training purposes.

Only a short part of the training in the host country should be carried out in the capital. Certainly, here the field worker will be able to see how the problems are perceived in the capital. However, the major portion of the training in the host country should take place in the area within which he will be working. Possibly this may be based on the district capital, but the visits and other activities suggested should take place in a similar area to that in which

the project will be working and with actual field situations.

(c) *Development of a P.P.P.*

With a new program in an area, the following phases often may develop:

Acceptance. To start with, in a new program it is wise and most productive to do little, but to settle quietly into the new surroundings, and to observe and be observed. It should, perhaps, be more a period of social adjustment, of introductions, and of mutual acclimatization by villagers and field worker than of technical activity.

The villagers should be aware of the main objectives of the program. However, all too often they have various misconceptions, so that discussions, both arranged and informal, will usually be the next stage.

Initial Action. It is always desirable to work with and through, a village group or committee, on which it may be possible to join with both the locally influential and the energetic innovators always to be found in any community. A suitable committee may already be in existence, or may develop, either through traditional or new channels. Group discussion and exchange of views should not only guide the program's initial development, but the committee should also be a sounding board to assess the successes and failures of future activities. It can be the permanent nucleus for liaison between villagers and field workers, permitting a two-way flow of information.

As a result of initial discussions and observation, it will be possible to carry out a census and community diagnosis, followed by the initiation of some part of the overall program—for example, perhaps, a Young Child Clinic, which is understandably likely to appeal.

Ultimately, it will usually be feasible to widen the program as people's trust and understanding increase, and their actual and felt needs become apparent.

Difficulties to be anticipated are related to the field worker's limited range of knowledge and experience, so that it is unwise to try to extend either the area covered by the program, or its content, too rapidly.

Readjustment. In some cases, the program may develop differently from what had been anticipated, while, in addition, village interests and needs may call on technical skills that the field worker does not possess.

For more immediate technical advice, the local government extension agencies or rural services should be consulted, if such are available. In addition, contact with and advice from the team's technical adviser should be sought if the program appears to need readjustment.

In larger teams, regular meetings of the field workers and the national counterparts at 3–6 monthly intervals are of great value. Encouragements and disappointments can be shared, ideas pooled, and new skills that have been found to be needed can be learned and taken back to the village.

These meetings act as a continuing feedback and aid in the evaluation of the program, leading to readjustment and modification of the original plan.

Evaluation. As with all public health or social welfare programs, evaluation is essential in order to assess the benefit or otherwise that has resulted.

With P.P.P. largely run by nonhealth trained personnel, both foreign and national, it is particularly important to be able to demonstrate and document success to governments of these com-

munity-based programs carried out with limited funds in collaboration with village people.

Methods of evaluation should be considered during the planning of the particular P.P.P., and incorporated into preliminary census and community diagnosis.

Evaluation can be based on data obtained at Young Child Clinics, and preferably by subsequent repetitions of the original census carried out in the community by home visiting. In the course of these, changes will be noted by observation, as with the adoption of ideas concerning food production suggested by nutrition education (p. 112), and by the use of questionnaires, as with the foods and recipes for infants (p. 176). Also, examination of young children for clinical features and by weighing will show whether the incidence of malnutrition has decreased or not.

Continuity. All programs designed to help improve the nutrition, health or development of village people must, except when dealing with emergency circumstances, be based on the need for continuity. What is left behind at the end of a project in terms of long-range future continuation is more important than the short term improvements, which may have been possible during the field worker's period in the village.

With this in mind, a P.P.P. aimed at improving the nutrition of young children in the community should always be planned as a joint endeavor with foreign field workers teamed with local personnel, either national volunteers or junior technical staff, often from the health service, working where possible through permanent village organizations, such as various types of clubs. In this way, the field worker can also more readily gain insight and acceptance in the village, as a result of the national counterparts' local knowledge. At the same time, the field worker's presence at the grassroots level may add prestige to this type of work.

As noted earlier, probably the main functions of the field worker should be as a catalyst to assist people to use their own resources to help themselves, and, also, to try to ensure that the program, in some form, can continue to be run by national personnel after the end of outside assistance.

With this in mind, the main long-range aims of this type of program should be to ensure its genuine acceptance, understanding and ultimate "take-over" by the rural people themselves, to demonstrate the true value of the village level approach to government authorities, and to try to develop a realistic and practical network of trained, enthusiastic personnel and volunteers in the village, who can carry on and develop the program in the future.

AMONG SCHOOL-AGE CHILDREN

Although school-age children are still growing quite rapidly, they do not usually exhibit the severe degree of malnutrition found so commonly in children in the early years of life, unless serious food shortage or near famine exists. Nevertheless, many school-age children in tropical countries are far from well nourished, and their appearance has been described elsewhere (p. 93). It must also be appreciated that, in many tropical coun-

tries, only a percentage of school-age children are actually attending school.

The health supervision of school children may be undertaken by a school health service, but, in tropical countries, this is usually rudimentary or nonexistent.

The nutrition of school children can be ascertained by "cross sectional surveys" (p. 116); while regular weighing of children by school masters may be practicable in some parts of the world, and can detect poorly nourished children who are not growing adequately.

Maximum Benefit from Education. Attention should be given to the problem of the nutrition of school children for two reasons. Firstly, a country's development is to a very large extent dependent on its trained personnel. So that it is most important that all being educated, including children at school, should derive as much advantage as possible from their experience. Too often children leave their homes with no breakfast to walk long distances to school, where they may then be too exhausted to benefit much from their lessons.

Attention to the nutrition of school children pays dividends not only in the actual improvement of the children's growth and often suboptimal nutritional status, but, more importantly, enables the pupils to benefit maximally from their schooling experience.

Target Group for Nutrition Education. Secondly, school children can be regarded as both accessible and "educationally vulnerable." At school they are by definition in the process of learning new things and may be more willing than their parents to listen to, and to absorb, fresh ideas concerning food and nutrition. In other words, school children, who themselves will be fathers and mothers of children in the near future, must be regarded as a priority target group for nutritional education. Also, under some circumstances, the new ideas learned at school may filter back with the children to their homes and influence the ideas of parents.

The principles and practice of nutrition, with a special reference to local circumstances, must form an important part of a child's schooling. It should be included, for example, in all science courses, where the examples must be carefully geared to the local situation. Ultimately, this may require a reconsideration of the curriculum and of the examinations.

For girls, the inclusion of domestic science, or home economics, and mothercraft must be regarded as an essential part of secondary education.

The teachers themselves must be aware of the basic facts concerning nutrition and their importance to real life. Undoubtedly, the most important places in a country where ideas on nutrition should be injected are teacher-training colleges.

However, more important than planned, formal education in nutrition are the new ideas gained by pupils by observation, and especially by practice. It is for this reason that school gardens, and school meals, if, in fact, really nutritionally adequate, are of great value educationally.

School Gardens. A school garden has five main purposes—(a) to familiarize children with local, and less often, exotic plants which can be cultivated locally and could play a considerable role in supplementing the

customary staple diet, (b) to demonstrate simply, but convincingly, modern scientific methods of food production (e.g., improved soil fertility, use of insecticides, and so forth), thus encouraging improvement of agricultural methods in the region, (c) to stress the importance of garden crops in the betterment of nutrition, (d) to illustrate instruction in science and nature classes with living examples, and (e) to show pupils that the ideas they learn at school have a practical application in real life (as in the arithmetic needed to calculate the quantity of seed required and to keep a record of crop yields, or by using insects collected in the garden for nature study classes).

In brief, the school garden ought to be thought of as "a method of teaching, a living education" in applied science and practical agriculture, both in relation to the local natural scene and to the nutrition of the particular community.

Planning the Garden. In planning a school garden, a suitably adjacent site, its area, crops, and watering and so forth, must be considered, together with equipment, tools and seed.

The most appropriate plants to be grown will vary with the soil and rainfall of the region, but usually should be local in origin, hardy and easily propagated. The range commonly possible has been given earlier.

Particular attention will have to be given to including and demonstrating methods of soil fertilization, rotation of crops, prevention of insect and other pests, and the propagation of plants (including seed beds).

The raising of small animals may also be practicable, including poultry, rabbits, guinea pigs, or fish ponds. However, as with other aspects of a school farm or garden, problems of continuing attention during holidays have to be overcome. It is wise to have some plants which are "semipermanent", such as papaya trees, or are self-seeding as with some types of tropical spinach, as these will last through the holiday period. Other crops can be cultivated within the range of the school calendar.

The produce of the garden should be eaten by the children themselves, either in the school meal, or when taken home to their parents. The nutrition education value will be enhanced if the produce is of good quality.

School gardens should not be used as a vegetable plot for the teacher, employing the free labor of the children. At the same time, the extra responsibilities and work required of the teacher in initiating and carrying on a school garden must be appreciated and encouraged. To be successful, the teachers need prior training in the running of school gardens and should work in cooperation with the parents. A gardner is usually required for the heavy work.

School Meals. Various forms of school meals may be practicable in different communities. In some countries, this may take the form of a breakfast and in others more suitably a lunch. The meal or snack may be cooked at the school, or sold at a cafeteria or canteen, or can be brought from home as a cold-packed meal.

(a) *Organization.* Problems of preparing meals at schools in tropical countries may be very considerable, and pose an extra burden of work, at least of a supervisory and administrative nature, for the headmaster. A simple

clean kitchen, cooking and eating utensils, water supply, secure thief-proof storage and fuel must be available; as well as a cook and staff to help prepare the meals. As usual with any development in any part of the world, especially in poorer tropical regions, the limiting factor is money.

(b) *Expense and Collaborative Schemes.* Although most governments would like to extend a school feeding program throughout the country, this is rarely economically possible as an exclusively governmental project. However, school feeding may be practicable as a collaborative venture between the government and the parents, possibly together with an outside agency.

It may, for example, be possible for a school feeding program to be launched in which at least some part of the food to be cooked may be supplied as food aid from outside sources (p. 143), where the parents pay a small, nominal sum towards the salaries of the cook, assistant and the fuel, while the government makes available a simple kitchen, store and cooking utensils. Catering for larger numbers often reduces the cost per individual.

(c) *Nutritional and Educational Value.* If the cooked meal is to be prepared at school, careful thought will have to be given to the nutritional and educational value of the menus used. The foods employed will, as far as possible, have to be based on the often intermitten supply and distribution of local resources and available crops, although they may be enriched by the addition of free or subsidized foods made available from elsewhere, in particular such good sources of protein as dried skimmed milk, and soy, or groundnut flour.

Within the limits of available finance, the school meal should aim at being a practical experience in nutrition education.

Meals should, if possible, supply the nutrients likely to be lacking in the home diet. However, extreme shortage of money may make only a largely carbohydrate dish possible.

If dishes are to be cooked, they can usually be only of a simple type (Appendix VI), often based on one-pot stew recipes. Again the "principle of multimixes" (p. 129) can be very useful. A "quadrimix" of staple, legume, dark green leafy vegetable and a small quantity of animal protein may be practicable.

(d) *Feeding Utensils and Cleanliness.* At least plates and usually spoons, or other cutlery, will be required for serving and eating the meals. Again, this should be used as an opportunity for health education with regard to cleanliness, by ensuring that pupils wash their hands before eating, and also take turns at washing up the plates after the food has been finished.

The "dining room" may be extremely simple, although, in some circumstances, a separate room with unelaborate tables and chairs may be feasible. Often the meal can be taken sitting on mats, as at home, or on the grass under the trees, which often are to be found near many tropical schools.

It is ideal if the food prepared at the school be that which has been grown already by the pupils in the school garden. In this way, education received in formal lessons concerning natural history, human digestion and nutrition can be demonstrated practically.

(e) *Cold Snacks.* It is important to try to ensure that "ill health" education

does not take place at schools, as can occur if the only foods available to childen are nonnutritious starchy or sugary snacks or carbonated drinks sold by street vendors near the school. If it is the practice for children to purchase either snacks or a meal from such vendors, it may well be possible to ensure that attractive, well-liked but nutritious, foods are in fact on sale. For example, in various parts of the world tasty preparations of legumes, groundnuts, or beans may be both popular and good sources of protein; while in other countries, the sale of bread rolls of wheat-soy flour may be feasible.

Uncommonly, it may be possible in towns for schools to provide cold snacks or meals brought in for the pupils, as. for example, milk and bread.

(f) *Packed Lunches.* Elsewhere, it may be more practicable and acceptable to try to persuade parents to supply their children with a cold packed lunch. Again, this would have to be based on the local dietary and can be quite simple, while satisfying the child's appetite and also being nutritionally and educationally desirable. In parts of East Africa, a packed lunch may be brought to school wrapped in the traditional plaintain leaf or carried in a covered handleless metal saucepan. Under these circumstances, it may be possible not only to persuade parents to allow their children to bring food, but also to develop a healthy rivalry as to who is going to bring the best meal (Appendix VII).

If only a limited number of school meals can be prepared, then problems of selection obviously occur. Parents who are able and willing to pay this small nominal fee may have their children included, but this often excludes the less well-fed, poorer children who are plainly more in need.

(g) *Use of Food Aid.* Food aid from overseas can be very useful temporarily, but has the obvious disadvantage that a long-term supply cannot be guaranteed for future years. Its use, therefore, has to be based on the realization that plans must be formulated to make increasing use of locally produced foods as the project develops. However, as well as the advantages of school meals that have already been mentioned, it should be noted that a meal program also has the advantage of increasing school attendance, decreasing the number of dropouts and thereby helping in the fight against illiteracy. This argument, however, is less valid in areas where the limited school accommodation is already overfilled.

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[1] G=Recommended for the general reader. T=Recommended for technically trained health workers.

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(1968)

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APPENDIX I

FOOD AND NUTRITION BOARD, NATIONAL ACADEMY OF SCIENCES

National Research Council Recommended Daily Dietary Allowances,[a] Revised 1968

Designed for the Maintenance of Good Nutritition of Practically All Healthy People in the U.S.A.

	Age[b] (years)	Weight		Height				Fat-Soluble Vitamins			Water-Soluble Vitamins							Minerals				
	From Up to	(kg)	(lbs)	cm	(in.)	kcal	Protein (gm)	Vitamin A Activity (IU)	Vitamin D (IU)	Vitamin E Activity (IU)	Ascorbic Acid (mg)	Folacin[c] (mg)	Niacin (mg equiv)[d]	Riboflavin (mg)	Thiamin (mg)	Vitamin B_6 (mg)	Vitamin B_{12} (μg)	Calcium (g)	Phosphorus (g)	Iodine (μg)	Iron (mg)	Magnesium (mg)
Infants	0–⅙	4	9	55	22	kg×120	kg×2.2[e]	1,500	400	5	35	0.05	5	0.4	0.2	0.2	1.0	0.4	0.2	25	6	40
	⅙–½	7	15	63	25	kg×110	kg×2.0[e]	1,500	400	5	35	0.05	7	0.5	0.4	0.3	1.5	0.5	0.4	40	10	60
	½–1	9	20	72	28	kg×100	kg×1.8[e]	1,500	400	5	35	0.1	8	0.6	0.5	0.4	2.0	0.6	0.5	45	15	70
Children	1–2	12	26	81	32	1,100	25	2,000	400	10	40	0.1	8	0.6	0.6	0.5	2.0	0.7	0.7	55	15	100
	2–3	14	31	91	36	1,250	25	2,000	400	10	40	0.2	8	0.7	0.6	0.6	2.5	0.8	0.8	60	15	150
	3–4	16	35	100	39	1,400	30	2,500	400	10	40	0.2	9	0.8	0.7	0.7	3	0.8	0.8	70	10	200
	4–6	19	42	110	43	1,600	30	2,500	400	10	40	0.2	11	0.9	0.8	0.9	4	0.8	0.8	80	10	200
	6–8	23	51	121	48	2,000	35	3,500	400	15	40	0.2	13	1.1	1.0	1.0	4	0.9	0.9	100	10	250
	8–10	28	62	131	52	2,200	40	3,500	400	15	40	0.3	15	1.2	1.1	1.2	5	1.0	1.0	110	10	250
Males	10–12	35	77	140	55	2,500	45	4,500	400	20	40	0.4	17	1.3	1.3	1.4	5	1.2	1.2	125	10	300
	12–14	43	95	151	59	2,700	50	5,000	400	20	45	0.4	18	1.4	1.4	1.6	5	1.4	1.4	135	18	350
	14–18	59	130	170	67	3,000	60	5,000	400	25	55	0.4	20	1.5	1.5	1.8	5	1.4	1.4	150	18	400
	18–22	67	147	175	69	2,800	60	5,000	400	30	60	0.4	18	1.6	1.4	2.0	5	0.8	0.8	140	10	400
	22–35	70	154	175	69	2,800	65	5,000	.....	30	60	0.4	18	1.7	1.4	2.0	5	0.8	0.8	140	10	350
	35–55	70	154	173	68	2,600	65	5,000	.....	30	60	0.4	17	1.7	1.3	2.0	5	0.8	0.8	125	10	350
	55–75+	70	154	171	67	2,400	65	5,000	.....	30	60	0.4	14	1.7	1.2	2.0	6	0.8	0.8	110	10	350
Females	10–12	35	77	142	56	2,250	50	4,500	400	20	40	0.4	15	1.3	1.1	1.4	5	1.2	1.2	110	18	300
	12–14	44	97	154	61	2,300	50	5,000	400	20	45	0.4	15	1.4	1.2	1.6	5	1.3	1.3	115	18	350
	14–16	52	114	157	62	2,400	55	5,000	400	25	50	0.4	16	1.4	1.2	1.8	5	1.3	1.3	120	18	350
	16–18	54	119	160	63	2,300	55	5,000	400	25	50	0.4	15	1.5	1.2	2.0	5	1.3	1.3	115	18	350
	18–22	58	128	163	64	2,000	55	5,000	400	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	100	18	350
	22–35	58	128	163	64	2,000	55	5,000	.....	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	100	18	300
	35–55	58	128	160	63	1,850	55	5,000	.....	25	55	0.4	13	1.5	1.0	2.0	5	0.8	0.8	90	18	300
	55–75+	58	128	157	62	1,700	55	5,000	.....	25	55	0.4	13	1.5	1.0	2.0	6	0.8	0.8	80	10	300
Pregnancy						+200	65	6,000	400	30	60	0.8	15	1.8	+0.1	2.5	8	+0.4	+0.4	125	18	450
Lactation						+1,000	75	8,000	400	30	60	0.5	20	2.0	+0.5	2.5	6	+0.5	+0.5	150	18	450

[a] The allowance levels are intended to cover individual variations among most normal persons as they live in the United States under usual environmental stresses. The recommended allowances can be attained with a variety of common foods, providing other nutrients for which human requirements have been less well defined. See text for more-detailed discussion of allowances and of nutrients not tabulated.

[b] Entries on lines for age range 22–35 years represent the reference man and woman at age 22. All other entries represent allowances for the midpoint of the specified age range.

[c] The folacin allowances refer to dietary sources as determined by *Lactobacillus casei* assay. Pure forms of folacin may be effective in doses less than ¼ of the RDA.

[d] Niacin equivalents include dietary sources of the vitamin itself plus 1 mg equivalent for each 60 mg of dietary tryptophan.

[e] Assumes protein equivalent to human milk. For proteins not 100 percent utilized factor should be increased proportionately.

APPENDIX II

Information Required Concerning Feeding Young Children

(a) Obstetrical—prenatal maternal diet;

(b) Neonatal—feeds in first days, laxatives, discarding of colostrum;

(c) Breast feeding—when started, technics of nipple preparation, indigenous tests of breast milk, duration of complete and partial breast feeding, diet of the mother (normal, restricted, increased);

(d) Animal milk—type, quantity, dilution, additions, feeding method (e.g., cup and spoon, bottle, local feeding vessel, and so forth), milk preparations (e.g., yogurt, cheese);

(e) Feeding orphans and twins—wet nurse, induced lactation, artificial feeding and method (e.g., bottle, feeding cup, spoon);

(f) Supplementary foods—age introduced, type, quantity, method of feeding (e.g., spoon, finger, tongue);

(g) Other protein foods (animal and vegetable)—age introduced, type, quantity, method of feeding;

(h) Method of stopping breast feeding (weaning)—age, abrupt or gradual, sent away or not, child prepared or not, the ue of deterrent substances on breast, "compensation" or not, apparent reasons for weaning;

(i) Food preparations for children—special foods and their preparations; if none, which part of adult dietary used, recipes, number of meals daily, methods of child feeding;

(j) Person responsible for feeding—mother, grandmother, older sibling, and so forth.

(k) Attention to sex of child—preferential treatment of male or female child.

APPENDIX III

Weight for Age Table (Birth to 60 Months, Sexes Combined)[1]

Age (months)	*Standard*		*80 percent*		*60 per cent*	
	lb-oz	*kilos*	*lb-oz*	*kilos*	*lb-oz*	*kilos*
0	7–8	3.4	5–14	2.7	4–6	2.0
3	12–8	5.7	9–14	4.5	7–8	3.4
6	16–5	7.4	13–0	5.9	9–14	4.5
9	19–9	8.9	15–9	7.1	11–11	5.3
12	21–12	9.9	17–6	7.9	13–3	6.0
15	23–5	10.6	18–11	8.5	14–1	6.4
18	24–14	11.3	19–13	9.0	14–15	6.8
24	27–5	12.4	21–12	9.9	16–8	7.5
30	29–11	13.5	23–12	10.8	17–13	8.1
36	31–14	14.5	25–8	11.6	19–2	8.7
42	34–2	15.5	27–5	12.4	20–8	9.3
48	36–5	16.5	29–0	13.2	21–12	9.9
54	38–4	17.4	30–13	14.0	23–2	10.5
60	40–8	18.4	32–5	14.7	24–3	11.0

[1] From Harvard Standards—Stuart and Stevenson (1959).

APPENDIX IV

A Planned Demonstration for Use in East Africa [1]

The following example may be given of a planned group-discussion demonstration organized for a particular group of people, the Baganda:

Topic—Prevention and Management of Diarrhea in Young Children

Aims—to discuss:

A. Diarrhea often caused by swallowed dirt and feces, containing "germsi" (bacteria)

B. Home hydration needed in early cases

C. Recognition of dehydration and need for urgent medical attention

Socio-economic Factors: none relevant

Cultural Attitudes:

"Blocks"—diarrhea locally considered due to *obusobya* (incorrect behavior) (difficulty with bacterial etiology; delay with treatment)

"Links"—none relevant

Presentation

I. General.

A. Diarrhea.

1. Dirt contains feces and bacteria ("germsi").

2. Baby can swallow "germsi" in: (a) Dirty water; (b) dirt on fingers; (c) dirt on feeding utensils.

3. Avoid baby's swallowing "germsi" by: (a) Breast feeding; (b) washing hands; (c) boiling water; (d) cleaning feeding utensils.

4. "Germsi" attack bowel, producing watery stools (resembling discharge from nose, in "cold").

5. Baby loses much water and dies because body dries up.

B. Home hydration needed in early cases.

1. Don't stop milk feeds, especially breast milk.

2. Coax baby to take large amounts of "sugar water" (prepared by adding ½ teaspoon salt, 6 teaspoons sugar to 1 pint boiled water); small quantities given frequently (¼ hourly) with cup and spoon, 2–3 pints daily.

C. Signs of dehydration.

1. Sunken eyes and fontanelle.

II. Teaching Aids.

A. Materials for "germsi" demonstration.

1. Magnifying glass, dirty water, and school microscope.

2. Equipment for *handwashing*, utensil cleaning, and water boiling.

B. Equipment for preparation of "sugar water" for home hydration.

1. Salt.

2. Sugar.

3. Teaspoon.

4. Pint bottle.

[1] Comment: probably needs two or three sessions.

5. Kettle.

C. Equipment for dehydration demonstration.

1. Photo of drooping dry plant and dry pond (e.g. fontanelle).

2. Photo of dehydrated child and/or patient in ward.

3. Hospital hydration apparatus (intravenous drip).

4. Photo of child after rehydration.

APPENDIX V

Specimen Recipes for Weaning Foods

The specimen recipes given below are from various parts of the world. They are listed by country.

Some are given in precise weights in grams, and would in practice have to be translated into suitable simple local domestic measures (e.g. cups, or handfuls, or gourds, or bottles). Others are already given in these household units.

Some of the recipes are for a single child; others are designed either for several children, or for a family, including a young child.

BRAZIL

'Tutu' (Beans) (for 1 serving)[1] (Quadrimix) (p. 131).

Black Beans (*P. vulgaris*)	60 g
Cassava flour	20 g
'Louro' leaf.	
Pepper and salt.	
Beef	30 g
Fat (for frying)	10 g

1. Boil beans with 'louro' leaf and seasonings until soft.
2. Add cassava flour and continue cooking until it looks like brown porridge.
3. Fry the meat in fat or use roast meat and serve together.

INDIA

Infant Meal[1] (for 2 servings) (Triple Mix) (p. 130).

Black gram (*P. mungo*)	50 g
Semolina	50 g
Sugar	10 g
Dried skimmed milk	10 g
Water.	
Salt to taste.	

1. Wash the beans, put in saucepan with water and boil till almost soft.
2. Sprinkle in the semolina sugar and continue cooking a little longer.
3. Stir in the DSM and mix well.
4. Serve to toddlers.

Kichri[1] (for approx. 8 servings) (Double mix) (p. 130).

Rice	435 g
Black gram (*P. mungo*)	435 g
Ghee	30 g
Salt	9 g
Water 8–10 parts with pulse and rice.	

1. Mix rice and pulse and wash once or twice to clean.
2. Add water, and cook gently until rice is soft and water absorbed. Keep lid on.
3. Add *ghee* and salt to taste.

Bengal gram—puffed rice mixture (Double mix).

Toasted Bengal gram (*Cicer arietinum*,) which can be crushed into a fine powder, and puffed rice are traditional foods.

Add 2 teaspoons of toasted Bengal gram flour to 1 average cup of boiling water and cook for 5 minutes. Add 8 teaspoons of puffed rice and 1 ounce of milk. Stir well and feed to young infant.

Older infants will take larger quantities and higher proportions of Bengal gram (2 : 1).

SIERRA LEONE

Rice and Egg [1] (for 2–3 servings) (Double mix).

Rice	200 g
Egg	50 g
Water, 1 pint approx.	
Salt as desired.	

1. Cook washed rice in usual way until soft.
2. Break egg into rice, and beat in until well mixed.
3. Serve promptly to toddler.

Rice and Groundnut [1] (for 5–6 servings) (Double mix).

Rice	200 g
Groundnut	200 g
Water 1 pint.	
Salt as desired.	

1. Lightly roast shelled groundnuts and remove skins.
2. Pound to a fine paste.
3. Cook washed rice in the usual way till soft.
4. Add groundnut paste and beat till creamy.
5. Serve promptly to toddler.

Rice, Cowpea and Milk [1] (for 3–4 servings) (Triple mix).

Rice	200 g
Cowpea	100 g
Milk, 300 g (½ pint).	
Water and salt as desired.	

1. Soak cowpeas overnight and rub to remove testa and eyes.
2. Cleanse the rice thoroughly in several waters and remove all stones.
3. Cook the cowpeas in boiling salted water.
4. When nearly cooked add the rice and continue cooking till both are soft.
5. Stir to mix well.
6. Serve to toddlers, with the milk to drink.

LEBANON

Lentil soup (sharabatadis) (Double mix).

This may be served to young children from about 6–9 months onwards.

3 cups lentils.
½ cup rice.
½ cup samneh, or other shortening.
1 cup chopped onions.
1 ½ teaspoon salt.
Water.

Soak lentils in cold water overnight. Wash and pick over. Cook with water until soft. Pass the soup through a sieve or food mill. Add water to desired consistency. Fry onions in hot fat until brown and add to soup. Simmer for ten minutes. Add salt. Serve thick and hot with squares of crisp fried bread.

To prepare in open kettle: Wash lentils. Pick them over. Boil until soft. Pass through sieve or food mill. Add fried onions and salt. Add more water if necessary, and simmer for ten minutes.

To either method, add cooked rice if desired (one-half cup before cooking).

PAKISTAN

Halwa—variation [1] (Double mix).

Semolina (*Suji*)	100 g
Red lentils	100 g
Sugar.	
Fat	15 g
Water.	

1. Boil the lentils until soft and water absorbed.
2. Melt fat, add semolina and sugar and brown lightly.
3. Add lentils to semolina, then add sufficient water, until the consistency of stiff dough.
4. Mould the mixture into different shapes.

If given with a little milk, this is converted to a "triple mix."

NIGERIA

White beans and cray fish (Double mix).

This recipe for the Yoruba dish, *ole*, is given by the Institute of Child Health, Ibadan. It has been modified by omitting the customary red peppers.

If used with a carbohydrate staple, it would become a "triple mix."

½ cigarette tin white beans.
½ onion.
1 tablespoon dry crayfish.
2 tablespoons palm oil.
Salt to taste.
Cold water.

Soak the beans in water, wash off seed coats, and grind. Grind other ingredients separately. Heat the oil, beat the ground beans, and all ingredients in hot oil. Add salt to taste and mix to a soft consistency with warm water. Wrap in leaves or greased tins and steam. Serve hot.

GAMBIA

Rice and spinach (for 1 or 2) (Double mix).

Rice	135 g
Water, pint	½–¾
Salt	2 g
Spinach	50 g

1. Add rice to boiling salted water.
2. Boil approximately ten minutes.
3. Add chopped spinach.
4. Continue cooking (five minutes).
5. Serve to toddlers.

TANZANIA

Banana-groundnut paste (Double mix).

1 ripe banana
1 handful groundnuts
Roast groundnuts and remove skin

Put pounded groundnuts and ripe banana in mortar and pound. When fine, smooth consistency, feed to child.

GHANA

"Siwee" [1] (Double mix).

Yam	120 g
Lightly roasted groundnuts	120 g
Palm oil (clear)	15 g
Salt	

1. Steam or roast the yam.
2. Remove skins from groundnuts.
3. Pound the yam and groundnuts till fine in a mortar.
4. Transfer to a mashing bowl.

5. Add salt and warmed palm oil.
6. Mould and serve.

Oto [1] (Double mix).

Yam	150 g
Eggs (hen's, 1)	50 g
Palm oil	15 g
Salt to taste.	
Water.	

1. Wash, peel and wash again slices of yam.
2. Boil some water and salt in a pot.
3. Add yam and egg in shell for 15 minutes.
4. When yam is cooked, strain off water.
5. Mash finely in a bowl. Add oil and mix well.
6. Mould the Oto in a bowl and make hole in center.
7. Remove shell from egg and put in hole in Oto.
8. Serve to toddler.

Sagbarigu [1] **(millet soup)** (Double mix).

Pennisetum flour	75 g
Powdered white fish	5 g
Salt to taste.	
Tomato	60 g
Water.	

1. Put some water on fire to boil.
2. Add the seasoning.
3. Add the powdered fish and simmer for some time.
4. Add millet flour and stir well.
5. Simmer for another 30 minutes.
6. Serve hot.

Akasa and Egg

Maize flour (made into a dough)	125 g
Egg (hen's, 1)	50 g
Sugar	10 g
Salt and water.	

1. Put water and salt into a saucepan and bring to boil.
2. Mix dough with a little cold water in a bowl.
3. Strain into the boiling water.
4. Stir until cooked and thickened.
5. Remove from fire and cool slightly.
6. Break egg into basin and beat well.
7. Stir into the *akasa* and stir till *akasa* is thick and creamy—serve to toddler.

UGANDA

Maize Porridge (Double mix).

Maize flour	120 g
Dried skimmed milk	20 g
Sugar	20 g
Water	½ pint (approx.)

1. Combine maize flour and DSM in a saucepan.
2. Mix with some of the water to a smooth paste.
3. Add the remainder of the water and bring to boil.
4. Cook gently for 45 minutes with constant stirring.
5. Add sugar for flavor and salt if desired.

Ettu Pastes (Triple mixes).

These recipes are based on method of cooking by steaming in small plantain leaf packets (*ettu*), used in one district of Uganda.

The local staples are the plantain (*matoke*) and the potato (*lumonde*). Vegetable protein sources are beans (*Phaseolus vulgaris*) and peanuts. Most easily available animal proteins are eggs, fish and dried skimmed milk.

Basic Recipes for Ettu Pastes

Exact or Kitchen Measures	*Household Measures*
12 oz *matoke* (weighed after peeling).	6 average "bananas" (fingers, pieces).
3 oz dry beans.	6 large spoons dry beans (English dessert spoon), or 1 large handful.
5 tablespoons water, pinch salt.	10 large spoons water, pinch salt.
12 oz *lumonde* (weighed after peeling).	1½ medium sized roots *lumonde.*
3 oz dry beans.	6 large spoons dry beans (English dessert spoon), or 1 large handful.
5 tablespoons water, pinch salt.	10 large spoons water, pinch salt.
8 oz *matoke* or *lumonde* (weighed after peeling).	4 average "bananas" (fingers, pieces).
4 oz groundnuts (pounded)	8 large spoons groundnuts (English dessert spoon).
5 tablespoons water, pinch salt.	10 large spoons water, pinch salt.

to ONE of these basic mixtures ONE of the following foods must be added:

(a) 1¼ oz. liquid egg.	(a) 1 beaten egg.
(b) 1¼ oz. DSM.	(b) 5 heaped teaspoons DSM.
(c) ⅝ oz. dried fish.	(c) 1 side of a fresh or dried medium sized *ngege* (small fish).

Preparation and Cooking of Ettu Pastes

The following is the general method for the preparation and cooking for *ettu* pastes using *matoke* (plantain) or *lumonde* (sweetpotato), dry beans and egg *or* DSM.

(1) Measure dry beans, wash and put to soak overnight in clean water. This softens the skins and makes removal easy. An alternative method of skinning beans is to put them on to boil for about 45 minutes; put into cold water and they skin easily.

(2) Next day when starting to prepare the child's food, remove outer skin from the beans.

(3) Peel *matoke* or *lumonde,* wash and cut into small pieces.

(4) Wrap prepared *matoke* or *lumonde,* beans and spoons of water inside the banana leaves; tie carefully and put the *ettu* in the cooking pot with the food for the rest of the family. Steam the *ettu* for about 2–2½ hours. (Use smoked banana leaves, *luwombo,* to prevent the leaf's breaking or cracking).

(5) Open the *ettu* and mash up the cooked food very well. Measure the DSM and sprinkle over the food and again mix *OR,* beat up the egg and add

it, to the cooked food, again mixing in well to make a soft mush.

Method for *ettu* pastes using *matoke* or *lumonde*, pounded groundnuts and egg *or* DSM.

As above substituting groundnuts for the beans. The nuts may be roasted and skinned before pounding when possible.

Method for *ettu* paste using *matoke* or *lumonde*, beans or groundnuts and fish (fresh or dried). The only difference in making this *ettu* paste is that fish is cooked in the *ettu*.

Soak dried fish in clean water or wash fresh fish. Separate the fish meat from the bones and skin, and use about ½ a medium sized *ngege* in the *ettu*.

Any of these mixtures makes enough for a midday and evening feed for 1- to 2-year-old child and preferably should be given warm. After the first meal, the *ettu* should be tied up and can then be given a second time later in the day, either cold or after re-heating.

Dark green leafy vegetables can be incorporated in any of these recipes, so converting a "triple mix" to a "quadrimix."

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[1] These recipes have been collected by Margaret E. Cameron of the Human Nutrition Unit, Nutritional Institute for Medical Research, Mill Hill, London, and are reproduced with permission.

CSM (Corn-Soya-Milk)

CSM was developed by the U.S. in recent years for distribution under the food aid program, as a food supplement for children (particularly the post-weaned young child). It can be used in school feeding and wherever there is need to improve the diet. CSM is a mixture of processed cornmeal (68%), defatted soy flour (25%), non-fat-dried milk (5%) plus vitamin and mineral supplements.

CSM is not intended to provide a complete diet for children, but to supplement the diet already used by providing additional amounts of nutrients, particularly protein, vitamins and minerals. Eighty grams (about ⅕ lb.) supplies 24% of the calories, 61% of the protein and between 40% and 88% of the other nutrients (except vitamin C) of the Daily Recommended Dietary Allowance for children 1–3 years of age as set up by the Food and Nutrition Board, National Academy of Sciences, National Research Council.

CSM is a bland food which can be used in many ways—as a beverage, a porridge, in soup, in puddings, in baked goods, etc. It is easy to prepare and since it has been pre-cooked, does not require long cooking. To make a beverage, one part by volume of CSM is mixed with six parts by volume of safe water; while for a porridge the proportion is one part CSM to three parts water. The mixture is cooked slowly to boiling, stirring constantly, and allowed to boil for one to two minutes. It can be served flavored only with salt or sugar and may be eaten hot or cold. Because of its blandness, it lends itself to use in local recipes and to suit local tastes. Recipes may be needed to conform to local custom and available cooking equipment.

APPENDIX VI

Approximate Guide for Uganda to Quantities of Foodstuff per Head for School Meals in Preparation of Triple Mixes

(For mixed age range)

Foodstuff	*Quantity per head*	
	Girls	*Boys*
Plantain (before peeling)	2–3 lbs. per meal	3–3½ lbs. per meal.
Sweet potatoes (before peeling)	1½–2 lbs. " "	2–3 lbs " "
Staple:		
Rice	3–6 ozs. " "	4–8 ozs. " "
Maize Flour (posho, thick)	3–6 ozs. " "	6–8 ozs. " "
Maize Flour (porridge)	2–3 ozs. " "	2–3 ozs. " "
Millet (thick)	3–6 ozs. " "	6–8 ozs. " "
Cassava (before peeling) [1]	1½–2 lbs. " "	2–3 lbs. " "
Bread [2]	2–4 ozs. " "	2–4 ozs. " "
Sugar [2]	1–3 ozs. daily	1–3 ozs. daily.
And Oil or Fat	½ oz. daily	½ oz. daily.
Protein:		
Milk (dried fat free)	½–1 oz. daily	½–1 oz. daily.
Meat with bone	4 ozs. per meal	4 ozs. per meal.
Meat no bone	3 ozs. " "	3 ozs. " "
Fish fresh with bone	4 ozs " "	4 ozs. " "
Fish fillet no bone	3 ozs. " "	3 ozs. " "
Fish dried	2 ozs. " "	2 ozs. " "
Eggs	1 egg	1 egg.
Cheese	1½–2 ozs. " "	1½–2 ozs. " "
Beans	3–4 ozs. " "	3–4 ozs. " "
Peas	3–4 ozs. " "	3–4 ozs. " "
Nuts	3–4 ozs. " "	3–4 ozs. " "
Dahl	3–4 ozs. " "	3–4 ozs. " "
Vegetable:		
Vegetables green and yellow	2–4 ozs. " "	2–4 ozs. " "
Fruit:		
Fruit	2–4 ozs. daily	2–4 ozs. daily.
Salt	¼–½ oz. daily	¼–½ oz. daily.

[1] Cassava is a poor food and should not be served too often.

[2] Among items which can be used but are governed by availability and money are: tea, coffee, sugar, bread, margarine, jam and syrup.

NOTES:

1) The above foodstuffs are divided into three nutritional groups and care should be taken when budgeting and planning the menu to see that at least one food from *each food group* is served at *each meal.*

If more than one item is used from any one food group it is necessary to see that the total overall quantities are used—e.g. *Supper Menu Secondary School (Boys)*—Plantain, Beans, Groundnut and Vegetable Sauce.

Ingredients:

Matoke 3 lbs., before peeling.
Oil ¼ oz., for frying onions.
Beans, 2 ozs.
Nuts, 2 ozs.
Vegetables including:
Onions 4 ozs., before preparing.
Salt as necessary.

2) *Oil.* Double refined edible oil fortified with Vitamin A is recommended particularly for schools and colleges serving a grain

staple food. The quantity listed above can be increased if the budget permits.

3) *Sugar* is expensive, poor nutritionally and too much is bad for the teeth.

4) *Eggs* have a high nutritional value and one easy way of serving is to boil the eggs hard and serve with a curried vegetable sauce and a staple food.

5) *Cheese* has a high nutritive value and can be cut into pieces or grated and added to the sauces in the cooking, or it can be eaten without cooking.

6) *Milk (Dried Fat Free)*. Milk powder is nutritionally very valuable and is low in cost (lb.=8 pints liquid fat free milk).

The powder can be added to the porridge and sauces or sprinkled dry onto the food. The quantity listed above can be increased if the budget permits.

7) *Vegetables*. Dark green and yellow vegetables are nutritionally best; onions should be used for flavoring.

8) *Fruit* of any variety should be served, and if possible once a day.

APPENDIX VII

Packed Meals for Children to Carry to School

Foods are divided into three nutritional groups and care should be taken to see that at least one food from each of the groups set out below is included in the packed meal daily. As different foods contain different amounts of essential nutrients, it is good to provide a variety of foods—this also avoids the meals becoming monotonous.

It is particularly important to provide plenty of the body building protein foods in the packed meals daily as these are necessary for growing children.

Protein	*Vegetable/Fruit*	*Staple*
Milk, Fresh	Vegetables—	Millet
Milk, Dried Skim	Green leaves	Maize
Cheese	Pumpkin leaves	Rice
Eggs	Spinach	Bread
Meat	Kale	Sweetpotato
Fish	Cabbage	Irish Potato
Grams	Bean leaves	*Matoke*
Groundnuts	Cowpea leaves	(Green Banana)
Peas	Carrots	Yam
Beans	Pumpkin	Cassava
	Tomatoes	Fat and Oil
	Fruit—	
	Orange	
	Lemon	
	Mangoes	
	Avocado	
	Papaya	
	Guava	
	Tree Tomatoes	
	Pineapple	
	Bread Fruit	
	Granadilla/Passion Fruit	
	Grapefruit	
	Cape Gooseberry	
	Lime and Salt	

SUGGESTIONS FOR PACKED MEALS

1. Roasted or steamed maize Cob
   Hard boiled egg
   Tomato
2. Cold millet bread
   Cold cooked dried fish and vegetable stew
   Mango
3. Cold roasted sweet potato
   Roasted groundnuts
   Tomato of fresh fruit
4. Cold millet bread
   Cold cooked beans with vegetables
   Slice of paw paw or other fruit
5. Cold boiled potatoes
   Cold ground nut sauce with vegetables in it
   Barasois palm fruit drink
6. Cold roasted cassava
   Roasted groundnuts
   Slice pineapple
7. Bread
   Hard boiled egg or piece of meat or cheese
   Tomato
8. Bottle of porridge made with maize or millet flour
   Sugar and milk
   Orange, bread fruit or banana, and so forth
9. Bottle of milk
   Maize cob
   Tomato

NOTE: The food should be properly packed so that it will survive the journey and will be easy for the child to carry.

The container must be of a material that can be easily cleaned or a hygenic material which can be disposed of after use, e.g., simple tin with well fitting lid; saucepan or basin with lid; polyethylene bag; clean paper or clean smoked or steamed banana leaf, or fiber; banana leaf which food has been cooked in and tied with banana or grass fiber.

APPENDIX VIII

Nutrition Rehabilitation Unit

Nothing is quite so important in the care of children with kwashiorkor as effective health education, yet few things are more difficult to provide on a large scale in a busy hospital. It was to fulfill this need that a nutrition rehabilitation unit was organized at Mulago Hospital. It is the first of its kind in Africa, and, though it is set up in a teaching hospital and staffed by a specialist pediatrician, there seems no reason why similar ones should not be equally effective on a more modest scale in district hospitals, for it is here that the need is greatest.

BUILDINGS

The buildings of the unit are simple. There is a "residential center" consisting of a dormitory and a kitchen where mothers can prepare their own meals. There is an out-patient hall and several minor but very important educational structures in the grounds nearby, such as a simple rural kitchen. The unit is housed in single story buildings some way from the hospital itself. At Mulago some of these are of mud-wattle and whitewash, but there is no reason why the whole of this type of unit should not be of the cheap local pattern.

OUTPATIENTS

At Mulago, all children with kwashiorkor come to the unit; mild cases are sent straight from the outpatient department, severe cases come to it after their discharge from the wards. Outpatient mothers in small groups are given health education talks, and are shown how to prepare a lunch for their children using the locally available foods and the dried skimmed milk powder that is issued to them in packets, either plain or Calorie reinforced. They are taught the importance of breast feeding, and the value of boiling water and milk. There is an immunization program and antimalarial drugs are prescribed.

THE RESIDENTIAL CENTER

From the outpatient group, twenty mothers with their children are selected for admission to the residential center for from four to six weeks. Great emphasis is placed on this period of residence so that a mother can actually see her child getting better without giving anything more than the correct food. In this way she becomes convinced that the disease is due to faulty feeding alone. A mother learns that the training she is given is to help her to teach her neighbours the dietary principles involved in the prevention and cure of kwashiorkor. *The program in the unit is mother-oriented rather than child-oriented* and mothers are taught general homecraft as well as good nutrition.

But residence probably has another effect. Mothers are in the unit long enough for them to form a community

and, if the general attitude of this community is that kwashiorkor is a nutritional disease, then new mothers are likely to be converted to this way of thinking by those who have already been convinced. It is likely that a useful part of the unit's teaching is done for it automatically in this way. Working in pairs, two mothers from the residential center, a more experienced and a less experienced one, are selected to teach the outpatient mothers. They show them how to prepare meals in the simple demonstration kitchen near the outpatient hall and, by working in pairs in this way, not only do both teach the outpatients, but the senior mother teaches the junior one how to teach. In this way a pair of mothers needs less supervision from the staff than they would otherwise.

On their discharge from the unit mother and child are taken home by a member of the staff. A meeting is arranged at which are present the mother and her child, who is now much better, the father, some neighbors and any chiefs or local authorities who can be persuaded to attend. The mother and staff member demonstrate the child to this group, and the mother tells them the dietary principles that she has learned.

Some important details. This is the essence of what the unit does, but there are many other points which contribute to success. Fathers, for instance, are considered very important. Every week there is a "Fathers Day" at the unit when fathers visit, particularly the fathers of children who have been admitted with their mothers. They are shown the work of the unit and how they can assist their wives when they return home.

On the grounds around the unit there are several demonstrations of how families can improve their own homes and diets. There is a local pattern hut with its cooking facilities incorporating various improvements that are within the means of the family. Thus, there is a raised fireplace to keep pots of boiling water away from small children. The hut has a high shelf to keep the family's paraffin bottle out of the children's reach; there is also an improved local pattern larder, and tables, and so forth. In the hut are two large local pattern pots with lids. In one of these a mother can keep boiled water, and in the other unboiled water. Outside the hut is a proper soak pit, a drying stand, and a compost heap. There is also a vegetable garden, an improved chicken coop on the deep litter system and some rabbit hutches. Mothers are also taught sewing and anything else that is likely to make them more effective wives and mothers.

The work of this unit can be expressed in another way. Baganda mothers variously attribute *omusana-obwosi,* the disease recognized as kwashiorkor, to the sun, to the seeds of a certain plant entering a child's body, to air entering him if he is not properly covered at night, and to heat from his mother's womb. The unit aims to send mothers back to their villages convinced that all these notions are wrong, and vigorous protagonists of the idea that incorrect feeding is the major cause of *omusana-obwosi.* If they are really convinced, they will, it is hoped, convince their friends and spread correct knowledge through the community. Properly instilled, the knowledge imparted by the unit in the minds of a few mothers can multiply many times.

APPENDIX IX

Home-Feeding Kit

This kit is designed for the feeding at home by foster parents of babies who *have* to be artificially reared. Because of the difficulty of cleaning a feeding bottlo and teat, with the consequent grave danger of infecting the baby with diarrhea, the feed is mixed and given in a special aluminum cup which is easier to keep clean.

Components of Kit:

(1) Container (aluminum pan with lid).

(2) A tin containing soap.

(3) A spoon.

(4) The feeding cup.

(5) A tin of milk.

Directions for Use:

(1) Open the container and put the lid down beside it.

(2) Take out the tin of soap and wash your hands.

(3) Take out the cup and spoon and put them on the lid.

(4) Put water into the container up to the mark and boil it.

(5) Pour some of the boiling water over the cup and spoon and then throw it away.

(6) Pour boiling water into the cup up to the mark.

(7) When the water is cool enough for you to be able to hold the cup comfortably, mix in — spoonfuls of milk and feed the child.

(8) When you have finished, wash the cup and spoon in soap and water before putting it away back in the container.

APPENDIX X

Preparation of Artificial Bottle Feeds in the Village Home

Artificial feeds are almost impossible to make up cleanly in many poorer tropical homes.

If artificial feeding has to be resorted to, a cup and spoon, or feeding cup (p. 137) should be used. The simplified, but still very complicated, procedure in preparing bottle feeds outlined below is difficult and unlikely to be followed.

Requirements: 1 tin full cream milk powder (or evaporated milk, and so forth), 1 tin household sugar, 1 wide-necked plastic feeding bottle, 2–3 rubber teats, 1 teaspoon (5–6 cc volume), 1 cup (7 fl. oz. volume), 1 saucepan with cover, 1 large tin or cardboard box with cover, for storing feeding utensils.

Sterilization by Boiling

The Bottle

1. Before feed, place bottle, teat, cup and spoon in cold water in saucepan, heat, boil for about 5 minutes, and allow to cool.
2. Wash hands.
3. Remove cup and spoon from saucepan.
4. Add required quantity of dried milk and sugar (p. 136) to cup with spoon.
5. Boil water in kettle or separate saucepan.
6. Mix required quantity (p. 136) of warm boiled water to dried powdered milk, stirring in well with spoon to avoid lumps.
7. Remove bottle from saucepan, fill with reconstituted milk, fix on teat and feed infant.
8. Immediately after feed, wash inside and outside of bottle, teats, cup and spoon with clean cold water, using bottle brush.
9. Store bottle, teats, cup and spoon in tin or cardboard box (preferably inside saucepan) until next feed.

Sterilization with Sodium Hypochlorite [1]

The Bottle

1. Immediately after feed, wash inside and outside of bottle, teats, cup and spoon with clean cold water.
2. Fill covered aluminum saucepan or other suitable container with 2 pints clean cold water, and add 3 teaspoonfuls 1% hypochlorite solution, or chloride of lime powder.[2]
3. Totally immerse bottle, teats, cup and spoon until next feed (3–4 hours), ensuring that bottle is filled with solution.

The Feed

1. Before preparing feed, wash hands.
2. Remove cup and spoon from

[1] Sodium hypochlorite solution can be bought ready prepared (e.g., as with "Milton Antiseptic" or other brands), or can be made cheaply in the home using chloride of lime ("Calx. chlorinata").

[2] The amount of chloride of lime required is very small, add the tip of a knifeful to about 2 pints of water. The chloride of lime should be kept in a small tightly sealed tin.

hypochlorite solution. Drain, but do not rinse.

3. Boil water.

4. Add required quantity of full cream powdered milk and sugar to cup (p. 136).

5. Mix. Add required quantity of warm boiled water into dried milk in the cup using spoon.

6. Remove bottle and teat from hypochlorite solution. Drain, but do not rinse.

7. Pour reconstituted milk into bottle and fix on teat.

8. Immediately after feed, wash bottle, teat, cup and spoon in clean cold water and immerse again in hypochorite solution.

9. Prepare fresh hypochlorite solution each morning.

APPENDIX XI

THE MULANDA PROJECT [1]

[An attempt to combat protein Calorie malnutrition in Eastern Uganda by utilizing the resources of a district hospital, a district farm institute, and a primary school]

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After nine months' experience of looking after the children's ward at Tororo Hospital, it became apparent that treating the acute cases was not contributing to the main problem of reducing the number of malnourished children in the area. We often had to readmit children for the same acute symptoms only a few weeks after they had been successfully treated. Sick children were brought to hospital on the point of death and others were not brought at all. It was therefore necessary to make the local people aware that the symptoms of malnutrition were curable in hospital and the disease could be prevented by the parents themselves.

After visiting some of the homes of these children we could see that the parents were often unable to put health education into practice because protein foods were not available to them. Although UNICEF dried skim milk was distributed in the District Child Welfare Clinics, many people lived far away and often supplies and transport were lacking. The local popular legume the cowpea (*Vigna sinensis*) was being grown less and less because of repeated failures due to bad weather and insect pests. The custom of eating protein dificient staples such as plantain and cassava was spreading amongst the previously millet-eating Jopadhola and Teso (the two main tribes in the W. Budama area.) We were told by local people that groundnuts and milk previously consumed in the homes were now being sold for cash.

In view of these facts we decided that before undertaking health education, it was necessary to encourage people to increase their production of protein foods so that they could then put our teaching into practice. There was no point in teaching people what foods to eat unless you could also show them how to grow and prepare them.

Children were admitted to the ward with an "attendant" usually the mother, father or elder sister. While the child was in the ward we gave the attendant information about the reason for the child's illness, how we intended to cure him, and how by producing protein foods at home and giving them to the child he would prevent the illness from recurring. This was done through a program incorporating the District

[1] This paper by Dr. P. S. E. G. Harland is reproduced from the Journal of Tropical Pediatrics in an abridged form as it represents a P.P.P. stemming from curative health services.

Hospital, District Farm Institute, and a Primary School.

Treatment of Severe Cases of Protein-Calorie Malnutrition in Hospital

Severely ill children were admitted to a 36 bedded ward staffed by two registered staff nurses, three locally trained nursing assistants supervised by a ward sister and a medical officer. We treated these children with "reinforced milk"—dried skim milk reinforced with edible oil and sugar to provide sufficient Calories to ensure efficient utilization of protein. Two and one-half ounces of this milk were given per lb body weight over 24 hours as a continuous drip through a nasogastric polythene tube (internal diameter 1 mm), if the child refused oral feeding. If the child accepted the diet orally it was given in 5 feeds during the day.

Health Education to the Attendants of Children Admitted to the Ward

When a child was admitted, the medical officer discussed his case with the attendant, with the participation of the attendants of the other children. He was told that his child was ill because he had not had enough of the correct food; that we would cure the child by giving him a special diet. The recovering children and the testimony of other attendants (who were usually well-indoctrinated by this time) were used to demonstrate this. We did not give routine injections of penicillin and unless we explained the reason for this the attendants complained that their children were being neglected. We also emphasized the need for the children to eat enough of the diet. As we had few trained staff, the attendants were responsible for feeding the children. When we had explained the reason, the mothers were very good at cajoling their children into taking the full amount of food and preventing them from filling themselves with staples between meals. Questions about hookworm anemia, diarrhea, tuberculosis and other diseases were also answered.

As the children improved, they were given the normal ward diet 3, that is, maize porridge, meat and bean sauce, groundnut soup and an egg each day, supplemented with reinforced milk mixed as a powder into the porridge. When possible we also gave them green vegetables, cowpea tops, and *dodo* (*Amaranthus*) and purees made from beans grown in the hospital garden which adjoined the ward as described later. These included cowpeas, black gram (*Phaseolus mungo*), soybean (*Glycine max*), green gram (*Phaseolus aureus*), and pigeon pea (*Cajanus cajan*). The beans were cooked by a local method in which they are boiled in an alkaline solution prepared from ash, for only 45 minutes instead of the 4 hours required with plain water.

HOSPITAL GARDEN

As their children improved, the attendants were asked to help cultivate the hospital garden adjoining the ward. The purpose of this was (1) To try out a variety of legumes and other vegetables to see which were acceptable to local people and would yield good amounts of vegetable protein, (2) To show the attendants how to cultivate these crops efficiently. By actually participating in the cultivation they could learn the techniques and value of row

planting, proper time of sowing, fertilizer and insecticides, (3) To use the produce of the garden to feed the children in the ward. The attendants were shown the method of preparation and could see the improvement in their children who were being fed on the foods that they themselves had helped to grow, (4) To give the seeds from the successful kinds of plants to the attendants on discharge from the ward, for planting in their own gardens at home.

In addition to the other types of legumes mentioned, we also grew and disseminated sunflower seeds (to be eaten parched), tomato, maize, and lettuce.

THE FARM INSTITUTE

The function of the Tororo District Farm Institute is to offer courses designed to introduce local farmers to efficient agricultural methods. The farmers participate in demonstrations of ox ploughing, soil improvement by rotation of crops and the use of fertilizer, the proper cultivation of cotton, millet, and maize, beekeeping and so on. In addition there are courses for farmers' wives on child welfare and nutrition. Particularly valuable are the demonstrations on the care and breeding of small animals—rabbits, guinea pigs, pigeons, chickens, quails, and turkeys, and also the care of cattle with emphasis on improving milk production.

Once a fortnight a group of hospital attendants was taken to the Institute by ambulance where they were taken on an educational farm walk by a member of the Institute staff. They were also shown how to join the residential courses run by the Institute, and many of them did. Normally farmers attending these courses were "good farmers" whose children were often well fed. By enabling the fathers of children with malnutrition to attend the courses, we hoped to extend benefits of the Institute to people who would not normally attend courses, but who were in the greatest need of such education. In return, the hospital medical officer lectured to farmers attending the courses on nutrition, and another member of the team gave demonstrations on food preparation. People attending the courses—chiefs and teachers as well as farmers—were taken to the hospital to see the treatment of malnutrition in practice in the hope that being leaders of their communities they would contribute to the solution of the problem in their home villages. As a result of these visits, we were often invited to village meetings arranged by the chiefs at which lectures and demonstrations were given.

Believing that it was important to bring the problem of infant malnutrition to the attention of important local people, a function was arranged at the Institute to which the *ssenkulu* (ceremonial head) of Bukedi Chiefs and politicians and councillors in local government were invited. The program consisted of a farm walk, the showing of a homemade 8 mm film about the work of the project and a meal at which 20 different locally grown protein foods were served and the nutritive value explained.

WORK IN THE SURROUNDING DISTRICT

As we wished to influence people in the villages more directly, we obtained the co-operation of the staff of the pri-

mary school at Mulanda, a village 15 miles from Tororo. The 300 children attending the school were aged from 8 to 18 years and their homes were in nearby villages in an area of W. Budama where the soil is infertile and malnutrition common. The school children themselves did not show signs of malnutrition which is mainly a disease of the preschool age group. In any case only the healthy children are sent to school.

We tried to awaken the children's interest in the prevention of malnutrition, in the hope that they would persuade people in their villages to send sick children to the hospital earlier. Also we asked them to cultivate a school protein garden whose produce could be used to supplement the school diet and which would provide a source of seed for children to take home.

We began by talking at length to the children, asking questions about local beliefs and answering their own questions about health and the causes of disease. With the help of the Institute and the local agricultural assistant, three acres of the school garden were ploughed, divided into plots and sown with soybeans, maize, sorghum, cowpeas, and elephant grass. The labor was provided by the children themselves during their gardening period (2 hours per week.) Seed, fertilizer and insecticide were donated by local businessmen.

The children were also taken to the Institute for farm walks and visited the hospital, and the Principal and other members of the staff spoke to them about agriculture and nutrition.

The school garden has not been a great success. The soybeans matured during the holidays and were not harvested. However, two sacks of sorghum were harvested, milled locally and used in the school meals. In spite of this discouraging start, the staff of the school are continuing with the garden and with a rabbit project.

FOLLOWUP

Five months after leaving Tororo we revisited the area and were happy to find that the hospital garden was flourishing. Visiting the homes of children treated for kwashiorkor the previous year, we found that a second planting of pigeon peas and sunflower seeds with enthusiasm was being undertaken. This is a completely new food in this area.

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