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WORLD HEALTH ORGANIZATION
TECHNICAL REPORT SERIES
No. 377

FAO NUTRITION MEETINGS
REPORT SERIES
No. 42

JOINT FAO/WHO EXPERT COMMITTEE ON NUTRITION

Seventh Report

Rome, Italy, 12-20 December 1966

Published by FAO and WHO

WORLD HEALTH ORGANIZATION
Geneva
1967

Printed in Italy

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INTRODUCTION

The Joint FAO/WHO Expert Committee on Nutrition[1] met in Rome from 12 to 20 December 1966. The session was opened by Dr. Oris V. Wells, Deputy Director-General of the Food and Agriculture Organization of the United Nations. Prof. V. Ramalingaswami was unanimously elected Chairman and Prof. M. J. L. Dols Vice-Chairman. The Committee was assisted in its consideration of particular problems by three FAO and three WHO consultants. A representative of the United Nations Children's Fund (UNICEF) attended the session.

The Committee reviewed the programs of the Food and Agriculture Organization of the United Nations and of the World Health Organization before turning its attention to the general food and nutrition situation in the world and to other subjects on the agenda.

The Committee stressed the urgency of the general food and nutrition position and outlook in the world. It recognized that people can be healthy only if well fed and was concerned for the prevailing poor nutritional health and future outlook. The rate of increase in population varies from 1.5 to 3.5 percent per year in most regions. The highest rate of increase occurs in those countries with the lowest per caput food production and income. According to the 1963 FAO *Third world food survey* "... should the population grow according to the United Nations 'medium' projection, the world's total food supply would have to be trebled by the year 2000 in order to provide a reasonably adequate level of nutrition. For the less developed areas total food supplies would need

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[1] The terms of reference of the Joint Committee, which have been accepted by the governing bodies of FAO and WHO, are as follows:

1. To advise the Directors-General of FAO and WHO in the problems of nutrition which might receive the attention of the two Organizations and to assist in co-ordinating their respective programs in this field.
2. To advise either Director-General or both on any technical problems concerned with nutrition which they may submit to the Committee.

to be quadrupled and the supplies of animal products should be raised nine times the present volume." This 'medium' projection for population growth may be exceeded unless methods of population control are widely instituted. Further, population change will be such that by the year 2000 the expected population of the developing regions will constitute four fifths of the world population instead of its present two thirds.

Since the time of the Third World Food Survey increase in food production has failed to keep pace with population increase; indeed the per caput world food production has decreased since 1962/63. Differences in regional trends exist but show an even greater decrease for developing regions, especially Latin America and Africa.

Indeed the FAO report *The state of food and agriculture 1966* reveals that there was no annual increase in world food production despite an increase of 70 million people to feed. In each of the developing regions except the Near East total food production fell 2 percent and per caput production declined 4 to 5 percent. This has occurred at a time when North American grain stocks are at the lowest level in a decade.

The yearly grain imports of developing countries have constantly increased to reach an estimated level in 1966 of 25 million tons. Calculations indicate that by 1980 the increase in cereal consumption needed to meet the projected increase in population of the developing countries will raise grain requirements by an amount approaching the current total output of North America, western Europe and Australasia combined. Such an estimate does not include the vast quantities of protective foods also needed. It is evident that dependence upon food supplies from the developed regions cannot be the permanent answer to the world food problem. It was the view of the Committee that productivity of the developing world must increase along with a decrease in the rate of population growth if these regions are to feed themselves.

The increase in population reflects in part a decrease in the death rate due to the success of mass disease control measures. In a limited number of countries there has been a significant decline in the death rate of children in the 1-4 year-old age group which the Committee considered a reflection of some nutritional improvement. But this rate in most developing countries remains many times — up to 30 times — that of developed countries. Such mortality figures are indices of the total morbidity from nutritional diseases.

More and more the problems of the young, fast-growing child have come to the fore in recent years as the appallingly high morbidity and

mortality rates in this age group in developing countries have been revealed. The Committee believed these rates to be for the most part directly or indirectly due to malnutrition. In this connection it is appropriate to note that the Sixth International Congress of Nutrition, held in Edinburgh in 1963, unanimously adopted a resolution to the effect that worldwide efforts should be made to relieve the plight of young children by promoting programs for the protection of the preschool child. Previous sessions[1] of the Joint Committee have considered this matter in detail and the present session continued to regard the problem as one deserving high priority.

Worldwide nutrition surveys such as those carried out by WHO, the United States Interdepartmental Committee on Nutrition for National Defense (ICNND) and other groups have shown that a wide variety of nutritional diseases continue to be prevalent in the developing countries: protein-calorie deficiency in infants and young children, avitaminoses and mineral deficiencies, anemias, goiter, rickets and other nutritionally related diseases. These often occur as multiple conditions in the same individual, along with parasitic and infectious diseases.

Urbanization in developing countries is presenting new burdens of disease and malnutrition. The Committee recognized that in urbanized areas there is a trend away from the breast-feeding of infants and that this results in the appearance of protein-calorie deficiency at earlier ages, that there is separation from familiar sources of foods and a dependence upon market supplies which must be bought with a limited amount of cash, and that inadequate housing and other environmental changes detrimental to health often adversely affect nutrition.

Such considerations indicate the urgent need to improve our knowledge of food in relation to health and to better the utilization, conservation and distribution of present food supplies. The Committee deemed it imperative that all effective means be used to increase the production of food, especially in developing regions, and it emphasized the need to encourage all methods of food production and food utilization — agricultural, tech-

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[1] FAO. Joint FAO/WHO Expert Committee on Nutrition. *Report on the second session*, p. 22. Rome, 1951. FAO Nutrition Meetings Report Series No. 5; Wld Hlth Org. Technical Report Series No. 44 - *Report on the third session*, p. 5. Rome, 1953. FAO Nutrition Meetings Report Series No. 7; Wld Hlth Org. Technical Report Series No. 72 - *Report on the fourth session*, p. 26. Rome, 1955. FAO Nutrition Meetings Report Series No. 9; Wld Hlth Org. Technical Report Series No. 97 - *Sixth report*, p. 23. Rome, 1962. FAO Nutrition Meetings Report Series No. 32; Wld Hlth Org. Technical Report Series No. 245.

nological and industrial — in order to provide for the years immediately ahead. The Committee supported a full exploration of new, unconventional sources of food, especially of protein, and recommended that promising methods of production be encouraged. Adoption of newer scientific means for production and preservation of foods must be promoted. Along with increased food production the problems of malnutrition will continue to demand a large number of health, agricultural, educational and other nutrition workers.

The key roles of nutrition workers in these efforts are to provide information to guide national planning for the utilization of food materials to best advantage, to educate at all levels, and to participate in development of the increased medical, agricultural and educational services which will be needed to meet these heavy demands. In order that nutritional needs may be met it is imperative that governments have a wide and realistic appreciation of the problems involved and that they make allowance for these in their development plans, including the training and utilization of the necessary personnel.

The Committee stressed the urgent need to maintain a proper balance between food production and population growth. To achieve such a balance demands realistic support by governments of developing nations for improved food production and, where necessary, acceptable methods of population control. In order ultimately to procure adequate nutrition and health in developing nations, temporary assistance in the form of money, food, equipment and personnel must be given them during the interim period of development. The present scale of all of the above activities, both on the part of developed and developing countries, is totally inadequate.

1. INDICATIVE WORLD PLAN FOR AGRICULTURAL DEVELOPMENT

In 1957, at its ninth session, the FAO Conference expressed its belief that the increasing efforts of many governments to plan agricultural development as a part of general economic development offer enhanced opportunities to link such policies with the aim of better nutrition. Since that time several conferences (Bangkok 1960,[1] Douala 1961,[2] La Napoule 1962,[3] Gardone 1963[4] — the latter two held at ministerial level) have stressed the need to define a sound food policy when establishing national plans for agricultural development. Following a recommendation of the World Food Congress (Washington 1963), which has subsequently received the approval of the FAO Conference at its thirteenth session, FAO is at present drawing up an Indicative World Plan for Agricultural Development.

The basic aim of the Plan is to indicate solutions to the problem of food shortage and hunger that faces the world over the next two decades. Elaboration of the World Plan is being approached from two directions simultaneously: by specific commodity on a worldwide scale to assess the prospects for international trade; and by geographical regions to consider the production possibilities in depth within a framework of balanced economic growth.

The choices open to developing countries in regard to agricultural development and satisfying their food needs are being examined in relation to world demand and supply of agricultural commodities, by studying agricultural development as part of overall economic development. The

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[1] FAO Technical Meeting on Nutrition in Food Policies and Plans in Asia and the Far East, Bangkok, Thailand, 1960.

[2] Fourth Joint FAO/WHO/CCTA Interafrican Nutrition Conference, Douala, Cameroon, 1961.

[3] FAO/WHO/UNICEF Conference of French-Speaking African Ministers on Food and Nutrition, La Napoule, France, 1962.

[4] FAO/WHO/UNICEF Conference of English-Speaking African Ministers on Food and Nutrition, Gardone, Italy, 1963.

Indicative World Plan will also deal with the developed countries from the point of view of how their agricultural and trade policies relate to export opportunities for developing countries. The Committee was glad to note that the Plan is intended to bring relevant national problems within their regional and world context, and that it will be prepared in close co-operation with governments, taking into account their own policies and plans.

The Plan is being drawn up with due regard both for economic criteria and for meeting nutritional requirements. To this end close co-operation has been established among nutritionists, economists and those responsible for agricultural production.

Various measures for selective development of food industries have been suggested, and for promotion of food imports which will take into account nutritional factors. The Plan will also permit the estimation of production possibilities and the potential demand for processed food mixtures of high biological value, with a view to improving the nutritional levels of vulnerable groups.

The Committee considered that the present report offers an excellent opportunity for defining realistic food policies. These policies should take into account not only physiological needs but also those ecologic, social and cultural factors which influence dietary patterns. In this respect, the Committee pointed out the need for regional or national food consumption and household surveys in order to determine any correlations which exist between regional and seasonal dietary variations and between levels of food consumption and income. These studies could lead to an improvement in the statistics on food supplies (see chapter 3).

2. NUTRITIONAL REQUIREMENTS

The Committee noted the progress made in the assessment of requirements for calories and nutrients of various population groups living and working under different environmental conditions. It recognized, however, that much remains to be done and specific suggestions were made with respect to calories and some nutrients.

Calories

The Committee was informed that, in accordance with recommendations made at its last session, a report had been made by an FAO/WHO consultant in 1964,[1] concerning the need to revise the report of the Second FAO Committee on Calorie Requirements, 1957. The consultant had found that the 1957 report still remains a practical working document and that there is no adequate basis for a revision of that report in the immediate future. The Committee agreed but recognized that further studies need to be made along the lines suggested by the Second FAO Committee on Calorie Requirements to provide the necessary basis for a future revision of the report. Field surveys of energy expenditure and calorie intake are required to provide a firm scientific basis for estimating requirements and the Committee recommended that a small group of nutritional field workers should be convened to consider how such surveys could best be organized in parts of the world where climate and socio-economic conditions differ greatly. The Committee also endorsed the suggestion that the contents of the FAO/WHO reports on calories and nutrients be written up in a form suitable for training of undergraduates and teachers.

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[1] FAO. *An assessment of the report of the Second Committee on Calorie Requirements (FAO, 1957)*, by R. Passmore. Rome, 1964.

Unit of energy

The Committee considered the implications of the Recommendation of the International Organization for Standardization (Ref. No. ISO/R31/Part III-1960E) to replace the calorie by the "joule" or by the kilowatt-hour as the unit of work or energy. It was recognized that this recommendation is of considerable interest to nutritionists who have always used the kilocalorie as the basic unit of energy. If the calorie is completely abandoned in schools, as recommended by ISO, the continued use of the calorie in the science of nutrition alone will be a source of confusion and difficulty to students as well as the general public. On the other hand it was also realized that there would be much confusion for many years, possibly without benefit, by abandoning the calorie for a new unit of energy in the field of nutrition. All those engaged in the nutrition field, and the general public, are familiar with the calorie and therefore nutrition education would become even more difficult than it is now. For those reasons, and recognizing the wide implications of the issue, the Committee agreed that it should be referred to the Committee on Nomenclature of the International Union of Nutritional Sciences (IUNS) and other appropriate organizations for their consideration.

Protein

The FAO/WHO Expert Group on Protein Requirements[2] which met in 1963 pioneered in proposing the use, at an international level, of a factorial approach to protein requirements which made it possible to calculate the requirements for all age groups from existing experimental data, and introduced an allowance for the effect of the stress of ordinary living. Already data are available, largely due to the stimulus of the report of that Expert Group, which will permit future committees to improve the precision of the factorial method. The Committee discussed recent evidence which suggests that the estimates used by the Expert Group for metabolic urinary and fecal nitrogen loss and losses through the skin in the form of sweat, hair, nails and integumental cells were somewhat high,

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[2] FAO. *Protein requirements: report of a Joint FAO/WHO Expert Group.* Rome, 1965. FAO Nutrition Meetings Report Series No. 37; Wld Hlth Org. Technical Report Series No. 301.

probably resulting in an overestimate of protein requirements, at least in the case of adults. On the other hand, the Committee questioned the adequacy of the recommendations for growth, particularly during adolescence.

Recent data on the effect of stress on protein metabolism support the figure for the average effect of stress assumed by the Expert Group but also indicate a wide range of individual variation. There are also indications that the overall variation in nitrogen requirements may be greater than the plus or minus 20 percent which was considered by the Expert Group to include most of the population.

Another major step taken by the 1963 Expert Group was to distinguish between the requirement for essential amino acids and that for nonspecific nitrogen, although there was insufficient information to specify the ratio of the essential amino acid to total nitrogen (E/T) for various ages and physiological states. New research data are accumulating from various parts of the world which will permit greater precision in expressing these factors. As a result of such advances the Committee considered that a new Expert Group on protein requirements should be convened within the next two or three years.

The Committee recognized the practical difficulties of using the ratio of individual to total essential amino acid nitrogen (A/E) as a basis for scoring the protein of foods and diets as proposed by the Expert Group. Much more work in calculating this ratio and more extensive data on the amino acid content of foods are required for scoring by the new method as compared with the method recommended in the 1957 Report,[3] and no better agreement with biological measures has been achieved. Data are now becoming available which will permit the next Joint Expert Group on Protein Requirements to specify the minimum E/T ratio, at least for older children and adults, and to adopt a more convenient scoring pattern. The Committee emphasized, however, that more information on amino acid composition and availability and net protein utilization (NPU) of dietary proteins must be obtained by appropiate techniques. This is essential in order that the method of chemical scoring as a useful indicator of nutritive value of proteins be placed on a secure basis.

The Committee recommended that further collaborative research should be initiated to ascertain the reproducibility and reliability of biolog-

[3] FAO. *Protein requirements: report of the FAO Committee.* Rome, 1957.

ical methods for evaluating protein quality.[4] Further information is also needed concerning:

(*a*) the maximum extent to which any protein, even of the quality of egg and breast milk, is used;

(*b*) whether the correction for protein quality should be made in the protein requirement figure or in the dietary protein intake;

(*c*) the applicability of the net protein utilization (NPU) to the protein intake of the growing child.

The Committee agreed that the concept and use of net dietary protein calories percent (NDpCal%) needed fuller explanation, justification and qualification than was given in the report of the 1963 Expert Group. As that report emphasized, requirements for dietary protein are meaningful only when calorie intake is adequate. For this reason requirements for both calories and proteins need to be expressed in a comparable and consistent manner which will permit their combined use. Also, allowances should be based on an appreciation of the range of individual variations applicable to both the protein and calorie requirements.

The Committee therefore recommends that:

1. FAO and WHO convene a new Joint Expert Group on Protein Requirements in two or three years' time.
2. FAO and WHO take the necessary steps to collect pertinent new data, experience and suggestions for the use of the proposed Expert Group.
3. The Expert Group review the value given to each factor used in the factorial approach to the estimation of protein requirements in the light of additional data available.
4. The Expert Group examine fully the interrelationship of calorie and protein requirements in order to facilitate the assessment of a diet or food supply with respect to both calories and protein.

Other nutrients

The Committee was informed that an FAO/WHO Expert Group to consider vitamin A, thiamine, riboflavine and niacin was convened in 1965 and its report would be published.[5] The Committee then considered

[4] National Research Council. *Evaluation of protein quality: report of an international conference, March 1963.* Washington, D.C., 1963.

[5] FAO. *Requirements of vitamin A, thiamine, riboflavine and niacin: report of a Joint FAO/WHO expert group.* Rome, 1967. FAO Nutrition Meetings Report Series No. 41; Wld Hlth Org. Technical Report Series No. 362.

the possibility of setting definitive requirements for several other vitamins and minerals. It was of the opinion that FAO and WHO should give continuing attention to the state of scientific knowledge concerning nutrients accepted as essential to man, and others of possible significance. Whenever the information concerning the metabolism of nutrients, their distribution in diets and availability from foods is sufficient to determine requirements for different sections of the population, Expert Groups should be convened by FAO and WHO. The Committee believed that sufficient information is now available to consider requirements for iron and ascorbic acid.

Similar information is accumulating on several other nutrients, especially for the hematopoietic factors vitamin B_{12}, folic acid, vitamin B_6, tocopherol and for vitamin D as well as certain trace elements. In any future plans for the assessment of data on these and other nutrients the Committee felt that nutrients with related physiological functions or metabolic interrelationships might well be considered together.

When considering nutritional needs, especially for protein and vitamins, due attention should be paid to the influence of stress, including stress of mental origin.

3. FOOD CONSUMPTION

Adequate information on the patterns and levels of food consumption as related to socio-economic factors is essential to the formulation of food and nutrition policies. The sixth report of the Joint FAO/WHO Expert Committee on Nutrition emphasized this fact and the present Committee noted that considerable progress had been made in this field. Major sources of such information continue to be FAO's Food Balance Sheets and Food Consumption Surveys.

Intensified efforts have been made to improve the coverage as well as the accuracy of the Food Balance Sheets, which estimate the average food supplies available for human consumption at the national level. These are now available for over 60 countries, while provisional estimates are available for another 50 countries. The officially approved Food Balance Sheets are now published by FAO on a three-year-average basis.

Only food consumption surveys can furnish comprehensive information on the actual food consumption of socio-economic groups within a country. Food balance sheets cannot provide this information. Since such data are essential for effective policies and programs with nutritional, economic and social objectives, the promotion of food consumption surveys has been vigorously pursued. As a first step in this direction FAO's program of food consumption surveys was put into final form with the assistance of nutritionists, statisticians and economists. It was published in 1964 in order to encourage uniformity of methods and to assist in the organization of appropriate surveys. For the same purpose and especially for training survey personnel, a *Manual on household food consumption surveys* was published in 1962.[1] Moreover, the *Bibliography of food consumption surveys* was first issued in 1964[2] with a Supplement in 1965

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[1] FAO. *Manual on household food consumption surveys*, by E. Reh. Rome, 1962. FAO Nutritional Studies No. 18.

[2] FAO. *Bibliography of food consumption surveys*. Rome, 1964.

to provide a ready source of references on surveys carried out in different countries.

Finally, several countries have been assisted, at their request, in organizing food consumption surveys but this activity has been severely restricted by lack of resources. The Committee felt that efforts to promote food consumption surveys will have to be stepped up during the next few years, especially in developing countries if essential data for their own national plans as well as for the Indicative World Plan are to be provided. It was suggested that such surveys should include both measurements of prevailing levels of food consumption and studies of the socio-economic factors which lie behind those levels. It was noted that, with little additional work, collection of information on food habits and trends could be included. The association of social anthropologists with the survey teams will, therefore, be desirable.

4. FOOD COMPOSITION

The Committee noted FAO's activities since the publication of the *Food composition tables for international use* in 1954.[1] A *Provisional table on fatty acid content of foods* (1961)[2] and a *Provisional table on amino acid content of foods* (1963)[3] have been prepared. A *Review of food composition tables* was issued in 1965[4] for the use of those in need of a ready source of reference to different countries or regions. *Food composition tables for use in Africa*[5] was published in 1967 by FAO and the Nutrition Section, Office of International Research, National Institutes of Health, U.S.A., and is similar to the INCAP-ICNND food composition tables[6] for use in Latin America.

The Committee considered the recent suggestion made by the FAO Conference (1965) that food composition tables should be prepared on a regional and subregional basis and should include data for both raw and processed foods. The relative priorities in the preparation of international or regional tables were considered. It was agreed that available data on both raw and processed foods will have to be collected on a regional basis in the first place and that will enable revision of the international tables at a later date. This revision should: (*a*) include additional foods consumed mainly on a regional basis, (*b*) extend coverage of the values for foods already included in the tables so that they have worldwide significance, and (*c*) include data on the nutrient composition of foods as processed for human consumption.

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[1] FAO. *Food composition tables — minerals and vitamins — for international use*, by C. Chatfield. Rome, 1954. FAO Nutritional Studies No. 11.

[2] FAO. *Provisional table on fatty acid content of foods.* Rome, 1961.

[3] FAO. *Provisional table on amino acid content of foods.* Rome, 1963.

[4] FAO. *Review of food composition tables.* Rome, 1965.

[5] FAO. *Food composition tables for use in Africa.* Rome, 1964.

[6] Institute of Nutrition of Central America and Panama and U.S. Interdepartmental Committee on Nutrition for National Defense. *Food composition tables for use in Latin America.* Guatemala.

The value of any food composition table depends primarily on the quality and quantity of the data on which it is based. The use of standard methods of analysis should be encouraged in order to ensure the reliability of such data (see chapter 16).

In order to make food composition tables more useful in practice it was suggested that in addition to average figures they should contain ranges of values. Other relevant indexes such as standard deviation should be included wherever possible. The botanical as well as the vernacular names of vegetable foods should be included.

The Committee agreed that attention should be given to alcoholic beverages, preferably on a regional basis in the first instance. It was also agreed that the contribution of alcohol to calorie intake should continue to be handled as suggested in *Calorie requirements: report of the Second Committee on Calorie Requirements*, 1957.[7]

Regarding amino acids it was agreed that efforts should be made to secure adequate data from different countries through modern internationally accepted methods of analysis so that a new provisional table can be prepared and published. Data on the quantity and availability of amino acids in foods should, as far as possible, be correlated with the biological evaluation made through accepted methods on the same samples (see chapter 19).

The Committee considered that special attention should be paid to the relation between nutritive value, particularly that of protein, and varietal differences for a given species of plant. It would be desirable to begin with cereals in view of their basic importance in human diets. In developing new varieties of higher nutritive value various desirable characteristics must be conserved or developed; for this reason plant geneticists and nutrition and food scientists should work together, especially for the improvement of those plants already making a major nutritional contribution to human diets.

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[7] FAO. *Calorie requirements: report of the Second Committee on Calorie Requirements.* Rome, 1957. FAO Nutritional Studies No. 15.

5. MEDICAL ASSESSMENT OF NUTRITIONAL STATUS

With a view to implementing the recommendations contained in the Committee's fourth and fifth reports, WHO convened in 1962 an Expert Committee on Medical Assessment of Nutritional Status. The report of the Committee [1] is addressed primarily to medically qualified workers concerned with detecting malnutrition in the population.

Because many interrelated environmental, social, economic and cultural factors are involved, the report stresses the importance in any nutrition survey of first collecting the relevant information on economic and social conditions, dietary patterns of the population under study and mortality and morbidity statistics for infants and children, since these often provide useful criteria for evaluating a community's nutritional status.

The report devotes considerable attention to clinical assessment, which is the major part of a nutrition survey. It also reviews the contribution which biochemical, biophysical and radiological procedures can make toward a complete assessment of the situation.

An important recommendation made in the report was that WHO should undertake the preparation of a manual for field workers to serve as a guide in planning and conducting nutrition surveys. This has now been done and WHO has published a monograph on the subject.[2]

WHO's procedures for the surveillance of the nutritional status of the world's populations have improved as the monitoring systems concerned with communicable and noncommunicable diseases have been extended. It will be possible to add to the information already available from the

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[1] World Health Organization. *Report of the Expert Committee on Medical Assessment of Nutritional Status.* Geneva, 1963. Wld Hlth Org. Technical Report Series No. 258.

[2] Jelliffe, D.B. *The assessment of the nutritional status of the community.* Geneva, 1966. Monograph Series No. 53.

limited clinical surveys of nutritional status, vital statistics, FAO food balance sheets and various food consumption surveys. The WHO Expert Committee recommended that WHO review at an appropriate moment the results of nutrition surveys which use its recommended clinical and biochemical techniques.

Need for anthropometric data

Basic anthropometric data are urgently needed by several of the specialized agencies of the United Nations. A WHO consultant visited the major research centers in Latin America, Africa, Asia and Europe to gather information on projects to assemble anthropometric measurements in national institutions and also explored the possibility of launching a co-operative study under WHO auspices. Based on this information WHO convened in November 1966 an informal meeting of experts to plan such a co-operative venture, possibly in collaboration with the International Biological Program and the International Children's Center. The experts proposed to collect a few anthropometric data in selected age groups on a periodic basis in co-operation with local institutions. WHO will then prepare a guide for the interpretation of anthropometric data as an index of nutritional status.

Having considered the background of the problem, the Joint FAO/WHO Committee went on to discuss the value of anthropometric measurements as indicators of the nutritional status of populations. Malnutrition, whether primary or associated with infection, results in retarded growth and development while improving the nutritional status of malnourished children increases their rate of growth. Therefore the Committee urged more extensive use of anthropometric measurements (and the development of appropriate standards of comparison) and welcomed the project proposed by WHO to collect anthropometric measurements on various population groups. Such measurements collected periodically will provide useful indicators of trends in nutritional status in the world population.

6. NUTRITION IN ADOLESCENCE

In 1964, a WHO Expert Committee [1] considered the complex problem of health in adolescence and judged that priority should be given to research on the growth and development patterns of healthy children and adolescents and to standardization of methods for assessing these. Studies of the causes of deviation from normal growth should be undertaken. Nutritional requirements during adolescence in various countries and cultures should be given close attention, along with the allied problem of the hazards of early pregnancy.

More specifically, the subject of nutrition in adolescence was considered and it was agreed that the demands for nutrients during the transitional period from childhood to adulthood are especially great and variable. This is due to the accelerated growth and development which follow puberty. Menarche in girls further enhances the need for iron and protein and normal vigorous physical activity during adolescence adds another increment to nutritional requirements. Pregnancy and lactation during adolescence are becoming more frequent in developed countries. Thus in both developing and developed countries adolescence increases the demand for nutrients.

At the same time psychological factors and social pressure may induce the adolescent to adopt unconventional dietary habits and become resistant to nutrition education. Nutritional problems especially prevalent in this period range from undernutrition to overnutrition, from ariboflavinosis, anemia and goiter to obesity. It appears that the early stages of certain chronic diseases, especially atherosclerosis, may also be set during this period.

Definitive data on the nutrient requirements of adolescents are inad-

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[1] World Health Organization. *Health problems of adolescence: report of a WHO Expert Committee.* Geneva, 1965. Wld Hlth Org. Technical Report Series No. 308.

equate, partly because information is lacking on variations in energy expenditure and mean or derived values are less applicable to this age group than to adults. The Committee therefore advised research on the relationship between nutrition and physical fitness in adolescence, to obtain a better understanding of the factors affecting fitness for various types of work. Better methods for measuring the effects of physical training and for assessing the cause of lack of fitness should be developed. Obesity in adolescence in many of the developed countries is a problem for study in this context.

Such information is needed so that better national standards may be set in relation to a variety of groups, such as adolescent students, military personnel and young mothers.

7. NUTRITION IN PREGNANCY AND LACTATION

At its sixth session the Committee briefly discussed the topic of nutrition in pregnancy and lactation. It was evident that basic information was lacking concerning many adjustments in pregnancy which influence the nutritional requirements, such as physiological weight gain. The influence of faulty maternal nutrition on the well-being of the fetus and the newborn child and the nutritional needs of the mother during lactation were incompletely known. The Committee had therefore recommended that an Expert Committee on nutrition in pregnancy and lactation should be convened by WHO and this was done in October 1964. The changed nutritional needs that relate to the metabolic and physiological aspects of pregnancy and lactation are considered in its report.[1]

The average weight gain of well-nourished pregnant women is usually of the order of 10-12 kg. Data from rural areas in India and west Africa indicate a corresponding figure of only 5-7 kg. The size of newborn infants is lower in many developing countries; a mean birth weight of 2,600-2,800 g was reported in several studies in low-class Indian communities as compared with 3,300-3,500 g in many developed countries. Several factors may contribute to lower birth weights in developing countries but faulty nutrition is often of most importance. In addition to these gross weight differences, babies born of malnourished mothers may be partially depleted of nutrients such as iron, calcium, iodine and certain vitamins.

During lactation the mother requires additional amounts of nutrients to replace those lost in milk and in the energy used for its production. However, it is striking that even in severely malnourished mothers lactation may continue for a considerable period with only slight deterioration of the quantity and quality of milk.

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[1] World Health Organization. *Nutrition in pregnancy and lactation: report of a WHO Expert Committee.* Geneva, 1965. Wld Hlth Org. Technical Report Series No. 302.

In the above-mentioned report these and other pertinent questions are dealt with in some detail. It is stated that " areas of ignorance relating to nutrition in pregnancy and lactation are extremely large. " This is the more deplorable since " probably the most important single aim of a nutrition policy is to safeguard the health and growth of children, from conception to adult life. "

" Much published work in nutrition, " the report continues, " in relation to pregnancy and lactation is of limited value because it is based on short-term investigations restricted to one particular facet." In order to improve our knowledge, the report recommends quantitative physiological studies related to the adjustments that occur during pregnancy and lactation, descriptive studies of the effects of variations in nutritional status on the health of mother and child, and epidemiological studies on pregnancy diseases, fetal waste and infants' health and disease in their relation to the nutritional situation.

Other information which it is desirable to collect concerns the metabolism of pregnant and lactating women, the utilization of various nutrients during pregnancy, proper standards for clinical and biochemical assessment of nutritional status during pregnancy and lactation, and more precise data related to food intake and its relation to social status and physical activities during pregnancy and lactation. The WHO Committee considered that a broad and successful attack on the many unsolved problems can be made only through teamwork of an unusually comprehensive nature. For this purpose it recommended that " WHO assist in planning and co-ordinating a long-term, broad program of study designed to obtain the needed information in this field, and that WHO encourage and assist in the development of units of investigators, competent to undertake the required investigations."

The Joint Committee endorsed this recommendation and urged WHO to encourage the development of public health measures along the lines suggested in the report of the WHO Committee. It also advised that WHO should initiate pertinent field and laboratory studies on carefully selected groups of pregnant and lactating women.

8. NUTRITION AND INFECTION

The report of the first session of the Committee recommended that WHO promote studies on the relationship between the state of nutrition and resistance to parasitic diseases. The report of the second session specifically recommended studies on the influence of tropical parasitism as a factor in the etiology of "kwashiorkor," a severe malnutrition of children, characterized by anemia, fatty degeneration of the liver, and general failure to grow. The fifth session recommended studies on the interrelationship between nutrition and infection in general.

That the interrelationship of malnutrition and infection constitutes a major public health problem is slowly becoming apparent. Support for this view comes from reports of a WHO Study Group on Diarrheal Disease[1] and a WHO Expert Committee on Enteric Infections.[2] A WHO Expert Committee on Helminthiasis[3] recommended a study of the nutritional factors involved in host resistance to helminth infections.[4] The fifth and sixth reports of the Joint FAO/WHO Expert Committee on Nutrition reiterated the need for continued attention to the subject, and to this purpose WHO convened an Expert Committee on Nutrition and Infection in March 1965.

The report of this Committee stressed that infections are a major factor in precipitating acute nutritional disease in chronically malnourished populations. In particular, infection is usually a contributory factor in the etiology of protein-calorie deficiency disease, xerophthalmia and nutritional

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[1] World Health Organization. Study Group on Diarrheal Disease. *Report.* Geneva, 1958. (Unpublished)

[2] World Health Organization. *Enteric infections: report of a WHO Expert Committee.* Geneva, 1964. Wlh Hlth Org. Technical Report Series No. 288.

[3] World Health Organization. *Soil-transmitted helminths: report of a WHO Expert Committee on Helminthiasis.* Geneva, 1964. Wld Hlth Org. Technical Report Series No. 277.

[4] World Health Organization. *Nutrition and infection: report of a WHO Expert Committee.* Geneva, 1965. Wld Hlth Org. Technical Report Series No. 314.

anemias. Moreover, much of the retardation of growth and the malnutrition of children in developing countries is due to the loss of appetite, altered food habits, malabsorption and loss of nitrogen and other nutrients which result from infections and parasitism.

Conversely, malnutrition contributes to increased morbidity and mortality from infection. Weanling diarrhea, an epidemiological entity almost universal in developing countries, arises from a combination of malnutrition and reduced resistance to infection in an environment of poor sanitation. Much more information is required, however, especially in developing countries, concerning the mechanisms whereby malnutrition lowers resistance to infection in man. The report of the WHO Expert Committee on Nutrition and Infection concludes by emphasizing that the synergism of malnutrition and infection needs to be taught to medical and public health workers and taken into account in planning and executing public health programs.

The present Committee supported these recommendations and asked that WHO encourage further epidemiological studies on the interaction of malnutrition and infection in developing countries and that both FAO and WHO emphasize the importance of this relationship in their education and training activities.

9. NUTRITIONAL ANEMIAS

The Joint FAO/WHO Expert Committee on Nutrition has periodically (between the years 1950 and 1960) discussed the problem of nutritional anemia and WHO has implemented some of its recommendations, depending upon the availability of funds. The work carried out by WHO up to 1960 was summarized in the Committee's sixth report.[1]

In 1961 WHO initiated a collaborative investigation based on the recommendations of the WHO Study Group on Iron Deficiency Anemia which met in Geneva in 1958. Financial support from the national institutes of health enabled WHO to prepare a program of research on nutritional megaloblastic anemia with a view to integrating it with that collaborative study and enlarging its scope. The problems now under investigation are (*a*) tissue iron stores; (*b*) availability of food iron; (*c*) dermal and total loss of body iron; (*d*) the role of hookworm infection; and (*e*) the anemias associated with pregnancy, including megaloblastic anemia. Investigators from India, Israel, Mexico, Poland, South Africa, the United Kingdom, the United States and Venezuela are participating and the study has now been in progress for nearly five years. The overall progress is briefly summarized below.

1. Over 2,000 autopsy specimens of liver obtained from 16 countries have been examined for tissue iron stores. The results show that such stores vary in different population groups. The non-heme iron of the liver was highest in Bantus and lowest in Indians. In general the iron stores in the livers of females were lower than in the livers of males in the same group.

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[1] FAO. Joint FAO/WHO Expert Committee on Nutrition. *Sixth report.* Rome, 1962. FAO Nutrition Meetings Report Series No. 32; Wld Hlth Org. Technical Report Series No. 245.

2. Absorption of iron was studied using Fe^{59}-labeled wheat, hemoglobin and ferritin labeled with Fe^{59} and Fe^{55}, and Fe^{59}-ferrous ascorbate. Iron from wheat was found to be the least available. The absorption of wheat iron was less in iron-deficient subjects.

3. The role of hookworm infestations in anemia was studied in Venezuela where the principal hookworm species is *Necator americanus*. It was found that the average blood loss in the intestines amounted to 2.4 ml $\pm$ 1.06 per gram of feces for a worm load of 1,000 ova per gram of feces. Nearly 40 percent of the iron lost in bleeding into the intestines was resorbed. Later studies of *Ancylostoma duodenale* infections in the United Arab Republic have indicated much higher blood losses (nearly ten times as great) for comparable worm loads.

4. Comparative studies are in progress in the United States, Venezuela, South Africa and India using identical techniques for determining the total loss of body iron. Preliminary results indicate that in South African Bantus the rate of iron loss from the body is nearly twice as much as was observed in Americans in Seattle, Washington.

5. Studies on anemias of pregnancy are expected to give information on the state of nutrition in the community with respect to deficiencies of iron, folic acid and vitamin B_{12}. In the investigations now in progress in five different countries, standardized procedures and techniques according to an agreed protocol are being used. Reference centers in London, Johannesburg and Caracas have been established to ensure comparability of results obtained in different participating institutions.

In March 1967 WHO convened a meeting of investigators participating in the collaborative study to review the progress made and to plan for the future. Anemia research programs are being further developed in Latin America with support from the United States National Institutes of Health and the Pan American Health Organization, and in Asia from the United States-Japan co-operative medical science program.

The methods of investigation now being tested in restricted population groups, with certain modifications, will be applicable to studies of prevalence. It is important to know the magnitude of the anemia problem and the nutritional deficiencies and other contributory factors which operate in different parts of the world.

While recommending the continuation of these collaborative studies the Committee pointed out that not enough attention has yet been devoted to anemias of infancy and childhood. Iron deficiency in this age group is widespread and often severe, affecting not only blood formation but also the integrity of other tissues such as the mucosa of the gastro-intestinal tract. It may well be that these latter effects, after many years of severe iron deficiency, are not completely reversible and result in malabsorption in later life. The Committee considered it important that this problem be made the object of further studies. If the assumption of permanent damage is borne out by further investigations, this will furnish added justification for a widespread and intense attack on iron deficiency anemia in childhood.

The Committee recommended that appropriate trials be conducted using (*a*) iron supplements, to be distributed to vulnerable groups in the population, and (*b*) iron-enriched foods. Such measures, if found effective, can be extended to wider areas as an interim preventive program until fuller information on the etiology becomes available.

10. VITAMIN A DEFICIENCY

Between 1950 and 1960 WHO recruited several short-term consultants to carry out surveys on the nature and prevalence of vitamin A deficiency in various countries including Indonesia, Malaysia and Zambia. WHO communicated to the governments concerned its views regarding the preventive action needed to control vitamin A deficiency. In 1962 WHO, with financial assistance from the United States National Institutes of Health, organized a rapid worldwide survey of xerophthalmia. Experts visited more than 30 countries in Southeast Asia, the Near East, Africa and Latin America. They collected information from a variety of sources such as government statistics, hospital records, answers received to questionnaires circulated to health ministries and from direct examination of groups of infants and children. Published information from some countries which could not be visited was also used to review the whole situation. The principal findings of the survey[1] are summarized below.

1. The clinical manifestations of vitamin A deficiency, ranging from night blindness to keratomalacia and their sequelae, are encountered in infants and young children in varying degrees in the developing countries of Asia, Africa and Latin America. They are most severe in countries in south and east Asia where they constitute an important cause of preventable blindness.

2. Vitamin A deficiency usually occurs in association with protein-calorie deficiency diseases and affects the same age groups. In Indonesia such association may be found in about 75 percent of cases of kwashiorkor and/or marasmus. On the other hand, in countries of the Near East less than 10 percent of such individuals may simultaneously suffer from overt vitamin A deficiency.

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[1] Oomen, H.A.P.C., McLaren, D.S. and Escapini, H. A global survey of xerophthalmia, epidemiology and public health aspects of hypovitaminosis A. *Trop. Geogr. Med.*, 16: 271, 1964.

3. The defective weaning and poor supplementary feeding responsible for protein-calorie deficiency also operate in cases of vitamin A deficiency. Infections such as diarrheas, measles and respiratory infections often precipitate the acute condition.
4. Fatality rates between 30 and 50 percent have been found among patients suffering simultaneously from protein-calorie deficiency diseases and keratomalacia. Most of the survivors suffer from partial or complete loss of vision.

In the course of this survey the WHO consultants were struck by the fact that the diagnostic ocular signs of vitamin A deficiency were not familiar to general physicians, and many patients were inadequately treated even when the deficiency was recognized. Sometimes even ophthalmologists were not aware of the significance of the diagnostic signs. In order to fill this gap a descriptive article amply illustrated has been published in the *Bulletin of the World Health Organization.*[2]

In accordance with recommendations of WHO experts a study of the epidemiology of xerophthalmia in Jordan was undertaken by WHO in 1963 with financial assistance from the United States National Institutes of Health. Information on the following points was collected during the study: (*a*) the incidence of vitamin A deficiency and other signs of malnutrition in children below six years of age; (*b*) the association of vitamin A deficiency with infectious diseases; (*c*) seasonal variation; (*d*) carotenoids and vitamin A in blood serum of children under six years and in breast milk; (*e*) infant feeding and weaning practices; (*f*) dietary habits and socio-economic conditions of families.

The field study was confined to the two most populous districts of Jordan and covered 532 families randomly selected from cities, villages, refugee camps and border villages. At the start of the investigations the Government of Jordan made xerophthalmia a notifiable disease. On information received from such notification 112 families with cases of xerophthalmia were visited for complete investigation. The study was completed in August 1965, and the data collected have been analyzed at WHO Headquarters.

The survey results thus far available indicate that xerophthalmia occurs in an appreciable proportion of Jordanian infants and young

[2] McLaren, D.S., Oomen, H.A.P.C. and Escapini, H. Ocular manifestations of vitamin-A deficiency in man. *Bull. Wld Hlth Org.*, 34: 357-361, 1966.

children. The peak incidence was found to be between 30 and 40 months, the sexes being equally affected. Vitamin A in the sera of more than 300 children below 6 years selected at random gave an average value of 20 μg/100 ml (range 0 to 97 μg/100 ml). More than half the values were below 20 μg. It was obvious that a large proportion of these children must suffer from chronic vitamin A deficiency without overt xerophthalmia. The stress of infection, particularly diarrheas, precipitated clinical manifestations.

As a follow-up of this investigation it was decided to test the feasibility of prophylactic measures. In April 1965 a pilot trial was undertaken to determine whether protection could be afforded by a single large dose of 100,000 μg given orally during the period when infants were entirely breastfed. A preliminary examination of the results obtained in a one-year period of observation revealed no differences in serum levels of vitamin A between the trial and control groups of infants. Thus at present a proper assessment of the utility of this approach is not possible.

The Committee noted the progress made in studying the problem of avitaminosis A and was gratified to learn that WHO had followed in general the recommendations made in the report of its fifth session (1957).[3] There still remains much to be done, particularly in the field of prevention. The Committee recommended that WHO continue these studies. It stressed the need to obtain further information on the fate of vitamin A when given as a large single dose to infants and young children.

The Committee emphasized that other programs for the control and prevention of xerophthalmia need not await the completion of current studies. Full use should be made of existing knowledge in devising active preventive measures and these measures should be co-ordinated with those adopted for combating the protein-calorie deficiency diseases.

The Committee re-endorsed the recommendations made in the report of the fifth session with respect to preventive measures.

One of the preventive methods likely to prove valuable is the enrichment of foodstuffs with vitamin A with a view to increasing its intake in population groups whose diets are at present deficient in the vitamin. Among such foodstuffs are wheat flour and the protein-rich food mixtures being developed to combat protein-calorie deficiency. The Committee suggested that the stability of vitamin A in enriched foodstuffs and the

[3] FAO. Joint FAO/WHO Expert Committee on Nutrition. *Fifth report.* Rome, 1957. FAO Nutrition Meetings Report Series No. 19; Wld Hlth Org. Technical Report Series No. 149.

effects of cooking on its biological activity should be investigated, and recommended that FAO and WHO devote attention to the development of suitable vitamin A-enriched foods.

The Committee recommended that FAO continue its efforts to identify good sources of vitamin A and its precursors, encourage their production and promote their wider use in family diets through nutrition education.

11. RICKETS

The report of the WHO Expert Committee on Medical Assessment of Nutritional Status[1] includes a brief section on vitamin D deficiency which is mainly a critical review of existing biochemical methods commonly used in the diagnosis of rickets.

In recent years WHO has had increasing evidence that rickets may be a public health problem of some magnitude in many tropical and subtropical countries. Accordingly in 1965 a WHO consultant made a rapid survey of the prevalence and severity of rickets in Algeria, Libya, Morocco and Tunisia. His report to WHO was considered by the present Committee.

The frequency and severity of rickets in North Africa

Children from birth to five years of age from towns and villages and from different socio-economic groups totaling 1,160 were examined, 491 in hospitals and the remainder in dispensaries. The diagnosis of rickets was established if at least two of the following four signs were present: craniotabes, rachitic rosary, epiphyseal enlargement, and the characteristic thoracic deformity. The severity was estimated from the presence of fractures or severe deformations of chest or limbs.

The proportion of children presenting signs of rickets varied between 45 and 60 percent in the four countries surveyed. Children with severe rickets formed only 3 to 18 percent of the total number examined. The severity of the disease differed markedly from country to country, apparently as a result of differences in the application of prophylactic measures,

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[1] World Health Organization. *Medical assessment of nutritional status: report of an Expert Committee.* Geneva, 1963. Wld Hlth Org. Technical Report Series No. 258.

including the administration of vitamin D. The overall prevalence in each country was approximately the same. Rickets was more frequent and more severe in towns than in rural areas.

Rickets in other tropical and subtropical countries

Rickets is prevalent in varying degrees in many tropical and subtropical countries. In these conditions the clinical and biochemical changes differ from those found in temperate zones. For example craniotabes may be absent in the tropics although other skeletal signs may be pronounced, probably because mothers in these areas carry their babies around on their backs in a sitting position, whereas the supine position, which allows more pressure on the skull, is more often the rule in more developed countries. Data derived from studies in Ethiopia and India suggest that levels of serum alkaline phosphatase may not be an indicator of the severity of rickets in the tropics. It is possible that a concurrent protein-calorie deficiency may counteract the factors which would otherwise result in raised serum alkaline phosphatase levels. On this point the Committee considered that further investigation is needed.

Such deviations from the classical picture of rickets make it difficult in individual cases to determine if the disease is active or not. X-ray investigation would be informative but is not usually feasible under field conditions.

In temperate zones active rickets is seldom found in children over two years of age unless it is associated with coeliac disease, malabsorption or kidney disease. Unless special studies are carried out it is impossible to decide whether skeletal changes found in children over two years of age, living in a tropical environment, represent active rickets. The so-called vitamin D-refractory rickets, which has lately attracted much attention in scientific literature, is of rare occurrence and could hardly influence the results of prevalence studies in developing countries.

The consequences of rickets

The report of the North Africa survey notes that many infants presenting frank signs of rickets died of bronchopneumonia. It has been suggested that rickets probably influences infant mortality by lowering resistance to infections and aggravating the course of pneumonia

and bronchopneumonia. Permanent deformities in schoolchildren and in women of childbearing age, which may be related to rickets in early life, are matters of concern to the Committee.

Factors responsible for the frequency and the severity of rickets in the tropics and subtropics

Lack of adequate exposure to sunshine or reflected light is an important cause of rickets. While practices vary between different countries, for a number of reasons babies in many families are not exposed to sunlight. In many cases it is only when infants begin to walk that they are able to profit from sunshine.

In many countries the vitamin D content of diets is low. Breast feeding in the first few months of infancy may provide a certain quantity of vitamin D but very soon this source of supply becomes insufficient and it is not supplemented by other foods rich in vitamin D. Furthermore, routine administration of vitamin D as a prophylactic measure is usually not practiced in developing countries. The relatively small number of physicians and the limited interest shown by many of them in the prevention of rickets could be a possible explanation.

Factors other than lack of vitamin D may perhaps contribute to the prevalence of rickets in tropical and subtropical areas. Such factors include: the relatively low amount of calcium in traditional diets and their low Ca/P ratio, the widespread protein-calorie deficiency (although severe forms of malnutrition seem to be incompatible with manifestations of rickets), intestinal infestations and recurrent diarrhea.

Prevention

The Committee considered the following preventive measures that can be recommended in the light of present knowledge:

1. Education of mothers to ensure that children are exposed to the sun under appropriate conditions.
2. Sources of vitamin D to supplement breast milk in infant feeding after the third or fourth month.
3. Prophylaxis with vitamin D in appropriate doses during the first two years of life as a public health measure.

The Committee suggested that alternative methods of prophylaxis should be sought since, in many populations, daily administration of vitamin D will be difficult to achieve; the use of periodic massive doses was discussed. The dosage to be employed will depend on local circumstances. Appropriate precautions will be required to avoid hypervitaminosis D from multiple doses or sources. Results of current trials of parenteral prophylaxis should be helpful in evaluating this procedure. A comparison of the effects of administering doses of 200,000-400,000 units either parenterally or orally every six months would be useful.

Further research

The Committee recommended that WHO initiate and encourage investigation of the following:

1. The frequency, severity and symptomatology of rickets in different parts of the world and the age groups most affected.
2. The influence of rickets on the severity and outcome of respiratory and other infections and its influence on infant mortality.
3. The frequency of deformities, especially those of the pelvis in women of childbearing age, which can be attributed to rickets in early life.
4. Biochemical procedures for the early detection of rickets.
5. The antirachitic effect and possible side effects of prophylaxis with massive doses of vitamin D, oral or parenteral.
6. The role of nutrients other than vitamin D in the pathogenesis of rickets.
7. The mechanism and site of biosynthesis of vitamin D.

The Committee also recommended that FAO collect information on diets in areas where rickets is prevalent, with particular reference to nutrients other than vitamin D which may play a role in the etiology of rickets.

12. ENDEMIC GOITER

Since its inception in 1948 WHO has paid considerable attention to the prevention of endemic goiter. At past sessions the Committee has pointed out the need to collect more information on the prevalence of this condition throughout the world and to apply control measures through the use of iodized salt. Recent advances in the use of radio-iodine, the development of modern methods for the estimation of stable iodine and the technological advances in iodizing crude salt with potassium iodate have set the stage for a worldwide attack on this problem. A monograph on endemic goiter published by WHO[1] contained information on the prevalence of this condition and its clinical and public health significance and listed practical measures for control and prevention. Special attention was given to the use of potassium iodate in the fortification of moist and impure salts.

A seminar on the control of endemic goiter through the use of iodized salt, with emphasis on administrative aspects, was held in Salta, Argentina, in 1965, sponsored by WHO/PAHO (Pan American Health Organization) and UNICEF. A similar seminar under the auspices of WHO was held in 1967 in New Delhi for the Southeast Asia Region.

The Committee noted that in spite of these developments and in spite of the fact that sufficient knowledge is now available to control goiter, the application of control measures has been very slow. Nevertheless, the Committee was impressed by results obtained in some recent follow-up studies in areas where iodized salt had been introduced. In a study which will last for five years in the Himalayan endemic goiter belt a striking reduction in the prevalence of goiter has already been observed in areas receiving salt fortified with either potassium iodide or potassium iodate.

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[1] World Health Organization. *Endemic goitre*. Geneva, 1960. Monograph Series No. 44.

The prevalence has fallen from around 40 percent at the beginning of the program to about 15 percent at the present time. The incidence of endemic goiter in Guatemala was 38.5 percent in 1952 but the introduction of iodated salt reduced this figure to 15 percent in 1962 and to 5 percent in 1965.

These and other current studies should encourage governments to undertake control measures wherever endemic goiter exists. It is possible that a certain number of residual cases of goiter may remain after the introduction of iodized or iodated salt in endemic zones, and in such instances etiological factors which may not be linked to iodine deficiency should be intensively studied.

Recent evidence indicates that endemic deaf-mutism and feeble-mindedness, as well as cretinism, may be related to endemic goiter. This is an additional reason for the early application of control measures.

The Committee also considered the effectiveness of a single injection of iodized oil in the control of endemic goiter; this method was recently tried in New Guinea. While the Committee believed that this technique may be useful in remote or isolated communities where iodization of salt presents difficulties, it cautioned against the general use of such a measure in the present state of our knowledge because of possible toxic reactions to large single doses of iodine.

13. NUTRITION AND MENTAL DEVELOPMENT

For the great majority of children in the technically underdeveloped countries of the world retardation in physical growth and development due to malnutrition and its interaction with infection is a fact of existence. The small body size of underprivileged populations, regardless of their genetic background, is apparent. Experimental animals' malnutrition in early life, which stunts growth, has repeatedly been shown to reduce subsequent learning ability, memory or behavior. Some evidence is also available to suggest that malnutrition during the first years of a child's life has an adverse effect on subsequent learning and behavior. The mechanisms involved are not yet well established and the precise timing, nature, and severity of the malnutrition need clarification.

Head circumference is a useful, if not absolute, indicator of brain size, although it is not an indicator of normal variations in intellectual capacity. When children are undernourished at an early age their brain growth, as indicated by head circumferences, is significantly less in contrast to that of matched controls. Differences in the head circumference of individuals from groups of comparable genetic but different nutritional background have been reported from Uganda, Peru, Mexico, South Africa and a number of other countries.

Complicating social factors

One of the most difficult aspects in conducting and interpreting field studies concerned with the effects of malnutrition on intellectual performance is the multiplicity of non-nutritional factors which are known to influence performance in intelligence tests. These include such cultural factors as psychological and social deprivation, motivation and external stimuli. For underprivileged children in the United States and other industrialized countries such factors are likely to override any effects of nutritional status and make them difficult or impossible to detect.

Required research

The Committee considered the subject to be of such importance that definitive research designed to determine the circumstances and manner in which malnutrition influences both intellectual and physical development is imperative. Such research should distinguish, in the preschool child, between the temporary effects on test performance and behavior of an acute disease and the long-term consequences of chronic malnutrition. It should take into account the variations in the social or cultural environment, including the education, intelligence and behavior patterns of the parents and others with whom the child is associated. It should consider differences of housing, sanitation and water supply in the physical environment and any influence of the biological environment, such as exposure to parasitic and infectious diseases. It should also distinguish between genetic factors and environmental ones.

Research of this nature is multidisciplinary, demands the highest professional competence and dedication, is costly and is exceedingly difficult; but it must be done. Unfortunately, it is so demanding of funds and talent that it can be carried out only in a very few places and at a very few times. Superficial and poorly controlled or single-factor studies will serve only to confuse the issue further. Experimental studies in animals have much to contribute to resolving the problems described, but they are no substitute for a few excellent field studies in human populations, continued over an extended period of time. The Committee proposed that WHO and FAO should encourage sound studies of this type.

The reduced physical growth and development and costly morbidity and mortality of preschool children in most developing areas are reason enough for giving high priority to programs for improving the nutritional status of the preschool child. The probability that early malnutrition can cause significant retardation of mental development is an important additional reason. The overall problem should be of urgent concern to both WHO and FAO. The Committee therefore recommended that:

1. WHO and FAO encourage and, if possible, contribute to field studies well designed to determine the effects of early malnutrition on the mental development, learning and behavior of young children.
2. When sufficient data have been accumulated to justify it, possibly within five years, an expert group be convened by WHO to discuss and report on the evidence so obtained.

14. NUTRITION AND NONINFECTIOUS DISEASES

While it is essential to intensify work directed to classical nutritional diseases such as protein-calorie deficiency and the vitamin and mineral deficiencies, there is a clear need to view the problem of nutrition from a wider perspective with reference to its future role in medicine and public health. The successful control of major communicable diseases in developed countries has resulted in an increased importance of "degenerative," metabolic and genetically determined diseases. In the developing countries such diseases will be of increasing concern in the years to come as the major communicable diseases are brought under control.

There are many clinical conditions whose etiology and pathogenesis are obscure, whose treatment is empirical and prevention not yet practicable. The relevance of nutrition as a major environmental factor in such conditions needs to be explored and clearly defined, and the results introduced into medical and public health practice. To this end epidemiological studies are needed involving population groups with differing cultures, ways of life and dietary habits — the kind of studies which international agencies such as WHO and FAO are in a key position to promote. The studies on geographic pathology in nutritional anemias, atherosclerosis and ischemic heart disease initiated by WHO are examples of such work already put in motion. The relationship between nutrition and atherosclerosis is currently an area of intensive inquiry.

There is not enough joint endeavor and communication between nutrition and medicine, largely because of the lack of attention paid to clinical nutrition in medical education. The sixth session of the Committee drew attention to this problem and the Committee now reiterates the view that the medical undergraduate must be exposed to nutritional problems in the environment in which he is learning medicine.

Much remains to be discovered about the effects of various forms of malnutrition on developmental maturity. An unsolved problem of consid-

erable public health significance is whether the arrested physical and mental growth of children exposed to malnutrition can be fully overcome by nutritional rehabilitation, or whether some degree of retardation persists.

A whole new chapter has been opened on the possibilities of correcting genetic failures of metabolic activity through appropriate nutritional means and a new approach to genotype-environment interaction is developing. For example, the increasing prevalence of diabetes mellitus in many parts of the world is becoming obvious, but the roles of staple cereals and other dietary constituents habitually consumed by populations, of their physical activity and genetic background remain largely unknown. Where malnutrition is common, as in parts of India, east Africa, Nigeria and Indonesia, diabetes attributable to pancreatic calcification occurs in young adults with significant frequency. A second example is the close relationship between nutrition and obesity. This is too well known to need comment, yet feeding behavior must be studied intensively to obtain a proper understanding of obesity.

Although urinary calculi have been produced in experimental animals through nutritional means, their occurrence is not a significant feature of any of the syndromes of human malnutrition. The relationship, if any, between nutrition and urinary calculi appears to be complex. Bladder stone disease in young growing children occurs with significant frequency in endemic form over widely scattered areas of the world — India, Thailand, West Pakistan, Jordan, Syria, Iraq, Iran and Indonesia. Once prevalent in the countries of the Western Hemisphere, endemic bladder stone disease has virtually disappeared there now. Nutritional deficiencies of various types have been advocated as etiologic factors but none have been shown to be clearly involved. A multidisciplinary approach to the study of this common pediatric problem is indicated.

Idiopathic or senile osteoporosis is known to be widely prevalent among white populations of Europe and North America. Although the worldwide prevalence of this condition is not known with precision, recent evidence indicates a high prevalence also in some parts of Southeast Asia and the Far East. The roles of dietary calcium and fluoride and of physical activity need to be explored.

Examples such as these can be multiplied. Nutritional factors may be involved in the pathogenesis of tropical malabsorption syndromes, tropical heart disease of obscure origin, the aging process and carcinogenesis.

In view of the importance of this subject the Committee considered that it would be valuable if the ideas expressed in the background document are published and made known widely to all workers in public health, nutrition and allied fields.

The Committee recommended that WHO encourage studies in these areas, particularly in those where some work had already been initiated by that Organization or where epidemiological and comparative studies in various population groups are involved. Specifically the Committee recommended that WHO initiate studies of osteoporosis, bladder stone disease in children, and juvenile diabetes due to pancreatic calcification.

15. NUTRITION IN FOOD SCIENCE AND TECHNOLOGY

Since the last meeting of the Committee in 1961 FAO has placed great emphasis on the development of food science and technology as a means to improve the nutrition of the peoples of the world. New programs have been created within the framework of the Organization. Member Governments have displayed a deeper understanding of the role of food science, food technology and the food industry in improving nutrition, trade and economic development. This expansion has become possible through increased staffing investments made by the United Nations Development Program (Special Fund and Technical Assistance) and the Freedom from Hunger Campaign. Research and training in food technology, development of food industries, food control and legislation, and expansion of the protein-rich food program are the general areas in which nutritional considerations are of primary importance.

Specific activities in food science and technology carried out by the Nutrition Division of FAO

1. Establishment of institutes of food science and technology (assisted by the United Nations Special Fund).
   Projects are in operation in Chile, Brazil, Ghana, Poland, Senegal, Turkey, China (Taiwan), Malaysia and Peru. Similar projects are under study in many other countries. The work of such institutes is geared to applied research of direct interest to the development of food industries and to training scientific and skilled technical personnel who in their turn will train the professional and technical staff needed by those industries.
2. Training in food technology.
   An important project has been sponsored by the Canadian Hunger Foundation in co-operation with the Government of India and FAO.

An International Food Technology Training Center has been established at the Central Food Technology Research Institute, Mysore, south India, which provides a two-year postgraduate course on food technology and *ad hoc* short-term courses for fellows from countries in Asia and the Far East. A similar project to be sponsored by the Canadian Hunger Foundation is now under consideration for Latin American countries.

3. Expert services to advise member governments (regular program and United Nations Development Program).
   With the help of consultants the Nutrition Division advises Member Governments on the following subjects, among others: development of food industries, refrigeration, meat utilization, canning and fruit juice industries, community or co-operative canning, millet processing and millet milling, food control and legislation, protein-rich foods, and cereal and bread technology. A special conference on cereal and bread technology for the Near East and North Africa was held in 1966.[1] Following the pattern of the First FAO Seminar on Food Technology for Asia and the Far East (Mysore, India, 1959)[2] seminars have been conducted for Latin American countries (Campinas, Brazil, 1964) and for African countries (Accra, Ghana, 1965).

4. Protein-rich food program (conducted jointly with UNICEF and WHO; see chapter 19).
   It is now clear that the development, production, promotion and marketing of protein-rich foods must become an industrial and commercial enterprise if these products are not to remain essentially laboratory or pilot plant exercises. A meeting held jointly with UNICEF in 1963 brought together internationally and nationally operating industries to find ways and means of making protein-rich foods available to the needy sectors of the populations in developing countries. FAO is following closely the development of foods and nutrients prepared from unconventional sources, such as synthetic amino acids, protein isolates, single-cell proteins produced by bacteria or yeasts grown on carbohydrates, petroleum or methane, and by algae through photosynthesis.

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[1] FAO. *Report of the FAO Conference on Cereals and Bread Technology for the Near East Region, 1966.* Rome, 1966.

[2] FAO. *Report of the FAO Regional Seminar on Food Technology for Asia and the Far East.* Rome, 1959. FAO/EPTA Report No. 1159.

The Committee considered that FAO should be actively but selectively involved in the development of unconventional sources of protein for human consumption. The United Nations Advisory Committee on Science and Technology has recently given high priority to the contribution to be made by science and technology in meeting world protein needs. A report on "Meeting Protein Needs for Human Consumption from Unconventional Sources" was presented to the sixth session of this Committee in October 1966.[3] To facilitate further discussions of the problem FAO, WHO and UNICEF have also drawn up a detailed report on this subject.

5. Cereal and bread technology (including noncereal bread technology). An important project which has been developed with support from the Freedom from Hunger Campaign deals with the development of bread from noncereal starchy products, like cassava flour mixed with protein concentrates made from soybeans, cottonseed or groundnuts. The results so far have been satisfactory and the work, continued with the assistance of the Netherlands Government, will in due course be transferred to the Food Science and Technology Institutes of Ghana, Senegal and Brazil. Among the publications on nutritional and technological subjects, the Nutrition Division is planning the issue of a monograph on bread and cereal diets and a manual on cereal and baking technology.

6. Food additives legislation and standards (see chapter 16).
In the field of food control and legislation a Regional Food Control and Legislation Seminar was held in 1962 in Bangkok[4] for the countries of Asia and the Far East. Projects are now developing, supported by either the United Nations Development Program (Special Fund and Technical Assistance) or Funds-in-Trust, to organize food control services in a number of Member Countries. They include aid in drafting basic food legislation, organization of laboratories, and training of analysts and inspectors. In view of the fact that the basic aim of food legislation for the benefit of the consumer is the prevention of health hazards and fraud and since such basic legislation needs trained analysts and inspectors as well as laboratories to make it effective, the Committee strongly recommended expansion of work in this field.

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[3] Published by United Nations Economic and Social Council, New York, 1966.
[4] FAO. *Report of the FAO Regional Seminar on Food Legislation for Asia and the Far East, 1962.* Rome, 1962. FAO/EPTA Report No. 1582.

Developments in food technology

Two important trends characterize modern methods used to supply foodstuffs:

1. An ever-increasing number of people eat food which has been stored, preserved, processed, or manufactured in one way or another.
2. The proportion of such foods in the diet is steadily increasing.

These trends, which are common to most industrially developed nations, are becoming established also in the low-income developing countries, although there the volume of trade in such foods is still comparatively small. Increasing urbanization and concentration of population lead to the use of processed foods. The application of modern food technology improves both the availability and the nutritional value of staple and protective foods and is essential if people are to be provided with sufficient food to meet their nutritional requirements.

The Committee considered that FAO should intensify its activities in developing countries to improve traditional methods of food processing by simple but effective means. It recognized that in the initial phases of food industry development, particularly when the production is for local markets, small and medium-sized food processing enterprises may prove economically more feasible than large ones. However, small-scale production equipment is not always easily available for such plants. Food machinery manufacturers should be urged to provide specially constructed equipment suitable for such plants.

The classical food preservation and processing techniques, such as cold storage, dehydration and canning, are always being improved so that cheaper and better conventional foods and new foods can be produced.

NEW PROCESSING TECHNIQUES

Freeze-drying and ionizing radiation were discussed as new processing techniques. In the more developed countries increased use of freeze-dried foods can be expected, but in countries where nutritional deficiencies are prevalent such foods will be expensive and beyond the economic means of most families for some time to come.

The use of ionizing radiation to preserve food is still in its infancy, and only a few radiation-preserved foods have been approved for commer-

cial production in industrialized countries. For this reason the method is at present of only limited importance. The radiation dosages now envisaged do not induce any significant degree of radioactivity in food and will not produce harmful constituents. Much work remains to be done to establish clearly in which instances radiation preservation of food used alone or synergistically provides significant advantages over the more conventional methods. At present the relatively high cost of food irradiation and the sophisticated handling required for foods so treated discourage the application of the procedure in developing countries. In addition to the use of "pasteurizing dosages" of radiation for meat, fish, fruit, etc., the most promising applications appear to be grain disinfestation and inhibition of sprouting in potatoes and onions. The attention of the Committee was drawn to the report of the Joint FAO/IAEA (International Atomic Energy Agency)/WHO Expert Committee (*The technical basis for legislation on irradiated foods*) which met in 1964 and recommended a common approach to legislative control in this field.[5] This may be followed up by another joint expert committee to consider the international clearance of irradiated foodstuffs and the effects of irradiation on food constituents and microflora.

The term "food technology," as applied today, includes packaging which is intimately related to both the preservation and processing of foods and to their marketing. A wide variety of new materials are now available for packaging. It is hoped that the publication by FAO in the near future of a food packaging guide for developing nations will prepare the ground for increased use of appropriate packaging material. This will certainly contribute to hygienic handling and distribution of food and have a positive impact on nutrition, especially that of infants.

A major aspect of modern food technology is the use of additives. This subject is dealt with in chapter 16.

Food storage

An extremely important aspect of food technology, which has not yet received adequate attention, is the large-scale application of modern techniques to prevent food waste and spoilage, particularly in tropical and

[5] FAO. *The technical basis for legislation on irradiated food: report of a Joint FAO/IAEA/WHO Expert Committee.* Rome, 1965. FAO Atomic Energy Series No. 6; Wld Hlth Org. Technical Report Series No. 316.

subtropical countries. Satisfactory storage is the proper solution and this is one of the most critical problems facing food technologists working in developing countries where there is little appreciation of the importance and practice of good storage. As a consequence huge quantities of food are lost by deterioration, spoilage and depredation through molds and other micro-organisms, insects, birds and rodents.

Assessment of the extent of such losses is difficult but recent data suggest that in some instances more than one third of the grain harvested is lost. A similar figure probably applies to other food crops. Prevention of these losses should improve nutritional status and economic levels. Rodent control and rat-proofing of stores and warehouses will also raise levels of hygiene and public health.

The Committee expressed the view that the prevention of losses in stored foods of both plant and animal origin should command as much attention in FAO's work program as that directed to modern food processing methods. It recommended that FAO provide more comprehensive assistance to Member Nations in this activity, preferably in the form of teams of specialists. In view of the nutritional, economic and public health implications of the food storage problem (including food hygiene and rodent control), the Committee considered it advisable that FAO and WHO convene an expert meeting to consider how food storage at both village and industrial levels can be improved.

Training in food technology

The increasing use of processed foodstuffs makes it necessary for the food industries to safeguard the nutritional value of their products as well as their quality and safety. Along with staff trained in the principles of hygiene, bacteriology, biochemistry and nutrition, professional personnel to carry on mechanical, chemical and food engineering are needed in increasing numbers. The need to make food technologists aware of the part all these disciplines have to play in product development thus becomes evident.

The Committee affirmed that food technicians have an important role to play along with food technologists in setting up food industries in developing countries. The training of food technicians, foremen and skilled workers must go hand in hand with the establishment and improvement of new food industries. The Committee suggested that training for food

technicians and the medium and lower levels of skilled personnel should be implemented on a national basis and in co-operation with laboratories and institutes devoted to applied research.

The Committee was convinced of the immediate need to establish new centers or strengthen existing ones which are concerned with applied research in the broad field of food technology. The program of institutes, whether national or regional in type, should include laboratory and pilot-scale investigations on storage, preservation, processing, marketing and utilization of the most important local foods, with particular attention to the retention of nutritive value in stored and manufactured foods. Processed products made from foods already acceptable to the local people should be developed with the object of meeting the nutritional needs of the vulnerable groups. In this respect protein-rich food mixtures, well balanced in respect of calories and other nutrients, yet cheap and palatable, should have priority.

16. FOOD ADDITIVES AND FOOD STANDARDS

Food additives

A great deal of work has been carried out by the Joint FAO/WHO Expert Committee on Food Additives in its five sessions since 1961. Based on principles laid down prior to that date, the sessions of this Committee have produced specifications for the identity and purity of food additives and their toxicological evaluation, the latter expressed in terms of an acceptable daily intake. Already over 150 of the most commonly used food additives have been considered. The groups of food additives covered in the various reports appearing since 1961 are as follows:

Sixth Report	Mainly antimicrobial preservatives and antioxidants
Seventh Report	Some emulsifiers and stabilizers, flour treatment agents
Eighth Report	Food colors and re-evaluation of some antimicrobials and antioxidants
Ninth Report	Further preservatives, flour treatment agents, acids and bases, as well as some antimicrobial preservatives and antioxidants
Tenth Report	Further emulsifiers and stabilizers as well as certain possibly toxic trace elements; food colors and antimicrobial preservatives.

The Second Joint FAO/WHO Conference on Food Additives was held in June 1963. Up to that time the scope of the program had been limited to "non-nutritive substances which are added intentionally to food, generally in small quantities, to improve its appearance, flavor, texture, or storage properties." The second conference found this definition too narrow and the scope of the program on food additives was widened to

cover all intentional additives except those substances added exclusively for their nutritive properties. The program now includes substances unintentionally introduced into human food, such as animal feed adjuncts which may result in residues in human food and components of packaging materials which may find their way into food. Both these items will be considered at future meetings of the Expert Committee on Food Additives after the work on more direct additives has been completed. Pesticide residues and radioactive contaminants of foods are being dealt with by other FAO and WHO expert groups and therefore have not been included in the future program of work on food additives.

Food Standards Program

Following recommendations made at the eleventh session of the FAO Conference and the twenty-ninth session of the WHO Executive Board, a Joint FAO/WHO Conference on Food Standards was held in October 1962. This Conference, in accordance with the wishes of the governing bodies of FAO and WHO, led to the establishment of the Codex Alimentarius Commission as the principal organ of the Joint FAO/WHO Food Standards Program. The Commission has held four annual sessions.

The Codex Alimentarius

The main objectives of the Codex Alimentarius Commission are the protection of consumers' health, the ensurance of fair practice in the food trade, the promotion of international food trade, the furtherance of food standards work in developing countries, and the simplification and co-ordination of all work on international food standards. International food standards adopted by the Codex Alimentarius Commission will be published in the *Codex Alimentarius* which can be described as an officially published book of internationally accepted food standards. Codex standards may be drawn up as worldwide or regional standards and the *Codex Alimentarius* will include not only standards for commodities, but also provisions concerning labeling, food additives, food hygiene, pesticide residues, methods of analysis and sampling.

The Codex Alimentarius Commission has created seventeen subsidiary bodies, of which two deal with general policy and co-ordination, six with subject matter relevant to the work of all commodity committees, and

nine with particular groups of foods. Two further groups created by the United Nations Economic Commission for Europe were also brought into relationship with the Codex Alimentarius Commission.

At the present time some 60 Member Countries of FAO and WHO are playing an active part in the work of the Codex Alimentarius Commission or its subsidiary bodies. The Commission has drawn up, in accordance with the constitutions of both organizations, its own rules of procedure which have recently been approved by the Directors-General of FAO and WHO. In addition to the rules of procedure the second session of the Commission established formal working procedures for elaborating standards on a worldwide and regional basis. These procedures contain a number of steps which afford members and associate members of FAO and WHO an opportunity to comment and participate in the preparation of the draft standards before they are approved by the Commission and submitted to governments for acceptance as international food standards.

A particularly significant development in the Commission's work at its third session was the adoption in full of general principles on the purpose and scope of the *Codex Alimentarius*, the nature of standards to be included in the *Codex Alimentarius* and the ways in which Codex standards may be accepted by governments.

Some 200 international food standards are in course of preparation by subsidiary bodies of the Codex Alimentarius Commission. The greatest progress to date has been made with international standards for milk and milk products. A Code of Principles dealing with the use of proper designations, definitions and ethical practices in the international trade of milk and milk products has been formally accepted by 71 countries. As an example, 65 countries have accepted a standard for milk powder.

VITAMINS, MINERALS AND DIETETIC FOODS

The Joint Committee on Nutrition was asked to advise on whether vitamins and minerals should be included in international food standards, and on the scope of the Codex Committee on Dietetic Foods.

Concerning supplementation of foods to combat dietetic deficiency diseases the Committee in general encouraged the use of such supplementation. This subject had been mentioned in a number of its past reports. However, the Committee was in agreement with the Executive Committee of the Codex Alimentarius Commission in considering that it would be difficult to lay down general provisions on vitamins which should be appli-

cable to all countries. It also agreed that in most cases it might be best to treat vitamins as optional ingredients. The Committee pointed out that the question of levels and the medium in which the supplement should be provided must be left flexible due to variations in food habits.

Regarding the report of the Codex Committee on Dietetic Foods the Committee felt that the definition of " dietetic " was not precise enough. The Committee recommended that foods which meet a particular physiological need of healthy people and also supplementary foods made necessary, for instance, because of unusual physical effort or strain should not be considered dietetic foods. They may be considered special foods and as such may be treated separately from ordinary foods. Some restrictions as to labeling and claims for such products may be necessary, and certain limitations may be needed as, for example, of food additives. The Committee recommended that the Codex Committee on Dietetic Foods should concentrate on foods which are strictly speaking dietetic, the use of which is connected with such morbid conditions as diabetes, and on foods low in various dietary components such as sodium, gluten, phenylalanine, etc.

The Committee recognized the important contribution which the Committee on Methods of Analysis of the Codex Alimentarius Commission could make in promoting the use of internationally accepted methods of analysis of foods and recommended that one of the tasks of the Codex Committee should be to standardize appropriate analytical methods for use in determining the composition of foods.

17. FOOD ADDITIVES IN INFANT FOODS

The sixth report of the Joint FAO/WHO Expert Committee on Food Additives[1] stated: "... there is one class of foods to which special reference must be made. Foods that are specifically prepared for babies require separate consideration from all other foods as regards the use of food additives and toxicological risks... "

It is evident that broad generalizations are not possible concerning the relative toxicity of substances for infants as compared with adults. The young infant exhibits biochemical peculiarities which may alter his sensitivity to a particular drug or chemical. This may be expected to reflect itself in some alteration in the metabolic conversion or degradation of a compound which may result in acute or subacute toxicity. This is likely to be a temporary metabolic condition which changes as the infant gets older. Not all such differences may be in the direction of decreased resistance to toxic substances; increased resistance to the toxic effects of some compounds may be found.

Because of these possibilities the assessment of a chemical's toxicity to infants raises questions not encountered in the adult.

A case in point is the fact that in infants large amounts of nitrate in food may be converted to nitrite by bacterial flora. This health problem has in the past been related to ingestion of nitrate in water, but now a possibility seems to be the high levels of nitrate in some vegetables. New observations of this kind will undoubtedly stimulate observation on " additives," using the word in its widest sense. On the other hand new experience may necessitate reappraisal of earlier concepts. An example is the

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[1] FAO. *Evaluation of the toxicity of a number of antimicrobials and antioxidants: sixth report of the Joint FAO/WHO Expert Committee on Food Additives.* Rome, 1962. FAO Nutrition Meetings Report Series No. 31; Wld Hlth Org. Technical Report Series No. 228.

attitude to certain chemical agents widely used in the preparation of acidified milk formulas.

Manufacturers of infant food products have exhibited commendable restraint in the use of non-nutritive additives in their products, and the Committee urged that such a conservative policy be continued. When additives are used the hazard or safety should be judged from data from appropriate toxicologic and metabolic studies, including those made on comparable young animals or infants. It is recommended that an early session of the FAO/WHO Committee on Food Additives, in which the pediatric discipline will be represented, consider the type of studies judged to be most informative in this respect.

18. MYCOTOXINS IN FOODS

The Committee considered the large volume of evidence relating to toxin production by various mold species and their incidence in human foodstuffs. Several of these species have been clearly implicated in incidents of toxicity in man, for instance *Claviceps purpurea* in ergotism and several species, e.g., *Fusarium poae*, *Fusarium sporotrichicides* and *Cladosporium epiphyllum*, in alimentary toxic aleukia. Numerous other molds which can develop in a wide variety of foodstuffs have been shown capable of producing substances toxic to various animal species. Outstanding are *Penicillium islandicum*, a species primarily involved in toxic yellow rice, which produces the toxins islanditoxin and luteoskyrin, and strains of *Aspergillus flavus* which produce a group of closely related chemical substances known as the aflatoxins. These latter substances were initially isolated and identified from a batch of groundnut meal which caused deaths in turkeys. Since this initial discovery it has been found that aflatoxin can arise in a number of other foodstuffs if they stand long enough at temperature and moisture levels favorable to the growth of molds. They have even been found occasionally in foods which are potential sources of protein concentrates for use in infant feeding, such as cottonseed, and in staple foods such as maize.

In view of the fact that aflatoxin may be present in components of children's formulas (groundnuts in particular being a valuable and, in many regions, a readily available protein ingredient) and in view of the importance of minimizing exposure of children to such agents, the Committee reviewed the report of the meeting of the FAO/WHO/UNICEF Protein Advisory Group in August 1966 which had made recommendations on this subject. On the best evidence available, derived from experiments conducted on various animal species including primates, this Group recommended that a level of aflatoxin in protein supplements, of which 100 g is eaten per day, should not exceed 0.03 ppm (30 μg/kg) of

food.[1] "Although the Group would prefer to impose a lower level of aflatoxin in the foods and food mixtures concerned in order to provide a wider margin of safety, it believed that there was an even more urgent need to provide extra protein in some parts of the world in order to prevent malnutrition and starvation. These considerations outweighed the desirability of introducing measures for reducing a hypothetical health hazard by limitations which were difficult to enforce under current agricultural practices and techniques of food processing." The Group hoped that with further improvements in agricultural practices it would become possible "to insist on lower levels of aflatoxin in food and yet remain confident that adequate supplies of protein-rich foods would remain available." The Committee endorsed this statement (although ideally it too would have preferred aflatoxin-free food) and recognized the maximum level of aflatoxin which had been specified by the Protein Advisory Group as set out above. Some specified level is needed for routine food testing; nevertheless, the Committee emphasized the tentative nature of these recommendations and the need for further research which should include even longer term feeding trials than have so far been possible.

The Committee drew attention to the number of test methods for aflatoxin currently in use and which have been published[2] and also noted that the International Union of Pure and Applied Chemistry is currently engaged in an international collaborative study of these tests with a view to producing an agreed standard test.

Mold toxin production, whether it occurs in oilseeds, cereals or other foodstuffs, can be minimized by careful control of harvesting, handling, processing (particularly drying), and storage methods. The Committee emphasized the need to educate and train all those concerned with the production, distribution and marketing of foodstuffs in the importance of avoiding conditions which favor mold growth.

The Committee welcomed the proposal that FAO and WHO set up an investigation of the incidence of mold toxins in foods commonly consumed by man in both temperate and tropical regions and study any correlation that may exist between such incidence and disease patterns.

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[1] In view of certain more recent evidence, the Protein Advisory Group was to reassess this level at its meeting in October 1967.

[2] Coomes, T., Crowther, P., Francis, B. and Stevens, L. *Analyst*, 90: 492, 1965; Lee, W.V. *Analyst*, 90: 305, 1965; Nabney, J. and Nesbitt, B. *Analyst*, 90: 155, 1965; Campbell, A.D. and Funkhouser, J.I. *Journal of the Association of Official Agricultural Chemists*, 49: 730, 1966; Iongh, H. de, Van Peet, I., Ord, W. and Barrett, C. *Veterinary Record*, 76: 901, 1964; Pons, W. and Goldblatt, L.A. *Journal of the American Oil Chemical Society*, 42: 471, 1965.

19. PROTEIN-RICH FOODS: PRODUCTION, UTILIZATION, PROMOTION AND COMMERCIALIZATION

The Protein Advisory Group was reorganized in 1961 as an advisory body to FAO, WHO and UNICEF. It has continued to provide advice to these agencies on ways and means to prevent the protein-calorie deficiency diseases. The secretariat of the Group has issued a series of bulletins related directly to work in the fields of research, development and testing of protein-rich food mixtures and related subjects.

The Committee recommended these means of prevention:

1. The development of local agricultural resources, including grain legumes, must be given the highest priority. It is also important that less conventional protein resources, such as those of oilseed press-cakes, be fully utilized. While these measures represent an important contribution toward the prevention of protein malnutrition, developments in other fields are potentially useful in improving protein nutrition. Upgrading the nutritive value of cereal proteins by changing the genetic amino acid pattern is one of the major new developments. Fortification of cereals with synthetic amino acids is another. The production of amino acids such as methionine and lysine by fermentation and by new methods of synthesis has reduced their cost and has made these supplements economically feasible.
2. Grain legumes as well as groundnuts, cottonseed, soybeans and fish protein concentrates are still the major protein sources used in the development of protein-rich food mixtures for supplementary feeding. Mention should also be made of sesame, sunflower and coconut as sources of protein concentrates which have recently been studied as ingredients of protein-rich mixtures for human use.

Groundnut

The possibility of contamination of groundnut products and other foodstuffs by *Aspergillus flavus* and the resultant production of aflatoxin is now widely recognized. The structure of aflatoxin has been identified

and sensitive physicochemical methods of detection have been developed (see chapter 18). Surveys are at present being conducted in many groundnut-producing countries to establish the prevalence of aflatoxin contamination and the best methods of prevention. Successful trials have been conducted jointly by FAO and UNICEF in Senegal and Nigeria on prevention by improved methods of harvesting and storage.

Cottonseed

Commercial production of cottonseed protein concentrate, low in free gossypol and fit for human consumption, has been achieved in the United States, El Salvador and Colombia. Cottonseed meal nearly free of gossypol has been produced on a pilot scale in several institutions, particularly in Italy, India and the United States. Two major developments have taken place, the first one being the production of gossypol-free cottonseed protein concentrate through the use of selective solvents (acetone) or azeotropic mixtures (hexane-acetone-water mixture). One process is already being used commercially. The second development is the production of glandless cottonseed through genetic manipulations. This important program is now in the development stage.

Soybeans

Interest has centered on development of milk-type soybean beverages, which are produced on an industrial scale and meet with considerable commercial success in some parts of Asia, and the development of full-fat soybean products by an extrusion cooking process. The flavor components, which sometimes constitute a drawback to a wider utilization of soybeans, are at present being investigated. There is growing interest in a simple process now being tested at the Northern Regional Research and Utilization Laboratory of the United States Department of Agriculture, Peoria, Illinois.

Fish protein concentrates

A plant has been erected in Agadir, Morocco, for the production of a defatted fish protein concentrate, but this is still in the experimental phase. The Bureau of Commercial Fisheries, Department of Agriculture, Washing-

ton, D.C., has announced a feasible process for the production of defatted and deodorized fish protein concentrate, and has launched studies on its use in human diets. Still other processes are in various stages of development and commercialization in several countries.

Supplementary and weaning food mixtures

" Incaparina " is produced and commercially distributed with increasing success in Guatemala and Colombia. A protein-rich food mixture based on grain legumes and wheat has been successfully tested on a small scale on children in Algeria; production on an industrial scale and commercial distribution were to begin in 1967. Another protein-rich food mixture, based on full-fat soybean flour and rice, has been tested successfully in China (Taiwan) and equipment for its production on a commercial scale is now being installed. In India several supplementary foods, based on blends of oilseed protein-concentrates, pulses and cereals, have recently been proposed for the improvement of protein nutrition. These food mixtures are to be produced and marketed in India under the generic term of " bal-ahar," which means " nutritious food for children." Bal-ahar formulas produced in the United States will be shipped to India, replacing some of the dried skim milk previously supplied. In Nigeria a mixture of groundnut protein-concentrate and skim milk powder is distributed in government feeding programs and on a semicommercial basis under the name " Arlac." In Senegal batches of groundnut-enriched " couscous " have been tested, with the aim of producing a weaning food of couscous and high quality groundnut concentrate, with small amounts of dried skim milk or fish protein concentrate. Other projects for the production of weaning foods are now in various stages of planning and development in Brazil, Ethiopia, Israel, Lebanon, Morocco, Peru, Tanzania, Thailand, Tunisia, the Arab Republic and Uganda.

Production and utilization

A review of the progress achieved up to 1961 in the development of protein-rich foods by the joint FAO/UNICEF/WHO program was presented at the sixth session of this Committee. Since then considerable experience has been acquired on the development of protein-rich foods and their

manufacture but the marketing phase of the program, including consumer studies and promotion campaigns, has not been given the attention it requires. What is necessary and urgent now is to proceed to the industrial production and marketing of the products that have been developed.

Industrial production of protein concentrates and of formulated products has been slow and uncertain. In a number of countries established food industries have made some efforts but the introduction of products and the promotion of sales have encountered difficulties. In addition well-equipped industries having the necessary facilities to launch the production and marketing of protein-rich food products in developing countries have been reluctant to become involved.

The work so far accomplished and the experience gained have resulted in a number of basic concepts which in some instances depart from those accepted 10 years ago. The principles now guiding protein-rich food programs are as follows:

1. There is widespread protein malnutrition in children from the weaning period until the early school years and protein-rich foods that have been developed should be used to meet the needs of this wide age group.
2. The original purpose of the joint FAO/UNICEF/WHO program was prevention, and this should be maintained as the primary working guide. The sixth report emphasized the increasing frequency of marasmus with urbanization in some developing areas and reiterated that the protein-rich food program of FAO/UNICEF/WHO is designed for the prevention of any form of protein-calorie deficiency.
3. While the development of protein-rich food mixtures for weaning or supplementary purposes in infants and young children has a high priority, it is recognized that in most instances these special formulas can only be part of a broader program of production which covers a wide range of products. Children of other ages and adults may also need an increased protein supply. Practical and economic considerations give further support to this approach.
4. The most efficient way of utilizing protein concentrates is to mix them with carbohydrate-rich foods. Staple food products are often suitable for this purpose. The use of protein concentrates to be added to food by the consumer is not considered effective as it presupposes an appreciation of nutritional benefits.

5. In order to correct specific nutritional deficiencies, formulated protein-rich food products, particularly those intended for infants and young children, may be fortified with vitamins and minerals. Iodization of such foods might also be of benefit in areas where the incidence of goiter is high.

6. Protein-rich foods, either for infants and children or for the entire family, should be developed from raw materials that are locally available. When some constituents, particularly the protein concentrates, are not actually available, they may be imported initially but with the understanding that immediate efforts be made for their eventual commercial production in the region.

7. From the early conception of a project, plans must take into consideration economic factors, food habits and behavior of the consumer. The plans should be developed in co-operation with industrial concerns having their own distribution channels, or with existing state manufacturing and distribution mechanisms, to assure that eventual large-scale production and distribution will be in effective hands.

Scientific evaluation and tests for safety and suitability

Scientific evaluation and tests for safety and suitability for human consumption, especially for infants and young children, are essential in the development of protein-rich foods. When materials which have not been used as human food are to be used as protein sources in new food products it is important that certain essential steps be taken before testing the products in man. These steps also apply to foods in common use when they are processed by new techniques to provide protein concentrates. These steps are:

1. Identification of the source of edible protein, the quantity available and economic study of its potential.

2. Chemical evaluation of the quality and quantity of protein and the amino acid composition of each of the component foodstuffs from which protein-rich food mixtures are to be made.

3. Determination of the proportions of various components in the proposed mixture based on nutritional or other considerations.

4. Chemical and biological estimation of the nutritive value of the mixture and evaluation of damage to protein which may have resulted from the processing necessary for industrial production.

5. Tests to determine freedom from toxicity due to the presence of intentional additives, of toxic substances naturally occurring or arising from mold infestation, or from the use of pesticides and fungicides.

6. Assurance that processing plants comply with hygienic requirements applicable to all food processing industries and that the product meets the microbiological and sanitary standards for edible products.

Qualitative and quantitative tests to determine the suitability and safety of such products for human consumption are necessary, as well as animal tests to rule out acute or subacute toxicity.[1] It is only when these steps have been satisfactorily accomplished that human tests should be initiated.

There is a need for the clinical testing of really new sources of protein and protein concentrates prepared by the use of new processes. However, there is no need to test formulas prepared from ingredients which have already been tested merely because the proportions of ingredients vary. Indeed such excessive and unnecessary testing can needlessly hamper progress. It is therefore suggested that:

1. Proteins and processed protein concentrates previously not considered in the WHO/FAO/UNICEF programs, or products previously considered but manufactured by new processes or by major changes in established processes must pass testing procedures of the type recommended in this document.[2] This is especially true if the changes in processing raise any suspicions as to nutritional or toxicological properties of the product.

2. Mixtures of well-known staple foods and protein sources which have already received favorable consideration should be accepted without insistence on clinical testing beyond acceptability and tolerance trials,

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[1] The rules specified by the Food and Drug Administration, Washington, D.C., for acceptance of additives to common foods provide useful guidelines. These include, among others, full acute and chronic toxicity trials.

[2] Further details are given in *Human protein requirements and their fulfillment in practice*. Proceedings of FAO/WHO/Josiah Macy, Jr. Foundation Conference. Princeton, N. J., U.S.A. 1955, p. 165.

unless they have been subjected to further processing which might cast doubt on their safety. It would be advisable to ascertain the nutritional value of the final product in terms of protein efficiency ratio or net protein utilization (PER, NPU) by animal experimentation.

3. When severe or unconventional processing of mixtures of well-known staple foods and protein sources has been used the products should be accepted for tests in man only after they have satisfied the necessary laboratory analysis and animal testing for protein quality. Clinical testing, although not mandatory in this case, may be helpful to determine the value of these food mixtures in supplementary feeding programs for children.

Knowledge of the technological steps involved in processing will help to decide in which of these last two categories a food mixture should be placed.

Human testing comprises acceptability and tolerance tests, growth tests (or nitrogen balance) and other criteria. The tests to be carried out will be determined in accordance with the recommendations made by the Protein Advisory Group at its annual meeting in August 1966, in Geneva.[3]

Marketing

The Committee recognized that the greatest obstacle to the widespread use of new protein-rich foods is not their production in a safe, palatable and inexpensive form but effective marketing and promotion. In this context, the main determinants can be summarized as: the prospect of continuing economic viability, allied to the prospects of continuing consumer acceptance of the product.

The requirements for effective consumer marketing and promotion planning involve virtually the same determinants as those which condition product formulation and development. The Committee therefore recommended that a consumer marketing and promotion specialist should be involved from the outset in planning protein-rich food projects.

The need for objective pre-evaluation, in depth, of all factors which may have a bearing on the long-term success of a project was agreed to

[3] *Note on human testing of supplementary food mixtures.* Nutrition Document R.10/Add. 91/Rev. 1 (WHO/FAO/UNICEF).

be essential. These planning procedures can substantially reduce risks and thereby help to promote investment by established food manufacturers. The Committee therefore recommended the adoption of the following procedures.

Recommended method of work in protein-rich food projects

1. Define the short-term and long-term objectives of the project.
2. Obtain accurate information on sources of finance and support. Adherence to time factors and commitments is necessary.
3. Draft a time schedule. The project should be divided into phases, allowing sufficient time for analysis of all base-line data and in particular for identification of missing important information for which additional time may be necessary to ensure success.
4. Appraise the project territory or country. Make a demographic breakdown of population covering age, sex, occupations, urban-rural distribution, per caput income, literacy, languages. In addition the following factors must be examined: nutritional status, dietary patterns and weaning practices, climate, local industries, transportation, food distribution patterns, seasonal factors, regional strength and weakness; published sociological information, raw material availability, food processing industries (if any) and expected profit margins.

After such data have been collected the problem can be better appraised.

Appraisal of the problem

1. Determine possible lines of solution, taking into account relevant experience derived from projects carried out elsewhere.
2. Outline further research if needed.
3. Identify target consumer groups.
4. Identify product qualities, bearing in mind the interrelationship between practical economic considerations and requirements as perceived by consumers. Consider possible alternatives in the formula of the product for consumer acceptance testing. Market pricing estimates are desirable at this stage.
5. Appraise the supply of raw material. Determine cost structure pricing policy, trade margins and possible distribution strategy.

6. To ensure nutritive value and safety as well as acceptability of the product, use the test procedures which were adopted by the Protein Advisory Group in August 1966.[4] A simple series of tests to be conducted with varying flavors and textures of product on representative " target " consumers will help ensure satisfaction.
7. Consider packaging — the cost, material, sizes and design. Prepare publicity and promotion material for testing. Conduct " test market " trials (commercial introduction of product on a limited scale to assess acceptability under normal conditions).
8. Determine manufacturing policy, equipment, geographical location, and recommended consumer selling price.
9. Evaluate the likely side effects of introduction and promotion. How will greater reliance on manufactured foods affect a money economy and the national food policy planning?

Because the market potential in many developing countries is limited, it was recognized that it will be necessary, in future projects, to give attention to protein foods intended for consumption by the whole family, as well as to formulate foods for weaning infants and preschool children. The Committee realized that foods intended for the whole family may well be formulated from the same basic ingredients as are suitable for infant feeding. The possibility exists, therefore, of production in a single plant of multiple products, some suitable for infants and young children, others for the rest of the family. It is important that the formulations for infants and young children meet the nutritional standards of the Protein Advisory Group. This Advisory Group on Food Habits and Trends, with special reference to the promotion of protein-rich foods, was set up to advise FAO under the aegis of the FAO/Industry Cooperative Program. Through the work of this Group FAO will obtain the guidance and counsel of the world's largest food processing and marketing firms.

FAO also proposes to prepare a comprehensive manual concerning consumer testing procedures and promotional methods appropriate to the introduction of protein-rich foods.

The Committee recognized the need to investigate regional projects in which a centrally located factory would serve the needs of several countries and thus be able to achieve economies through appeal to a wider market.

[4] See footnote on preceding page.

20. FACTORS AFFECTING THE UTILIZATION OF FOOD IN THE HOME

In previous reports the Committee has considered measures for improving maternal and child nutrition.[1] At the present session the Committee gave attention to factors affecting the distribution of food within the family. It is traditional that the father as head of the home is given preference for both quantity and quality of food, the children coming next, the wife or wives being content with the remainder. Again, in another cultural group, it may be the eldest son or an invalid who is given more than his share in terms of physiological requirements. The operation of these factors means that there must be enough — or more than enough — food to meet the family's total needs in order that the children's and the mother's requirements be met.

Adult members of the family can be taught the kinds of foods that are needed to improve health and well-being for themselves and their children, but this teaching, in many instances, leads to a conflict between traditional dietary practices for child feeding and the content of the new teaching. It is not uncommon to find that custom forbids the use of such highly nutritious food as eggs in infant feeding. The family food patterns dictate that such foods be reserved for the members of the family considered most important, or that the head of the household provide such food only as a setting for a business transaction. Taboos based on folklore cause certain foods to be categorized as foods for women or foods for the sick and thereby deny highly desirable and nutritious foods to other members of the family.

Where tradition rather than education determines food utilization in the home, an understanding of the forces behind the tradition must be comprehended before positive approaches toward re-education in food

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[1] FAO. Joint FAO/WHO Expert Committee on Nutrition. *Sixth report.* Rome, 1962. FAO Nutrition Meetings Report Series No. 32; Wld Hlth Org. Technical Report Series No. 245.

utilization can be undertaken. The size of the family and its composition — number of children, number of dependents, ages, sex, degree of activity of each, number of food producers or wage earners — must be known before an assessment of the total food needs can be determined.

The Committee stressed the importance of improved techniques for the safe storage of food as a positive step toward improving food utilization and the level of nutrition. Preservation of food crops through improved harvesting and conditioning before and during storage can increase the amount of food available to the family throughout the year. The Committee recommended that special attention be given to the design and construction of improved family grain stores.

The use of simple drying apparatus and cleaning equipment can effectively spare the time of the homemaker for other jobs, and helps improve the quality and increase the quantity of food available to the family. Kerosene tins are useful as containers for storing cereals and flours prepared from root crops. The introduction of hand mills can be effective as forerunners to community mills which clean and grind cereals. With greater efficiency in food preparation, preservation and processing in the home, more can be offered for sale in local markets. The Committee urged that community action be stimulated to set up milling, processing and storage equipment to process food grown locally.

Many of the foodstuffs required daily can be grown at home in a well-managed garden fertilized from a properly prepared compost heap. The produce of a home garden can greatly improve the health of the family, particularly that of young children. Better distribution of food within the family can be encouraged by serving food for each child in individual bowls at a small table or on individual mats placed on the ground. Simple home demonstrations of the use of foods can be very effective, such as mixing home-pounded fish into the stew or soup, breaking an egg into cooked porridge, or methods of preparing and mashing beans and lentils to provide tasty dishes for children.

The Committee recognized that housing is a major factor influencing food utilization. The kitchen or food preparation area should be planned for efficiency and sanitation, careful attention being given to utensils and fuel required for cooking. Good housekeeping depends on the improvement of facilities for cleaning household utensils. The provision of a clean and adequate family water supply is of primary importance. Examples of such improvements are to be found in FAO's publication *Housing and home improvement in the Caribbean* (1958).

Poor dwellings with inadequate sanitation and little space result in badly arranged food preparation areas. The cooking utensils may be so limited that the quality of cooking is inferior and the foods which can be used and the meals served are spoiled. The Committee recommended that home economists give attention to the improvement and development of new kitchen utensils and interest local industries in their production at low cost.

As the socio-economic level of a country develops through national programs, the trend is toward a money economy and the family purchaser must be educated in wise buying and in simple methods of budgeting and accounting.

The fundamental problem of improved utilization of food in the home is one of practical education. It is possible for the home economist through her close contact with the family to promote this education not only through infancy and childhood but throughout the life of the whole family. Therefore programs which form an integral part of the broad activities which relate to the home and the family are most successful. A number of professional advisers have a responsibility to the family because of special knowledge on certain aspects of the family's needs. Public health nurses, who have direct contact with families and are concerned with the health aspects of improved utilization of foods, should be particularly interested in infant feeding and should have appropriate training for this work with the family.

The Committee considered that the governments of developing countries should support programs designed to develop a cadre of nationals who are trained in practical home economics and can work within the community on the problems both of the home and of the community. Attention must be given to facilities for the scientific and technical training of staff.

Mass media can have a significant influence on decisions made in the home and on the promotion of good nutrition. Their use should be integrated into national planning when appropriate, but it should be recognized that the efficient use of mass media is itself a highly specialized discipline.

The Committee approved the attention being given to improved nutrition at the family level and urged that action be taken both in the training of personnel and in the extension of activities at the village level, including services to provide for the design and construction of utensils and equipment for the preparation, preservation and processing of food for the family.

21. FEEDING OF INDUSTRIAL WORKERS

Following the recommendations of the Sixth Joint FAO/WHO Expert Committee on Nutrition (1961) FAO and WHO, jointly with ILO (International Labour Office) have undertaken a series of studies on the situation and problems in the field of industrial feeding.

Surveys of industrial canteens were conducted by an FAO consultant in Czechoslovakia, France, Federal Republic of Germany, Israel, Italy, Poland, Sweden, Switzerland and Yugoslavia. A Joint FAO/WHO/ILO Symposium on Industrial Feeding and Canteen Management in Europe was held in Rome.[1] Its main recommendations were that FAO should organize a service for centralizing documentation in this field and that the three international agencies FAO, WHO and ILO should organize a study group composed of specialists in industrial feeding and canteen administration. For budgetary and other reasons it has not yet been possible to implement these recommendations.

A survey was also conducted in the Near East by an FAO/WHO team of two consultants, whose report was used as a working document for a Joint FAO/WHO Seminar on Industrial Feeding in the Near East, held in Alexandria, United Arab Republic, in 1965. The main recommendations of this Seminar related to training of personnel, hygienic maintenance of canteens and the educational components of these activities.

Governments are beginning to recognize the importance of industrial feeding and requests to international organizations for assistance in this field are now frequent. Two factors are responsible for this new interest in catering activities in industry: first, food and nutritional problems are a corollary of urbanization, which raises many governmental problems and, second, improved nutrition has an impact on the productivity of

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[1] FAO. *Report of the Joint Symposium on Industrial Feeding and Canteen Management in Europe.* Rome, 1965. FAO Nutrition Meetings Report Series No. 36.

industrial enterprises through better working efficiency and decreased absenteeism.

It should be recognized, however, that the value of industrial canteens in helping to solve the nutrition problem resulting from rapid urbanization has not been properly evaluated and that further studies are needed. Although a study on *Nutrition and working efficiency*[2] was published by FAO in 1962, the relation between the feeding of workers and their industrial productivity needs more research.

Governments and industries need well-trained personnel at all levels to implement their catering activities. Such personnel are very scarce, particularly in developing and newly industrialized countries. Requests for assistance are concerned first with the training of personnel. FAO is already assisting some countries in the organization and implementation of such training programs in the many different aspects of catering. It is interesting to note the great effort made in this field by the Government of India which has built four institutes for this purpose, training more than 1,600 specialists a year in catering and institutional feeding and management. In other countries fellowships for study abroad are offered to national specialists through projects supported by the United Nations Development Program (UNDP).

The Committee considered that more countries will soon need assistance to develop catering activities for their labor forces and that FAO and WHO, jointly with ILO, should devote particular attention to these needs and give more attention to industrial feeding within their programs.

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[2] FAO. *Nutrition and working efficiency*. Rome, 1962. Freedom from Hunger Campaign Basic Studies No. 5.

22. PLANNING, IMPLEMENTATION AND EVALUATION OF CO-ORDINATED APPLIED NUTRITION PROGRAMS

The sixth session of the Committee recommended that greater emphasis should be placed on systematic planning and evaluation of applied nutrition programs. Since that session substantial progress has been made toward the development of sounder and more effective procedures for planning, implementing and evaluating these programs, and they are currently under way in some 65 countries.

An FAO/WHO intersecretariat meeting took place late in 1963, assisted by two consultants. Considerable background information was collected during 1964 by consultants who visited projects in selected countries of Asia, Africa and Latin America. A Joint FAO/WHO Technical Meeting on Methods of Planning and Evaluation of Applied Nutrition Programs was held in January 1965. It was agreed that "applied nutrition" in this context is a comprehensive and interrelated complex of educational activities aimed at the improvement of local food production, conservation, distribution and consumption for the benefit of local communities, particularly mothers and children in rural areas. The guiding principles are co-ordinated among different agencies and institutions together with the active participation of the people themselves.

One of the main conclusions of the 1965 meeting was that greater attention and more time should be allowed for careful and detailed planning as an integral part of program activities in this field. Programs should not be initiated in the absence of clear indications, based on thorough feasibility surveys, that essential prerequisites would be met. It was considered necessary during the planning stage that sufficient base-line data be collected and that clear-cut objectives and criteria of progress be established in order to permit subsequent evaluation as a continuous "built-in" process rather than a mere attempt, after the event, to determine relative success or failure.

The 1965 meeting made extensive recommendations intended to help

put into practice the principles which should govern planning and evaluation of applied nutrition programs in future and could serve to reorient many existing programs. As a follow-up to the technical meeting and the publication of its report, three regional seminars — one for Africa, one for Latin America and one for Asia and the Far East — were organized jointly by FAO and WHO late in 1965 and in 1966. For participants from Member Countries these provided orientation to the new approaches and suggested how they could be adapted to differing conditions.

These different activities have formed the basis for the *Field manual on planning and evaluation in applied nutrition* to be published by FAO and WHO in 1968 or 1969 after extensive testing under field conditions.

A broad assessment undertaken jointly by FAO, WHO and UNICEF in several countries in Africa, Asia and Latin America has indicated that the main concepts on which the applied nutrition programs are based are essentially sound.

The Committee believed that the increased emphasis being placed on systematic planning and on the concept of " built-in " continuous evaluation was very useful. It suggested that since co-operation and co-ordination among various ministries or departments (principally those responsible for agriculture, public health, education and social welfare or community development) are some of the main distinguishing characteristics of this type of activity, the name " Co-ordinated Applied Nutrition Program " would be more appropriate than simply " Applied Nutrition Program." Such programs are broadly educational in nature, involving as an essential principle the active participation of local communities and the more effective use of local resources. The increasing importance being given to integrating applied nutrition activities into overall national plans for economic and social development was considered to be sound.

Protein-calorie deficiency, especially in young children, continues to be the main nutritional problem throughout the developing world. The interrelationships between malnutrition and infectious diseases of various kinds are more and more clearly recognized (see chapter 8). The Committee therefore considered that greater attention should be given in the co-ordinated programs to the prevention and control of infectious diseases which are known to have a definitive influence on nutritional status, particularly in children. The health services have in many instances already taken an active role in such programs but too often the health components — e.g., measures for communicable disease control, the improvement of environmental sanitation, health education of the public

and the early detection and rehabilitation of malnourished children — have not been given due weight. Malnutrition should be attacked on several fronts by developing appropriate projects simultaneously in the same areas.

The single most important health problem in most developing countries is control of diarrheal diseases, which are spread mainly by person-to-person contact. The inculcation of sound principles of personal hygiene thus becomes a matter of crucial importance, although consideration ought also to be given to certain immunization procedures which can be applied at fairly low cost and without large numbers of highly trained personnel.

Although the co-ordinated nutrition programs continue to be useful in rural areas, much greater attention should be given to similar work in urban and periurban areas of countries in the process of industrialization. The rapid growth of cities and the creation of urban agglomerations in which large numbers of people live under conditions of extreme poverty and overcrowding are creating nutritional problems of new and relatively unknown dimensions. Following detailed studies to be undertaken in urban areas as a basis for determining the measures that should be adopted, it may be necessary to develop entirely new concepts and new approaches. However, the same basic principles of co-ordination among different services, systematic planning and careful evaluation and community participation would apply in both urban and rural environments.

The Committee recommended that more attention be given to the education of women in rural areas and that training of agricultural, home economics, extension, and public health personnel be improved, not only within the framework of community development projects but also in the context of co-ordinated applied nutrition programs.

The Committee stressed the importance of ensuring adequate support wherever co-ordinated programs of applied nutrition are undertaken. The programs must be supported both by the national ministries or departments concerned and by adequately trained personnel. Instances have been observed in which, despite the fact that one or another ministry or department was interested and fully committed, the program failed to develop as it should because other ministries were not consulted in time and had no real sense of involvement. Such a situation should be avoided by devoting enough time to initial consultations and careful joint planning on the part of all who would be expected later to take part in operating the program. In certain cases suitable personnel, both

national and international, was not available at the start of co-ordinated applied nutrition programs and as a result essential continuity and efficiency of operations were lost. The attempts already being made by international agencies and by individual countries to train adequate numbers of staff for these activities are commendable, but more efforts are needed both for training personnel and for utilizing it effectively when trained.

23. FOOD AND NUTRITION PERSONNEL: REQUIREMENTS AND TRAINING

In previous sessions the Committee has considered various aspects of training in nutrition but no attempts have hitherto been made to define the needs for food and nutrition personnel in conjunction with the facilities for their training.

It is now generally recognized that no single ministry, department or service should appropriate to itself the solution of food and nutrition problems that may exist. Only through the co-ordinated action of the relevant ministries and their personnel can a solution be effected.

Each ministry or department having responsibility in the field of food and nutrition must have a central person or persons to co-ordinate the related activities: a single, highly trained officer or a well-staffed service, depending on the needs and possibilities in each particular case. Similarly, at regional and local levels officers are needed to organize and implement food and nutrition activities, co-ordination at national level being assured by an interministerial food and nutrition board or commission acting in conjunction with the planning board.

In determining the minimum needs for personnel the Committee recognized a need for both advisory and executive persons at the central planning level as well as technical personnel in ministries of health, agriculture, education, community or rural development and other ministries, and research workers and technical staff in institutes and universities.

Some developing regions and even some countries already possess nutrition institutes, well staffed and able to carry out the studies and research required.

In general, however, there is a dearth of policy makers as well as of executive organizers and workers.

Criteria governing personnel needs

The Committee recognized five criteria that should be considered when studying a country's needs for personnel and when planning their training:

1. The nature and magnitude of the food and nutrition problems.
   The magnitude and the extent of the food and nutrition problems will govern the importance to be given in any country to the appropriate services and, consequently, to the number of personnel required to staff them effectively. Consideration should be given not only to existing problems but also to foreseeable future problems. The nature of food and nutrition problems will affect the kind and numbers of personnel required.

2. The overall resources of personnel available to a country.
   The potential manpower to satisfy the requirements of trained personnel in developing countries does not always exist, particularly in Africa. Malnutrition is not the only problem with which a developing country must contend and it is rarely given high priority. Various other professional skills are required and the needs for doctors, veterinarians, engineers, lawyers or businessmen are usually placed before those for food scientists and nutritionists. The needs for nutrition and food science personnel must be considered in relation to the overall needs for professional personnel in all spheres.

3. Importance and priority given to the food and nutrition problems within the national development plan.
   It is rare that sufficient consideration is given to the solution of national nutrition problems within the framework of the overall social or economic development plan. Even in those countries where it has been recognized that such a problem exists it is necessary that the nutritionists and food scientists inform the national planners and advise on ways of solving it. Food and nutrition activities should be planned within the framework of overall development and the requirements in terms of personnel and action programs should be considered as part of the national plan. Thus due consideration must be given to financing nutrition posts at all levels and also to financing the nutrition activities that may be required.

4. The demand for personnel trained in food and nutrition.
   It is necessary to create career opportunities for nutritionists in both the public and private sectors. The Committee considered that a study of the means whereby some countries have established different cadres of nutritionists and nutrition services would be profitable. It recommended that attention should be given to the capacity of governments, particularly in developing areas, to absorb nutritionists and considered that it was essential to establish job and career opportunities in food science and nutrition before large-scale nutrition training programs are undertaken.

5. The political and administrative structure of the government.
   A centralized government frequently requires that nutrition services be concentrated at central level. A decentralized system of government may call for the establishment of several departments of food and nutrition with a consequential effect upon the numbers of trained personnel needed.

The classes of personnel required may be differentiated in a number of ways: according to the length and levels of their training; by the nature of their responsibilities; and by the function they have to perform according to the disciplines in which their posts are established. In practice, however, a combination of these factors must be considered.

It is evident that different training is necessary for government officers who perform different kinds of work. For instance, a public health officer does not need to understand fully those aspects of food and nutrition with which an economist working in a planning board or an agriculturalist advising food production policy should be familiar. While each class of personnel must be trained in its particular field of responsibility, all nutrition specialists must be aware of the roles of other workers in fields affecting nutrition and, in consequence, integrated nutrition training facilities must be provided. Too often national personnel in complementary fields are not familiar with the work done by their colleagues, nor do they understand how their own work is complementary to that of others.

To overcome this difficulty, the international courses organized by FAO and WHO bring together fellows from different disciplines (doctors of medicine, pharmacists, agriculturalists, veterinarians, educators, social workers, nurses, etc.). The Committee considered that although the

experience thus gained has been useful, the training offered is too general and does not fulfill the specific requirements of some fellows. Parallel courses should be organized, when possible, for different types of personnel, bringing all the participants together for joint activities. Where only a single course is available for one type of specialist, care should be taken to provide an opportunity for discussions with personnel from other disciplines.

A sequence of approaches and decisions was recognized by the Committee to be necessary for assessing the numbers of food and nutrition personnel needed and the forms of training required. The food and nutrition problem must be defined through research in both basic and applied aspects and its importance assessed in relation to other national problems. The government should then establish a policy for its solution. It is only at this stage that the organization and administration of technical structures and action programs, including training of personnel, can be planned and put into effect. The administrative and technical structures must be staffed by personnel who have received training in general nutrition and, if possible, have had experience of similar services elsewhere.

The Committee recognized that developing countries have difficulties in meeting their demands for trained personnel and that strong support from international organizations, as well as direct assistance from developed countries, will be needed for some time to come. The assessment of a country's needs for personnel cannot, for this reason, be separated from the question of their training.

Classification of training levels

At its second session (1951) the Committee considered training in nutrition in underdeveloped areas, and the different levels that should be provided. At its present session it considered that the classification given in the report of the second session is, in general terms, still valid, i.e., four categories, based on the student's level of education.

1. University graduates in other basic disciplines may take postgraduate courses in the field of nutrition. Such personnel should be of high level and capable of assuming responsibility.
2. Undergraduates may take specialized degree courses in nutrition and food science. Nutritionists, food scientists and technologists, professional dieticians and home economists are trained in such courses.

Postgraduate studies may follow in the same institutions. These groups are usually employed in key scientific posts, such as senior teaching staff or research officers in food and nutrition institutes, and as persons in charge of applied nutrition activities.

3. At intermediate level those who have successfully completed secondary school education but who do not possess a university degree may take courses in food and nutrition. Many dieticians and home economists belong to this category.

4. Ancillary field level personnel working in many departments may have nutrition included as a subject in their basic training. Nutrition orientation is also given to them through in-service courses of short duration. Special efforts are made to include such training for field workers in countries where co-ordinated applied nutrition projects have been started. The "counterparts" provided by governments to work in Technical Assistance and other UNDP projects with specialists from the international agencies also acquire some degree of training in food and nutrition.

The Committee was concerned by the lack of emphasis given, in most countries, to nutrition in schools of medicine, agriculture, veterinary sciences, pharmacy and dentistry. It noted that the creation of nutrition teaching posts in such schools is taking place in a few countries. The increasing number of food science and technology institutes was noted and the Committee considered that provision should be made for the presentation of basic nutrition courses, including laboratory teaching, in their curricula. In developed countries too, there is a need to further nutrition training programs as there is a lack of young nutritionists and food scientists to fill existing and potential positions in those countries.

In conjunction with UNICEF, FAO and WHO have initiated liaison between university departments in developed countries and those in developing countries, an excellent means for furthering nutrition training facilities for different regions of the developing world.

All developing countries need a nucleus of highly trained professional officers capable of handling the complex problems of nutrition and food science which confront them and which hamper their economic and social development. At present most of these individuals must receive their training either in industrialized countries or in those few developing countries which offer advanced professional education. The number of

fellowships now available to developing countries for graduate and post-graduate training in nutrition and food science is quite inadequate. An intensified fellowship program is required on the part of WHO, FAO, governmental and nongovernmental agencies to enable developing countries to conduct most of their own professional education and training within the next ten years. This training should, insofar as possible, prepare fellows for the kinds of problems which they will face in their own countries. The Committee recognized that it is difficult to find well-qualified candidates in many of the developing countries.

A considerable amount of professional education can and should be given in regional and national training centers in developing countries. Many centers of this nature have been established with international support. Training of personnel in applied nutrition, in food science and in food technology can often be conducted in developing countries themselves. As far as possible FAO and WHO should provide technical assistance in this field until suitable national personnel can be trained for the purpose.

The Committee concluded that further studies are needed to assess the needs for nutrition personnel and the possibilities of employing them in developing countries so that plans for nutrition training can be framed at regional and world level. The Committee recommended that FAO and WHO, together with other interested international organizations, assist governments in undertaking these studies.

24. NUTRITION RESEARCH FOR THE FUTURE

Research in nutritional sciences reflects the social, economic and general scientific milieu of an era.

Research, both basic and applied, is essential in order to revise knowledge, to devise effective nutrition programs and to develop the independence of thought and critical understanding which discards dogma and authoritarian concepts and which evolves the new fundamental knowledge necessary for progress. No major agency or country can continuously fail to support well-planned research and maintain an effective nutrition program. By the same token, the needs are such that society cannot afford unnecessary research costs nor useless duplication of effort.

The scope and subject matter of nutritional research are not now dominated by a single concept as has sometimes been the case in the past. Scientists and administrators today must be aware of the need for research to extend knowledge of nutrient requirements and how they are influenced by type of diet and available foodstuffs, of trace elements in human and animal nutrition, of factors elaborated by micro-organisms (nutrients, antimetabolites, toxic substances) and of naturally occurring components of foodstuffs which may be toxic or of little understood significance, at best. In sum, research must be directed not only to the role of food and nutrition in disease but also to their effects on normal physical and mental growth and performance.

Nutritional toxicology, which treats of the metabolic and biological effects of components of foods, is a relatively newly developed research field which must be adequately supported by governments, institutions, industries and international groups. Similarly, the emphasis now being given to the need for more information concerning sociological, anthropometric and physiological factors which determine food attitudes, acceptability and appetite demands additional research support. Long-term epidemiological field studies of the multifactorial causation of many

diseases in which nutrition plays a role must be supported. Applied and developmental research directed toward raising the nutritive values of the diet, developing new sources of nutrients, improving food processing and the like is basic to utilization of nutritional knowledge to attain maximum health goals. At the same time nutrition research must retain a solid foundation in basic sciences — agricultural sciences and the chemistry of foods, biochemistry, physiology and pathology.

The wide scope of nutritional considerations must not permit research to become diluted, superficial or uncritical. The nutritional scientist is not expert in all fields related to production, processing, distribution of foods, development of attitudes toward foods, metabolism, public health, behavioral sciences and population control. He must, therefore, relate himself closely in research to scholars in other fields whose depth and expertise complement his own. He must not oversimplify his problem or his experimental design in an effort to identify a single cause or risk factor in a given situation. This consideration becomes especially important as nutrition research moves more and more into studies of the many diseases which are but tangentially related to diet.

The Committee wishes to express its concern that adequate support be forthcoming for nutrition research and urges that foundations, other research funding agencies, and national, bilateral and international agencies include realistic support for research activities in the broad field of food and nutritional sciences.

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