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THE PROTEIN PROBLEM

Report of the Secretary-General

CONTENTS

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CONTENTS (continued)

PREFACE

This report was prepared by the Secretary-General in response to Economic and Social Council resolution 1257 (XLIII) and General Assembly resolution 2319 (XXII). These resolutions in turn arose from the consideration by the Council and the Assembly of the report entitled Feeding the Expanding World Population: International Action to Avert the Impending Protein Crisis 1/ adopted by the Advisory Committee on the Application of Science and Technology to Development (ACST) at its seventh session in May 1967.

In its resolution 1257 (XLIII) the Economic and Social Council requested the Secretary-General,

> "in consultation with the Administrative Committee on Co-ordination and drawing, as appropriate, on the advice of the Advisory Committee on the Application of Science and Technology to Development, to undertake a review of the present and proposed programmes of the United Nations system of organizations, with a view to the possible reallocation of resources directed towards the implementation of proposals designed to close the protein gap and to report to the Economic and Social Council at its forty-fifth session on the existing allocation of resources, at both the national and the international levels, which are directed towards closing this gap and to make any appropriate and feasible recommendations for further action to this end."

The General Assembly, in its resolution 2319 (XXII) requested the Secretary-General,

> "to submit a report, through the Economic and Social Council, to the General Assembly at its twenty-third session on the implementation of the present resolution, including the activities reported by Governments and the work undertaken within the United Nations system, together with the comments of the Protein Advisory Group and the Advisory Committee on the Application of Science and Technology to Development."

In order to obtain information on activities within countries, and as a guide to assist them in the preparation of their replies, the Secretary-General sent a questionnaire 2/ to Governments on 18 January 1968, with the request that replies be received by 1 July 1968. Chapter I of this report contains the comments received from Governments on the ACST report, 1/ and the conclusions and recommendations of the Secretary-General. Chapter II of this report is based upon the replies of Governments to the protein questionnaire which were received before 1 September 1968. Because of the voluminous material provided by Governments, this chapter has been made illustrative and necessarily selective. Information provided

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1/ United Nations publication, Sales No.: E.68.XIII.2.

2/ Reproduced in the annex.

by organizations within the United Nations family provided the basis for chapter III.

Pursuant to the request of the General Assembly this report has been transmitted for comment to the WHO/FAO/UNICEF Protein Advisory Group and to the Advisory Committee on the Application of Science and Technology to Development. Addenda 1 and 2 contain their comments.

INTRODUCTION

1. All living things contain protein, which is essential for life. The young require more protein in relation to their size than adults because they are growing. The more rapid their growth the greater their relative need for protein. Thus, very young infants, whose rate of growth is greater than it will be later in life, require more protein in relation to their size and calorie intake than people of older ages. Human beings can obtain the protein they need only from the food they eat. While most foods contain protein, some foods possess better quality and quantity of proteins than others. The crux of the protein problem lies in the need to ensure that those who are growing most rapidly, the young, should eat foods that are rich in good quality protein.

2. The main constituents of foods - carbohydrates, fats and proteins - all supply calories which are needed to keep the body warm, growing and active. If sufficient calories are supplied in a child's diet to meet its need for warmth and activity, the proteins in its diet will be used for the maintenance of the body's tissues and for growth, but if sufficient calories are not available proteins will be used simply as a source of calories and not for body-building purposes. It is therefore wasteful of protein to give a child protein without sufficient calories to meet his total calorie requirements. An adult needs calories principally to maintain body temperature and for activity and has relatively smaller protein requirements. Requirements are increased in any kind of stress, infectious diseases, physical injuries and convalescence as well as pregnancy and lactation.

3. The diet available almost everywhere contains sufficiently high concentrations of protein to meet adult protein requirements, but only when sufficient food is eaten to meet calorie requirements. If the basic foods of a country are relatively rich in protein content, this generalization may also apply to young children. If, however, the staple foods of a country are relatively poor sources of protein, such as maize or rice, or very poor sources, such as cassava, sago or plantains, young children are unlikely to be able to obtain the quantity and quality of protein they need. As a result, unless their diets are supplemented with protein-rich foods or improved in some other way, they will suffer from malnutrition probably due to shortages of both protein and calories.

4. This lack of proteins of sufficient quality is particularly likely to arise during infancy at the time of weaning from breast milk. At this time protein requirements are very high and the child is not yet able to get his full share of the family meals. This may occur even among older children in poor families unable to afford the relatively expensive foods which are sources of good proteins, such as foods of animal origin or legumes. The situation is often made worse in these families by the fact that the mothers are usually not well enough educated to know how to make the best use of whatever foods are available. Thus, the protein problem is most frequent and severe among the children of poor families, and is particularly concentrated in those areas of the world where the staple foods are poor sources of protein.

5. The protein problem is complex, embracing such considerations as the supply and prices of foods or the behaviour of individual mothers in feeding their children as well as the scientific study of the functions of the numerous different proteins within living tissues. Most other nutritional deficiencies can be prevented by some simple public health measure like the addition of a particular vitamin to the food supply. To ensure that children should be provided with and actually consume sufficient protein is, however, a much more complex matter. It entails the interrelationship of many disciplines, including agriculture, public health, manufacturing industry, economics, education and the social sciences. Activity in one sector alone is not enough. All need to work together and at the same time, and such a multidisciplinary approach requires co-operation among institutions, organizations and individuals whose activities are often, in other respects, quite distinct. A strong chain of linked policies and activities is necessary and the strength of the weakest link will determine the strength of the whole chain in achieving concerted progress on protein.

6. World-wide awareness of the problems relating to protein malnutrition in developing countries, particularly in young children, is very recent. Thirty years ago these problems were not even discussed in international meetings on nutrition, at which almost all attention was devoted to the nutritional needs of the poor in affluent industrialized societies. It was only after the Second World War that the Food and Agriculture Organization (FAO) initiated the first attempt to assess the amount of food available in terms of calories in various countries in relation to calorie needs: this first world food survey showed that there were shortages of calories, that is, of food, over large areas of the world, a situation which has persisted during the succeeding twenty years, in spite of slowly growing awareness of the nature of the problem and world-wide efforts to solve it.

7. Twenty years ago the inquiries began to be focused sharply on malnutrition among children in developing countries and in 1952 the first United Nations report on protein malnutrition among children in Africa was published by FAO and the World Health Organization (WHO); the international scientific community started to gather and collate evidence on the widespread occurrence among children in developing countries of the condition which has been described under a variety of names, including kwashiorkor, and which is now included under the heading of protein-calorie malnutrition. This condition was at that time recognized as a dominant cause of widespread physical stunting, sickness and death.

8. Much has been learned in the last twenty years. The nature of the problem of protein-calorie malnutrition is now fairly well understood. Increasing attention is being directed to the likely detrimental effect of protein malnutrition on mental development. The types of foods or food mixtures effective in combating protein-calorie malnutrition are known. It is understood that simply making new protein foods available will not necessarily lead to their acceptance, actual consumption and continued use. It is clear that, to reach large population groups, such foods must be produced on a large scale at low cost and be distributed effectively. A further aspect receiving increasing attention is the use of indigenously available raw materials as the basis for the production of suitable weaning foods. It becomes clear that basic research must be linked to development, and industrial activity to agricultural effort, and that technological endeavour must be oriented towards achieving consumption of sufficient protein of good quality by target segments of populations in the developing countries. It is known further that, to be fully effective, related preventive measures must also be multidisciplinary and must include a series of public health activities such as environmental sanitation and other measures to control infectious disease.

9. The immense problem that lies ahead appears to be to ensure that protein, whether from traditional sources such as milk, soya products or other legumes, various cereals, meat, poultry, eggs or fish or from new high-protein formulated mixtures, should reach the children in need of protein, particularly once breast milk is no longer adequate as a sole source of protein and in the immediately succeeding pre-school years. There is no easy or universal way of solving this problem because the situation in each country is different; a plan developed for one region of a country may not be useful for another region and, perhaps even more important, the food problems of children living in towns differ greatly from those of children in rural areas in any country.

10. Thus, every country must develop individual plans for ensuring that their own pre-school children should eat sufficient nourishing food. The importance of doing this cannot be over-emphasized, because protein-calorie malnutrition in early life can lead to physical and mental retardation which may not be reversible. If such damage has been done, the consumption of extra protein in adult life will not repair it and if such damage is widespread in a country, it will likely impede that country's future development in almost every respect.

11. The size, urgency and rapid emergence of this problem must be fully understood. About half the population of the developing world is under the age of twenty years and about a quarter is below the age of eight. Thus, the number of growing children is already very large, and, irrespective of the effectiveness of present and future programmes to limit population growth, the young people already alive will themselves soon become the parents of yet more children. The key to the protein problem is to have sufficient supplies of appropriate foods, that will be accepted and actually consumed, ready in time to feed the children who will inevitably be born within the next few years. Indeed, the remainder of this century is likely to be crucial for mankind.

CONCLUSIONS AND RECOMMENDATIONS

12. Many Governments have replied to the questionnaire 1/ drawn up to assist them in responding to General Assembly resolution 2319 (XXII) on increasing the production and use of edible protein and have described their present and proposed activities in the context of the fourteen specific proposals contained in the report of the Advisory Committee on the Application of Science and Technology to Development. 2/

13. For the purposes of this report on activities within countries the various activities are grouped under the following headings: protein from conventional sources (plant crops, livestock, fish and reduction of waste of protein foods from conventional sources); 3/ protein from unconventional sources; 4/ distribution, marketing and public education; 5/ research and professional training; 6/ and food policies and legislation. 7/ Throughout this report, reference has been made under the appropriate headings to countries whose replies to the questionnaire contain pertinent information. In this chapter, countries have been mentioned by way of example.

14. It is in the context of the size and urgency of the problem of achieving adequate consumption of nourishing foods by infants and young children that the activities within countries are reviewed in this report. It is clear from the reports from Governments that many have not given adequate consideration to this particular and crucial central aspect of the protein problem. The complexity of the matter is such that it should be reviewed in each country at the highest level, using the best scientific, economic, sociological, managerial and political competence available. No blueprint for the solution of the problem can be developed by those unfamiliar with local problems. Plans which have any chance of being applied can be made only by those on the spot and aware of all the circumstances. Plans which do not lead to appropriate action do not help to solve the protein problem.

15. Examples of the way some Governments are tackling their protein problem come from Pakistan and Indonesia. The National Science Council of Pakistan has

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1/ See the annex.

2/ Feeding the Expanding World Population: International Action to Avert the Impending Protein Crisis (United Nations publication, Sales No.: E.68.XIII.2). The numbers of the specific proposels used in this report are taken from the report of the Advisory Committee.

3/ Specific proposals 1, 2, 3 and 4.

4/ Specific proposals 5, 6, 7, 8 and 11.

5/ Specific proposals 9 and 12.

6/ Specific proposals 10 and 13.

7/ Specific proposal 14.

constituted a protein committee, in pursuance of a directive issued by the President of Pakistan after studying the report of the Advisory Committee on the Application of Science and Technology to Development. The Pakistan Protein Committee, which is composed of scientists from universities, research councils and the central and provincial governments recently prepared a report on the protein problem of Pakistan. The Pakistan report attempts to provide an estimate of the supply and demand for protein from plant and animal sources in East and West Pakistan during the years ending in 1985 and draws attention to the likely consequences of protein malnutrition in the country. It makes recommendations concerning future work on research, training and development and the organizational framework necessary for combating protein malnutrition. A similar comprehensive review of the problem was made in May 1968 for Indonesia by a group of eminent Indonesian and American scientists. Their report NAS-LIPI Workshop on Food reviews all aspects of the food problem in Indonesia, including discussion on population trends and nutritional needs; agricultural production, incentives to farmers, land use and other agricultural matters; the alleviation of problems relating to processing, storage and distribution of food; and the institutional facilities needed for research, education and extension programmes.

16. Another example of the way the protein problem is being tackled comes from the report prepared for the Government of the Philippines by the National Science Development Board of that country which states that "for the first time in the history of the Philippines, the present administration considered nutrition as one of the bases in formulating its national food production plans".

17. A fourth example is provided by the Government of the United Republic of Tanzania which reports that it fully recognizes the inadequacy of its protein resources and that steps have been taken to overcome the problem. The report of the Government states that "the task is very great and calls for the co-operation of many government and non-governmment institutions. On the government side we have the National Nutrition Committee and the various ministries concerned with Food and Human Nutrition. The key Ministries in this connexion are Agriculture and Co-operatives, Health and Housing, Local Government and Rural Development, Education, and Commerce and Industries. Non-governmental institutions include the University, the East Africa Academy, voluntary agencies and various national organizations affiliated to the ruling TANU party".

A. Comments by Governments on the report of the Advisory Committee on the Application of Science and Technology to Development

18. Many comments have been received from Governments on the policies set forth in the report of the Advisory Committee on the Application of Science and Technology to Development (ACST) 8/ in response to the Secretary-General's questionnaire 9/ based on General Assembly resolution 2319 (XXII). The nature of the replies, based on critical review by Governments, reflects wide general agreement, with minor reservations, with the general approach in that report, its policy objectives and its specific proposals. Governments have reviewed the report in the context of

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8/ Feeding the Expanding World Population: International Action to Avert the Impending Protein Crisis (United Nations publication, Sales No.: E.68.XIII.2).

9/ See the annex.

their individual situations and it is clear that there is widespread support for an immediate emphasis on the use of conventional sources of supply to meet protein needs. There is a general recognition that in the medium and long-term unconventional sources of protein will play an increasingly critical role; at the present time some unconventional sources are proving particularly necessary because they are specially designed to meet the needs of target segments of population.

19. In general, some concern has been expressed about the relationship between likely increases in total food availability and population growth; Venezuela, for example, states that in recent years population has increased at such a rate that it has been impossible for agricultural production to keep pace, and El Salvador refers to the fact that its serious nutritional problem is aggravated by its population problem. There is also widespread agreement on the need to reduce losses of protein supplies caused by wastage of food in field, store or the home or by inefficient distribution. Many countries consider that single-cell protein offers promise eventually as animal feed, which in turn contributes to protein supplies by conversion through the animal to forms of proteins traditionally consumed by human beings. Several Governments urge that, though single-cell protein may contribute directly to human consumption in the long run, much research and testing will be needed before this can be judged to be safe and acceptable.

20. Some Governments have commented on the particular emphasis within the report. For example, the Soviet Union considers that the main way of eliminating protein deficiency would be to raise the economic potential of developing countries by changing their social and economic conditions and that this aspect of the matter is not reflected in the report. France considers that too little emphasis is laid in the report on the crucial importance of effective and appropriate distribution and the creation of demand, as opposed to the production of food.

B. Principal general conclusions

21. The replies by Governments to the Secretary-General's questionnaire 10/ on increasing the production and use of edible protein make it clear that some Governments are aware of, and are beginning to explore, the protein problem in their own countries. There appears to be a world-wide recognition that the protein problem is complex and that there are no short-cuts to its solution, and many Governments understand the crippling urgency of finding a solution. For example, the Government of Zambia "is generally worried about the future of mankind if the availability of protein for human consumption does not catch up with the increase in the world's population", and is "particularly concerned about the health of babies and young children who are the main victims of malnutrition". Central to the protein problem are the facts that already about half the population of the developing world is under the age of twenty years, and that population growth is concentrated in the very young age-group wherein protein-calorie malnutrition is very critical. The heart of the matter is to ensure adequate consumption of protein by the very young and by pregnant and lactating women. This will require complex arrangements for the production and effective distribution of suitable and acceptable foods and for educating and training the

10/ See the annex.

general public and professional personnel. It is urgent that all Governments give increased attention to the nutrition of their present and future populations and in a forthright manner deal with the complexities involved. By the time the Second Development Decade is over at the end of the 1970's, the problem must be significantly in hand. Otherwise the outlook is grave. The protein problem must be seen in the context of the development and transformation of the economics of the developing countries, and action must clearly be planned and implemented at the national level.

22. The protein problem is not merely scientific and technical. Although more scientific and technical knowledge is needed, the key to its solution lies in the ability to draw on existing scientific and technical knowledge and to remove technological obstacles to the adaptation of existing technology to conditions in various developing countries. There is a critical need to find ways of making this economically feasible, to incorporate modern technology into the agricultural and industrial production of food and to ensure that the food produced should be distributed and in fact eaten. To meet this challenge effectively requires the adoption of an economic and management point of view; scientific and technical consideration must be seen in their broad perspective so that such activities are not undertaken in isolation. In any country this will require, first, government structure responsible at the highest level to scientific and technical information and, secondly, personnel and facilities in each country for applied research to adapt this knowledge to local conditions. It will be necessary to find ways of involving the relevant groups within the scientific community, nationally and internationally.

23. The protein problem is complex. It must be dealt with by many disciplines working together and in an interrelated manner. This implies the need for mission-oriented applied research, which in turn points to the importance of an over-all systems approach. Such an approach would ensure that actual consumption needs of the target segments of the population could be linked with appropriate aspects of distribution, industrial processing, agricultural production, applied research and, where necessary, basic research. Similarly, basic research can be linked by such a chain to the ultimate consumption of protein. Efforts must be made, particularly at the national level, to minimize compartmentalization of efforts and disciplines, and to ensure strong connexions between different sectors; progress is determined by the strength of the weakest link in the chain.

24. There is a clear need to increase awareness of the protein problem, and the possibility of solving it, both at national and international levels. This is particularly important at the highest policy levels of decision making, both national and international. This need suggests that regular review of progress in countries and internationally before the United Nations General Assembly could serve a useful purpose.

25. Some Governments are able to draw on and utilize scientific and technical knowledge relevant to various aspects of the protein problem. Others appear to be having great difficulty in doing so. This is reflected in the ways some countries have, or have not, formulated policies dealing with production, consumption and nutrition. Nationally, this requires an appropriate form of government organizational and decision-making structure, and the input of information at the highest level. It is necessary to assure that there should be a number of permanent posts within national government departments for persons

with qualifications and experience in nutrition and allied subjects. Internationally, there appears to be need to stimulate further the exchange of information on various aspects of the protein problem. This point is made in the reply from Sweden, which stresses that "it is vital that all research efforts be co-ordinated. FAO and WHO have a vast experience from existing programmes and their practical feasibility. If this experience is not drawn upon... there is a great risk that research projects of an esoteric and unrealistic nature will diminish the contributions of science in general to the fight against malnutrition. There is a danger in delegating decisions about research policy to specialized scientific societies, which might overlook the broad approach necessary. It is a fact that many research problems are tackled at the same time by scientists in different countries. It is perhaps unavoidable that scientific problems, which are already solved, are being worked on by other scientists, but co-ordination efforts should be intensified in order to avoid duplication of efforts. Much material is not easily accessible, even if it is printed. Efforts... to facilitate a wide distribution of research results and to make possible publishing of material not printed should be intensified". Canada considers that "the specialized agencies should place increased emphasis... on their traditional role of promoting the exchange of information among countries on the results of studies and research". Mexico suggests the appointment of an international co-ordinating committee, on which FAO, WHO, IBRD, IAEA, UNESCO, UNICEF and UNIDO would be represented, one of whose functions would be to serve as a clearing house for all information arising from work directed towards solving the protein problem.

26. The questionnaire sent to Governments as a result of General Assembly resolution 2319 (XXII) on "Increasing the production and use of edible protein" has served usefully to stimulate Governments to review their food and nutrition policies and programmes. It seems that, for the first time, some Governments have had to pool information from many national sources never previously collected together. Others were able to show in their replies that the necessary information is collected nationally on a continuing basis.

27. Some Governments state the great need to attract the allocation of greater resources to the protein problem. For example, Pakistan feels strongly "that the work of research, training and development will require technical and financial assistance from United Nations and other international organizations". Thailand poses the question of whether it is possible for the United Nations "to accord some priority to requests for assistance in developing research aimed at improving protein supplies". Canada believes that "some increase is justified in the assessed budgets of the appropriate agencies in order to permit an expansion of work on the food problem. This would be subject to the condition that the expanded programmes would be carried out in a fully co-ordinated and rational manner". The United Kingdom considers that "a genuinely high priority should be accorded" to the protein problem and that "one of the more promising ways of tackling the problem of the production of edible protein outside the bilateral aid programmes would be for Governments of developing countries to take the initiative and submit requests to the UNDP for preinvestment projects for the production and use of edible protein, which could ultimately lead to investment by private firms or United Nations bodies". Most of the Governments which have commented on financial matters urge the reallocation of existing resources and the co-ordination of existing programmes so that the maximum use can be made of existing resources of funds, laboratory facilities and manpower.

28. The resources and capability that should be brought to bear on the protein problem exist in many countries and a way must be found to mobilize these on a more effective and larger scale than has so far been achieved. A catalytic means of doing this, if well conceived and fully supported, could lead to effective results. A number of Governments have indicated their interest in bringing their technological capability to bear on various aspects of the protein problem in developing countries. For example, Czechoslovakia is willing, in all ways other than financial, to collaborate actively. Denmark "welcomes requests from developing countries for assistance... including projects within a multilateral-bilateral framework". The Soviet Union is ready to participate in scientific research and co-ordination as well as in technical assistance relating to the protein problem in the developing countries. Furthermore, within the framework of UNDP, the Soviet Union is able to join in the general programme of assistance to developing countries with the aim of eliminating protein deficiency.

29. Other means to marshal resources must include the search for a suitable mechanism for more effectively mobilizing industry in the developed countries as well as in the developing countries to direct an increasing portion of their concern to the protein problem of the developing countries. This applies in particular to agri-industrial businesses and to various areas of applied research.

30. Most of the reports from the developing countries indicate extremely limited numbers of trained persons, at any level, in nutrition, agriculture, food science and food technology. Although existing training facilities are improving, they are still grossly inadequate to correct this shortage. The strengthening or, if necessary, establishment of national institutions for research and training in nutrition and related subjects is likely to have a stimulating effect not only on producing more trained personnel but on the whole national effort to solve the protein problem, particularly by helping to integrate, adapt and apply existing scientific and technical knowledge within a country.

31. There is a need for education in specialized scientific subjects. This might be accomplished at regional or national level or overseas. There is also need for training at intermediate levels of technologists, such as food technologists, public health nutritionists and dietitians. Thus, regional and national facilities for research and training in nutrition and allied subjects, such as food science and technology, should include schools for such technological training. Further, there is a great need for education of the general public in nutrition and allied subjects and a great deal would be achieved if the study of human nutrition were to be included in the training of professional personnel who will be in close and confident touch with the people during their working careers; chief among these groups are members of the medical and nursing professions.

32. Many countries mention the need for public education in nutrition, and medical and public health workers can be particularly effective at teaching nutrition if they themselves are sufficiently well educated in the subject. Another group which can apply human nutrition during the course of their working careers are the agriculturists and they too can profit by training in human nutrition. The major effect in education and training must be made nationally, but there is a critical role for the relevant specialized agencies.

C. Recommendations

Need for interdisciplinary and systems approach

33. A considerable body of scientific and technical information is already available on protein. There is a critical need for strong political support to ensure an integration of managerial, economic, social and scientific considerations. The organizational structure of Governments at the national level should be such that they are responsive at the highest policy levels to scientific and technical information and able, through their own trained staff and research facilities, to arrange for applied research to adapt this knowledge to local conditions. The protein problem is so complex that it can be dealt with effectively only on a multi-disciplinary basis and by using the most modern management approaches and techniques. It is recommended that Governments give this matter the most serious consideration.

Continuing urgency of the problem

34. The recent breakthroughs in the development of cereal grains resulting in increased yields with possible improved attendent quantity and quality of protein are highly encouraging because they indicate that developing countries can greatly increase present agricultural production of food crops. They should not be taken as grounds for complacency for three main reasons: they provide excellent examples of the benefits to be gained from effective marshalling of scientific and technological skills and financial resources, but it is difficult for most developing countries to achieve this result without effective international assistance; they are threatened by the rapid rate of population increase during the final third of this century; and food production alone is not enough - the food produced must not be wasted and it must get to people who need it.

Significance of oil-seed protein

35. The advance in the utilization of oil-seed protein is another excellent example of the benefits to be gained from effective marshalling of resources for practically-oriented research in agricultural and food science. The direct incorporation of oil-seed protein into human diets needs to be accelerated and will be of major importance in meeting future protein needs.

Assignment of priority to vulnerable groups

Priority allocation of additional supplies of edible protein that become available should be consumed by expectant and nursing mothers and young children in developing countries who are in need of additional dietary protein. The effective implementation of this aim will require an improvement in the level of education of the public in nutrition and related subjects and an increased awareness by Governments of the nutritional needs of these target segments of populations.

Mobilization of international co-operation

36. A number of the developed countries have shown that they are endeavouring to make a useful contribution to the protein situation in some of the developing countries. However, there is no doubt that more progress would be achieved if a way were found to increase further the involvement of Governments and institutions of the developed countries so that their capability and resources might be fully mobilized for the benefit of the developing countries. In addition, by raising the priority given to the protein problem by the developing countries, a larger flow of their own resources would be directed to their particular protein situations. Indeed, the bulk of all resources to be devoted to the protein problem must come from the developing countries themselves. The United Nations could play a useful catalytic role in stimulating Governments in both developed and developing countries to devote more of their capability and resources in an international co-operative and concerted effort for a long-term campaign on the protein question. Furthermore, the United Nations would be able to help to forge links of a multidisciplinary nature between particular institutions in developed and developing countries having capability in key sectors of the protein problem on which work must be done. The involvement of the non-governmental scientific community both national and international is also essential.

Need for financial resources and their effective use

37. The question of financing such an international effort has not been considered in this report. The catalytic concept envisaged above to mobilize and involve Governments and institutions would require only modest funds on a much smaller scale than originally envisaged in the proposal 11/ of the Advisory Committee on the Application of Science and Technology to Development for a "Protein Promotion Fund", and would entail a major reorientation of purpose. It may not be unrealistic to expect that modest means, which are within the possibilities of Governments and the international community, if used in an effective catalytic manner, would make a significant impact on the protein problem confronting the developing countries.

Importance of assembling and disseminating information

38. The Secretary-General's questionnaire on protein 12/ has resulted in the assembling of a large amount of valuable information, which illustrates the great advantage of collecting information of this kind in a systematic way. To make full use of it requires the establishment of some system of classification of the material for subsequent retrieval. The widespread and effective dissemination of this and other pertinent information could have a stimulating effect on future activities within countries and internationally, and it is recommended that the United Nations should investigate the feasibility of instituting a system of

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11/ See Feeding the Expanding World Population: International Action to Avert the Impending Protein Crisis (United Nations publication, Sales No.: E.68.XIII.2), paras. 77-78.

12/ See the annex.

classifying relevant information pertaining to the protein problem and of insuring its dissemination and use. Such a system may embody a co-operative arrangement between interested countries already engaged in such information work.

39. One clear result of the Secretary-General's questionnaire has been the stimulus to Governments to review, both generally and on specific matters, their food and nutrition programmes and policies. It has furthermore provided the opportunity for a global review. This suggests that periodic reviews would serve a useful purpose and it is recommended that the United Nations should review annually the progress being made by countries in combating protein malnutrition and report annually to the General Assembly. This would ensure that the protein problem should be maintained as a matter of continuing concern in the United Nations.

II. PROTEIN ACTIVITIES REPORTED BY GOVERNMENTS

A. Proteins from conventional sources (plant crops, livestock and fish)[1/]

40. A few countries discuss in their reports the way in which they have approached the problem of deciding how to increase their protein supplies. The United Republic of Tanzania, for example, provides statistics showing that the annual average production during the years 1964 to 1966 amounted to some 3 million tons of food crops supplying some 178,000 tons of protein of which about one half came from cereals and one quarter from pulses and ground-nuts. It also provides data showing that protein production differs widely between the various regions of the country; explains that because "protein resources do not move much between regions, this wide discrepancy in production may be expected to reflect on rates of consumption"; and states further that protein quality also is "both inadequate and poorly distributed both regionally and seasonally". In illustration, it is stated that the average consumption of meat is 24 pounds per head per year, the range being from 2 ounces to 100 pounds and that similar variations are found for milk and fish. The National Nutrition Committee has conducted nutrition surveys in four of the country's sixty-five districts, finding a high incidence of malnutrition, the most prevalent disorder being protein-calorie malnutrition, and as a result of these alarming results "has initiated applied nutrition programmes in the areas surveyed in order to combat malnutrition in the villages using mobile clinics. These programmes are very promising indeed, but are at present limited by the available human and financial resources".

41. Ethiopia states that recent surveys, representative of more than half of the country, show that the main problem in nutrition is the lack of good traditional weaning foods, resulting in a "high incidence of malnutrition and undernutrition among children with adverse consequences for their health and normal development". In Ethiopia's third Five-Year Development Plan it is stressed that the food situation is changing rapidly, that there is "a steadily increasing non-agricultural population, increase in non-agricultural production, income, and consequently an increased consumption per head. With the expected acceleration of the economic development these changes will also accelerate. There will be a demand for more food and of better quality, a demand that will outstrip the growth of population... This changing situation, together with the lack of innovations in agricultural practice and production, have led to a situation where the food supply, even if it has more or less followed the growth of population, cannot meet even the existing needs not to mention the future... In the third Five-Year Development Plan therefore these problems have been given great attention and ways and means to change the development in a positive direction are planned".

42. The Indonesian comprehensive review concludes that, while there is as yet no national food policy "a national system for applying science and technology to food and nutrition can evolve without crippling delays and diversions if strong

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1/ Specific proposals 1 to 4.

and widespread convictions are created to the effect that success depends on technically adequate staff, valid and reliable recommendations, continuity and versatility in programmes and productive working relations among all concerned". It also states that "food supplies will increase if farmers are motivated to produce them, and if the institutions and agencies involved are similarly inclined. All the elements in the complex system of agricultural production influence the farmers' incentive to act. The evidence is that even traditional cultivators, like modern men of business, will respond to what they can see to be a favourable cost-benefit ratio. If the technical means of better farming are at hand, the favourable result of their use is understood, and the risks of trying a new thing are not too great, and if the possibility exists of marketing for a favourable price, a farmer will shift from old to new practices".

43. These three examples have been chosen to illustrate the need to conduct surveys of food production and consumption in various regions of countries at different seasons; to study the food consumption and nutritional condition of families belonging to different socio-economic groups and particularly to investigate what is eaten by the young children and whether it is sufficient; to consider changing economic and social conditions and methods of food production, processing, storage and distribution; to collate such information and to use it as the basis for formulating national food policies and for implementing necessary action.

44. The reports from Governments on the production of protein from conventional sources will be discussed in the four subsections: plant crops, livestock, fish and reduction of waste of protein foods from conventional sources.

Plant crops

45. All proteins, whether in food or animal feed, are derived from nitrogen and other chemical elements. Most are produced by action of the sun on plants, either on land or in the sea, and are made up of a group of simple components containing nitrogen, which are called amino acids. There are countless different proteins which vary in their structure and composition and thus in their nutritional value. The nutritional quality of a protein depends on the kind relative and quantities of amino acid it contains.

46. By far the largest contributions to human protein requirements come from plant sources, mainly cereal grains. Because of the traditional reliance on such conventional sources of supply it is essential to improve the yield and quality, particularly the protein content of cereal crops by the use of fertilizers, irrigation and other means and to reduce losses caused by pests, weeds or disease on the field or in storage. If the staple cereal of a country can be made to produce better yields, this alone will increase protein supplies. If the staple cereal can be made to produce not only better yields but yields of higher protein content, this will even further increase protein supplies. If both the quality and the quantity of the protein in the staple cereal can be improved, this will have an even greater beneficial effect. The reports of many Governments show that they are aware of these possibilities.

47. New strains of wheat developed in Mexico at the International Maize and Wheat Improvement Centre and of rice at the International Rice Research Centre at Los Baños in the Philippines which are almost entirely supported by the Rockefeller and Ford Foundations, are revolutionizing agricultural production in several countries. The Rockefeller Foundation is also financing research into

sorghum in India and potatoes in Mexico, and it is planning two new international agricultural research institutes in Colombia and Nigeria. The results of these investments in plant breeding are perhaps the outstanding example of how relatively small funds spent on soundly conceived and effectively managed projects can change the agricultural prospects of continents.

48. The reports from several Governments reflect this. In Mexico, an over-all active policy for irrigation, land reform, road building in rural areas, agricultural research, education and farm extension services, credit and guaranteed prices has borne fruit. Fourteen years ago Mexico imported more than half a million tons of wheat a year. Since then the production of new disease-resistant high-yielding strains, which are suited to flour and bread production, has enabled Mexico, in spite of a doubling of its population in the past two decades, to meet home demand for wheat and to export its surplus. As a result of this success, wheat specialists from several Middle East countries receive training each year in Mexico under FAO auspices and 80,000 tons of certified wheat grain has been exported to India, Pakistan, Turkey and other countries. Two types of research are in progress: the late use of fertilizers to increase the protein content of the grain and the selection of strains which possess genetic characteristics conducive to high protein values. The production of maize, rice and sorghum has also increased considerably so that Mexico has become self-sufficient in all three cereals and has supplies available for export.

49. Pakistan reports "a major breakthrough" in the increased production of wheat and rice and that "the country is likely to become self-sufficient in food-grains by 1970. For example, the current year's wheat harvest in West Pakistan is estimated at over 6 million tons as against only 4.2 million tons last year. The success in wheat production has largely resulted from a large-scale use of dwarf Mexican wheat varieties, manifold increase in the use of chemical fertilizers and irrigation water development. Similar efforts are on hand for increasing the production of rice, and other food grains". At present the emphasis in the Philippines is on producing hybrids that can give high yields rather than high protein content, and this "is understandable since the yield per hectare, especially of rice, has been until recently one of the lowest in South-East Asia". The Government states that the "International Rice Research Institute has been appraised of the need for high protein varieties and may undertake the project after their primary objective has been attained". The Republic of Korea plans to increase the production of rice by seed improvement and the adoption of improved agricultural techniques. Argentina plans similarly for wheat and maize.

50. The United Republic of Tanzania considers that the "production of high protein food crops by breeding would probably be the most important single factor in overcoming protein malnutrition" because "the bulk of the population still gets most of its protein from staple foods which are intrinsically low in protein and usually have protein of low biological value. The success made in the United States of America in the production of high lysine maize makes efforts in this field very attractive". A number of other Governments, including those of Brazil, France, India, Israel, Iraq, Malawi, Mexico, Nigeria, Peru, Uruguay and Zambia report either that they are conducting experiments to improve the protein yields of maize, that they are taking steps to include the new types of maize in their maize breeding programmes or that they are considering the adoption of generally improved varieties of maize, wheat and rice. The Indian Agricultural Research Institute (IARI) is experimenting with a large number of such varieties and finds

that the protein contents of several of them (e.g., Sharbati Sonora wheat, Cuba II maize and Talchung Native rice) are about 50 per cent higher than those of traditional varieties. The use of fertilizer will, in most cases, increase not only yield but also protein content. India warns, however, that the development of such cereals of desired content and quality of protein may take five to ten years and that many new varieties with high protein contents do not give high yields and that "unless the yield of the high protein strains can be considerably increased, the chances of their successful introduction into the rural economy will not be good".

51. Work is in progress in the Ukrainian Soviet Socialist Republic with the object of increasing the protein content of their two main agricultural crops, wheat and maize, and new types of wheat with increased protein content are undergoing state quality tests. New strains of wheat and corn have also been developed in France, and tremendous improvement of grazing pastures has been achieved. The Commonwealth Bureau of Scientific and Industrial Research Organization (CSIRO) of Australia is studying the biochemistry of the protein of wheat as an aid to wheat-breeding programmes and the CSIRO and the Institute of Agriculture in the University of Western Australia are jointly attempting to breed wheats with high lysine content.

52. A number of Governments report that they are attempting to increase the yield of protein from grain legumes, including soya beans, which are good sources of high-quality protein. For example, the Department of Agriculture in Botswana "has an active programme of breeding and testing legumes and improved varieties have already been distributed to farmers throughout the territory". The Ministry of Agriculture in Guyana is engaged in "investigations with the object of determining the more suitable varieties of soya beans, seeds of which have been imported from several parts of the world" and in "the production and distribution of high yielding peas and beans". Peru reports the introduction of two varieties of beans suitable for mechanized cultivation from planting to harvest and of a third climbing variety of good yield, pointing out that all three varieties are in great demand on the consumer market. This Government also reports that the giant American variety of chick pea, introduced into and improved in Peru, of high yield and drought resistant, is in great demand. Israel reports experiments to develop blight-resistant strains of chick peas. The Republic of Viet-Nam is introducing new varieties of soya beans.

53. An important part of the efforts to modernize agriculture in Ethiopia must be devoted to "crop variety trials in various regions and the creation of more productive strains of crop. The Agricultural Research Institute is at its very beginning but is expected soon to contribute to the development of suitable crops through studies of existing varieties and varieties imported from neighbouring or other countries" and the "Ethiopian Nutrition Institute with a well-equipped modern laboratory for food analysis" is to assist. The Ministry of Agriculture in Lesotho has a seed production scheme "which in due course should encourage the growing of improved crops" and a seed testing laboratory which is already functioning. Honduras reports a programme for selecting high-quality maize, bean, rice and sorghum seed for distribution, and experiments with different varieties of basic grain to determine those best suited to the various regions of the country and likely to give higher yields than those traditionally grown. Malta mentions

a study by an FAO seed specialist on the development and growing of "genetically improved plants of high protein value and improved agronomic characteristics".

54. Within the framework of the International Biological Programme which is responsible to the International Council of Scientific Unions (ICSO), a Nordic Committee has been established to plan research projects in the four Nordic countries designed to increase protein production from conventional plant and livestock sources. The Norwegian part of this is directed towards protein production from food plants and the study will include experiments on food plants grown in various climates at two centres in Norway and at the Department of Agricultural Botany at Makerere University College at Kampala in Uganda, the last centre being established by agreement between the University of East Africa and the Norwegian Agency of International Development. Swedish genetic investigations are directed towards the development of varieties of crops for human consumption better adapted to the Swedish climate and showing good resistance to yield-limiting parasites. Work has started at the Royal Agricultural College and the Swedish Seed Association to find varieties of cereals and legumes with improved amino acid composition, both for human food and animal feed. In June 1968 the Joint FAO/IAEA Division of Atomic Energy In Agriculture organized a panel meeting in Sweden to discuss problems connected with this type of work, including the development of simple means of determining which plants show the desired protein characteristics. Measures have been taken in Finland to accelerate the development and growing of fodder plants of high protein value and "practical results from this will probably be seen in the 1980's".

55. It has already been stated that proteins are made up of a group of simple components containing nitrogen called amino acids and that the nutritional quality of a protein depends on the amounts and kinds of amino acids of which it is composed. Some proteins are short of one or another amino acid and can be improved in nutritional value by the addition of the particular one which is in short supply or, as it is usually termed, which is "limiting". The proteins of most cereals are short of one or more of the essential amino acids. The addition of the amino acids, lysine to wheat, or lysine and trytophan to maize, nearly doubles the value of their proteins when they are the sole source of dietary protein. With wheat it is feasible to add the amino acid lysine, which can be synthesized cheaply, to either the grain or the flour. For maize the discovery of the genes opaque-2 and floury-2 provides a means whereby the protein quality of any variety of maize can be upgraded and, as already stated, proposals to grow such improved varieties of maize have been initiated in a number of countries. In the long run genetic research to improve the protein quality of wheat, sorghum and rice, as well as maize, offers great promise, but fortification with the limiting synthetic amino acids or with protein concentrates such as fish-protein concentrate or dried skimmed milk are the means which can be applied currently where fortification is indicated.

56. A number of countries report that they are considering amino-acid fortification of basic cereals. For example, in the near future the Ethiopian Nutrition Institute will start a feasibility study of lysine enrichment of wheat flour. Pakistan considers that factories for the manufacture of amino acids should be set up and fortification of cereal foods and beverages should start at "an early date". The possibility of fortification will be given due consideration by Singapore, while Thailand has approached two Japanese firms about the possibility of fortifying rice with lysine. Brazil is considering ways of producing amino

acids and national research groups in Chile, though alert to the possibility of using amino acids, are awaiting technological progress before attempting to test their use. In contrast, Peru reports that its Ministry of Agriculture, through the Corporación Nacional de Abastecimientos del Peru (CONAP) is studying enrichment of such cereals as wheat flour and rice and that their enrichment programmes will be launched by a decree declaring enrichment to be a "public utility and national necessity" and ordering CONAP, with the co-operation of the Ministries of Health and Development to prepare a regulation describing the most suitable procedures so that the Peruvian milling industries can start the process. Sweden mentions that a considerable part of the cereal crop in many developing countries which might benefit from amino-acid enrichment is processed in small village mills and that "it is not known whether it is possible to introduce enrichment with synthetic amino acids at this level". El Salvador will consider the enrichment of wheat flour when amino acids can be obtained at reasonable cost but states that the pattern of consuming maize as tortillas made in the home makes it extremely unlikely that it will be possible in the near future to produce an enriched maize flour.

57. If the nature of crops can be changed from those of low protein content to those of higher protein content this will, of course, increase protein production, and a number of Governments report policies of this kind. For example, Botswana reports educational efforts to get farmers to grow more legumes. The Ministry of Agriculture in Lesotho is fostering the growing of pulse crops and encouraging the people to consume them at home instead of exporting them. The United Republic of Tanzania is hoping to double the production of grain legumes by improved crop husbandry and is promoting increased consumption at home, stating that the inclusion of 30 to 50 per cent of grain legume in the usual meals of their country has been found to increase their protein quantity and quality very substantially. They add that "at the moment, however, legume consumption is low and inconsistent". They are also planting cashew nuts and coconuts for local consumption, stating that their current production of cashew nuts, equivalent to about 5,000 tons of high quality protein a year, is all exported, but that "there is room for expansion and internal consumption of surpluses". Zambia reports the distribution of two varieties of ground-nut seed in different regions, that extension officers are encouraging the cultivation of sugar beans and that the Research Department of the Ministry of Agriculture began a plant-breeding programme of soya beans in 1967.

58. In the Democratic Republic of the Congo an effort is being made to expand the production of soya beans and to introduce them into the usual meal pattern (with assistance from Belgium). Pakistan considers that the production of legumes should be increased by evolving high-yielding varieties because of their protein content and "because they form a traditional item of diet". The Bureau of Plant Industry of the Philippines has programmed production of pulses and nuts so as to increase actual consumption from 3 to 7.3 kilograms per head per year. The activities of the Philippine Coconut Research Institute are directed towards improving the culture and production of coconuts and studies concerning the use of coconut protein for human consumption are in progress in several research departments. Peru has many sources of protein which the population has not used to the best advantage, for example, beans, and the Government of Peru has established support prices to encourage farmers to plant crops, has instituted a public education campaign by distributing pamphlets giving recipes and nutritional information to encourage people to buy and eat them and has found

that the sale of lima beans, for example, has been successfully increased. Considerable research has been done in Panama on numerous varieties of Venezuelan and other Central American beans, and an agricultural credit programme is operated to promote bean and maize production. Iraq states that their policy is to include legumes in the system of crop rotation to help to increase soil fertility and to make them available as human food.

Livestock

59. The improvement of the quantity and quality of the protein in the staple plant food of a country is likely to make the greatest impact on the protein problem, but, if the production of milk, meat, poultry and eggs can be increased economically and without too great a competition for basic food supplies between animal and human needs, this will increase not only the protein value of the national food supply but also its palatability. This is clearly recognized in many of the reports from Governments. A point apparently not so clearly understood is that, to have a decisive impact on the protein problem, plans to increase the production of protein from livestock sources should be coupled with policies to ensure that a fair proportion of this increased protein supply should be consumed by young children, pregnant women and nursing mothers of all social and economic groups.

60. Many Governments are surveying their fodder resources, attempting to establish better pastures, to grow more of their own animal feed and so to reduce imports. Some report that they have introduced broad agricultural policies designed to increase their livestock production. For example, a national beef scheme has been initiated in Zambia to encourage and enable progressively-minded farmers to improve their herds. Subsidies are available for the construction of night paddocks, crush pens and calf pens, for tick control and the control of internal parasites. Two demonstration units will be established in each district. It is hoped that these measures will bring about a considerable improvement in the change from the traditional herd. Zambia also reports its policy to increase milk production: this includes a heifer bounty for all farmers enlarging their herds and subsidies for the import of heifers and improved buildings. Two state dairy units have been set up to help to maintain the level of milk production and consideration is being given to establishing milk collection centres in rural areas, in the first instance near the railway. The scheme will be operated on a co-operative basis with producers using cross-bred cattle. Botswana reports attempts to persuade farmers to increase the culling of livestock from the veld. They state that the "dairy industry in Botswana took a heavy blow after the recurrent drought of the last few years, but there is a considerable, if unmeasured, consumption of milk by all classes of persons in the rural areas".

61. In Malawi there is no shortage of plant proteins "though there is need to increase production of animal proteins", and they are improving and increasing livestock through the introduction of further stall-feeding schemes and establishing insemination centres in order to increase animal production of cross-bred calves to 2,400 by 1970; introducing cattle markets with scales (fixed or portable) and by expanding and establishing holding grounds; rearing and distributing annually 90,000 six-week old chicks of an improved strain by 1970; controlling animal diseases through the construction of new dip tanks, cattle crushes for East Coast fever and vaccination of cattle against tuberculosis in the northern and central regions; and improving and expanding the veterinary staff training.

They also report that four rural demonstration dairies are being constructed and will be ready for use in 1970 and that with the assistance of FAO and the United Nations Children's Fund (UNICEF) the Government has established a dairy and livestock industry project, which will encourage increased production of safe and hygienic milk and tackle the question of distribution.

62. The Livestock Division of the Ministry of Agriculture in Lesotho, with FAO and UNICEF, has embarked on a poultry nutrition scheme which is already contributing to the local diet large numbers of eggs and some broiler poultry from intensively kept stock. Zambia also reports rapid development in the poultry industry, the value of poultry products produced and sold increasing from $1,254,400 in 1963 to $4,760,000 in 1967. "A National Poultry Training Institute has been set up, and provincial centres to train general extension staff and farmers are in operation in all provinces. Many hundreds of farmers have already had training at these centres. Trained poultry extension staff now number sixty and cover all provinces. Large poultry farming co-operatives with many thousands of birds have done very well and small farming co-operatives are being encouraged. About 120,000 pullets will be distributed to Zambian farmers this year and the distribution of improved poultry stock to villagers and young farmers' and women's clubs is being expanded". A subsidy is available for housing of pigs, sheep and goats and the formation of pig co-operatives is being encouraged, particularly in areas where surplus maize is available.

63. All these examples are taken from reports from Africa. A few further examples will be cited from other continents. The animal husbandry and poultry industries of China (Taiwan) are being encouraged through the development of balanced feed, increase of feeding crops and the development of feed industries, imports of feed and the promotion of family pig and poultry raising activities. They estimate that the numbers of pigs and chickens raised will double between 1968 and 1978 and that the number of ducks will increase by about a quarter. They propose to develop grassland on mountain slopes for cattle feeding. In the Republic of Viet-Nam new breeds of pigs and poultry have been introduced and production, particularly of poultry, is increasing. There is need to multiply livestock on pastural ranges in West Pakistan. Nepal sets out its achieved and proposed targets for the dairy industry, cattle farming, sheep and buffalo breeding and poultry development, also for pasture development, animal feed production, artificial insemination and for their animal health service. The Philippine Government provides their target proposals for livestock and states that it is hoped that the country will be self-sufficient in eggs, poultry and pork by 1971 and in milk, beef and other meats by 1975. Among the activities they describe are: backyard gardening, domestic pig and poultry production and 4-H club activities encouraged by the field personnel of various agencies as well as diversification and intercropping to increase farm of production of animal feeds resulting in increased production of higher quality poultry, pigs and cattle.

64. A livestock-breeding programme in Honduras is designed to accelerate the growth in national livestock production by the distribution of locally-reared thoroughbred stud beasts at prices within the purchasing power of all livestock breeders and an agricultural improvement programme which includes technical assistance for breeders of pigs, poultry and cattle; artificial insemination using liquid or frozen semen; poultry breeding to increase and improve the

production of eggs and poultry meat in specialized distribution centres; and pig breeding to produce improved breeds for distribution is being practised. The National Agricultural Development Plan of Peru is an integral part of the 1967-1970 Development Plan, and its basic objective is "to galvanize the crop and livestock sector so that it will expand in keeping with its increasingly important role in the national economy, thereby raising the income of the rural population and ensuring their integration in the economic, political and social life of the nation". The Agricultural Promotion and Development Act of 1967 provides special tax exemptions for a ten-year period from April 1968 for the domestic production of foods, animal feeds and raw materials, and for their marketing and initial processing as well as for credit incentives. Priority in technical assistance will be given to crops and livestock intended for domestic consumption and help will be given in marketing. Other developments include a loan programme administered by the Agricultural Development Bank and the Agricultural Research and Development Service (Servicio de Investigaciones y Promoción Agraria (SIPA)) to improve Peruvian cattle. An experimental cattle cross-breeding programme aims at determining which breeds thrive best in the forest region; several SIPA-sponsored sheep and pig feeding and breeding experiments are under way in various parts of the country; the cui (a kind of guinea pig) is being developed and improved as a cheap source of animal protein for the rural population. The poultry industry has recently been developed, and, in order to encourage the consumption of poultry and also of fish of which Peru's coastal waters could provide an abundance for human consumption and to prevent large-scale imports of beef, the sale and public consumption of beef is forbidden on Tuesdays.

65. In Argentina the Instituto Nacional de Tecnología Agropecuaria (INTA) is conducting an extension programme of research on beef production, including studies on cross-breeding; selection of breeding animals on the basis of fertility, food conversion capacity, weight at weaning, quality of progeny; stock management; management of pastures and fodder resources; health management of herds, including vaccinations and antiparasitic treatment; farm management, including fencing and water supplies; the economics of beef production; analysis of the quality of slaughtered cattle; meat technology; and analysis of domestic and world markets. In order to accelerate research and the training of young technical staff, a United Nations Development Programme (UNDP) project, administered by FAO, is under way at one of the experimental stations. Two extension programmes, one for the pampas region and the other for the northern region have been prepared with the object of disseminating information among producers and creating interest in modern practices and technology, which can gradually be adopted as capital becomes available. Important work in sheep breeding is in progress in the Patagonian region as part of a UNDP/FAO project and experimental pig production has led to the introduction of lean European breeds which give high commercial returns. Work is also in progress in Argentina and also in Panama to increase the production of milk by improved husbandry and of eggs and poultry by intensive methods of production.

66. The Government of Malta is aiming at expansion of animal population and better health and veterinary services and is advising farmers on the best use of fodder and on the adoption of efficient farming techniques. Cyprus is now in the second year of its second Five-Year Plan and "it is anticipated that growth rates and gross returns to farmers will be increased". Prominent among the efforts they describe are expansion in the cultivation of forage leguminous

crops and of hay, in the drying of lucerne and in the intensive production of sheep, goats and cattle for meat and milk production. A special project assisted by the World Food Programme (WFP) has been in operation for over a year to promote mixed livestock and crop farming "on dry land areas with a view of increasing animal protein". The aim of the Greek Government is to raise the production of beef, poultry, eggs, milk and fish; in 1966 animal protein consumption per head was already twice as high as it was in 1956.

67. There is a comprehensive programme in Czechoslovakia for increasing the consumption of protein, particularly by increased production of beef, milk and eggs. They lay particular emphasis on the need for animal feeding-stuffs which they state can be covered through imports of fish and bone meal, imports of oil-seed cakes of high protein content or the production of forage yeast. They hope in the future to be able to reduce the imports and to economize in the use of farm land, of which Czechoslovakia has a relatively small area per capita by increasing the production of forage yeast from such waste materials as sulphite liquors, citric liquors and molasses, and from petroleum. Romania is also developing the production of animal fodder from conventional materials and forage yeast grown on sulphite liquors and is making technological studies directed towards production from other waste materials. Finland mentions the experiments in that country which have demonstrated that considerable milk yields can be produced on cattle feed composed of protein-free fodder, using urea (a simple nitrogen compound) as the sole source of nitrogen, the essential constituent of protein. The potentialities of this are being explored in the United Kingdom.

68. The report received from France states that a scientific committee of "agricultural technology" established within the Délégation générale à la recherche scientifique et technique (DGRST) is supporting a programme of research on the physiology, the improvement through genetic manipulation and the technology of harvesting, drying and storage of forages. Government and private laboratories are participating in this programme.

69. Canada, with its considerable agricultural resources, is emphasizing studies and practices aimed at further increasing its efficiency of production and utilization of forage and grain crops in producing meat, milk and eggs. In the Canadian studies on ruminant-animal nutrition special attention is paid to increasing the proportion and quality of forages in the ration, to methods of enhancing the utilization of low-quality roughages and wood products and to the incorporation of urea and other simple compounds of nitrogen rather than protein in the feed. In Canada ways are being studied of adapting plant proteins for calf feeding with the objective of making more milk proteins available for human nutrition. More attention is being directed to protein quantity and quality in cereals so as to reduce the requirement for protein supplements for pig and poultry feed and also to increase the value of the cereals in the human diet.

70. In Oceania, the CSIRO of Australia is directing most of its cattle research to the needs of the cattle industries in the subtropical and tropical regions of the country. The application of this research is being assisted by the building of roads in the northern areas. It has been shown that a large increase (mainly for export) in the amount of beef produced in northern Australia is possible because of a marked rise in stock-carrying capacity, a more rapid increase in liveweight gain leading to a quicker turnover for slaughter, a higher

rate of reproduction and improved stock health and vigour. These improvements are based on two developments, the improvement of the nutritional value of tropical pastures by numerous projects and increase in the numbers and improvements in the performance of cattle on the improved pastures, by studies on cross-breeding, resistance to cattle tick, the influence of nutrition on reproductive mechanisms and the mechanisms by which improved nutrition leads to improved growth and production of meat and the study and control of important cattle diseases. CSIRO programmes are also concerned with raising the productivity of dairy cattle, particularly in subtropical and tropical dairying areas; with increasing yields of sheep meat; and with genetic selection aimed at raising the rate of egg-laying in hens. New Zealand has established targets for increasing livestock production. Increases in meat production "will find markets for the next ten years or so, mainly in what are regarded as developed countries until the incomes of developing countries attain a level where imported meat begins to play a more important role in the diet". Production of dried skimmed milk in New Zealand has now reached 160,000 tons a year compared with 42,000 tons in 1961-1962 and, for various reasons, "it seems this year that New Zealand will be faced for the first time in its history with stocks of skimmed milk powder for which it may not be possible to find commercial markets. Severe marketing problems exist with cheese, another very valuable form of animal protein". One of New Zealand's aims is "the initiation of a multilaterally financed food aid agreement which would utilize the surplus of dairy products which... are accumulating in many countries.... New Zealand has a considerable potential for increasing production of protein-containing food-stuffs but if this potential is to be realized it is necessary that fairer trading conditions are obtained in order that markets are available at reasonable prices for an increasing quantity of production". It is New Zealand's view that "much more effort should be made to find ways and means of utilizing the great potential which already exists in temperate countries for increased production of orthodox protein foods. This will require international co-operation on a major scale. In this respect there is a precedent in the Food Aid Convention of the Kennedy Round Wheat Agreement".

Fish

71. Fish is one of the best sources of protein, both in terms of quality and quantity, but it does not make as large a contribution to world protein supplies as it might. Among the reasons for this are inadequate fishing boats and gear, shortage of trained fishermen, difficulties in preserving fish, which is highly perishable, and, in some countries, dislike of fish. The reports from Governments show that there are widespread activities throughout the world directed towards the improvement of the world's marine and fresh-water fisheries - they include identifying and assessing new sources of fish; conserving fishery resources; promoting the development of commercial fisheries with the object of catching, processing and distributing fish and fish products in acceptable form as widely as possible.

72. It is recognized that to modernize a fishing industry requires large inputs in the form of modern fishing vessels with refrigerating and freezing capacity, fishermen trained to use this equipment, and transport, storage and marketing facilities. Where such facilities are not already in operation, even if capital is available to develop them, it may take too long for sufficient high-quality fish to be harvested and consumed by the people for this excellent food to make

quick impact on the protein problem. The production of marine fish may have to be a long-term aim. This aspect was considered by the group of scientists in Indonesia who recently reviewed the critical food problem in that country. In reviewing the urgency of the protein problem they expressed the opinion that to improve sea fishing quickly enough would take more ships and facilities than can be "pressed into service immediately". They considered that effort should be concentrated in the short term on developing inland or brackish water fisheries because these are easier to improve with existing knowledge supplemented by adaptive research and because the immediate costs are less, and that effort to develop marine fishing should take second place and be of a long-term nature.

73. The Philippine Government states that their efforts to increase protein sources are directed to fish rather than livestock production because they have great fisheries potential and this is less expensive than livestock development. Their first planned activity is to increase their area of fish ponds, especially in brackish water. Their other planned activities illustrate clearly the great cost of developing a marine fishing industry - they need more commercial fishing vessels; increased efficiency in the equipment of their existing fishing vessels; a pier, dry-docking space and marketing facilities and refrigerated warehouses for storing the catch. They plan to request the assistance of the present FAO experts in a location study for regional fishing ports and harbours.

74. Singapore's first aim is also to increase the productivity of fish ponds, and various schemes for marine fisheries are also being implemented. These include a fish training institute at Changi which is being established with the aid of UNDP for the training of off-shore and deep-sea fishermen; a marine fisheries research department also at Changi, sponsored by the South-East Asian Development Centre. Several South-East Asian countries and Japan are participating in the establishment of this department which "will function to develop fishing grounds by experimental fishing; to research into fishing gears, equipment, fishing methods and handling of fish at sea; to investigate fisheries resources and fisheries oceanography; and to train research personnel. The department will be equipped with a modern research vessel." A modern fishing harbour costing several million dollars at the Jurong Industrial Wharf is being built. This new harbour is ready for use and other shore supporting facilities, such as ice plants, cold rooms and processing installations are being established. A central fish auction market is being constructed at the new harbour and other subsidiary markets are planned elsewhere. Participation of private enterprise is being actively sought; a few joint fishing ventures involving participation and expert help from the more advanced fishing nations have begun and more are at advanced stages of negotiation. The Singapore Economic Development Board gives loans to finance large fishing enterprises, and the Primary Production Department is planning a financial loan scheme for the small fishermen and fishing co-operatives. These activities are described here in detail to illustrate the complexity of developing fisheries, the need for international co-operation and co-operation between Governments and private industry and the expense involved. The Republic of Viet-Nam, with the assistance of UNDP is studying the fish potentialities of the continental shelf. Between 1962 and 1966 (the first Five-Year Economic Development) there was remarkable development of fisheries in the Republic of Korea and the Government plans to increase production at an annual rate of 15 per cent during the Second Five-Year Economic Development (1967-1971).

75. The FAO/UNDP Regional Central American Fishery Development Project, which covers several countries, including El Salvador, Mexico and Panama, will operate for the next five years. Its immediate goals are to obtain information on resources of fish, including crustaceans, in the Atlantic through exploratory fishing and laboratory investigations with a view to industrial production and marketing and to improve the professional competence of those involved in fisheries research in the area. Venezuela mentions an agreement made with FAO and UNDP in 1967 which will make possible the most comprehensive programme of fisheries research and development which has yet been made in that country. There are also many national activities directed towards the improvement of fisheries in Central American countries. In Mexico, the National Biological Research Institute is investigating the area, size, structure and potential of known fishing grounds and is attempting to find new ones with the aim of developing the national fishing industry and making it more efficient. The Ministry of Agriculture of Panama is administering an FAO project for promoting the consumption of herrings, which exist in abundance around the coast of Panama and can be sold at very low prices below the average price of fish and which have never been caught in commercial quantities or marketed on a large scale because they have not been in demand. In El Salvador credits and technical assistance are granted for the artificial ponds for fish farming and lakes are artificially stocked with high-yielding fish. Flourishing shrimp fisheries with seventy-three vessels are engaged in fishing, though nearly 80 per cent of the catch is exported and only 1.5 per cent is used for domestic consumption.

76. Peru reports that 98 per cent of the marine fish landed in that country is used by the fish-meal and fish-oil industries, the rest going to human consumption. They believe that there are many species of fish available which are not already used for human consumption. Peru has innumerable rivers, lakes and lagoons, but little is known about fishing these waters, although the abundant trout in Lake Titicaca in the Andean region is popular both in its fresh and preserved forms and three enterprises are producing canned trout. Direct public action has concentrated on research and the conservation and development of fisheries resources, and a number of government programmes are in operation. The State's economic policy concerning fisheries is laid down in an act which states that the encouragement of fishing for human consumption is a matter of social importance and national necessity; it provides for tax exemptions, particularly for fishermen's co-operatives and stipulates that fishery activities are to be given credit priorities; it provides for training in the operation of co-operatives and for an educational plan to promote fish consumption. The major obstacles to the development of fishing for human consumption are the traditional methods used in the industry, the lack of knowledge of Peru's fisheries resources, lack of enterprises concerned with the exploitation of species suitable for human consumption and the fact demand is limited by high prices, resulting from a defective system of marketing and poor presentation. They hope that these obstacles will be overcome with the implementation of the Sectoral Fishery Plan, which forms an integral part of the Economic and Social Development Plan, 1967-1970.

77. The Ministry of Agriculture of Guyana has long been involved in developing marine fisheries by provision of credit, duty-free concessions for petrol, oil and nets, and substantial discounts on ice purchases and by providing landing facilities both in the cities and rural areas. The Government supplies selected species of fresh-water fish to farmers interested in the development of fish ponds. The fish are reared in carefully designed ponds and they usually provide a substantial amount of protein food for the farmers.

78. Essentially similar reports come from Africa. For example, "although Ethiopia's inland waters and the coast of the Red Sea have good potentialities for fish exploitation, the insufficiency of modern fishing equipment and the lack of technical know-how have greatly retarded the possible development of fish economy in Ethiopia. Also the potentials in the rivers, lakes and the Red Sea coast have not been completely surveyed. Obstacles for the development of the fishing besides the lack of equipment and vessels are due to an under-developed market and a lack of organizations to help the small fisherman. At present, the greater part of the fish caught comes from the Red Sea while inland waters are still unexploited and used only for small scale fishing for the local population or not at all in areas where fish is considered a low status food." The Government is planning measures to overcome these obstacles and states that for the domestic market the first fish-exploiting project in the country will soon be begun in one of the inland lakes.

79. The United Republic of Tanzania also reports great potential for both fresh-water and marine fisheries "which so far remain virtually unexploited" and describes its present and proposed activities. A variety of isolated activities are reported from other African countries. For example, with the help of funds from OXFAM (The Oxford Committee for Famine Relief of the United Kingdom) Liberia has embarked on a pilot project for the production of carp, and a private corporation, Mesufish, distributes salt-water fish to virtually all the major centres of population, the source being the off-shore waters of Liberia and west Africa. After processing and freezing, it is distributed to cold storage centres "from whence it moves into retail channels, largely operated by local marketers. The result of this private initiative has been to make fish protein available throughout the country at prices lower than have been realized previously." The Federal Government of Nigeria has invited fish experts to examine the potentiality of the fisheries industry in the country with a view to increasing the intake of fish protein, and other examples could be given.

80. In Cyprus, Iraq, Jordan, Kuwait, Malta and Turkey activities essentially similar to those already described for other parts of the world are in progress or planned. In addition, Israel reports that a considerable amount of knowledge has been accumulated and research is continuing at the Hebrew University - Hadassah Medical School as well as the Fish Breeding Research Laboratory on the control of brackish-water and fresh-water algae which produce toxins lethal to fish in ponds. This research has already achieved many practical results. In Greece, there are plans for increased fish production aimed at achieving an important volume of exports.

81. France, the Netherlands, Norway, and the United Kingdom as well as Canada report constant efforts to improve their own fisheries and catches, although during recent years the Swedish fishing industry has tended to stagnate, mainly due to competition from inexpensive foreign-caught fish. Denmark mentions investigations in the Research Laboratory of the Ministry of Fisheries.

82. In the United Kingdom considerable sea-fisheries research is undertaken in Government laboratories "to help the fishing industry to catch fish efficiently and economically and, in collaboration with scientists of other countries, to provide the scientific basis for conservation measures to protect the stocks and ensure rational exploitation of the resources". Research is being undertaken in Government laboratories, the National Environment Research Council and by

grant-aided bodies such as the White Fish Authority into the development of techniques for the artificial rearing in tanks of plaice, sole and turbot and of oysters, clams and prawns; it is not yet known whether such fish farming can be established as an economic or competitive source of food supply. Good progress is reported in work on the rearing of young fish to marketable size in sea-loch enclosures and in warm water effluent from the cobling systems of generating stations. A pilot scale plant has been constructed for developing methods for the mass production of shell fish and research is being undertaken on river management with the aim of increasing production of salmon, sea trout and brown trout. A preliminary investigation on the possible use of krill and previously unexploited fish stocks in the Antarctic as a new source of protein is being made by a working party of the National Environment Research Council. In France sea resources are developed through intensification of traditional fishing, improvement of fishing procedures and methods of preservation, development of new methods of exploitation and creation of new resources and better utilization of fish-protein resources. Expanded research on hydrobiology of fresh water fish and other living organisms is also conducted. Both France and the United Kingdom report fisheries activities directed towards the developing countries, particularly in education and training, catching ability, processing and distribution, fish culture and research. France is concerned with providing assistance for the development of fishery resources in the Ivory Coast, Madagascar and Senegal. Le Centre Technique Forestier Tropical is responsible for the operation of a UNDP project on training of fishery personnel and research in fish culture in centres in Cameroon, Congo (Brazzaville), Gabon and the Central African Republic.

Reduction of waste of protein foods from conventional sources

83. Many countries report serious losses of food produced from plant, livestock and fisheries sources and some are attempting to save these potential supplies of protein. This is important as the use of effective and efficient methods of storage and preservation of existing harvests is indeed likely to be the quickest method of increasing the supplies of foods such as cereals, meat, milk and fish, which are important sources of protein.

84. The situation described by Ethiopia appears to be typical of many countries. "The storage facilities on Ethiopian farms are very poor and high losses have been sustained. More than 25 per cent of the stored quantity is often lost. The existing stores offer poor protection against moisture, grain-eating insects and rats and other rodents." Research to find inexpensive methods of storing grain has resulted in improvement of simple storage facilities which are to be demonstrated to farmers and sold to them, when necessary on credit. The Ethiopian Government states that to "subsidize these programmes funds will be allocated to the Ministry of Agriculture".

85. The United Republic of Tanzania also gives estimates of losses, those due to vermin and pests being estimated at 30 per cent and those sustained during the harvesting, storage and distribution of maize perhaps as high as 50 per cent, and explains that "losses due to perishable foods being spoilt in the field, in storage or in transit may also be very high. In some cases it is not unusual for two or more causes of waste to occur successively on the same food crop resulting in a harvest that never was". Many control programmes are in operation. Groups of farmers on the advice of the Ministry of Agriculture staff attempt to

control vermin, which include mice, baboons, elephants and wild pigs. The report from United Republic of Tanzania comments that "these activities could be improved and in certain cases could provide protein from suitable game". Aerial spraying with parathion is used to control the most serious bird pests, and locust control is assisted by FAO. Insect pests are controlled by the farmers themselves by application of suitable insecticides, but insufficient effort goes to this and losses are still high. The Government proposes to improve domestic storage, to step up control of birds and other pests and to establish village mills for cereals and legumes to reduce the heavy losses due to domestic processing and also to "encourage the supplementation of cereals with legume protein for improved nutritional value".

86. Zambia reports that a rural maize storage showed that from 1963 to 1965 none of the types of bins used was really suitable and that "storage losses of between 30 and 40 per cent, mainly due to insects and rodents, were at least twice as great as previously considered possible". Since then storage trials using various types of improved small bins constructed of sun-dried mud bricks plastered with cement, which have proved to be rodent proof, have shown that losses due to insects can be reduced to 1 per cent. Studies are in progress on the two major pests of stored maize which infest the crop before harvest and also on the use of insecticides.

87. Malawi and Nigeria both state that agricultural extension workers instruct the farmers in the means of keeping grains free from insect pests and of preventing other forms of deterioration during storage. Pakistan considers that, if the present wastage of wheat and rice in storage in that country could be prevented, 10 million more people could be fed annually at the existing rates of consumption.

88. In Argentina, losses resulting from agricultural scourges in 1966 were estimated to be equivalent to 250,000 million pesos and it is considered that this loss will increase appreciably unless instruction is given to those concerned with handling and storing wheat and maize in bulk. In Mexico a constant battle against pests and diseases is led by specialists from the Directorate General of Plant Health at the Secretariat of Agriculture and Cattle Breeding and from private industry. Emergency campaigns are launched whenever necessary and serious damage to crops has been avoided by campaigns against locusts, field rats, copra weevil and other pests. There has been increased use of weed killers, which has improved the results of the increased use of fertilizers - previously weeds were competing with crops for nourishment, water and light. Many new warehouses have been built in which modern techniques of drying and fumigating are used. A vigorous campaign against rodents and other pests has resulted in reduction of losses in Panama where housewives, as well as farmers, are given instruction and demonstrations on improved methods of protecting and preserving grains and other foods.

89. The Stored Product and Food Control Division of the Israeli Ministry of Agriculture is responsible for the inspection of all grain in storage for human consumption and gives advice on prevention of losses. It also does research on the improvement of methods of storage and of control of insect pests which infest stored products. It proposes to make an estimate of grain losses in Israel during storage, to study the effect of spontaneous heating on the quality of stored soya beans and to investigate the means of preventing the development

of certain poisonous substances in stored grains and seeds. Studies are in progress at the Hebrew University on the toxic products produced by moulds on ground-nuts. In Zambia ground-nuts for export are fumigated before despatch and efforts are being made to improve methods of fumigating in specially lined sacks devised for the export market. The United Kingdom Tropical Products Institute is assisting several producer countries in problems of this kind. This Institute, including the Tropical Stored Products Centre, and the pest infestation laboratories of the United Kingdom Agricultural Research Council are engaged on many aspects of basic and applied research and the biology and control of insects and other pests that attack products in store.

90. A few countries report efforts to alleviate losses of animal products. In Botswana there was "heavy wastage of cattle during the drought and attempts are being made to improve and facilitate marketing of cattle through finishing ranches in order to tap off more stock and prevent this wastage". In El Salvador a meat inspection act will improve slaughtering methods and is expected to raise output by 20 per cent. In this country increased assistance will also be provided for preventing and combating animal epidemics and for improving the marketing of both live and dead cattle. Mexico also reports campaigns against diseases of animals, and in Venezuela progress has recently been made in establishing meat-canning plants and modern abbatoirs in which all by-products of slaughter can be utilized. Argentina estimates that wastage due to cattle diseases, poor methods of slaughter and under-utilization of the by-products of animal slaughter are equivalent to 150,000 million pesos a year. In Guyana there have been recent efforts to set up a blast-freezing unit at the government's marketing agency, and the Government has also tried to promote the preservation of pork by pickling, while private industry has established factories for canning, among other foods, certain meats and fish.

91. In Pakistan "about 7 million head of livestock, 20 million head of poultry" and large quantities of foods of animal origin go to "waste every year for various reasons" and consequently "research and development work is needed on a country-wide scale to control plant and animal diseases on the one hand, and introduction of efficient methods of marketing of produce on the other.... Efforts on marketing reforms have lagged far behind those for technological advances in production in this country. Large quantities of products like carcass by-products, milk, eggs, skins, bones and casings go to waste every year for want of a demand from home industries, which are either under-developed or non-existent".

92. One of the projects proposed in the United Republic of Tanzania is to establish village processing and preservation plants for meat, vegetables and fruits to ensure reduction of losses and to achieve rational distribution; another project is to develop better fish processing and packing to reduce losses in storage and transit, which are estimated at 20 per cent. Refrigerated warehouses are being set up at different places in the Philippines to store the fish catch and most fishing vessels are being provided with adequate refrigeration; public markets, particularly in Manila, are being modernized to reduce retailing waste, insanitary practices and "unfair trade practices"; farmers' associations and marketing co-operatives are being organized; and the need to strengthen the existing livestock co-operatives is being considered. Co-operatives are greatly needed in this country where 80 to 85 per cent of the vegetables and fish comes from small farms. The Republic of Viet-Nam describes general agricultural and fisheries methods of reducing waste. In Singapire waste human food is collected

and used as pig feed and it is intended that meat and meat products condemned as unfit for human consumption will be used for manufacture into animal feeding-stuffs.

93. Comprehensive measures are proposed in Brazil to cut losses of protein foods during storage, transport, marketing and distribution. An agreement has been made between the National Bank for Economic Development and the Brazilian Storage Company (BNDE/CIBRAZEM) to remedy storage deficiencies, principally in refrigerated storage. The expansion and improvement of the highway system is planned to improve the transport, particularly of perishable foods, and the possibility is being studied of establishing a "national integration fleet", to promote more rapid and efficient coastal transport. The Executive Group of the Food Products Industries (GEIPAL) is "to grant exemption and other facilities to promote the establishment of food industries in the producing zones so as to make use of production surpluses and further the use of the industrialized product during the between-harvest period".

94. In Kuwait slaughter house by-products, meat, bone and blood, by-products of the fishing industry, date residues and by-products of flour mills are all used to produce animal feed. Similar efforts are reported by Cyprus, where grape seeds, olive kernels and orange pulp are manufactured into animal feed; and price differentials, quality incentives and improvements in the disposal of produce also help farmers to reduce waste. An effort has been made in Greece to reduce waste by developing food processing, and six large processing units have been promoted through the Hellenic Bank for Industrial Development. The general trend in the Netherlands is also to convert horticultural waste and the by-products of the human food and drink industries into animal feeding-stuffs to supplement the long-established utilization of slaughter houses and fisheries by-products for this purpose. Feathers from slaughtered poultry and droppings from poultry batteries are used on a limited scale for the production of livestock feed.

95. Considerable efforts are being made in Czechoslovakia, Romania and the Ukrainian Soviet Socialist Republic to use the waste material of the processing industries of animal and plant raw material, particularly to produce animal feeding-stuffs. Norway describes efforts to reduce waste as "part of the ordinary programmes to increase the productivity of agriculture and fisheries in general", and this summary might also be applied to the manifold activities of Australia, France, Spain and the United Kingdom. Canada mentions that the special and increasing attention that "is being given to improved and new processing techniques, to pasteurization and sterilization, and to improved packaging, storaging and distribution".

B. Protein from unconventional sources[2/]

96. If the protein problem is to be solved, use must be made of protein from new and unconventional as well as traditional sources. The residues of oil-seeds, left after the extraction of oil, contain protein, which has been used for many years for animal feeding. As soon as it was understood that shortage of protein for young children was the primary nutritional problem in the developing world,

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2/ Specific proposals 5 through 8 and 11.

efforts were begun to make some of this source of protein suitable for human food, particularly in weaning foods for young children. Similarly, waste fish was at one time widely used as a fertilizer; later on techniques were developed for preparing fish meal for use as animal feed, and more recently much effort has been devoted to refining methods of production so that now it is possible to produce a bland fish flour intended for human consumption which is usually called fish-protein concentrate. Green leaves and sea-weed and other similar plants contain protein, and scientists in many countries are seeking feasible ways of extracting protein from these sources. It has been known for many years that yeast containing about 50 per cent protein will grow on waste carbohydrates such as molasses and sulphited liquors of the paper pulp industry,and these have been used on a small scale in processed foods. The most recent development is the observation that yeasts and other single-cell organisms can be produced on fractions of petroleum or natural gas supplemented by certain other required nutrients which are cheap and abundant. Some of this new material has already been extensively tested in animal feeding, and one future aim is to produce it eventually in forms suitable for incorporation into human diets.

97. The aim of some of these developments is to make protein concentrates which can be added to the staple food of a country, such as bread or noodles; the aim of others is to make foods which can be combined perhaps with cereal and root flours of various kinds and possibly with dried skimmed milk to produce weaning foods for children.

98. Since the beginning of this work it has been understood that protein foods which have not been used traditionally as human food must be tested for toxicity and for nutritional value, particularly if they are to be major foods for young children, and much effort has gone into these two important aspects of the problem. Only recently has the importance of adapting a new food to the tastes and customs of the intended market been fully appreciated. New protein foods that can fit traditional dietary patterns are most easily introduced, but even these require extensive promotional efforts. Thus, the problem of ensuring that foods of good protein value should be eaten by young children has turned out to be much more difficult to solve than was thought at one time. This may be the reason why no country without an adequate milk supply has wholly solved the problem of assuring the consumption of adequate amounts of good quality protein by young children.

99. The replies from Governments are discussed under the following headings: oil-seed protein foods, fish protein concentrate, single-cell proteins and testing of new protein foods.

Oil-seed protein foods

100. Oil-seed meals provide the most readily available source of good protein for human consumption other than the conventional protein foods discussed in section A of this chapter. The appropriate combination of an oil-seed meal and a cereal grain can provide a protein food which is an adequate replacement for milk in the feeding of young children. Although some countries report that no work is in progress or contemplated to develop these foods for human consumption, many describe important progress.

101. The Nutrition Institute of the Federal University of Pernambuco is making studies on the chemical composition of the oil-seed products of north-east Brazil with a view to using them for the industrial production of food for human consumption, and Incaparina, the low-cost vegetable-protein mixture produced in Colombia, Guatemala, Nicaragua, and Panama will, it is hoped, be available on a commercial basis in El Salvador within the next year. Cotton-seed meal has been produced in Venezuela of a quality suitable for use in human foods and there are plans to use it in products of high protein value. In Mexico a considerable amount of research on soya flour, which is produced in limited quantities at two small factories, is in progress, and tests of soya products have been made on children and on other groups of the population. As a result of this research, one low-cost infant food based on soya flour is already being produced and marketed and another is about to be marketed; it is hoped that the daily sales of these two soya foods will reach several hundred thousand units. Good progress has also been made in studies intended to make possible the use of mixtures of soya flour and corn flour, enriched with the amino acids methionine and lysine, intended for the preparation of tortillas. Other research is in progress with the object of making an acceptable sesame-flour paste, though a cotton-seed paste, which has already been made experimentally, has not yet been made sufficiently palatable.

102. At present ground-nuts are cultivated on a small scale in Peru and are used for direct human consumption - indeed studies are in progress to find varieties suitable for use in candied or salted form or for manufacturing into peanut butter, sauces and beverages. Soya beans are grown in small areas and are used by the settlers in some places for consumption in the form of milk or dried as beans. The Agricultural Research and Development Service (SIPA) is promoting the cultivation of ground-nuts and soya beans in both coastal regions and jungle for oil production, the residue being used for livestock feed. At La Molina Agricultural Experimental Station mixtures of wheat flour and soya have been made successfully into bread, biscuits and noodles on an experimental scale; the protein content of the products has been increased without changing their physical characteristics. A booklet of soya recipes has been published for the rural population with the object of teaching them how to use various forms of soya in their meals. SIPA is also engaged in research on the development of sesame, which is at present cultivated to a very limited extent and used in the preparation of Chinese food and in pastries and confections. Cotton-seed paste, which has a protein content of from 32 to 36 per cent, is another important item under study. In Chile attempts are being made to include sunflower presscake concentrate in the national feeding programmes.

103. There are some small factories in Thailand for the extraction of oil from ground-nuts, coconuts, sesame and rice bran, and the meals produced from these extraction plants are used mainly for animal feed. However, under the newly proposed protein food development programme for improvement of the nutritional status of pre-school children in Thailand, the Ministry of Health in collaboration with the United States Agency for International Development (US/AID), FAO and the Government Processed Food Organization is exploring the use of the by-products of the oil-extraction factories as ingredients of supplementary food mixtures for young children. They are also considering the use of by-products left after the extraction of starch in the processing of the mung-bean noodle - these are found to contain as much as 15 to 16 per cent protein.

104. In Taiwan, soya-bean milk, containing from 2.4 to 3.0 per cent protein is produced in thirty-four factories and distributed in sterilized bottles (in 1967, 1.2 million bottles of 280 cc capacity were produced). About half of the production is consumed in rural areas. One factory is producing a cooked full-fat soya-bean powder containing 42 per cent protein and two factories are producing spray-dried soya-bean milk powder containing 22 per cent protein. Soya-bean foods are accepted by the Indonesian people, and high priority is to be given to agricultural research directed towards the development of new varieties and better cultural techniques and to local processing operations designed to make soya-bean foods suitable for young children. It is thought in Singapore that, although oil-seed meals are mainly used as animal feed, their use as direct sources of protein for human diets requires study by food technologists "as the protein is not attractive by itself. The subject deserves urgent study and research in view of the general protein deficiency in local human diets and the unavailability of low-cost protein foods."

105. In the Republic of Viet-Nam, although many years of research have gone to investigating the nutritive value of oil-seed meals, because the present war has caused the destruction of much of the primary products such as ground-nuts, sesame seed and coconut, no programme is envisaged to encourage the production and consumption of these protein foods. There is, however, a programme for expanding the production of soya-beans from 7,500 tons in 1968 to 13,500 tons in 1971; in 1965 production was only 4,000 tons. In the Republic of Korea soya products are traditional items of diet and those most often eaten are soya sauce and paste, soya-beans, soya-bean sprouts and soya-bean flour. The Korean Government has provided detailed information about the production of these products. It also states that in Hong Kong a high protein soft drink made from soya-beans is being successfully produced and marketed.

106. Oil-seeds are one of India's major natural resources and constitute an enormous source of protein, which is at present used almost enitrely for the production of animal feed, some of which is exported. The Government has approved of high-grade ground-nut flour for human consumption and a product containing 50 per cent protein can be produced in a large number of places. Also two plants are now producing a ground-nut concentrate containing 85 per cent protein, and several other plants are being considered. The regional research laboratories have produced small quantitites of edible-grade cotton-seed flour and will soon begin work on cotton-seed concentrate. The Government is fortifying atta with ground-nut flour on a small scale and small amounts of fortified atta are being produced for commercial sale in Bombay and Madras through consumer co-operatives.

107. The amount of buffalo milk (which has roughly double the fat content of cow's milk) supplied through urban milk schemes in India can be doubled through a process of "toning" with added skimmed milk. This "toning" can now be done with a solution of oil-seed protein concentrate; the product is a milk of roughly the same protein and fat content as cow's milk. By using this process the milk supply can be doubled at a cost increase of 25 per cent. If it can be successfully adopted, it will relieve significantly the current pressure on imported dried skimmed milk. A feasibility test on the process is being conducted in Bangalore. A simply processed food for children, called Bal Ahar, made from cereals and oil-seed protein concentrate and fortified with vitamins and mineral salts, is being manufactured under the auspices of the Food Corporation of India and distributed to children in scarcity areas. The Ministry of Food and Agriculture

is considering both its use in a large-scale feeding programme and its eventual commercial production. Bal Ahar is perhaps the least expensive combination of locally available nutritious foods which fits local taste patterns, is appropriate for children and is palatable. Ground-nut flour is one of its ingredients and there may be difficulty in obtaining adequate supplies of this material at certain seasons of the year that are free of the toxic substance, aflatoxin, which develops under certain conditions during the harvesting and storage of ground-nuts.

108. At present the oil-seed residues available in Pakistan in large quantities are used solely for animal feed, and it is acknowledged that laboratory research should be organized with a view to using the residues for human food. It is known that the residues can be freed from toxins and used for developing low-cost high-protein foods. As a start, the laboratories of the Pakistan Council of Scientific and Industrial Research have undertaken research work on the use of cotton-seed meal in human diets; this work is still at the experimental stage. The activities of the Philippine Coconut Research Institute are directed towards improving the culture and production of coconuts, and basic research and studies designed to promote the use of coconut protein for human consumption are in progress in five university departments and other research centres.

109. In Turkey experiments have been made in several villages on the addition of soya flour to home-baked breads and it has been found that 7 per cent can be added without adverse effects on the taste or appearance of the bread. Studies are also being made with the object of including soya flour in baby foods. A product, Arlac, based on ground-nut flour and dried skimmed milk is in production in Nigeria, and is widely consumed in the northern states; in addition UNICEF has bought a substantial quantity of the product for use in a supplementary feeding programme.

110. In the United Republic of Tanzania oil-seed meals are either wasted or exported for livestock feed and at the present time nothing is done to make use of this material for the preparation of human foods. However, the Government proposes to promote the production of soya beans, ground-nuts and sunflowers with a view to increasing the sources of oil-seed protein and to set up a pilot plant at a proposed new food science institute in which tests can be made to find out whether it is feasible to produce oil-seed protein from the meals available in that country. A local firm in Zambia is investigating the possibility of using ground-nut and soya flour to make a locally acceptable product. At present there is no production or consumption of oil-seed meal in Ethiopia, but during the past two years attempts have been made in the Ethiopian Nutrition Institute in co-operation with the Medico-Chemical Institution at the University of Uppsala, Sweden, to produce suitable indigenous oil-seed protein concentrates to use in making high-protein supplementary mixtures for children. At the present time the Institute is producing and marketing mixtures based on a combination of cereals, legumes and, at present, dried skimmed milk. The Ethiopian Government states that because of the shortage of dried skimmed milk on the world market it is hoped to begin production of mixtures containing imported soya meal soon, but the ultimate aim is to replace this with a product made from indigenous oil-seeds. To date, the most promising indigenous material appears to be sunflower meal and it is expected that a sunflower-protein concentrate will be produced in Ethiopia within the next few years. Funds for the establishment of protein concentrate production in Ethiopia will be made available by the Swedish Government. In Senegal a product based on sorghum and ground-nuts was developed with the assistance of

France, but the product was not a commercial success; further efforts to promote it were interrupted when the problem of aflatoxin contamination of ground-nuts arose.

111. In Malawi oil-seed protein foods are not considered necessary because they already eat ground-nuts, beans and other legumes. A similar explanation comes from Guyana where it is the tradition to use peas and beans and coconut milk in cooking. Improved varieties of sunflower seed are being imported into Botswana and tested, but apparently only as a source of oil, and agricultural extension workers are encouraging peasants to grow ground-nuts.

112. A considerable amount of work is in progress in Israel on oil-seeds. A factory exists for the production of protein concentrates particularly from soya beans and could be used for the production of similar material from other sources. At the Techno-Israel Institute of Technology, the nutritional value of protein concentrates has been tested on experimental animals, and the concentrates could be developed into conventional and new foods. However, they have not yet been tried on human beings. At the Department of Food Technology of the Centre for Industrial Research a UNDP project is in operation. The main problems to be tackled by a group of research workers are the development of more economic methods for the preparation of protein concentrates, particularly from oil-seeds, and the development of new production methods, in particular for the manufacture of new protein foods palatable to people in developing countries. At a unit of Technion, which is receiving assistance from UNICEF, methods of producing soya bean milk have been investigated, and a vegetable protein mixture containing chick peas, sesame flour and heated soya-bean flour has been developed at the Hebrew University Hadassah Medical School, and, when tested as a diet for infants at the Beilinson Medical Centre, it compared favourably with cow's milk in promoting growth of the infants. Studies are being made in various laboratories in Israel on the toxic substances naturally present in some of the oil-seeds, and in one laboratory attempts are being made to develop methods of treatment to improve the nutritional quality of soya beans. The Government of Iraq is promoting an expansion of the cultivation and production of ground-nuts and soya beans with the object of incorporating them into human food. The National Institute of Nutrition and the oil-seed factories are starting experimental work to assess the nutritional value of sesame cake and other oil-seeds.

113. In Canada the Department of Agriculture sponsors a project in co-operation with the University of Toronto with the objective of processing and developing uses for rape-seed meal as human food, while the Department of Industry sponsors research aimed at using the material as animal food. The University of Alberta has completed some research and plans further study with the objective of developing cheese-type foods from various mixtures based on oil-seed meals; acceptable products have already been produced from soya-bean protein and soya-milk protein mixtures.

114. There is considerable activity in Europe mainly directed towards the needs of developing countries. Sweden has recently started breeding sunflowers and soya beans with emphasis on their protein content, and during the last four years different oil-seeds have been tested at the Department of Medical Chemistry of Uppsala University as possible sources for the production of protein concentrates for enrichment purposes. Some of the oil-seeds have been found to contain anti-nutritional factors, some of which have proved difficult to remove. Protein

concentrates from both safflower and nug seeds (Guizota abyssinica), which contain more than 50 per cent of protein of good quality produced diarrhoea in rats as well as children and no way of overcoming this defect has been found. Protein concentrate prepared from sunflower seeds has been proved to be non-toxic in long-term experiments on rats, and a product containing more than 55 per cent of protein has been tested on animals and children. A mixture of plant foods containing 15 per cent of sunflower protein concentrate has been used for feeding children who have been found to grow normally in height and weight. In animal experiments, it has been shown that the nutritional value of this mixture can be made even better if it is enriched with the amino acid lysine, which has been discussed earlier in this report in relation to the enrichment of wheat flour and other cereals. Experiments have been made in Sweden with the aim of preparing protein concentrates from linseed, cotton seed and rape-seed by unconventional extraction procedures designed to decrease or remove the anti-nutritional factors in the seeds. It is not yet known whether protein concentrates prepared by these unconventional procedures will prove to be cheaper than skimmed milk powder on fish-protein concentrate.

115. Work is also in progress in the United Kingdom where several industrial firms have been active in the preparation of oil-seed protein-based foods for sale, for example, in North and East Africa, China (Taiwan), Indonesia, Jordan, the Republic of Korea and the West Indies. Other firms produce invalid and baby foods fortified with oil-seed protein concentrate. One firm, in co-operation with FAO, has undertaken development work on the baking of flours fortified with protein concentrates; another has produced a bread fortified with soya flour and is experimenting in the use of other oil-seed meals while yet another has taken out a patent covering a process for spinning oil-seed protein into filaments, which can be used to make foods similar to meat products. The quality of protein from ground-nuts is being studied at the Rowett Research Institute in Scotland, and, with the collaboration of plant geneticists, this work will be extended to other oil-seeds and also cereals.

116. It is now well known that toxic substances (mycotoxins) can be produced in oil-seeds by the action of moulds during harvesting and storage, and, following the discovery of the first of these, aflatoxin, on ground-nuts, by workers in the Tropical Products Institute of the United Kingdom, studies have been made on the removal of the toxic substances. It is important for this work to progress because the development of mycotoxins is a limiting factor in the practical utilization of oil-seed protein preparations. The Institute has given advice to producer countries on correct agricultural storage, transport and sorting practices as a means of helping to prevent the development of mycotoxins and it also offers consultative aid on the economic aspects of oil-seed production, processing and marketing.

117. In France oil-seed protein concentrates are not used in the food industry except for a few products containing soya or sunflower flour and which are used as a substitute for milk for children intolerant to the latter.

Fish protein concentrate

118. Activities concerned with the production and consumption of fish protein concentrate are reported from a few countries, while a few others are considering the matter.

119. The Government of Chile reports that they "enthusiastically welcomed the offer made by FAO and UNICEF in 1956 to set up the first pilot plant in the world at Quintero to produce fish flour for human consumption". This followed laboratory tests with samples from South Africa, which were produced by refinement of products designed for animal feeding. Technical and administrative difficulties hampered progress, but eventually Chile produced a fish flour which Chilean and foreign research workers have pronounced non-toxic, of high nutritive value, stable, easily digested and assimilated either directly or as a supplement to conventional foods and preparations.

120. The Chilean experience stimulated attempts to produce fish flour in other countries, while in Chile itself the Government has, since 1964, promoted and supported studies on ways of using the product, particularly by an interministerial committee composed of representatives of the Ministries of Agriculture, Economic Affairs and Health and agencies such as the National Health Service and the School Welfare Board, university groups and others. As a result, protein-rich mixtures have been developed and successfully tested on groups of very young and school-age children during the last two years. Trials in rural communities are now being planned in co-operation with the food industries with a view to using the mixtures in the national feeding programmes of the National Health Service and the School Welfare Board. It is estimated that demand by these feeding programmes, which are compulsory by law, far exceeds the production capacity of even the most modern fish-flour plants in Chile. Thus, the problem of placing the concentrates on the free market and the danger of their reaching groups other than those for whom they are intended "is less acute than it is in other countries with different administrative ard political structures and a different economic and social system".

121. An expert from the Panamanian Health Organization (PAHO) has advised El Salvador that because of lack of development of the fishing industry in that country the production of fish protein for human consumption is not likely to be feasible in the near future. In Peru production is encouraged and research is in progress; for example, a study is being made of the use of stick-water in fish-meal factories. In Uruguay there is laboratory production of a powder which is made by drying material produced by the fermentation of ground fish with yeast and sugar. This powder is hygenically prepared, stable, cheap and highly nutritious and has been tested successfully in feeding undernourished children. There are plans for future production of the material in a pilot plant at the Fisheries Research Institute of the University of the Republic of Uruguay.

122. Ethiopia and Sweden are jointly attempting to produce fish protein concentrate for human consumption. In Massawa on the Red Sea Coast in northern Ethiopia a modern fish-meal factory, which was originally a Bulgarian-Ethiopian venture, has been established for the production of fish meal for animal feeding. Although fish meal is used for animal feed in Sweden, production at the factory in Ethiopia has stopped because of supply and marketing difficulties. Recently the Ethiopian Ministry of Commerce and Industry has sought the help of private Swedish industry in making a feasibility study of the possibility of using the existing fish-meal factory, fishing vessels and fish resources in the Massawa region to produce fish protein concentrate. The product might possibly be used as an ingredient of supplementary mixtures for children or in a possible school feeding programme.

123. A foreign company is exploring the possibility - and advisability - of manufacturing fish-protein concentrate in Nigeria, but they fear that the price may be too high for Nigerians in need of such foods. As a result of a bilateral agreement between the Netherlands and the United Republic of Tanzania, an experimental factory for the production of fish-protein concentrate has been established in the latter country. Attempts will be made there to manufacture a product acceptable to the people of the country. The Instituut voor Visserijprodukten T.N.O. of the Netherlands is co-operating in this project. The Government of the United Republic of Tanzania reports that the work is hampered by lack of fishing gear. They have found that samples made from fresh-water fish appear to be more acceptable than those made from marine fish. It is proposed to establish a number of pilot plants on Lakes Tanganyika and Victoria to manufacture, say, 10,000 tons of the product; this alone would require 80 per cent of the present fish catch and it is thought that such an enterprise might stimulate the fishing industry. The next aim is to manufacture high protein food supplements containing fish-protein concentrate for children, and it is recognized that this will require market research, recipe development, studies on consumer acceptance and methods of publicity and an appropriate team of research workers. Finally, it is intended to investigate the possibility of making marine-fish-protein concentrate.

124. Similar activity is reported from the Republic of Korea, where it is considered that the production of fish-protein concentrate from waste fish might help to improve the income of fishermen and so stimulate the fishing industry, which is reported to be poorly developed. The Department of Fisheries Processing of the Pusan Fisheries College is investigating the experimental production of fish-protein concentrate and this work is financed by the Ministry of Science and Technology. The Division of Food from the Sea of US/AID and the Oceanic Development Cooperation have approached the Government of Thailand about the possibility of producing fish-protein concentrate.

125. The Republic of Viet-Nam is not at the present time considering production because insufficient fresh fish is produced to meet demand, but they are aware of the possibility of adding the concentrate to bread and using it in supplementary foods for children. Fish-protein concentrates are not made in Pakistan though, again, the Government is aware of the potential usefulness of the product. Jordan proposes to build a factory for the production of fish-protein concentrate for human consumption when a fishing fleet becomes available, and in Turkey experiments are in progress on the use of the material. Some of the European countries, for example, France, Norway and the United Kingdom, as well as the Netherlands and Sweden, have considered the subject but report no positive development. Research is in progress in the Soviet Union directed towards the enrichment of bread with fish-protein concentrate and the preparation mixtures of this concentrate with plant products. In Canada there is unlikely to be production and marketing of the product on a large scale within the next three years, although small-scale production for nutritional and Food and Drug Directorate evaluation is likely to continue. Full commercial scale production is likely to develop three to five years hence. In any consideration concerning the production of fish-protein concentrate in a developing country, it is important to appreciate that the technology necessary for production is such that, at present, the product is expensive compared to more conventional protein sources. Production would require massive industrial installations and capital input that would not be sound economic investments at the high price of the product, which, as explained above, is caused by the processing involved in producing a product suitable for human consumption.

Single-cell protein

126. About half of the Governments which have replied state that some degree of consideration is being given to the possibility of producing yeasts and similar organisms either for animal feeding or, more rarely, to be used as human food.

127. About 10,000 tons of food yeast are produced annually in France, a country which has been interested for a long time in the production of yeast from many waste products and which has a history of excellent technological knowledge in this field. Intensive research on the production of yeast from crude oil or from paraffins has been conducted since 1959 by a private company in co-operation with the Centre National de la Recherche Scientifique (CNRS). A plant is now being erected in Marseilles with a yearly production of over 16,000 tons. The product which contains from 65 to 70 per cent of protein has been tested for five years on animals with good results, and it is intended that when the plant begins production in 1970 the product will be used for animal feeding. L'Institut français du Pétrole in collaboration with the Council for Scientific and Industrial Research of India (CSIR) is working on a similar process. A pilot plant with a production capacity of 50 kilograms a day has been set up in India, the objective being to produce a protein which could be used either as a human food or as an animal feed.

128. The Institut voor Landbouwkundig in the Netherlands has been investigating the nutritive value of a yeast produced by a private petroleum company by means of tests on poultry and pigs made throughout the entire life of the animals and over several generations. So far the results of the tests are most encouraging. This work is entirely concentrated on using the material as animal feed. Other petroleum companies in the United Kingdom are studying the growth of similar organisms on petroleum oil and natural gas. One of these products is intended for human consumption.

129. Work on these lines is also in progress in Sweden and at the Academy of Sciences of the Soviet Union. Canada is watching such developments with interest. Efforts are being made in the Byelorussian SSR to discover yeast-like and other organisms of good protein content which will grow on petroleum hydrocarbons or petroleum gases, the intention being to produce animal feed. It is planned to build factories, the first series of which will produce 200,000 to 300,000 tons a year of food yeasts grown on paraffin wax.

130. Yeasts and similar organisms will also grow on waste carbohydrates, such as molasses, sulphited liquors of the paper pulp industry and wood waste, and several countries report investigations on this form of production. Such importance is attached to activities such as these by the Soviet Union that the Government has instituted a main office for the microbiological industry which is responsible to the Council of Ministers of the country. Its function is to provide for new industrial plants and for the administration of existing plants and scientific research institutes working on increasing the production of fodder proteins. One firm in the United Kingdom is investigating production on flour-milling waste material and is able to produce a fine, free-flowing bland protein powder similar in amino acid composition to meat. This material is at present undergoing a full range of wholesomeness, digestibility and nutritional tests, and already a semi-commercial plant is projected to make a product to incorporate into animal feed. The Tropical Products Institute is investigating two methods for producing protein by fermentation, based on tropical starch crops

such as cassava, simple nitrogen salts or plants and plant wastes. The products of these processes have not yet been tested for wholesomeness and nutritive value. Similar work is in progress in Czechoslovakia, Finland, Romania, Sweden and Turkey where research work has been delayed because of insufficient financial resources.

131. During 1967, Swedish experts investigated in Ethiopia possible ways of using techniques to produce single-cell proteins for animal feeding and human food but concluded that the present methods of production are not suitable for a developing country because of the lack of technical knowledge and marketing facilities. A different conclusion has been reached in Pakistan where it is thought that the subject should be investigated and in the United Republic of Tanzania, where the existence of many cheap carbohydrate substances, such as molasses, sisal waste and bananas, should make the production of yeasts feasible. It is proposed to initiate research into the production of protein from yeasts, and also from sea-weeds and algae and to establish pilot plants to use such single-cell protein as a base for the production of infant foods. The production of yeasts is also being studied in the Philippines.

132. In France, the Institut français du Pétrole has been interested in the production of a blue algae, which has been consumed traditionally in Chad. The protein content is high, up to 70 per cent, and the nutritive value of the algae, which has been studied in Belgium, is excellent. Cultivation trials have been done in the south of France in the open air. It is expected that under good climatic conditions a yearly production of from 40 to 50 tons could be reached per hectare. A pilot study for industrial production is under way in Mexico. Singapore is looking into the feasibility of producing protein by fermentation methods from petroleum fractions, which are readily available from local refineries. Kuwait is also studying this, and there is interest in various forms of production in Brazil, where one firm is preparing to put on the market a product rich in protein and protein derivatives obtained by the fermentation of the residues of the fisheries industry.

133. The Guyana Development Corporation in co-operation with the Department of Biology of the University of Guyana is making a survey of the crude protein content of fast-growing algae found in the fresh-water ponds and trenches of Guyana, the object being to use it for animal feed if it can be economically produced. The opinion of experts in Israel is that it is not worth while for that country to enter this field commercially because it is lagging behind such other countries as France, Japan and the United States of America. It may be able to contribute, however, by evaluating the quality of the protein products produced, by testing for toxicity and by research on some basic aspects of the problem. The mass culture of algae has been investigated in Israel, but work has stopped because of lack of funds. It is reported that such experiments could be resumed and expanded if support were available.

Testing of new protein foods

134. It is important to determine the safe level of intake of any new food or new food additive, and protein foods are no exception, especially if they have been produced or processed by some new method. It is also necessary to check their nutritive value by biological methods and to test their acceptability to the people for whom they are intended.

135. It is clear from the replies from Governments that there is awareness of these facts in the countries developing new protein foods or mixtures. In some developing countries facilities already exist; for example, an arrangement has been made by Ethiopia and Sweden according to which chemical and biological tests of new mixtures are done in Sweden and clinical and acceptability tests in Ethiopia. In other countries, facilities do not exist, but are planned; for example, in the United Republic of Tanzania no facilities exist, "but seriousness of the gap is already felt. It is proposed that these facilities would be part of the proposed Food Science and Nutrition Institute." The WHO-approved centres for the human testing of high protein food mixtures are the Ethiopian Institute of Nutrition, Addis Ababa, Ethiopia; the Christian Medical College Hospital, Vallore, Madras State, India; the College of Medicine, National Taiwan University, Taipei, China (Taiwan); the Instituto de Nutrición de Centro America y Panamá, Guatemala City, Guatemala; and the Laboratory for Pediatric Research, Universidad de Chile, Santiago, Chile.

C. Distribution, marketing and public education[3/]

136. In recent years some Governments have become increasingly aware of the problems associated with the promotion and marketing of low-cost protein foods of indigenous origin, and some studies are under way which it is hoped will indicate the means whereby the needy peoples in developing countries can best be persuaded to produce and consume or buy and consume more foods rich in good-quality protein. This essential activity has had a somewhat hesitant start but it is now well understood that such foods, if they are to be successful in preventing protein-calorie malnutrition, must appeal to the family as a whole and perhaps become part of the customary family diet. The importance of interesting, where appropriate, industrial firms in the production, promotion and marketing of protein-rich foods in developing countries cannot be over-emphasized.

137. In many countries efficient marketing facilities are lacking for conventional protein foods, and this reduces the availability of foods such as meat, milk, fish, poultry and eggs for large sections of their populations and also hinders the development of the industries producing these foods. Some of the proposals to establish efficient markets have already been described in chapter II with regard to conventional foods. A few others will be mentioned here.

138. To overcome marketing problems in Ethiopia, the Livestock and Meat Board, in co-operation with the Ministries of Agriculture and of Commerce and Industry and the slaughter industries, intends to develop a suitable marketing system. Stock routes between the main livestock grazing areas and the big consumer markets or slaughter-houses will be constructed with facilities for overnight stay with grazing and watering. During the next five years, twelve market centres for livestock and eight for hides and skins will be established. The Livestock and Meat Board will be responsible for collecting and disseminating information relating to the production, processing, transport and marketing of livestock, poultry meat, eggs, hides, skins and by-products and in co-operation with the veterinary services will operate the marketing centres. A dairy industry with an established network of milk collection centres exists in Addis Ababa and the

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3/ Specific proposals 9 and 12.

Government will support the establishment of at least four new dairy processing plants in the larger cities and of appropriate milk collecting centres, the aim being to create markets close to the producers and so to encourage the development of dairy production. Credits and other measures will be available to assist the development of modern dairy farms to supply the large cities, and as a demonstration a modern dairy farm with at least 500 dairy cows will be established within the next few years as a semi-governmental or governmental enterprise to provide as regular as possible a milk supply to Addis Ababa. Iraq is also trying to establish a dairy administration to ensure distribution of dairy products among the people for consumption and also a general poultry company in order to make eggs and chickens available for consumers.

139. It is thought that the shortcomings of the present distribution system in Indonesia will reduce the effectiveness of proposals for the improvement of agricultural food production and counteract many of the benefits which might be expected to come from the application of agricultural technology. Specific marketing difficulties include inadequacy of transport and storage, pricing policy and shortage of farm credit. For example, at a time when extra transport is needed, there is evidence of a decline in transport capacity caused by lack of spare parts for trucks or railway equipment and a growing shortage of railway rolling stock. Again, more than half the agricultural credit extended to farmers comes from the private sector on terms of a kind that often reduces the incentive to apply new technology, and, although the price of farm produce often has to be doubled to induce movement through private channels from one area to another, transport costs amount to less than a tenth of the price increase, the rest going to commissions, licensing fees, illegal taxes and large margins of profit. Recommendations have been made to change the existing pattern of distribution and liberalize internal trade. The measures introduced in Turkey's Second Five-Year Development Plan, and especially the 1968 programme, are expected to bring substantial improvement in the distribution and consumption of protein foods; better warehousing and more economic distribution are among the targets.

140. A number of developing countries are introducing schemes to distribute suitable foods to the vulnerable groups of their populations. The Ethiopian Nutrition Institute working in co-operation with the Ministry of Public Health has for several years promoted the production and marketing of suitable protein-rich supplementary mixtures, with success in increasing sales and in gaining marketing experience. The production, distribution and promotion costs are, and for the next few years will remain, higher than revenue and the Swedish Government is providing subsidies. The Ethiopian Government states that "experience has clearly shown that it is possible to make a product of this kind known to people. The crucial point is to change the feeding habits and although the information has been successful knowledgewise and people now understand the benefit of good food during early childhood, much more effort is needed to change the habits of feeding children. The Institute therefore plans to enlarge the scope of its information activities and more than before bring down the information to the 'grass-roots' level. The success of a supplementary food programme needs also the co-operation of health staff, community development workers, extension agents and other personnel working in close contact with people and the efforts to inform and include such staff in the programme must be strengthened and will need the co-operation of the government bodies involved. Funds for these activities will be made available from the Swedish and the Ethiopian Governments."

141. Lesotho is distributing skimmed milk powder and egg powder through various organizations, mainly to children throughout the country. In a large country, such as the United Republic of Tanzania with poor land communications, distribution of suitable protein foods can present formidable difficulties. There are no activities at present directed towards overcoming them but future plans include developing and modernizing traditional high protein recipes; encouraging the manufacture of high protein mixtures, particularly infant foods using cereals, dried skimmed milk, legumes, fish protein concentrate, yeast and vitamins, the target production being enough food for half a million babies the development of new recipes as a means of making suitable protein foods popular; and the processing of meat, including game meat, fish and vegetables into dehydrated, light products for ease of distribution.

142. The activities of Zambia are different. In that country the Ministry of Health established the first Under-Five Clinic in May 1967 and there are now 127 such clinics. The major number of these clinics are supervised by volunteers from the Netherlands volunteer service, and it is intended to expand further as the supply of suitably trained staff permits. Protein foods are distributed through these clinics and also at hospitals and rural health services. Because there is malnutrition among children in primary schools, consideration is at present being given to introducing a daily high protein supplement into these schools; at present two supplements are being tested in a peri-urban primary school near Lusaka, and others are being investigated.

143. An applied nutrition project in the Republic of Korea was begun with the assistance of FAO, WHO and UNICEF at the end of 1967 and includes among its comprehensive objectives increased production of nutritionally valuable foods and the utilization of part of the increase for feeding pre-school and school children in villages which will be used for demonstration. There are plans for increasing goat's milk production and for ensuring that the milk, after proper treatment, should be consumed by village children through organized promotion and education, including feeding in village nutrition stations. It is intended that in each demonstration village a nutrition station will be established for infants and pre-school children to provide foods specially prepared for these age-groups, to spread nutrition education, and, at the same time, to stimulate food production; during the rice planting and harvesting season the young children may be kept temporarily in the station so that mothers will be free for farm work. Local food, such as soya beans and vegetables, will always be the main components of the children's meals though at first imported cereals and skimmed milk may be used also. Parents will pay for the meals either in cash or in kind.

144. The Joint Commission on Rural Reconstruction of China (Taiwan) has launched a pilot project for providing soya-bean-powder soup, containing 5 per cent protein and fortified with lysine, to school children at ten elementary schools and orphanages and observing their physical development. Under another project, 5,000 children from forty elementary schools are to be given cottage cheese every day for five years, and their health is to be observed. Yet another project, aided by a grant from the Rockefeller Foundation, and being conducted in co-operation with the United States Navy Medical Research Institute and Johns Hopkins University, aims to study the effects on pregnant women and their babies in indigent coastal areas of supplying them with protein-rich food.

145. So far, little effort has been made in Pakistan to promote or distribute protein foods, mainly because of lack of cheap protein foods, lack of information on protein malnutrition, ignorance of the people as to the importance of protein and absence of machinery for undertaking the work. Recent investigations have shown that the diet of as much as two thirds of the population appears to be short of protein, the shortages for nursing mothers and pre-school children being particularly grave. Pakistan considers that "in view of this situation, it is imperative to develop applied nutrition programmes in order to bring about an awareness and understanding of the problem so that nation-wide effective programmes for the production and distribution of protein supplies could be developed".

146. At present, there are four applied nutrition projects in the Philippines, in which one of the activities is feeding pre-school children, and it is hoped that more can be initiated. The Nutrition Division of the Department of Health of Thailand, as co-ordinator of the Protein Food Development Programme, is mainly responsible for the promotion and distribution of suitable protein foods for human consumption; its activities include nutrition education, propaganda and demonstrations. The work of the Republic of Viet-Nam in distribution is mainly concerned with feeding war refugees.

147. In El Salvador a project for promoting fish consumption exists under the Regional Fisheries Development Project, and Incaparina, which is distributed commercially, will be promoted by the distributing company, the Health Department and the Agricultural Extension Service. In Peru a decree of 1964 offered various incentives to promote the industrial production of cheap protein foods for human consumption. The decree exempts machinery and raw materials from import duties and offers income tax and other tax incentives as a means of stimulating investment. All projects are subject to approval by the Institute of Nutrition of the Ministry of Health and Social Welfare, and the food to be produced must contain from 10 to 70 per cent protein.

148. There is great interest in Jordan in developing a new protein-rich food similar to Laubina, the food developed at the American University of Beirut in Lebanon. Already a mixture called CSM (corn, soya-bean, milk) distributed at maternity and child health centres in Jordan, is widely accepted and greatly consumed by different sections of the population. The Government of Kuwait distributes free reconstituted milk and poultry meat four times a week to more than 100,000 students, and it supplies pasteurized milk to hospitals.

149. Very few developing countries support the training of personnel in marketing, distribution and promotion, market research or systems analysis to assist the marketing and promotion of new protein foods. Ethiopia reports most fully on these activities. At present, marketing of new protein foods is done by the Ethiopian Nutrition Institute on a trial basis. Two teams are working on the distribution and promotion of new products in co-operation with the education and information department of the Institute. Progress is evaluated as the work proceeds and, where necessary, methods are changed. No specialized training is given, but the practical work and discussions train the staff on the job. Very little is known about consumption patterns for supplementary protein foods or buying habits, and it is planned to employ an expert in market research to start making appropriate studies in 1968. "The groups of population which are of greatest interest as a possible market for supplementary and other protein rich foods are the group with cash economy, particularly farmers with cash crops like coffee. It is the intention

of the Institute to conduct economical, sociological and nutritional studies in communities with, or in transition to, cash-crop growing. It is well known from other countries that nutrition often deteriorates when subsistence economy is changed into cash economy and also therefore these groups are of great interest in the marketing of protein-rich foods." The Institute has also for the past two years employed a consultant in marketing who, with the management and staff, analyses the results of the studies and, in co-operation with the management, plans the marketing activities. "This part of the programme for marketing supplementary mixtures and possibly other protein-rich foods will grow in the future and is considered to be of the utmost importance to the outcome of the supplementary food programme."

150. A few industrial firms in Nigeria train their personnel in marketing, but there is no national scheme for training in marketing new protein foods. Nor is there any scheme in the United Republic of Tanzania because new protein foods are not yet available in the country. "But since there are many projects proposed for producing new protein sources, the need for training in this field is felt... (and) could probably be linked with training in nutrition." The need for training is expressed by Pakistan, but no plans have been made and "this indifference... is mainly due to a lack of knowledge of the protein problems". Assistance from in international agencies will be needed for both the production and the marketing of new protein foods. No plans have been made in the Philippines but the importance of the subject is understood.

151. A course of training is to be given within the coming year in Brazil under the sponsorship of the Getulio Vargas Foundation in collaboration with the Organization of American States. The Government of Guyana has selected two individuals at the Guyana Marketing Corporation who are to have brief training in the United States of America. Iraq hopes for government consideration of the subject in the near future. The Government of Jordan in co-operation with UNDP and FAO has established a national agricultural marketing centre to make investigations, provide information, make demonstrations and train personnel so as to develop an effective structure of marketing for the increased agricultural output planned for the country. About fifty students have been trained in market research, packing, processing, storage and distribution of the food from farm to consumer. The Central Planning Board of Kuwait is surveying the food consumption of the different communities living in the country. The Productivity Centre of the Ministry of Labour of Cyprus is conducting courses, seminars and visits on marketing and market research.

D. Research and professional training[4/]

152. There is no doubt that the need for research and training in the scientific subjects relating to the production and consumption of nutritionally desirable foods is appreciated by the scientific community throughout the world. It is less certain that these needs are understood by politicians and others responsible for directing national policies and allocating national resources.

4/ Specific proposals 10 and 13.

153. Much basic research has already been done and its results are known to the world scientific community. It is important for this information to be communicated to scientists throughout the world, as a basis for further research in the developing countries, particularly in nutrition, agriculture, food science and food technology as well as in related social sciences. The establishment of a few centres of excellence in the developing world will hasten this process and could also be expected to have a catalytic effect on training at all levels in the regions in which the centres are situated. A further catalytic effect would, it is hoped, be a gradual impact of trained personnel on the making of government policies.

154. The group of Indonesian and American scientists who reviewed the Indonesian food situation in May 1968 make such points in their report. They note a recent encouraging decision of the Indonesian Government to strengthen university education, especially in basic sciences, including biology, and also in agriculture, medicine, technology, economics and the training of teachers and to concentrate in a restricted number of centres of excellence, with institutes for middle-level training in the rest of the country. Such centres of higher learning at national and regional levels could become more influential as places in which key personnel and managers can obtain extra training and experience; they could provide effective working relations with appropriate government research institutes and so contribute significantly to the national or regional research capabilities, especially applied research; and they could have an important effect on national and regional planning in matters relating to food and nutrition if they are able to achieve close relations with national, regional or district administrators. This group of scientists, having reviewed the situation in Indonesia, consider that existing research units in the country may have to be reorganized "to improve their functioning in the framework of a national research policy".

155. Four of the reports from Governments propose the establishment of such regional centres. Turkey proposes that a food technology and nutrition research and training centre similar to those in Mysore, India and Guatemala, Central America, should be set up for nearby countries in Turkey, which is a suitable base for social and economic reasons. Plans have been made by the Food and Nutrition Centre and the College of Agriculture of the University of the Philippines for the establishment of a national training centre in applied nutrition, which it is hoped can eventually be developed into a regional training centre. Norway may take the initiative in investigating the possibility of co-operation between eastern African countries and Norway regarding the establishment of a regional centre for research in nutritional physiology, particularly in protein problems. Sweden considers that "one of the major contributions by United Nations organizations could be to establish regional training centres in developing countries (e.g., Ethiopia) or in nearby countries (e.g., southern Europe) for the formation of qualified professionals", and that close co-operation between such centres in developing and advanced countries is of great importance.

156. It is impossible in this report to summarize all the detailed information that has been given about the institutions for research and training that already exist in many countries. Descriptions will be confined to those institutions either in developed or developing countries in which research and training is directed towards the protein problem in the developing world as discussed earlier in this report.

157. The Department of Agriculture in Botswana, supported by the Department of Community Development, is in the process of establishing two farmers' short course

centres for the training of rural people in agriculture and home economics, and the first course for women began in April 1968. The Department of Community Development has an active extension programme directed to the formation and encouragement of women's clubs throughout the territory, and this is being received with enthusiasm. An agricultural college in Lesotho is giving similar types of training, and a national training programme given in Liberia in co-operation with FAO is centred in villages and is designed to help women and children to know and use available local protein foods.

158. In Ethiopia's third Five-Year Development Plan the growing need for manpower is considered to be the crucial obstacle to the achievement of the national targets for agriculture and fisheries. The existing agricultural schools cannot meet requirements for skilled and semi-skilled workers and measures have been taken for immediate crash training; it is recognized that the training system must be developed so that sufficient manpower at various levels of skills will eventually be available. The Ethiopian Nutrition Institute, which began work in 1962, serves as a national centre for training at various levels, including training of laboratory workers and teachers of nutrition. The Institute will arrange courses in nutrition for public health staff and teachers of nutrition and will take part in nutrition training for doctors and nurses. The Institute is also a service institution in food science, and workers in food technology will be trained during the production of protein concentrates and supplementary food mixtures. Nutrition surveys of special groups of the population will continue to provide background information for applied programmes, and dietetic advice will be given to industry and hospitals on request.

159. The Democratic Republic of the Congo stresses the need to train more veterinarians and the Government is to seek assistance from FAO to reopen a school for veterinary assistants at Bolombo. Agricultural education at the University of Lovanium will be financed by US/AID and assistance in the construction and equipping of an experimental farm at the official university at Lubumbashi will be sought from US/AID. A food science and applied nutrition unit has been set up at the University of Ibadan in Nigeria and personnel from various parts of the country are being trained. Agricultural workers are trained at the School of Agriculture at Ibadan. Six research centres in the United Republic of Tanzania are at present equipped only for research in agricultural technology, but it is proposed to reorganize their research activities so as to include food science and nutrition and provide training facilities, possibly in collaboration with a central food science institute. There is considerable organization for agricultural research in Zambia and the Agricultural Research Council of Zambia, recently set up to replace the disbanded Agricultural Research Council of Central Africa, is already considering the establishment of a stored products research unit. It is hoped that a chair of nutrition will in due course be established at the University of Zambia; it is understood that a central nutrition training institute for supervisory staff and probably local centres for field staff are also required, for which it is thought that it may be possible to obtain bilateral assistance. In the Ivory Coast the main difficulty appears to be that food habits are faulty, and the government reply makes clear its recognition of the need for education of the public and professional workers in matters relating to food.

160. The Government of the Republic of Korea established a training centre for agricultural and forestry officers in 1963 which provides technical training for farmers and other workers and instructs them in new techniques. In Pakistan there

are "about 150 agricultural research institutes and experimental stations, at some of which food problems are investigated". The universities and health institutes have modest research programmes in nutrition and the main centres of research and training in food science and technology are at the Agricultural Universities of Lyallpur and Mymensingh, Punjab University at Lahore, Dacca University, the National Health Laboratories at Islambad and the laboratories of the Pakistan Council of Scientific and Industrial Research and of the Pakistan Atomic Energy Commission. The Universities of Lyallpur and Mymansingh award degrees in food science and nutrition. More people trained in nutrition are needed, and it is thought that nutritional research institutes should be established immediately in universities for research and training.

161. A national institute has been established in Thailand with assistance from FAO and UNICEF and it is giving regular short courses in applied nutrition to school teachers, community development workers, midwives and other related field workers. Courses in food science, technology and applied nutrition are given regularly at various universities, and the programme of the Institute of Applied Sciences Research, recently established at the National Research Council, will include research on food technology and nutrition. Courses in nutrition for health workers are organized in the Republic of Viet-Nam with the technical assistance of WHO and UNICEF.

162. In Central America the Institute of Nutrition of Central America and Panama (INCAP) acts as the regional centre for research and training in nutrition, food science and food technology and there are national centres for training in agricultural technology. In Brazil and Chile research in the science of food and nutrition is carried out in the nutrition institutes of the universities. In Peru the Centro Nacional para el Desarrollo de la Industria Alimentaria (CENDIA), an independent public body, was established in 1967. Its main activities concern applied research in food utilization, preservation and processing, the development of food industries and the promotion of the consumption of processed foods of high nutritive value. It is planned to begin constructing a semi-industrial processing plant in 1969. The Caribbean Food and Nutrition Institute is the regional centre for the Caribbean and influences training in the area through various applied nutrition programmes. Training available in agricultural technology is reported from Guyana where training in food science and technology still leaves a "great deal to be desired".

163. A department of experimental nutrition and food science has been established in a university in Argentina. This department teaches both nutrition and food science and has a research programme in nutrition; it is proposed to hold post-graduate refresher courses in experimental nutrition and food science. The research programme of the department is hampered by an inadequate budget.

164. The National Centre for Agricultural Education, Research and Extension of Mexico co-ordinates the activities of the National School of Agriculture, the Post-Graduate College of that School, the National Institute of Agricultural Research and the National Agricultural Extension Service. The National Institute of Agricultural Research has eight regional centres, and the National Institute of Livestock Research has one centre. In addition to these facilities for research, both the universities and private industry makes contributions to the national research effort, and there are considerable facilities for education and training in agriculture. In an attempt to strengthen the national agricultural effort, the Government of Mexico has approved the doubling of the

budgetary appropriation for agricultural research, and that for agricultural extension services will also be considerably expanded in 1969. Another development is the establishment of the National Institute for Food Science and Technology, for which assistance has been requested from UNDP; it is hoped that this will make possible more extensive research on preservation, processing, distribution and marketing of food products and provide training for specialists in food technology. The Institute of Marine Sciences and Technology will conduct research into fisheries resources and into the technology required for using them effectively and, with the assistance of UNESCO, will also carry out oceanographic research. The National Institute of Nutrition, which acts as an advisory body to various secretariats of State, as well as to some government-owned and privately operated industries, is concerned with biochemistry and composition of foods and with food technology, including experiments with different mixtures of protein foods, and with advisory assistance in various programmes of food enrichment.

165. The Government of Venezuela reports that the 180 agricultural extension agencies in existence cover a small proportion of agricultural producers and that there is need for greater resources for training of agronomists at university and intermediate levels. The Government considers that, despite recent advances, not enough agricultural research is being done and that greater emphasis must be placed on applied research designed to meet Venezuela's most urgent needs. Courses in food technology, food science and nutrition are given in various academic institutions.

166. There are four centres for research and training in food technology and two in nutrition in Israel. The Government of Iraq has established a National Institute of Nutrition, and training in agricultural and food technologies and food science is given in institutions of Baghdad University. The national centre for agricultural research in Jordan is the Agricultural Research Department, which has several local research stations, and a food utilization laboratory has been recommended. Local training in agricultural technology is given at three agricultural high schools and one junior college.

167. The Government of Kuwait is studying the possibility of establishing an arid zone research and agricultural development centre with a view to increasing agricultural production and improving training in agricultural technology, and it has accepted an offer from the Arabian Oil Company (Japan) to plan for the establishment of the Kuwait Institute of Scientific Research to be operated under the guidance of a Japanese consultant; the Institute would consist of three departments: arid zone agriculture, fisheries and petroleum research. It is hoped to find a food research centre in the near future. In 1964 the Ministry of Health established a Nutrition Section which is responsible for hospital catering. Two surveys on the nutritional position of school children and the general population have been made. The Turkish Scientific and Technical Research Centre has planned for an institute of industrial research which will contain a nutrition and food technology division in which research will be undertaken. The training of research workers will be given high priority. A nutrition institute has been set up in the Ministry of Health, and the veterinary faculty of Ankara University has been expanded to include a branch concerned with animal feed.

168. The reports from Belgium, Canada, Czechoslovakia, France, the Netherlands, Norway, Sweden and the United Kingdom all discuss various aspects of research and training directed towards the developing countries. In Belgium, four faculties in agricultural universities attract large numbers of students from developing

countries. Seven Canadian universities have faculties of agriculture with resources for research and education in food sciences. Most include a college of home economics with substantial interests in food. A number of other universities maintain programmes in nutrition. In all, more of the post-graduate students come from foreign countries than from Canada. In Czechoslovakia "dozens of workers from all over the world" have been trained during the last ten years in industrial microbiology including the production of single-cell protein, and about half of the students were young scientists from developing countries. The report from Czechoslovakia offers the training of foreign scientists from developing countries in institutions and production plants in Czechoslovakia; advice by Czechoslovak experts in developing countries; the supplying of technological and operational information regarding the processing of various kinds of single-cell proteins; and, after 1970, the construction of plants for the production of yeast for animal feed and use in protein foods for human consumption. The Czechoslovak report discusses the world shortage of veterinarians, estimating that the existing number must be doubled by 1980, the greatest number of trained men being needed in the countries in most need of increased supplies of animal protein, and considers it possible, through such organizations as FAO, to offer its capacity in some aspects of veterinary training. In Sweden an institute for nutritional research and education focussing on the problems of developing countries will be established at the University of Uppsala in 1970 on a permanent basis; with support from SIDA the institute will start its activity in 1968 and should eventually function as a mother institute to the Ethiopian Institute of Nutrition.

169. France, the Netherlands and the United Kingdom give detailed information about the academic and other institutions in their countries in which research relating to developing countries is carried out and students are trained. In particular, France discusses the course in applied nutrition and food economics, created with the assistance of FAO, WHO and UNICEF and organized between the Universities of Paris and Dakar in Senegal in 1964/65 and 1965/66. A similar course, in food science and applied nutrition, was organized with the assistance of FAO and UNICEF for four years by the Universities of London and Ibadan in Nigeria and for one year by the Universities of London and Accra in Ghana. At the present time the United Kingdom Ministry of Overseas Development is financing twelve students from developing countries studying nutrition and two studying food technology. The University of Amsterdam in the Netherlands has a department of tropical dietetics in which post-graduate courses are held for doctors intending to work in the tropics.

170. It is impossible to summarize the answers given by Governments to the question concerning the numbers and proposed level of training of personnel in nutrition, food science and food technology. Most of the reports from the developing countries indicate extremely limited numbers of trained persons in those disciplines. Moreover, existing training facilities, although improving, are grossly inadequate to correct this shortage. The need for national and regional training centres is repeatedly stressed.

E. Food and policies and legislation[5/]

171. In their replies to the questionnaire on the protein problem no country gives a comprehensive review of "its policies and its legislation and regulations regarding all aspects of food and protein production, processing and marketing"

5/ Specific proposal 14.

designed "to remove unnecessary obstacles and encourage appropriate activities". Several European countries, including Finland, France, the Netherlands, Norway, Spain, Sweden, Switzerland and the United Kingdom describe their system of food legislation and several mention their participation in the work of the FAO/WHO on the Codex Alimentarius. The reply of Canada is typical of those of other advanced countries and is to the effect that "Canada's policies, legislation and regulations are under continuing review with the objectives of removing unnecessary obstacles and encouraging appropriate activities. It co-operates with those international agencies interested in ensuring policies, legislation and regulations which will promote rather than erect barriers to international trade. An example is its contribution to the programme of the FAO/WHO Codex Alimentarius where the objective is international food standards."

172. Only the United Kingdom reports the existence of any national regulation that might have an effect on the development of unconventional sources of protein and it describes two such sets of regulations: "The Bread and Flour Regulations do not permit the use of any amino acid in bread at present while if any protein were to be derived from mineral oil (petroleum) the Mineral Hydrocarbons in Food Regulations may be restrictive. The system is, however, sufficiently flexible to allow changes to be made in the light of the latest scientific evidence. In particular the Bread and Flour Regulations are about to be subject to a periodic review." The Ukrainian SSR states that to aid developing countries it is able to offer, through the usual channels, production regulations and documents on the production of protein concentrates and amino acids available in the Republic.

173. Several countries, for example, El Salvador, Honduras, Kuwait, Peru, Singapore and Uruguay give information on their existing legislation. Malta is considering making plans to review its food legislation and in Guyana the existing Food and Drug Act is being revised in the light of the changing situation. Mexico considers that its food legislation needs to be brought up to date and that its system of food control needs to be reorganized to make it more effective. A national food law has just been drafted by the Permanent Commission for Food Regulations of Argentina, and this has gone to the Secretary of State for Public Health. In Israel there are no legal obstacles to the production or marketing of protein foods with the exception of pork. In Botswana legislation is being considered to control natural resources and steps are being taken to appoint an officer to review marketing policy and to implement improvements where necessary. The Government of Iraq is planning to enact legislation relating to dairy products, and in Jordan there is concern among governmental officials "to improve the policies, legislation and regulations regarding all aspects of food and protein production".

174. Referring to broader aspects of food policy, Lesotho states that its Government has a Bureau of Nutrition; in Nigeria the Federal Ministry of Health is responsible for nutrition, there is a National Council of Health with a sub-committee on nutrition and it is planned "to have a National Council on Nutrition to serve the whole federation by co-ordinating the efforts of all the states in the federation" and to review present policies, legislation on the enrichment programme and food standards; and in the the United Republic of Tanzania, although there are no existing regulations governing the production and distribution of protein foods, "the gap is being felt and should be filled as a matter of urgency". In this country it is proposed by legislation to specify the minimum protein requirement in processed foods, especially those made for children, and the minimum nutritive value of foods for general use; to control the advertisement of products; to lay down "minimum specifications for food eaten in public institutions to ensure enough allowance for protein"; to govern the safety of protein foods; and to control food additives.

175. Thailand describes how it set about devising a food and nutrition policy as follows:

> "In September 1967, the National Seminar on Food and Nutrition was held in the presence of H.E. the Prime Minister of Thailand. The Seminar had the following objectives:
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> > "1. To suggest to the institutions concerned the importance of nutrition in the development of national economics;
> >
> > "2. To suggest to the institutions concerned the creation of appropriate food and nutrition policies;
> >
> > "3. To create close co-operation and co-ordination among institutions; and
> >
> > "4. To review and improve methods of work of the existing food and nutrition programme.
>
> "The Seminar has proved to be the first step forward in the food and nutrition development of the country. Steps are being taken to strengthen the national food and nutrition committee and to formulate a national policy.
>
> "As regards the legislation and regulations, a new food law concerning all aspects of food and protein production, processing and marketing has been enforced. Regulations for the standard identity of each product are under preparation."

176. In reviewing the general world food situation the United Kingdom concludes by stating that it "feels that the improvement of protein standards in the diet of the whole world population in the next twenty years or so depends as much on effective measures to control population growth as on increasing production standards: both are necessary".

F. Regional activities

177. The General Assembly, in its resolution 2319 (XXII), "requested the Secretary-General, in consultation with the organizations in the United Nations system, including the regional economic commissions and the Economic and Social Office in Beirut, to consider what action may be appropriate at the regional level in dealing with the impending protein crisis". The Secretary-General considers that a useful number of suggestions in this connexion are contained in the report entitled Feeding the Expanding World Population: International Action to Avert the Impending Protein Crisis issued by the Advisory Committee on the Application of Science and Technology to Development. In addition, in the present report a mention 6/ is made of a possible role for the regional economic commissions.

6/ See chapter III, section D, of this report.

178. The establishment of a few centres of excellence for research and training in the developing countries would hasten the process of communication between scientists working in nutrition, agriculture, food science and food technology and related subjects. Such centres should serve regions and would have a stimulating effect throughout the region in which they were situated. In supporting proposals to develop and support regional centres for research and training the United Kingdom points out that these should be based on existing rather than new institutions unless new institutions "are manifestly necessary", because the creation of new centres might have the effect of "creaming-off" national experts.

179. For example, in Central America, the Institute of Nutrition of Central America and Panama (INCAP) acts as a regional centre for research and training in nutrition, food science and food technology. The FAO International Food Technology Training Centre at the Central Food Technological Research Institute in Mysore, India, provides facilities for many nearby Asian countries and thus, although it is a national centre, its work has a regional applicability. The Caribbean Food and Nutrition Institute has started its programme of research and training for the Caribbean subregion. There are proposals from Norway, the Philippines and Turkey (see chapter III D) for the establishment of certain regional centres while Sweden considers that one of the major contributions by United Nations organizations could be to establish regional training centres in suitable places for the benefit of developing countries.

III. PROTEIN ACTIVITIES IN THE UNITED NATIONS FAMILY

180. A number of activities are undertaken within the United Nations family of organizations that relate to the protein problem within developing countries. For many years FAO, WHO and UNICEF, have been co-operating with Governments in their efforts to combat protein-calorie malnutrition. More recently, the United Nations Industrial Development Organization (UNIDO), the International Atomic Energy Agency (IAEA), the United Nations Educational, Scientific and Cultural Organization (UNESCO) and the World Meteorological Organization (WMO) have become directly or indirectly involved in the development of protein sources, their industrial production or their utilization. The United Nations Development Programme (UNDP) and the International Bank for Reconstruction and Development (IBRD) and its affiliates have been providing financial support for projects that directly or indirectly bear on the problem. The funds have been derived from the regular budgets of the specialized agencies, from technical assistance supported by the technical assistance component of the UNDP and from the pre-investment support from the Special Fund component of the UNDP and the IBRD.

181. In its resolution 1257 (XLIII) the Economic and Social Council requested the Secretary-General "in consultation with the Administrative Committee on Co-ordination... to undertake a review of the present and proposed programmes of the United Nations system of organizations, with a view to the possible reallocation of resources directed towards the implementation of proposals designed to close the protein gap...". This has been considered by the Administrative Committee on Co-ordination, which has reported 1/ that "with respect to the question of the reallocation of resources... this is a complex and difficult matter. If the Council's resolution is intended to refer to the reallocation of resources between the agencies, the situation would be complicated by the fact that each agency's programme is determined by its own governing and legislative organs. On the other hand, if the Council had been suggesting a reallocation of resources within each agency, there is little room to manoeuvre. The UNDP is examining ways of increasing the number of appropriate projects that it can support, and the interest of the World Food Programme in this area has also been noted".

182. Later in this chapter a brief résumé is given of the activities related to the protein question which are undertaken by the United Nations organizations concerned.

183. It is difficult to assembly with precision the actual flow of resources through the United Nations system that directly bear upon the protein problem. Over the years IBRD and its affiliates have been making funds available under various arrangements for the support of agricultural and other activities that have contributed to increasing protein supplies. UNDP, under both the Special

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1/ Official Records of the Economic and Social Council, Forty-fifth Session, Annexes, agenda item 23, document E/4486, para. 50.

Fund and technical assistance components, has been supporting projects in developing countries that relate to the production of conventional sources of protein from plants, livestock and fisheries; in addition it has supported institutions for agricultural and food technological research and training and projects relating to food technology. UNDP estimates that in 1967 it spent almost $20 million on projects related to production and use of protein-bearing foodstuffs. Most of this was spent through FAO on production of conventional foods. UNICEF spent about $2.6 million, mainly on production and distribution of milk. The other agencies have spent much smaller sums.

184. For the purpose of this brief résumé the various activities have been grouped under the headings: protein from conventional sources (plant crops, livestock and fish); protein from unconventional sources, distribution and marketing; research and training; and food policies and legislation.

A. Protein from conventional sources (plant crops, livestock and fish) 2/

185. It has been stated in this chapter that by far the largest contribution to human protein requirements come from plant sources, mainly cereal grains, and that much can be done to improve protein supplies if the yield and quality as well as the protein content of cereal crops can be improved and if losses caused by pests, weeds and disease on the field and in storage can be reduced. Most of the work of FAO is devoted to helping Governments to do these things. A comprehensive programme involving FAO, UNDP and the Freedom from Hunger Campaign to breed higher-yielding varieties is in operation in many countries. Important examples are wheat and barley-breeding programmes in the Near East and rice improvement in Asia and the Far East. Much effort is devoted to promoting the adequate use of fertilizers and irrigation. Changes can be made to plants by various means, including the use of atomic radiation and, by a successive process of causing changes, growing the plants and resowing the seeds from those that show the desired changes, new varieties can be developed. The Joint FAO/IAEA Division of Atomic Energy in Agriculture has promoted work of this kind directed towards improving the quantity and quality of the major food crops.

186. One of the principal obstacles to the introduction of new and improved varieties of food crops lies in supplying the improved seeds to farmers. FAO has developed a programme for supplying farmers with such seeds through the establishment of seed production, certification and distribution schemes in Guyana, Iran, Iraq, Liberia and Libya. Similar schemes are under consideration for a number of other countries. It is recognized that, if high-yielding varieties are to be introduced, attention must also be paid to the use of fertilizers, pesticides and irrigation and to farm management.

187. If the staple food of a country is cassava, sago or plantains, this will provide little protein. Therefore the supplementation of such crops by fish or by rice or maize, which can be grown under local conditions and which are of better protein value, is an important part of the plan of FAO for certain developing regions. FAO is also assisting Governments in their efforts to increase the

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2/ Specific proposals 1 through 4.

production of grain legumes, including soya beans. However, regions unaccustomed in the use of these good sources of protein must be educated in their processing and consumption.

188. Another important approach to increasing a country's supply of protein is to improve the feeding of its livestock. FAO is helping Governments to survey fodder resources, to establish better pastures, to rehabilitate over-cropped land and to demonstrate the proper use of forage crops. It is now likely that various roughages, in combination with urea, a simple compound of nitrogen, can be used in cattle feeding instead of conventional feeding-stuffs. This possibility offers new hope for milk and meat production in countries with resources of straw, sugar-cane-bagasse wood waste or other waste cellulose. Closely associated with the development of pasture and fodder production, an extensive and world-wide programme of animal husbandry and health is being conducted to the full extent of funds available from international, multilateral, non-governmental and other resources.

189. Milk conservation is an extremely important way of increasing supplies of protein and UNICEF provides equipment, supplies and engineering services to establish milk collection facilities and milk processing plants. Over the last two decades, UNICEF has spend about $US28 million in forty-four countries on milk conservation; this expenditure has been more than matched by the recipient Governments, which have arranged for the distribution of free and subsidized milk to low-income groups.

190. The widespread activities of FAO directed towards the improvement of the world's marine and fresh-water fisheries contribute to increasing the world protein supply - they include identifying and assessing new sources of fish; conserving fishery resources; and promoting the development of commercial fisheries with the object of catching, processing and distributing fish and fish products in acceptable form as widely as possible throughout the world. The harmful effects of pollution on marine and fresh-water fishery resources and fishing are being investigated, and a special study is being made on the great man-made lakes and reservoirs, especially in Africa, with a view to management for optimal production.

191. Millions of families in developing countries are likely to continue to live for many years in a subsistence economy in which they must grow rather than buy their food. If the diets of these families are to be improved, they must be educated and assisted in the production and proper use of foods that will supply balanced meals. FAO, WHO and UNICEF provide assistance in activities of this sort through applied nutrition projects.

192. An important way of increasing available protein supplies is to prevent waste of conventional agricultural output. A world-wide survey of field losses of sixty major food crops made in 1967 showed that pest and disease caused the loss of about 35 per cent of the potential or 54 per cent of the actual world production. A major item of the programme of FAO continues to be devoted to helping to reduce such waste in all regions. FAO is also helping to reduce the waste associated with slaughtering cattle, meat distribution and the culling of potential resources of wild game by assisting Governments to develop satisfactory abattoirs.

193. Many diseases of plants and animals and many of their pests are extremely sensitive to weather, and the effectiveness of control often depends upon weather.

The quality and quantity of crops and their successful harvest and storage often depends on a careful choice of planting dates based on climatological studies. Similarly, the effectiveness of fertilizer application and irrigation is improved when local weather and climate are taken into account. The WMO Commission for Agricultural Meteorology promotes and encourages such practical applications of meteorology to agriculture by national meteorological services through its sessions and technical publications and WMO has an active programme in all parts of the world to promote the application of meteorological knowledge and experience to increasing and improving agricultural production. A new co-ordinating group on which FAO, UNDP, UNESCO and WMO are represented is acting to encourage the application of meteorology to agriculture and to promote interdisciplinary research and education in the use of meteorological knowledge to improve food production.

194. Another way of preventing waste is to develop the food processing and distribution industries, and FAO is helping Governments to do this. Codes of practice for fish and fishery products and for the freezing of fish are being developed; these may play an important part in the prevention of losses of these food-stuffs during storage and distribution.

B. Protein from unconventional sources[3/]

195. The joint FAO/WHO/UNICEF programme on protein-rich foods, conceived in the early 1950's, was concentrated at first on the use of protein derived from such seeds as soya, ground-nut, cotton, sunflower and sesame, and from fish.

196. Much early work from 1956 onward on the nutritional value and safety of such new sources of protein was done under the guidance of the WHO/FAO/UNICEF Protein Advisory Group. The Rockefeller Foundation made available some $US550,000 for the research phase of this programme. This grant was administered by the Committee on Protein Malnutrition of the United States National Academy of Sciences - National Research Council, with which FAO, WHO and UNICEF co-operated closely. Concomitantly the UNICEF Executive Board allocated funds for process development and testing of protein concentrate preparation from unconventional sources. The research and development sponsored by the three agencies between 1954 and 1967 involved the investment and other expenditure of more than $US4.5 million. This work, relative to developing products, processing methods and related details of safety and nutritive value, demonstrated the usefulness and safety of protein derived from representative oil-seeds and fish for the vulnerable groups of the population. The Protein Advisory Group has prepared tentative processing and quality guidelines in connexion with the development of high-grade standardized protein products from oil-seeds and fish. In recent months the membership of the Protein Advisory Group has been expanded and some additional disciplines are reflected in its composition.

197. Since the safety and nutritional value of these products were established, many attempts have been made to use them to formulate mixtures suitable for feeding children at the time of weaning and during the pre-school years. Such formulated protein foods have been made from concentrates from oil-seeds mixed with legumes and cereals and sometimes with dried skimmed milk, fish-protein concentrate or

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3/ Specific proposals 5 through 8 and 11.

other sources of animal protein. Breads have been baked from yam or cassava flour enriched with protein from oil-seeds or fish. It has been found that the successful promotion of any such product depends upon the interest shown by Governments and by the private food processing industries in developing them for use in government-sponsored feeding projects or for commercial exploitation.

198. The formulated foods developed so far from vegetable-protein mixtures have been proved to be as satisfactory as dried skimmed milk in the prevention of protein-calorie malnutrition. The main stumbling blocks against their successful production on a large scale in the developing countries have been a lack of full appreciation of the need to create economically viable industrial operations and to understand that such foods must be palatable if they are to be commercially successful.

199. Recently, UNIDO in co-operation with FAO has been assisting the Government of Morocco in the redesign of its fish-protein-concentrate plant at Agadir and in the promotion and marketing of its products and has surveyed the possibility of commercial production in Brazil and Chile. At the present time attempts are being made in India with UNICEF help to extend the supplies of milk with protein from ground-nuts, and in other countries private industries are trying to do the same thing with soya beans, cotton seed and fish protein. In the next few years UNIDO is planning to hold seminars on subjects relating to the production of a number of protein products.

200. The proteins in wheat are limited first by an amino acid, lysine, which can be synthetized at fairly low cost, and there are many proposals to fortify wheat with lysine. Field trials using wheat flour enriched with lysine are being initiated in Iran and Tunisia by co-operative arrangements between the Governments concerned, FAO, WHO and the amino acid manufacturing industries. Such enrichment may be important in countries where the cereal in question provides a large part of the national supply of protein without adequate supplementation with animal proteins and legumes. In other countries where the staple cereal is eaten in combination with many other foods it may be found that the amino acid which is in short supply in the cereal may not be that which is lacking in the total diet. Indeed, it has been found that most actual daily meals are not short of lysine, but of one of two or three other amino acids, some of which may still be too expensive to produce.

201. UNESCO is sponsoring fundamental biological research and training on protein synthesis in living cells with emphasis on the production processes of proteins by micro-organisms (single-cell proteins). It organizes training courses and provides fellowships for research in these subjects. It proposes to sponsor research on the effect of malnutrition on brain development and the selection of and continuous cultivation of edible protein-producing micro-organisms. FAO and UNIDO are following closely the progress at present being made by the private and government-owned oil industries in the growing of yeasts and other organisms on by-products of petroleum refining, on natural gas or other nutrients. Similar experiments by other industries using waste carbohydrates, such as molasses and sulphited liquors of the paper pulp industry, are also being watched.

202. The biological value of new protein food mixtures and new protein products added to ordinary foods, has been assessed by FAO, WHO and UNICEF, under the guidance of the WHO/FAO/UNICEF Protein Advisory Group.

203. The clinical testing of new protein food mixtures, which have been shown to be safe and of good nutritive value, is the responsibility of WHO, which has made funds available for this purpose and has selected five testing centres in various parts of the world which are co-operating in the testing programme. Such testing is highly specialized and expensive.

C. Distribution, marketing and public education[4/]

204. In recent years, FAO, collaborating with WHO and UNICEF and under the guidance of the WHO/FAO/UNICEF Protein Advisory Group, has increased its awareness of the problems associated with the promotion and marketing of low-cost protein food of indigenous origin, both processed and unprocessed; it has a few studies under way which it is hoped will indicate how the people in developing countries can be persuaded to grow or buy more foods rich in good-quality protein and to consume them. While some new food products are intended for infants and for other special groups of the population, most must appeal sufficiently to the whole family to become part of the customary family diet. Applied nutrition programmes and nutrition education in general are directed towards this end. The importance of interesting private industries in the production, promotion and marketing of protein-rich foods in developing countries is also increasingly appreciated, and it is recognized that co-operation between them and the international agencies must be extended.

D. Research and professional training[5/]

205. Support for agricultural education and training is a basic part of the activities of FAO and has been implemented in all regions through that organization's regular programme. Home economics training and extension in consumer education, food utilization and family budgeting are stressed. The problem of directing the training of agronomists and veterinarians towards human nutrition, including the protein problem, was given serious consideration at the 1967 FAO Conference, at which a resolution on the subject was passed.

206. WHO is providing assistance to many countries in developing the teaching of nutrition through the faculties of medicine, schools of public health, schools of nursing and nutrition, training centres for health and allied personnel. The Nutrition Research Laboratory at Hyderabad, India, the Institute of Nutrition of Central America and Panama in Guatemala and the Caribbean Food and Nutrition Institute are examples of the assistance provided in this field. Following a special survey on nutrition training made in 1960-1961, FAO, WHO and UNICEF expanded their activities in this regard and have organized several ad hoc interdisciplinary training courses and seminars at graduate and intermediate levels, such as the London/Ibadan course (1963-1967), the Paris/Dakar course (1964-1966) and the Fiji/Noumea course from 1967 onward.

4/ Specific proposals 9 and 12.

5/ Specific proposals 10 and 13.

207. Assistance to Governments and national training institutions in nutrition is being given in many countries, and formal training in the subject is complemented by practical applied nutrition programmes conducted in sixty countries jointly with WHO and UNICEF. The basic aim of an applied nutrition programme is to improve food production and consumption through education and to provide material assistance with respect to production of certain foods and training of supervisory personnel. In many countries these programmes are mainly directed towards the production and the best use of vegetable and animal products locally produced.

208. One of the most important barriers to nutrition improvement in developing countries is undoubtedly ignorance of the nutritional value of food-stuffs, nutritional needs (in particular, protein requirements of young children) and of the relationship between foods and health. Nutrition education programmes should receive more attention, although changes in cultural patterns, food habits, customs and taboos cannot be expected to occur rapidly. For the past ten years many programmes have been developed with the assistance of FAO, WHO and UNICEF under various labels in addition to applied nutrition, such as school feeding, mothercraft/homecraft, community development and health programmes, which include nutrition education in nutrition rehabilitation centres and maternity and child health and health centres.

209. Priorities in establishing the content of nutrition education programmes must be based on a sound knowledge of local problems - nutritional deficiencies, foods (proteins in particular) available or potentially available, transport, marketing facilities, economic conditions, food habits and trends.

210. With a view to reducing the shortage of food technologists and technicians, particularly those with experience in the development of food industries in the emergent countries, FAO and UNDP have established food industry research and training centres in, to date, ten countries. Food processing in these centres is carried to the pilot-plant stage and the centres have already provided Governments and the private sector with an incentive to further development of food industries. In certain instances Governments and the FAO/IBRD programmes have shown interest in larger investment in food industry development. The FAO/Industries Co-operative Programme is also active in this field. The need to accelerate these activities is of the utmost importance but progress is limited by resources both of funds and trained manpower.

211. Other activities developed by FAO with UNDP and Freedom from Hunger Campaign support are training personnel to work in the catering industry and training for, and development of, industrial, institutional and group feeding. FAO, with strong support from the Canadian Hunger Foundation, has established with the Government of India an international food technology training centre which serves students from many countries in Asia and the Far East. Training in food technology and catering helps to promote the preservation of protein-rich foods and their satisfactory storage and ultimate presentation to the consumer.

212. FAO, WHO and UNICEF have granted a substantial number of fellowships either abroad or locally for training related to proteins.

213. The regional economic commissions, in co-operation with appropriate specialized agencies, may be able to play a useful role by reviewing the protein problem within their regions, in particular from the point of view of research and training.

E. Food policies and legislation[6/]

214. It took long years, major wars and other disasters to persuade the Governments of industrialized countries that some thought should be given to policies leading to the "marriage of health and agriculture". It took much less time to persuade those responsible, at one time or another, for the peoples living in the developing countries that cash crops for export were essential to their financial survival; some such cash crops contain valuable protein, which might be used to prevent protein-calorie malnutrition among the children in the country where they were grown.

215. Not enough attention has yet been given by the developing countries to the fact that their social and economic potential is based on a healthy population reliant on its own national food production; a balance must be struck between the production of cash crops for export and of home-grown foods sufficient to meet the nutritional needs of the people. A good example of the way these problems may be approached lies in the project proposed by Zambia, FAO and UNDP to survey, with WHO co-operation, the food problems of Zambia with the object of developing a future national food and nutrition programme for the country. In the assistance of UNICEF to Governments in planning for the needs of children, one of the aims is the development of effective national food and nutrition policies.

216. In the development of legislation to protect the public from hazards, either nutritional or toxicological, which might arise from food processing and the use of food additives (preservatives, colours, flavouring agents, etc.), FAO and WHO, with member Governments, have been active for many years through the food standards (Codex Alimentarius) and food additives programmes.

6/ Specific proposal 14.

Annex

INCREASING THE PRODUCTION AND USE OF EDIBLE PROTEIN

Questionnaire sent by the Secretary-General on 18 January 1968 as a guide to Governments in responding to General Assembly resolution 2319 (XXII)

Part A

Please provide information on present and proposed activities in your country on the part of government, industry, agriculture, universities, scientific and technological institutes and other interested organizations relating to improving and increasing the production and human consumption of protein. Present activities refer to those in calendar year 1968 and proposed activities might cover those in the next five years. If it is possible, it would be useful to include an indication of the national priorities attached to such activities, the anticipated gaps between the level of these activities and your country's needs and the funds involved for such activities as the following:

1. What are the present and proposed activities in your country to increase protein production from conventional plant and livestock sources?

2. What are the present and proposed activities in your country to increase protein availability from marine and fresh-water fisheries sources?

3. What are the present and proposed activities in your country to reduce the waste of foods contributing to protein supplies?

4. What are the present and proposed activities in your country to accelerate the development and growing of genetically improved plants of high protein value and improved agronomic characteristics?

5. What are the present and proposed activities in your country to expand the use of oil-seed meals as direct sources of protein for human diets?

6. What are the present and proposed activities in your country being considered regarding the production and marketing of acceptable fish-protein concentrates for human consumption?

7. What consideration is being given to the feasibility in your country of research and development of protein from single-cell sources suitable for animal and human consumption?

8. What consideration is being given to the present and future use of synthetic amino acids or protein concentrates in your country to improve the nutritive value of cereal and other plant proteins?

9. What are the present and proposed activities in your country to support the promotion and distribution of suitable protein foods for human consumption?

10. What are the present and proposed activities in your country relating to the development and support of regional and national centres for research and training in agricultural technology, food science, food technology and nutrition or other appropriate fields?

11. What is the present and proposed status of centres for the animal and clinical testing of new protein foods in your country?

12. What is the present and proposed support for training of personnel in the fields of marketing (including distribution and promotion), market research (including socio-cultural surveys of consumers) and systems analysis to assist the marketing and promotion of new protein foods?

13. What are the present and proposed numbers and level of training of personnel in nutrition, food science and food technology, and other fields important to the production and consumption of protein foods?

14. What are the present and proposed steps for your Government to review and improve its policies and its legislation and regulations regarding all aspects of food and protein production, processing and marketing so as to remove unnecessary obstacles and encourage appropriate activities?

Part B

Please provide comments on the report entitled "Feeding the expanding world population: recommendations for international action to avert the impending protein "crisis" (E/4343) of the Advisory Committee on the Application of Science and Technology to Development. Such comments, apart from those directed to its technical recommendations, may cover institutional, organizational and any other aspects which Governments consider important.

Part C

Please provide suggestions relating to the implementation at the international level of proposals in the report (E/4343). In this connexion, it may also be useful to refer to possible international efforts through the United Nations system and other ways relating to each of the fourteen areas indicated in Part A above.