

# **SCIENCE AND NIGERIAN DEVELOPMENT**

## **Report of a Workshop**

*August 19-25, 1965*

*Bellagio, Italy*



*Sponsored by the*  
**African Science Board**  
*of the*  
**National Academy of Sciences**  
**National Research Council**

*In Cooperation With*  
**The Rockefeller Foundation**  
*and the*  
**Agency for International Development**

SUMMARY REPORT

WORKSHOP ON SCIENCE AND NIGERIAN DEVELOPMENT

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## SUMMARY REPORT

### WORKSHOP ON SCIENCE AND NIGERIAN DEVELOPMENT

#### Introduction

The detailed discussions in the attached, unedited draft report took place at a workshop, attended by Nigerian scientists and government leaders, representatives of the Royal Society, the Agency for International Development, and members of the Africa Science Board of the National Academy of Sciences. The Africa Science Board sponsored the meeting as the result of requests voiced by Nigerian scientists in February, 1965, for guidance in organizing a Nigerian Academy of Sciences, a Nigerian Research Council, and a scientific policy for Nigeria. The needs and priorities mentioned are not intended as recommendations, but as subjects of future planning and an attempt to clarify the most vital and attainable future objectives, both long- and short-term.

The discussions were divided into eight sessions: (1) development of scientific personnel--education and training; (2) division of labor between universities and research institutes--contributions of universities to economic development--the issue of "pure" versus "applied" research; (3) public health aspects of economic development; (4) natural resources; (5) economic planning and the use of data from agricultural research; (6) priorities and international cooperation; and (7) contributions of academies and research councils to economic development; the eighth session was left open for unfinished discussions and planning. As the basic theme of the workshop was "development," many of the stated needs apply to more than one session subject.

#### Development of Scientific Personnel: Education and Training

The training of scientists in Nigeria has several important aspects which are lacking in more developed countries. Among these is the traditional lack of scientific curiosity. Children are not encouraged to ask questions about their environment, mechanical toys are not available, and, at the secondary school and university levels, there is a dearth of qualified students in scientific disciplines. At the same time, to reach the maximum attainable numbers of needed technical and scientific personnel would require at least a ten per cent per year growth rate for fifty years, and even this would fail to provide the desired ratio of scientists. Therefore, it was suggested that science teaching begin in primary schools to help overcome the traditional lack of scientific curiosity; that summer schools be established in secondary schools, with university students teaching during their long vacations; that secondary school curricula be revised to abolish the Sixth Form system, which has no flexibility and which reduces the number of students eligible for entrance into universities; and that consideration be given to establishing, as boarding schools, technical high schools where potential scientists can be identified and equipped for scientific training in universities. As aids to science teaching, consideration should also be given to setting up facilities to produce local teaching materials for secondary schools and to establishing small-scale factories to manufacture simple laboratory equipment. It was further suggested that junior science colleges be established, with two-year

diploma courses, to alleviate the shortage of middle-level technical people. This shortage might also be alleviated by means of in-job training apprenticeships in service institutes.

There was general agreement that, in most instances, Nigerian students should be trained in Nigeria, and that it should be permissible for fellowship funds from abroad to be used in Nigeria. In addition, American and British universities should sponsor research in Africa by American and British Ph.D. candidates. It was recognized that it would be necessary for many years to import teachers, and one possible mechanism for doing this would be if foreign fellowship funds could be spent for professors as well as students. A study should be made of the factors causing the high costs of university education, and steps taken to counteract them.

#### Division of Labor Between Research Institutes and Universities

In this connection, the emphasis should be to achieve maximum use of existing facilities and staffs. Research institutes should be located near universities so that institute staff can assist with teaching, the research facilities may be used to train students, and such common facilities as libraries can be shared. Universities should see their function not only as training, but as conducting research, and here they should cooperate with the institutes. There is great need for diffusion of knowledge of what is going on in the universities and institutes. The Nigerian Geological Survey was mentioned as a place where there is a combination of basic and applied research, and as a place where field work and practical training could be obtained by both professors and students during summer vacations. There is need for free movement of staff between universities and institutes, and the problem here is a question of loss of pension rights, a matter requiring joint counsel between the Universities Commission and the new Research Council when it is formed. It was suggested that university science curricula should be modernized to take into account the trend toward interdisciplinary teams, as the distinction between "pure" and "applied" research is no longer possible. It was felt that the Nigerian Universities Commission should provide research funds to the universities. It was further suggested that industry be encouraged to establish research institutes at the universities with participation by students. The Illinois Institute of Technology was cited as an example.

#### Contributions of Academies and Research Councils to Development of Academic and Governmental Research Bearing on Economic Development

It is essential to have an organization in Nigeria which will be responsible for the planning of scientific policy. It is such a body that will determine the priorities of scientific activity in the light of the demands and needs of the country. In view of Nigeria's acknowledged scarcity of human, financial, and material resources, it is important to ensure that the lines chosen produce the most beneficial effects on the national welfare, and are those most closely integrated with economic development. The Government of Nigeria is actively considering setting up a national research council to formulate general policies for research. On the non-government side, the establishment of a national academy of sciences is being considered. If the academy and the council can have sufficiently interlocking membership, it is

hoped to achieve the necessary coordination. The roles of the two types of organization were defined as follows: A Research Council is responsible for the statement of needs and the ordering of priorities in relation to the facilities available; an Academy has similar functions for university research. It has the duty of ensuring the integrity of scientific work, and also of assessing the work of the scientific effort in the context of the community.

It was agreed that the composition of the Research Council should not be confined to representatives from ministries, but that there should be multiple representation composed of people with broad views.

### Public Health

The importance of public health as an investment item in economic development was emphasized. Although 40% of all children born in Nigeria die before their fifth birthday, and the morbidity rate from such illnesses as malaria and worm infestations debilitates a large proportion of the survivors, only 5% of the total national research expenditure is devoted to health problems, and this is largely spent in urban areas for curative, rather than preventive, services. The present ratio of doctors to the population is approximately one to 35,000, and using traditional training methods, it would take many years to train enough doctors. One approach suggested was to train doctors as leaders of teams of health workers who could serve the community. Education of the public and of Government officials to the importance of public health measures, as opposed to the more politically popular curative measures, was considered essential. Training centers should be established to train other categories of medical staff, such as research workers, nurses, and technicians, and an attempt should be made to improve the financial and prestige status of the public health worker. The establishment of service institutes where middle-level medical technicians could receive in-job training was mentioned. In addition, it was felt that more money should be put into research which could be done in the medical schools. Research is needed on the patterns of illness and disease. Statistical data on epidemiology are urgently needed, not only in various parts of Nigeria where epidemiology differs from place to place, but also in neighboring countries. Malaria was mentioned as deserving priority of effort; an outbreak of a resistant strain of malaria could paralyze the economy.

It was pointed out that some economic planners feel that better public health has led to population pressures. Those responsible for birth control measures are more willing to function when longevity is assured by public health programs. Medical school curricular should be oriented toward Nigerian health problems and over-specialization should be avoided. Each doctor should make the greatest possible impact on the community. No matter what his specialization, he should be compelled by his community conscience to spend a sizeable amount of his efforts in improving the public health of his nation. The people are the prime national resource and Nigeria is wasting between 30% and 60% of its natural resources.

It was suggested that ECA and UNESCO might consider local planning institutes where there could be a multi-disciplinary approach with doctors,

sociologists, water specialists, economists, etc., to look into the problems of each area. Areas should be identified in which, by solving problems, the most beneficial effects could be attained in terms of the general economy, namely, water, schistosomiasis, tsetse fly, human health, animal health, nutrition, etc.

### Natural Resources

The discussion opened with an historical account of the development of research on natural resources in government departments (federal and regional), research institutes, and university departments. Contrary to the impression which might be created by the large number of organizations involved in natural resources research, much has been done, beginning with the Council on Natural Resources in 1950, to coordinate research. Although the Council has been discontinued, the four technical committees--Agriculture, Forestry, Fisheries, and Veterinary Medicine--have survived and continue to meet once or twice annually. It is hoped that the proposed research council will take over the responsibility of coordinating research in these sectors as well as the total research effort of the country.

Federal agricultural research, primarily concerned with food crops, was described. The chief activity has been in plant breeding, and considerable success has been achieved with rice, maize, cassava, and palm oil, as well as in the production of high-yield, quick-maturing varieties of cocoa. An International Institute of Tropical Agriculture is now being planned as a joint venture of the Federal Government, Ford Foundation, and the Rockefeller Foundation. Research is needed on soil fertility, irrigation, food storage, food processing, animal breeding, agricultural engineering, horticulture, and fish culture. In addition, a soil survey of the entire country is urgently needed.

Concerning such non-renewable resources as minerals, fuels, and construction materials, Nigeria has passed the prospecting stage, and to find new deposits must use more complicated techniques. Geological mapping is needed, as is a continuing inventory of resources. Geological research must be used to find concealed deposits. The Geological Survey of Nigeria is, by its very nature, the place where research, both basic and applied, should be carried out on a national basis. In the training of geologists, a great deal of effort should be put into the geochemical and geophysical aspects. Field geologists with good laboratory backgrounds are needed and arrangements should be made by the universities and the Survey so that all the geology students spend their long vacations working in the field as assistants in the Survey. In regard to the foreign exchange problem, the best solution would be to use non-returnable natural resources. Later, with the development of technology, materials which could not be sold at the present time can be used. Metals will be reworked at an economic profit. Consideration should be given to expanding production of high-grade mineral resources.

Power is the key to much of the development process. There is need for long-range planning in the provision of power since supply often creates demand, and judging from the Tennessee Valley experience, it will probably not be long before the hydroelectric generating scheme at Kainji Dam cannot meet all of Nigeria's needs. Oil and gas, the alternatives to electricity, have certain

operating advantages, and an economic evaluation should be made of oil versus electricity for power so that a total system can be built at minimum cost. Special consideration should be given to rural electrification, which, if provided, will lead to new development, such as food storage methods. It is important, also, to pay close attention to the chemical content of all types of resources in an effort to find by-products which otherwise would be wasted. For example, an important drug is being extracted from a variety of Mexican yam. In dealing with natural resources, erosion and flood control, conserving soils, and improving the quality of streams are all important.

With regard to water resources, the proposal to establish a lake research institute at the Kainji Dam was described. The institute would deal with hydrology, climatology, limnology, archeology, the economics and sociology of resettlement, etc. The importance of this kind of work is now well recognized, and the aspects of research which the institute hopes to cover are far more comprehensive than was undertaken at Colorado when Lake Mead was formed. However, hydrological data at the Niger project are not as detailed and do not cover as long a period as in the Colorado project. There is need for continuing effort to collect these data after the dam is in operation, and this continuing research should be supported by the Government of Nigeria.

Economic development implies changes in the structure of production in favor of processing and simple manufactures. Attention should be given to the use of Nigeria's natural resources in the development of industries, e.g., efforts should be made to develop a petrochemical industry, especially fertilizer production. An inventory of natural resources should be built up, modern management techniques should be developed, and urgent attention should be given to increasing local food production and processing domestic crops for local consumption. Agricultural products and other raw materials should be processed for export. In connection with local food production, reference was made to an abstract of a paper by Dr. W. M. Chapman (Appendix A) which stressed the need for oceanographic and marine fisheries research and training in an effort to supply protein from local marine resources. If suitable port and processing facilities were provided, it was suggested that commercial fisheries might be developed to meet local demands for fish, and, in the case of shrimp, an export market could develop.

#### Economic Planning and the Use of Data from Agricultural Research

A new form of technology--intermediate-level technology--should be developed to industrialize rural development and produce consumer goods, building materials, agricultural equipment, etc. An intermediate-level technology was described as one which did not reject modern devices, but was not dependent upon them. Often, in light industries, automation is confused with modern technology, such as laboratories for the analysis of food and the pharmaceutical industry, both of which require the most modern technology. However, with plentiful labor, these activities can be done by hand.

Nigerian agriculture is a vital sector of the economy and unless it grows, there is little that can be done in the way of development. Nigerian agriculture is based on peasant conditions which existed years ago, and during the past few years, social and economic changes have taken place without any change in agriculture. In planning agricultural priorities, there is a lack of competent



agricultural demographic institutes and of reliable agricultural economic data on which to base economic plans. It was suggested that demographic institutes might be connected with universities. Most of the available data relate to cash crops and there are not enough data to transmit to the farmer on food crops. Some of the research in Nigeria is much more sophisticated than required, and often research is not related to national needs. Agricultural engineering and training should be built up in order to do such research as the soil structure of Africa.

Extension work is relatively new in Nigeria and there has been a "crash program" to train extension workers. The program has reduced the time of training, which has been a detriment to African extension work. There are difficulties in dealing with illiterate farmers and attempting to change his food habits. Farming methods are based on simple hand tools; mechanization of the work is based on a capital investment that no small farm can afford. However, there are a number of large farms near Lagos growing market garden crops and doing research on them on a large scale. It was suggested that it might be good to concentrate on market garden crops for a canning industry. If one or two crops were grown to support such a factory, it might be possible to run them without losses. Another suggestion was to have more experimental farms so that regional experiments of a wider scope could be located all over the various ecological zones. Until recently, federal research has not maintained statistical data; the computer is not being used to the extent it should.

At first, the priority in agriculture was the introduction into the economy of crops that could be sold; secondly, the improvement of those crops by research, and third, sufficient attention to food crops to ensure that the country would not suffer from a famine in bad years. The plan was dominated by the exchange of agricultural products for the products of urban places in other countries. The demands are now different and the priorities must be different. The western markets are virtually saturated with the cash crops, and it is no longer possible to base economic development on the traditional exchange of agricultural products for industrial goods. Another factor is population pressure and the associated movement of the people from the countryside to town. The greatest priority in agriculture is its contribution to the feeding of the people in the towns. Nigeria cannot afford the large and increasing burden of foreign exchange for the purchase of food. When people move to the towns, they cannot afford the protective foods they were able to grow in the country. An urban population eats differently from a rural population; the traditional food-stuffs are not adaptable for mid-day meals of commuters. Home economics teams might meet this need. In any event, agricultural growth must take place near the towns to provide milk, meat, and garden supplies.

There was discussion of the difficulties involved in developing a meat and dairy industry in view of the nomadic lives of the herding peoples. By supplying the farmer with credit, new varieties, and a workable marketing system, it is not difficult to get him to change his activities, but the picture is different with dairy products. Two chief problems mentioned were the processing of dairy products and the necessity to educate the people in the utilization of dairy products.



## Priorities and International Cooperation

In the discussion of priorities, it was felt that the matter of foreign exchange was one of the most important. As for priorities under specific items, the immediate objective should be to make broader use of existing facilities, particularly in areas where there is the greatest shortage, such as science teaching. Existing laboratories and equipment could be used twelve hours a day. Furthermore, it should not be difficult to have a pilot scheme which attempts to make better use of the long holidays in the universities. Every university student could be put to useful work teaching short courses in secondary schools. Another measure which could be quickly and easily put into effect is the manufacture of simple laboratory equipment.

As for division of labor, a lot of effort is required and foreign assistance could contribute. The use of facilities can be worked out by the universities and research institutes. There could be a comprehensive volume of references for those engaged in research and it could be widely distributed. Interdisciplinary research could be encouraged.

In the field of natural resources, there should be geological surveys, fisheries surveys, research on agricultural products, underground water resources, etc. Foreign laboratories could be used initially for testing. More attention should be paid to food crops and agricultural and other raw materials should increasingly be the basis for domestic industries. Existing facilities for research into food processing and preservation could make significant contributions within a short period. This ties in with foreign exchange with Nigeria's neighbors and opens a market which can support a considerable amount of industry.

In the field of technical cooperation, the needs can be divided into three categories: scientific, technical assistance, and personnel. Technical assistance should be directed toward building up local institutions. It is desirable that research and technical assistance for research be organized on the basis of more cooperation between Nigerian scholars and foreign scholars so that foreign assistance may have more than quantitative results and will improve relations between institutions, between nations, and between scholars. Examples were cited where AID contracts had been signed with foreign institutions to do research in Nigeria without any collaboration with Nigerian institutions. Two of these involved economic development and rural development, projects on which Nigerian institutions were already engaged.

It was stated that the economist cannot be expected to give detailed assignments of priorities to the tasks that need to be done. When priorities are set, it must be on very broad lines. In the matter of intermediate technology, it is a question of a combination of factors in production, and the objective should be in each how to use the factors in a combination that will give maximum output versus input. There are likely to be a number of industries where it would be desirable to adopt the most highly automated system because of the shortage of skilled labor. Rather than speaking in terms of basic versus applied research, it was urged that another type of classification be used, namely, to classify research according to estimated time to pay-off.

There is necessity for increased communication among scientists. High emphasis should be placed on devices to increase the communication of knowledge.

An appreciation of the time scale involved in research was mentioned as an item of highest priority. For instance, it takes 25 years to produce a scientist and about 15 years for a result in a laboratory to be put into widespread practice on any real scale. In the United States, the scientific and engineering population has expanded at a natural rate of about ten-fold every half century. Although this rate can be increased, it is virtually impossible to achieve a rate of 30%. If a system were devised to maintain a 10% growth rate a year in Nigeria, in 50 years this would mean a technical population of 55,000. However, at the current rate of population growth, Nigeria's population would be 200-million, which would give one technical person per 3,000 population, which is still much below the needs. How can one identify the potential candidates early enough and channel them into this kind of university and interest? This is a problem faced elsewhere. There has been a recent development in Turkey which might be applicable to Nigeria, and that is the establishment of technical highschoools--boarding schools--where they attempt to identify the most intelligent children. Those children are given free room and board and when they emerge, they have a good scientific and engineering background which equips them to go on to the university. Such a mechanism could conceivably provide the raw material for the first 25 years of the 50-year program. Perhaps several of these schools could be built. During the initial stages, it will be necessary to import technical people from other countries. The Nigerian scientific community must fraternize more with the world scientific community so that foreign scientists will be aware of Nigeria's problems as well as research opportunities there.

Another priority which had been mentioned earlier was the necessity to expand production of high-grade mineral resources. A little more effort on the production of exportable metals and fuel might be the answer to the foreign exchange problem.

#### "Expansion Chamber"

Following a description of the U.S. AID-Nigeria agricultural program, the discussion turned to the question of population growth. It was felt that a demographic institute could solve the problem of lack of statistics. As for policy on population growth, some felt that the key factor is that population is discussed without relating it to economic growth and resources. Others expressed concern, saying that infant mortality rates can be cut very quickly, with the result of a 4% population growth per year. The case of Central America was cited where food production was declining and infant mortality was declining to the point where 50% of the population was under fifteen years of age and unproductive. Policy should be established now, and the educated Nigerian has a responsibility to start thinking seriously about the population problem.

Another problem mentioned was urbanization and the long-range political consequences. The rapid growth of cities, with consequent unemployment and frustrations can create political instability which would undercut development. On the other hand, if things go right, Nigeria could be a catalytic force for the whole continent.

Referring back to comments on gaps in technical education in such areas as electrical engineering and design engineering, it was stated that the trend in modern engineering is toward adaptability rather than specialization. During the war, it turned out that physicists were extremely good engineers, and it was the broad, basic education that made this possible. The adaptability of people in terms of fundamental education is significant.

In a discussion of training abroad versus training in Nigerian institutions, it was felt that everything should be done to give the student training in Nigeria, particularly at the undergraduate level, and that scholarship money should be reserved for post-graduate work which can be obtained in Nigeria or to sponsor professorships. Students studying abroad often specialize in work that has no relation to Nigeria's needs or priorities. The demand for scholarships is increasing and resources are declining. However, there are abundant opportunities for support of students at the graduate level in the form of research assistantships. Another type of grant mentioned was the in-job training grant in geological surveys, other governmental agencies, and industry.

Overseas work on the part of U.S. and U.K. personnel should be on a long-term basis, simply because a lot of things cannot be done in a short time. There should be long-term opportunities for careers in developing countries around the world. Another source of support, aside from AID and the foundations, which the Nigerians might tap was the growing interest and awareness of American universities and scientists in many disciplines with the problems of the rest of the world. An effort should be made to sell to the American universities the proposition that this is an activity in which they must engage and a place where there is real and critical need and that the contributions made to American institutions would be equal to those made to the Nigerian institutions. It was also suggested that another source of trained people might be among junior research Fellows, such as those at Cambridge. When established, the Academy of Nigeria might offer fellowships to attract these people.

### Regional Cooperation

The history and functions of CSA (Scientific Council for Africa) and STRC (Scientific and Technical Research Commission) were described and the reasons for having a single agency dealing with scientific and technical matters on a continental basis were explained, as follows: Africa is the second largest continent and its position in relation to other land masses may be of great strategic and political significance in the future. Africa must overcome a legacy of social, scientific, and economic separatism. The boundaries that separate African states are so senseless that without a sense of unity, they will be a source of friction. The most important question is whether the development of African resources can keep pace with the population. International cooperation is needed. In planning guidelines for STRC research for 1966-67, the following disciplines were decided upon: agricultural crops research, animal production, soil research, forestry research, arid land research, oceanography, fish research, biological research, aquatic taxonomy, industrial research, geological and geophysical research, building materials, roads, solar energy and petrology, and physical chemistry. The studies of water-borne diseases should be expanded. A number of projects in which AID is participating with STRC were described, including Project 15 on rinderpest

control, the cereal crop project, the trawling survey, and a recently completed soils map of Africa. It was felt that the rinderpest project has the prospect of great advances in animal industries in Africa. However, there must be continued maintenance of the program or the money expended would be wasted.

The questions of food and population were further commented upon, and the problem of coordination of effort was brought up. There is a Nutrition Commission for Africa, which is a joint body of FAO, WHO, and CCTA. The CCTA was changed to the Fifth Commission (STRC), and there is a question who should handle this function in view of the fact that OAU has a Third Commission which deals with nutrition. One example of an effort to coordinate these functions is the specialist meetings. Of thirty-one such meetings, twenty-one were attended by representatives of FAO, WHO, etc. In addition, many of the scientists in Africa also serve on international committees. It was felt that one immediate priority would be to organize the Nigerian Research Council, which would provide an important forum through which action and coordination can be effected. Another short-term priority mentioned was that Nigerian scientists maintain a continuous dialogue among themselves. Many of the questions discussed at the workshop will need more detailed examination. A third point raised was the question of strategy to be formulated by Nigerian scientists to bring effectively to the attention of the administrators and national leaders the priorities for national economic development.

It was proposed that a joint U.S.-Nigeria committee be formed to assess research and development needs in various sectors--possibly with the help of special panels--and make recommendations. Until the formation of the Nigerian Research Council, the two groups could meet informally, both in Nigeria and in the United States. It was felt that the workshop would provide a model for other parts of Africa and other governments in Africa. Although, as a result of this meeting, Nigeria could not expect an immediate increase in the amount of technical assistance, it has put the problems into better perspective, and better utilization of the present amount of aid would be a great achievement.

It was suggested that one of the Nigerians be appointed with whom arrangements could be made for the next U.S.-Nigerian meeting, possibly to be held in Nigeria in early 1966.

APPENDIX A

ABSTRACT OF INFORMAL WRITINGS  
OF W. M. CHAPMAN  
ON SCIENCE AND THE DEVELOPMENT OF AFRICA'S OCEAN RESOURCES  
WITH PARTICULAR REFERENCE TO NIGERIA AND THE GULF OF GUINEA

Protein Resources of the Ocean

One of the things that the United States is primarily and basically interested in is providing adequate nutrition as far as is possible in the developing world. This comes down pretty close at the present stage of history of providing adequate intakes of animal protein. The source of animal protein in the world that is growing in use most rapidly, and which is capable of expanded use on a world-wide basis most rapidly and largely, is the living resources of the ocean.

Lack of Coordinated Research

Although it appears now to be generally conceded that animal protein is what is wanted most in these various attacks on human protein malnutrition problems, that there is plenty of it in the ocean that can be gotten out and to the users in a quick and reasonably cheap manner, that ocean research is a fundamental way of attacking the problem of getting it out of the ocean cheaply to the consumers, and that great scopes exist for bringing the resources of the ocean to bear upon the alleviation of this primary human problem in the world, I am unable to detect any great relationship in the United States amongst the activities of the various boards, commissions, academic groups, private foundations, government offices, laboratories, agencies, etc., dealing with the problem . . . I will simply sum up by saying that the organization of international oceanography and ocean use activities within the United States Government is an unholy mess, and that the same is true amongst the international agencies, councils, commissions, etc., associated with the ocean.

Commercial Fisheries for Nigeria

I have not been enthusiastic about the feasibility of large fisheries being established off Nigeria for generating exports, with the possible exception of shrimp. When we were in Nigeria in early February, two modern American shrimp boats had just begun exploratory operations fishing mostly off eastern region, and fishing with typical Gulf of Mexico shrimping gear. In January and February, the yield per 24-hours of fishing in terms of heads-off shrimp, was between 100 and 350 pounds. By April, this had increased to 530 pounds, by May to 690 pounds, and in June it was slightly over 1000 pounds. The latter figure is approaching satisfactory commercial levels. Accordingly, there is still some expectation that continued exploratory fishing in the region may develop a commercial shrimp fishery, which could be capable of providing a good source of foreign exchange for Nigeria.

### University Role in Studying Marine Resources

Nigerian and overseas scientists might well consider ways and means to bring Nigerian and overseas universities into some kinds of collaborative relationships so that universities will have a larger role in studying marine resources.

### Collaboration in Ocean Research Among Countries

The Gulf of Guinea is bordered by a number of countries . . . the ocean area bathing these coasts and the fish populations contained therein are continuous and require to be studied on a unitary basis.

### Sardinella Survey

Of primary importance to the whole of West Africa is a comprehensive Sardinella survey of the West African area. This is the volume fish in that area; it is also a type of fish which West Africans like very much, for which a marketing setup is already available, and which can be processed and transported cheaply and satisfactorily in West Africa.

### Fresh Water Versus Ocean Resources

Although I am fully cognizant of the importance of the agricultural, hydrological, animal husbandry, and other topics the Board has under review for the purpose of seeing how science and technology can benefit the economy of West Africa, I do not believe that any of these fields show better opportunity for benefit to West Africa than does marine production of animal protein.

I question very much whether quite extensive fishery research on fresh water impoundments would make as much as 5% difference in annual yield from what will occur naturally. The fresh waters of tropical Africa are so productive (and impoundments are too, after they go through the settling down period and come to equilibrium with their surroundings) that the production of fish from them is rather astounding to people from higher latitudes. If I had control of a considerable pot of money for fishery research in West Africa which was aimed at developing an increased supply of animal protein for human nutrition in the area, I would bet that money on salt water fish rather than fresh water fish production.

### Nigerian Port Facilities

Nigeria has considerable difficulties in the development of her sea fisheries. In the first place, the coastal inhabitants of Nigeria are not sea-faring people . . . they are lagoon and river people who venture out normally only into the margins of the ocean. The harbor at Lagos is quite suitable for basing a fishing operation on, but the harbor is so crowded with other shoreside activities that there is no suitable base for fishing vessels to work out of. I am quite sure that the small boat fishery for strictly Nigerian consumption would develop out of Lagos to a considerable size if adequate port facilities were made available for it, and I am just as sure that it will not develop until these port facilities are made available to it.

Nigeria needs much expansion in its supply of fish, can ill afford to buy them with foreign exchange, has quite considerable resources off its coast capable of use by its people, and it would seem to me sensible to begin getting these things all together somewhat better. Elsewhere the academic community has been useful in developments of this nature.

#### Ocean Research Training

It should be mentioned that there are United States research vessels working in the area from time to time which would be quite willing, as well as able, to take Nigerian trainees out for ocean research training. The U.S. Bureau of Commercial Fisheries is continuing research work in that area of West Africa, and does, in fact, take out African trainees from other countries along this area on their cruises to the region.





DRAFT

TRANSCRIPT OF DISCUSSIONS  
AND RAPPORTEURS' REPORTS

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 Dr. Bide Okigbo, Professor of Agricultural Biology, University of Nigeria  
 Dr. G. E. Okiy, Permanent Secretary, Ministry of Research and Natural Resources  
 Dr. H. M. A. Onitiri, Head, Nigerian Institute of Social and Economic Research,  
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Observers

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SUMMARY PROPOSALSEducation and Training

- a) Science teaching should be started in primary schools to help overcome traditional lack of scientific curiosity. (6, 34)
- b) American and British universities should sponsor research in Africa by American and British students working for Ph.D. degrees. (8)
- c) Nigerian secondary school curricula should be revised so that Fifth Form students could undertake university education in sciences. The Sixth Form should be abolished. (9)
- d) Set up facilities to produce, in Nigeria, local teaching materials for secondary schools. (10)
- e) Establish junior science colleges with two-year diploma courses. (10)
- f) Establish summer schools in secondary schools and employ university students to teach short courses. (10, 40)
- g) Allow fellowship funds from international bodies to be used for training students in Nigeria rather than abroad. (10)
- h) Establish service laboratories, i.e., pathology, for in-job training of middle-level technicians. (11)
- i) Establish small-scale factories to manufacture simple laboratory equipment. (11, 40)

Division of Labor Between Research Institutes and Universities

- a) Research institutes should be located in or near universities; there should be interchange of staffs, common use of laboratories and libraries, etc. (12)
- b) Research information should be widely disseminated. (13, 40, 43)
- c) University professors and students should be employed by the Geological Survey during long vacations for field work and training. (14, 30)
- d) A system should be devised whereby research institute staff members could change jobs without loss of pension rights. (15)
- e) Study should be made of factors causing exceptionally high cost of university education, and steps taken to counteract them. (16)

- f) The Nigerian Universities Commission should provide funds to universities for research. (15)

#### Public Health

- a) Auxiliary medical staffs should be trained to work as teams under a doctor's supervision to help alleviate the shortage of doctors. (24, 27)
- b) Change the status system so that public health experts will have as much or more prestige as surgeons. (25)
- c) Statistical data on epidemiology are urgently needed, not only in various parts of Nigeria where epidemiology differs from place to place, but also in neighboring countries. (25, 26)
- d) There is great need for malaria research. (25)
- e) Establish service institutes. (11)
- f) Do more research on preventive medicine rather than curative medicine. (23)
- g) More money should be put into research which could be done in the medical schools. (27)
- h) Research is needed on the patterns of disease and the patterns of illness. (25)
- i) There should be improved collaboration between government institutes and teaching hospitals. (25)

#### Natural Resources

- a) Research is needed on tropical agriculture, soil fertility, irrigation, food processing, agrometeorology, animal breeding and health, soil surveys, agricultural engineering, horticulture, and fish culture. (29)
- b) Oceanographic and marine fisheries research and training is needed. Establishment of port facilities for commercial fishing enterprise (particularly shrimp). (See Appendix A in Summary Report, abstract of W. M. Chapman paper)
- c) Geological mapping is needed; inventory of resources should be made. More trained field geologists are needed. The economy should be built on the basis of non-renewable resources. Technology will develop new resources and new ways to process low-grade materials. (29, 41, 45)



- d) An evaluation should be made of oil versus electricity for power so that a total system can be built at minimum cost. (31)
- e) Research should be done to find by-products of present agricultural products. (31)
- f) Domestic crops should be processed for local consumption. Agricultural products and other raw materials should be processed for export.
- g) Should concentrate on a limited number of food crops for a canning industry. (35)
- h) There should be a directory of research to give foreign institutions a clear picture of Nigerian needs and priorities. (46)
- i) Expand production of high-grade mineral resources for export. (45)

#### Expansion Chamber

- a) Policy on population growth control should be established now. (48, 49)
- b) Over-specialization should be avoided in education, i.e., engineering; the adaptability of people in terms of fundamental education is important. (50)
- c) Scholarship money should be reserved for post-graduate work in Nigeria or to sponsor professorships. (51)

#### Regional Cooperation

- a) Expand studies on water-borne diseases. (55)
- b) Organize National Research Council. One function to coordinate research. (56, 57)
- c) Establish joint U.S.-Nigeria Committee, possibly with panels to consider various development sectors and assess research and development priorities and make recommendations. (57, 58)
- d) Encourage U.S. and U.K. students to make lifelong careers in developing countries. (59)

Economic Planning

- a) Establish intermediate-level industrialization to produce consumer goods, building materials, agricultural equipment. (34, 38)
- b) Need demographic institutes, perhaps connected with universities. (35, 48)
- c) Reliable agricultural data on food crops are needed. (35)
- d) Concentrate on market garden crops and establish a canning industry. (35)
- e) Agricultural growth should take place near towns to provide them with market produce, meat, and dairy products. (37)
- f) There is need for agricultural engineering experiments in such subjects as soil structure. (39)
- g) Sociological factors should be given attention to determine incentives and motivation. (39)
- h) One difficulty in establishing a dairy industry is to educate people in the use of dairy products. (39)
- i) Workable market systems are needed to assure that goods will flow to farming communities in exchange for food. (39)

Priorities

- a) Improve communications about research in Nigeria and AID research contracts with outside agencies to avoid duplication and to give Nigeria the opportunity to state its priorities and to participate in research. (41, 42)
- b) Make broader use of existing facilities. (41)
- c) There should be geological surveys, fisheries surveys, research on agricultural products, underground water resources, etc., using foreign laboratories to test products initially. (41)
- d) Research is needed on food processing and preservation. (41)
- e) Research should be classified, not as basic or applied, but in terms of time to pay-off. (43)
- f) In order to maintain a 10% growth rate in scientific personnel, technical high schools might be developed where potential scientists can be identified and equipped to go to universities. (44)

## WORKSHOP ON SCIENCE AND NIGERIAN DEVELOPMENT

### Opening Remarks

Dr. de Kiewiet opened the meeting with some general remarks concerning the importance of education and the strides being made by Nigeria in that field. He spoke of Nigeria's good fortune in being able to build, for the first time, from the bottom up. He said, "You have an opportunity which no longer is ours, of seeing your problems with clarity and of drawing upon the successes and failures of others. The opportunity lies before you of building wisely and well." He also spoke of the importance of knowing one another's countries in the deepest way, and expressed the hope that the fruits of the conference would be the means of having that deep acquaintance which is one of the best bases for co-operation and peaceful relations between the men of the earth.

Dr. Brown welcomed the workshop participants on behalf of the National Academy of Sciences. He explained the status of the U.S. NAS as a quasi-governmental agency. "It is not a government agency, but is chartered by Congress and is charged with advising the government, although the government is in no way charged with the responsibility for taking the advice." He went on to describe the organization of the Office of the Foreign Secretary and the function of the Africa Science Board. With regard to the workshop, he said, "We are gathered together this week to participate in a discussion of the importance of research and development in economic development and to discuss the problems of assessing how much and what kinds of organization are met in various parts of the world, but specifically in Nigeria and the United States." Dr. Brown went on to speak of the difficult problem of determining how much of a country's gross national product should be spent on research and development. "Many groups have studied this problem, but the answer is that we don't know. In the case of developing countries, UNESCO looked at the problem and came up with a recommendation that a country should spend 2% of its gross national product on research and development and the production of a local research competence. There is no particular basis for that figure and it is clear that it will vary from situation to situation and from country to country. The only thing to do is to examine the research and development needs sector by sector—agriculture, geology, etc. Both basic and applied research are needed. We should look at basic research and its importance in relation to the applied research area. How can needs be met? We are constantly

faced with this in the U.S. Are we producing enough scientists and engineers? Under what conditions can they work most effectively? How can this problem be handled within our government without having a bureaucracy bringing everything to a grinding halt? In our own government, particularly since the war, we have been concerned about how science should be organized within the framework of our government. There has been a move to centralize. Many of us strongly favor the decentralized approach." Dr. Brown mentioned a number of other problems, such as the financing of research in universities, teaching versus research, etc., stating that obviously these problems could not be solved in the five days available for the workshop; they could only be enumerated. He hoped that once an understanding of the problems was reached, plans could be made for continuing the discussions at a later date.

\* \* \*

Dr. Edozien expressed his pleasure and that of his Nigerian colleagues at being present. He spoke of the difficulties in developing countries where systems of government have been imported and the division of labor and authority has not had time to grow in an historical fashion. "One achievement of this discussion," he said, "is that civil servants and scientists have been brought together and I hope we will establish communications which can be continued in Nigeria. If we establish lines of contact, it is not difficult to understand one another." He hoped to benefit from the experiences of members of the U.S. scientific community as well as those of the members of the Royal Society.

\* \* \*

Sir John Cockroft expressed the gratitude of the Royal Society for the invitations to participate in the meeting. The relations of the Royal Society to government are similar to those of the NAS, and its interest in international collaboration in science were described. He specifically mentioned its concern with the operations of ICSU-IGY, IBP, Indian Ocean, etc., and its concern in arranging formal exchanges with China and Russia. The Royal Society initiated the European Organization for Nuclear Research and started the work on space research leading to the European Space Research Organization. The Royal Society advises government in these fields. He spoke of the expenditures of research on overseas development and the growth of these expenditures at the rate of 15% per year over the last few years. He proposed, as a possible item for discussion, how expenditures of this kind should be developed in the future.

\* \* \*

Following the introductory remarks, Dr. de Kiewiet asked each of the conferees to identify himself and briefly state his scientific interests. He then described the agenda as permissive and requested comments or suggestions for revising it. The remainder of the morning was spent in rearranging the order of agenda items and in assigning rapporteurs. The necessity for establishing research priorities in each sector was emphasized.

As an introduction to the discussions of the afternoon session, Dr. de Kiewiet suggested that it would be useful to have some descriptions of the Nigerian university world, and the governmental relations that cause the institutions to differ. There are real differences of organization and approach among the Nigerian universities.

Dr. Edozien said that in order to understand and fully appreciate the position of the University of Ibadan, it was necessary to look at it from the historical context. Ibadan is the oldest university in Nigeria, having been established as part of the London University system. Until recently, its priorities in development have been those which the colonial government thought best for Nigeria. Even after independence, the historical facts of ten or more years could not easily be set aside. This allowed the University to use a system that was known to work and time to see the defects in the system. The association had both advantages and disadvantages. "Very often it appears that we have not been conscious of the needs of the country and how to relate the programs to our culture and tempo, and this opened Ibadan to criticism both from the government and the public. Since independence, we have tried to reorganize the system to assure our consciousness of the needs and to integrate the university with the community. We have attempted to reorganize our curriculum to meet local needs and to introduce new subjects which the country needed. To illustrate, the curriculum of the Medical Faculty was the same as at the University of London, and soon after the establishment of clinical training, we found that the curriculum of the University of London did not fit the Nigerian situation. We tried to get the University of London to modify the curriculum and the examination system (for example, in pediatrics and in tropical public health) but could not do so. The only solution was our own degree system. We insist that every student learn the problems of the community. These developments are new and have not yet caught the public imagination. During the last 20 years there has been some kind of fetish attached to getting a degree; it opens the gates to many things and there is a big barrier between those who have degrees. It is important to break this fetish and in

order to do this, it is necessary to give degrees to technicians who ordinarily would not receive degrees. This has met with strong resistance from the National Universities Commission and the government."

Development of Scientific Personnel: Education and Training:

Dr. de Kiewiet asked Drs. Okigbo and Njoku to comment on institutional arrangements in Nigeria.

Dr. Okigbo said that the University of Nigeria was founded in 1960 at the time of the independence celebrations. The objective was to fuse together some of the best aspects of the American system and the English system of education. "We had cooperation from Michigan State University and from the University Council of Great Britain. It took many years to collect the money for the university, but took a very short time to start it. We have gone from 250 students in 1960 (mainly in social studies) to about 1000 this academic year, 1965-66. The university started by offering degrees in areas where the British only offered diplomas, such as secretarial studies, music, physical education, and business administration. The university has some other institutions allied to it, such as the Economic Research Institute. There is also a research committee which controls all the departments of the university. Students are offered 3-year and 4-year degree programs. The curriculum has been undergoing changes; some departments are stabilized while in others there are slight changes each year."

Dr. Njoku said that as far as the educational structure or philosophy is concerned, particularly in Lagos, the university is like universities elsewhere. It is the result of historical circumstances. When Ibadan was founded it followed the standard British pattern—degrees, honors courses. For a long time it was the only institution in Nigeria and it could pick and choose. It got a name for being too selective. Current ideas have had repercussions on Ibadan, especially since they have their own degree structure. These elements of high selectivity and specialized courses were what the university was known for. Then Nsukka was founded on the basis of the land grant colleges of America. The University of Nigeria established a system of broader education and opened its doors to a larger number of students. The next two universities to start, Ahmadu Bello and Ife, both followed the Ibadan pattern. Ibadan has gone a long way from its original labels. Even Nsukka is now feeding back into its system the systems of other universities. Gradually, we will tend to form a common pattern in five or more years. Another important problem concerns the question of 6th forms. Again, this is labeled a British system. Nsukka started with a 4-year course, taking students directly from the secondary school. The system was criticized because there were not many 6th forms and entry was therefore limited. This criticism may be out of date now, however,



as this system had quite an effect on the secondary schools and the number of qualified students is increasing. In science, even with a greater number of 6th forms, there is a shortage of science students. The universities are forced to take science students and give a one-year course at the university. In some ways, it is more expensive to run 6th forms, and in other ways it is more expensive to abolish them and have the universities do the work. On the whole, the effect of the 6th forms on the schools has been a good one.

In reply to a question by Dr. Munger concerning an increase in the number of universities in Nigeria, Dr. Njoku replied that the five universities now in existence were not being used to the optimum. The largest, the University of Nigeria, for example, has a student body of only 3000, and Dr. Njoku felt that until the 500 level is reached in the present universities, there should be a pause in increasing the number.

Dr. Njoku said that it should be borne in mind that unless there is some sort of policy, the training schemes would not be related to what will happen in Nigeria. "We must decide what fields people should be trained in and what type of scientific activities should be encouraged, whether we should try to keep up the fashion of previous decades or evolve programs in such things as space research. We don't think we should spend our resources on space research. On the question of training scientists, apart from the standpoint of quality, there is the whole question of quantity." The Lagos Conference of UNESCO tried to establish a target on the number of scientists in African countries, but without statistical data you cannot establish any figure that would have any meaning. The figure that was produced was 200 for a population of one million as a target until 1980. According to this figure, Nigeria, with a population of 55 million should have 11,000 scientific and technical personnel. There are about 500 at present. We have not come up with a more realistic figure and are working in the dark in terms of quantity. In terms of a breakdown into fields, it is even more uncertain. In spite of the fact that the Manpower Board surveys show that the requirements are high indeed, and that the universities are not likely to produce them, there are still voices in Nigeria talking about a reduction. To take only the factor of school teachers, we don't have the students; they prefer other jobs. As you are aware, the training of scientists in Africa has several important aspects which are perhaps lacking in more advanced countries. In Nigeria, we have to think in terms of elementary schools because the first thing is to break down the acceptance of traditional ways which don't make a child curious about his environment. You have mechanical toys which introduce a child to scientific ideas. Our system is primary schooling, secondary schooling, the 6th form, and universities. If new ideas

are introduced about education, one has to sell the ideas to 5 different governments and Ministers of Education. Most of the governments are now aware of the need to institute some kind of science teaching even at the primary school level. According to the figures of the Ministry of Education, the primary school population in 1964 was about 2.85 million children; the secondary schools had only 205,000; the 6th forms, 4,000; and the universities, 6,700. As far as science is concerned, of the 6,700 university students, only about 40% are taking scientific or technological subjects. The target we have set ourselves and which is being pushed at the universities is that we should aim at 60%; however, none of the universities has achieved this because of lack of science students from the secondary schools. This target was set by the National Universities Commission. The 6,700 figure does not include approximately 3,000 Nigerian students abroad.

Dr. Jones asked Dr. Njoku why it was necessary to sell innovations to all five regional governments. He wondered why one government couldn't innovate on its own problems. Dr. Brown felt this was not an insurmountable problem. He referred to the United States where fifty state governments set educational policies. Dr. Njoku said that the main problem was a matter of textbooks.

Dr. Lambo mentioned a point he considered of vital interest, namely the relationships between university and government. This relationship may influence the intellectual growth of any of the universities, and a university may not be able to accept aid or develop a particular scientific course. They have to carry out a certain amount of policy of the government.

Dr. Jones said, "We are citizens of a federal union where the principle of state autonomy is important. We see advantages in the State of California, for example, initiating innovations in its educational system. One advantage is that you don't have to sell the total system to put in a good new idea and the other advantage is that this permits a greater amount of experimentation at a lower cost. It goes beyond the state; as a matter of fact a school district can engage in innovations, and if they are successful, they can be picked up and copied elsewhere. You also are a citizen of a federal union, and I hope you see the point I am making."

Dr. Njoku explained that, in Nigeria, they are dealing not with the question of one state innovating, but with an independent group, such as chemistry teachers. When they decide what should be done, the Chemical Society must persuade at least one government to try it out. The Nigerian system is not as flexible as the United States'.

Dr. Myers mentioned the research institutes which are separate from universities and whose trained scientists do no teaching. Dr. Njoku said the research institutes constitute trained scientists who should play some part in the training of young scientists. There is also the question of what the universities should do at the higher levels of training. There is the matter of post-graduate training. "Many of our friends say 'Why not send students abroad?' Some visitors come and ask whether we propose to do research. They say, 'Why don't you content yourselves and let the students go abroad?' Most of our universities feel they cannot adequately fulfill themselves unless they do research and give post-graduate training. There is the whole question whether students will benefit more by being trained locally rather than abroad. They get training abroad, but it is often not relevant to what is needed in Nigeria." Dr. McKelvey felt strongly that cost factors should not enter into the matter of graduate school education. If you have strong professors and good students, graduate education will evolve. Sir Joseph felt it was very important for Nigerian scientists to train Nigerian scientists. He explained the British degree system and said British universities could help with certain special courses or subjects, but that Nigerian students should do their Ph.D. work in Nigeria on problems relevant to that country. Dr. Brown agreed and added that professors in universities in temperate climates would do well to think of what kinds of research they might sponsor in countries such as Nigeria. He cited the case of ten Ph.D. candidates from Stanford University who are doing basic work in Brazil—work that could not be done elsewhere—and suggested that, until Nigerian universities are able to give their own Ph.D.'s, possibly some of the U.S. universities might make research in Nigeria for Ph.D. degrees.

Dr. Edozien referred to the earlier statement concerning the 40% of 6,700 university students being trained in science, stating that many of these students would go into administrative work rather than science, and that the actual number doing engineering and technological subjects was very small indeed. He said, "If we are going to apply science to development, the whole problem of training in technological fields will have to be developed more extensively than at present." He also spoke of the costs of education, stating that the more scientists introduced into the universities, the higher the cost becomes. At present, the cost is just under £1000 per student per year. Dr. Munger said that in encouraging graduate work in Nigerian universities, there is the problem of critical mass. American or British students could be encouraged to go out to do Ph.D. work in Nigerian institutions. This would solve the critical mass problem and would be stimulating to the Nigerian students.

Mr. Ayida spoke of the political link between the universities and the regional governments. For instance, if the University of Nigeria wanted to work on a research problem in northern Africa, it might be politically impossible. He felt that each university should specialize—Ahmadu Bello in engineering; Ibadan in medicine, etc. At present, there is too much prestige attached to the idea of each university trying to cover the whole range.

Dr. Okigbo said the figure of 1-50,000 is a general average for all of Africa, rather than for Nigeria.

Dr. Njoku corrected the university enrollment figures after the arrival of Mr. Ayida, as follows: Ibadan - 2284; Nsukka - 2482; Ife - 659; Ahmadu Bello - 719; and Lagos - 563. Before proceeding to the new topic for discussion, he called for concrete suggestions for implementing the training of scientists.

Dr. de Kiewiet said that, for a number of reasons, the 6th form is failing to produce an adequate input into the universities, and there is an imbalance between the main fields in the universities. "Let us assume," he said, "that it is possible to step up the training of scientists in the secondary school system and that it will be possible to find the laboratories, the capital equipment, the manpower, etc., to train more scientists in high school. This will take a considerable period of time, and in the meantime the universities languish in this area, or they do the best they can to introduce into the student population as high a proportion of science students as they can. I understand that, at Nsukka, 50% were brought in not at A level, but at O level. My point is this: surely, if we are in the presence of a serious shortage, it would be worthwhile, even on a temporary basis, to solicit support for the laboratories that are necessary for training scientists who have had insufficient training in high school."

Sir Joseph felt that the 6th form system exercised a tyranny over the students, and that Nigeria should establish a system whereby a substantial portion came from O level. "I would suggest that, in the interests of Nigerian education, you maintain and organize the entry from the 5th form where the student is not yet committed and can change his subject in the light of national needs and of his own desires as he grows older."

Mr. Okiy agreed that the 6th form system should be abolished in Nigeria and said that it would be a great help if the universities would take students at O level and organize pre-entry science classes at O level for one year. Regarding the problem

of students going abroad for graduate work, he said that such donor countries as the U.K. and U.S.AID will not make grants for them to train in Nigeria. He also mentioned that, in the research departments, it was often found that graduates in the applied sciences did not have sufficient practical experience. The University of Nigeria has been making arrangements to send students to these departments during their long vacations; however, many of these government departments do not have the funds to do this. Mr. Okiy hoped the Africa Science Board might be able to help so that students could get practical experience. Another point he raised had to do with the scarcity of middle-level staff, a very important group for field work in agriculture. There is a great need for provision of middle-level staff training.

Dr. Okigbo pointed out that, in the training of scientists, many of the laboratories in Nigeria are equipped with teaching materials prepared in foreign countries. Facilities should be set up to provide teaching materials to secondary schools at a minimum cost. The use of local materials in teaching is quite necessary. In addition, the universities should be given some financial support so as to run short courses or long vacation courses to introduce people in secondary schools to modern principles.

In this connection, Mr. Lardner said that the U.S. is conducting summer science courses for teachers in Latin America, and that the number of courses offered in the U.K. is fantastic. He suggested that some attention might be given to establishing junior science colleges.

Dr. Edozien agreed that junior colleges should be established, and said that they could train students for middle-grade work. As for graduate work, it should be done in Nigeria. "I would like to emphasize a point made by Mr. Okiy about financing for graduate students. International bodies stipulate that you cannot use fellowships in your own country." There should be joint programs whereby students would do most of their work in Nigeria and part of their work overseas. The situation regarding overseas training has changed. Five years ago, Nigerian universities did not have enough qualified applicants; now there are more qualified applicants than the universities can accept.

Dr. Lambo suggested that other African universities, such as Makerere, might be able to take Nigerian students.

Dr. Brown, speaking of the target figure for scientists, said that the growth rate of scientists during the last 150 years has remained relatively constant. "Even in fields where tremendous effort has been placed, it is virtually impossible to have a growth

rate of more than 30% per year. A 70% increase per year would be required for you to meet your target. I suspect it is not realistic in the light of what is possible. You would have to quickly start on the creation of higher degrees locally and also consider major importation of scientists, engineers, professors, research workers, etc. In looking over your economy, it would seem to me that you are primarily an agricultural country and the logical area in which to give higher degrees would be in agricultural sciences. Here is an area where perhaps you could come up with some specific concrete recommendations."

Dr. Weller said that if Nigeria is going to develop in the health field, it will have to have service institutes, pathology labs., etc. They could not only provide service, but could provide training at the technical level and be tied in with the universities. Dr. Weller felt that formal courses were not necessary to train middle-grade staff or technicians. In the U.S. many are trained as apprentices. A high school graduate can be trained to do many things that we think takes a doctor's degree.

Dr. Onitiri felt that most of the laboratories in Nigeria were underused, and that with better planning more people could be trained. He also considered it a luxury for a poor country to have primary, elementary, and university students all on vacation at the same time. Plans should be made to use these university students during vacation time. He agreed that laboratory facilities should be expanded, but, because of the foreign exchange situation, felt that Nigeria should have some small-scale factories to manufacture simple laboratory equipment.

Mr. Lardner said that a great deal of graduate training abroad is conducted by industry, and that this possibility should be explored. He pointed out that the discussion of training had only considered supply of trained people, and that the question of demand should not be forgotten.

Dr. Lambo endorsed Dr. Weller's suggestion regarding service and research combined, but pointed out the Nigerian attitude toward degrees, or having some sort of piece of paper. Dr. Page suggested that they could be given certificates.

The Division of Labor Between Universities and Research Institutes

Sir John spoke of two categories of university research: basic and applied. In the first, he cited examples of research where the eventual applications had been unpredictable, such as the quantum theory which led to semiconductors; work which led to the new solid state devices, lasers and masers; low temperature work; radio astronomy; molecular biology on the structure of proteins, etc. The second category is research of technological interest. For example, the work of metallurgists on the flow of metals; the development of new materials; computers; instrumentation of satellites; work by organic chemists which produced penicillin; as well as work in agricultural departments, medical departments, and economics and business administration schools. Sir John felt that it was very important that such work in the universities receive support from outside bodies such as research councils because university funds are usually not sufficient. As for the role of research institutes, Sir John said that certain types of research were too large in scale to be conducted in universities. For example, nuclear energy, work on electronics, aerodynamics, standards, basic data, the work of the public health laboratories, etc. In Britain, there are also small-scale research units set up for universities to carry out special work in the field of medicine. One example of this is the work on nuclear biology. Some of the research departments of the Agricultural Institute are important to university teaching. In the last few years, it has been recommended that, so far as possible, new research institutes be located within the grounds of universities. The reason is that institute staff can help with teaching and the facilities can be used to train research students. There are many common services at universities which can also be used by research institutes, such as the library. In Britain, there is a tendency to try to make use of the staffs of institutes because the universities are expanding so fast and are short of teachers. Arrangements have been made for staffs of government laboratories to spend some time in universities. There are problems in this relationship between universities and research institutes, and often the fault lies with the universities. Professors do not always take kindly to students going off to research institutes rather than working in their own departments.

Dr. Onitiri commented that Nigeria had similar problems. He felt that in Nigeria it would not be desirable to press too much the division of labor between research institutes and universities. The emphasis should be to achieve the maximum use of resources and to obtain the greatest coordination of activities. From this point of view, the shortage of facilities and staff can be remedied or



can be less serious if universities and institutes consider themselves as part of the same organization working toward the objective of economic growth. Still, there has to be some division of labor. Universities have the primary function of training scholars and institutes have the primary function of looking into new problems. Universities should see their function not only as training, but as conducting research, and here they should cooperate with the institutes. It is easy to cooperate when they are university institutes; otherwise, it is difficult. Sometimes the universities consider themselves as separate. The institutes themselves speak of universities as something removed from them. This should be broken down. One great need in this direction is the diffusion of knowledge of what is going on in both universities and institutes. Dr. Onitiri cited cacao research as an example of two organizations working at cross purposes. His own institute, NISER, started as a branch of the University of Ibadan and is located at the University. The Institute was reorganized and is independent of the University, but has a governing council which sets the policy. "Arrangements were made with the University to let us use their machinery, so technically, our staff is appointed by a joint committee of University of Ibadan and the governing council of NISER. Staff members teach at the University and some members of the departments do research in the Institute. In this way the staffs of both institutions can complement each other and it is in this direction that relations between institutes and universities should be developed."

Dr. de Kiewiet said he proposed to try to sharpen up certain important propositions which are vital to the development of science in Nigeria. He divided his remarks into three arguments. The first is an economic argument because we are dealing with a society which has a shortage of resources and must allocate them as effectively as possible. The gross national product per capita is £20 per year. The cost per student per year is £1000. This is one way of dramatizing the great burden upon the Nigerian economy in developing its five universities. Another economic factor is that the annual growth rate in Nigeria between 1950 and 1955 was a very promising 6% per annum. It dropped to 2% per annum. If one assumes a population growth of 2% per annum, then the growth of income is 1% per head. Eighty-four per cent of the gross product has to be spent on consumption; this leaves a very small margin. We have to worry about primary education, secondary education, and university education. There is a serious argument for studying the coordination of functions, the common use of facilities, and the economies that could result. There are some very important arguments in the area of competition between pure and applied research that give some weight to the view that the men and institutions which deal with applied research can profitably be brought much closer to the men who deal in pure research. The Manhattan Project is an example

of a mixture of both pure and applied research. The third argument has to do with the atmosphere of consent and understanding that is necessary to the healthy conduct and development of university institutes. "I have heard criticism of the spirit of aloofness of the universities. I wonder whether, because of the high priorities that exist in the Nigerian economy, the university community and the government departments do not have before them an essential dialogue that, in the long run, would be of great benefit to both sides."

Dr. Arikpo described the work of research institute staffs as sterile and routine owing to their lack of contacts with academic activities. He hoped, in the future, that research institutes would be associated with or sponsored by the universities.

Dr. Page: I would like to mention that the Nigerian Geological Survey has done a great deal of work in what geologists would consider pure research, particularly on rocks and minerals. The Nigerian Survey is like many others in the world in that it has to be the place where there is a combination of basic and applied geological research. In many countries, like my own, there is a system whereby university professors, during their long vacation, become employed by surveys—also students. This produces a grouping of training and teaching personnel that will do research which is directly applicable to the development of the country. In your country, there seems to me to be a division between the geology departments and the geological survey. I feel this is an opportunity of meshing the universities and what has to be the research establishment in the country. Geological surveys are too expensive to run except on a national basis. There should be both basic and applied research in one establishment. The division of one type of research in a university and in a research institute would be unusually expensive. This holds both for minerals and water. These are two very important items in economic development in any country. I urge you to keep the university and the Geological Survey meshed in that fashion. I feel the same thing is true in certain parts of physics and chemistry—geophysics and geochemistry. They might be meshed in the geological survey also.

Dr. Thomas: I have the same sentiment. Insofar as water is concerned, the geological survey might constitute one of the service institutes. It is a separate institute geographically and it has been my feeling that the universities are not aware of the close relations. At the Survey, there are opportunities for field work, field training, technician development, where the student would be in training and not just thrust out with only theoretical training.

Dr. Page: The Geological Survey also serves as a training ground for geologists for industry.

Dr. Brown said he was delighted with the attitude that there should not be separate research institutes.

Dr. Edozien emphasized two points which must be considered if the desired relationship between universities and research institutes is to be developed. 1) The differences that exist in terms of research facilities. It is important to find more money for the universities to have their own research facilities. A department that cannot attract funds from outside cannot do research. The National Universities Commission has some responsibility for providing money for research. 2) The second difficulty is the need for free movement of staff between universities and institutes. The limiting factor is the question of pensions, etc. This requires joint council between the Universities Commission and the new Research Council.

Mr. Lardner said that Nigeria today is building institutions comparable to those of the 1930's in eastern Europe. It is no longer possible to make distinctions between pure and applied sciences. Today there is the interdisciplinary team which is becoming dominant. Nothing we do here will have any effect unless we are prepared to mount an assault against the policy making ministries in African countries. We have to persuade the Ministers.

Mr. Okiy asked for suggestions on ways to break down the barriers between universities and research institutes, stating that the doors of the research institutes are always open, but the universities are reluctant to come in. He disagreed with the statement that the work at research institutes is sterile, but felt that young people were attracted to the universities because of higher salaries. He hoped the barriers might be broken if the Nigerian Council for Scientific Research and the Universities Commission got together to find a way to permit research institute staff to move around without loss of pensions.

Chief Deko felt that a formula should be found which would be a departure from established tradition in the U.S. and Britain. The universities and the institutes have material and means enough to do a fair amount of work if the work is coordinated. The universities have the men; the institutes can get a government grant. It might be a good idea to establish an institute which is practically the "joint baby" of the university and the government.

Dr. Myers referred to the high cost of university education per student. He felt it might be enlightening to study the factors that contribute to these high costs and then attempt to find some way of counteracting them.

Dr. Lindvall said that in the U.S. there is another type of research institute that should be identified. They are part of a university and were created to work on research and development for industry for a fee. The margin of income over expenses goes to exploratory research and the development of facilities. Illinois Institute of Technology is an example. Purdue is encouraging this in a different way. They are encouraging industry to establish research institutes on university property with participation by students. A similar thing exists at Duke and the University of North Carolina.

Contributions of Academies and Research Councils to Development of Academic and Governmental Research Bearing on Economic Development

Dr. Njoku said the need to have some organization within Nigeria which will be responsible for the planning of scientific policy is essential. If recommendations are to be implemented, there must be some organization which can deal with these matters. It is such a body that will determine the priorities of scientific activity in the light of the demands and needs of the country. In the light of our acknowledged scarcity of human, financial, and material resources, it is important to ensure that the lines we choose are capable of producing the most beneficial effects on our national welfare, and are likely to be most closely integrated with our economic development. At present, there is a great lack of coordination. Without coordination, a poor country can dissipate its energy in too many fields. We have now created a Ministry of Natural Resources and Research—a sign that the government is doing something to correct this lack of coordination. However, this Ministry is concerned mainly with agricultural research; medical research is under the Ministry of Health; industrial research under the Ministry of Industry—so there are still deficiencies in the over-all organization. Apart from these ministries, the government is actively considering setting up a National Council for Research which will be able to formulate general policies for research over a much wider field. On the non-government side, we have also been considering the idea of a National Academy of Sciences. This would bring together social sciences, arts, and humanities, as well as sciences. If our Academy can have a sufficiently inter-locking membership with the Council of Research, we may be able to achieve the coordination, the lack of which we feel so acutely. We want to evolve something as simple as possible. Unless care is taken to make the organization simple, we might find the few scientists we have involved in one meeting after another, with no one to do the bench work. We want to ensure that our organization has access to the centers of power by having organizations they will respect. I have a private fear that by creating a Council for Research it will be considered a council attached to the Ministry. There are difficulties in creating these bodies. To have one body is the best thing for some countries. Are we doing the right thing?

Sir Joseph said that his own experience had been more with research council types of organizations than with Academy organizations. He believed having the two types was right. He described a research institute as being headed by a director and an academic body being headed by a dean. The director directs; the dean does so at his peril. There is directed research and there is free enterprise research—or uncommitted research, and either of them can

involve basic research. The distinction between the research institutes and the academic research is not between pure and applied research; it is between directed and uncommitted. It is the function of the kinds of bodies we are discussing this afternoon to care for the health of the research organization. A Research Council is responsible for the statement of needs and the ordering of priorities in relation to the facilities available. The Research Council, therefore, is the guiding and advisory body for the director of a research institute. An Academy of Sciences has similar functions for university research. It has the duty not only of ensuring the integrity of scientific work, but also of assessing the worth of the scientific effort in the context of the community. The Royal Society is in close touch with the climate of opinion and current needs of research in the U.K., and it makes its influence felt in two ways: through its contacts with the government and through its members at the universities and research institutes. The balance of interest as between the academic and the research council approach is going to be different in every country. I would like to pursue the responsibility of the Academy to a problem that is related to this balance. That is, academic freedom. This is a crusade where any academy worth its salt would go to its death. We British have talked about academic freedom without analyzing in our minds what goes with it. What we have recognized is that we have done some of the countries where we have gone an academic disservice. Academic responsibility is something we have often forgotten. In Britain we have a good tradition of freedom of universities which are subsidized by the government. It is important in relation to academic freedom to be able to take money from the government without giving up academic freedom. What is important is that our academic freedom depends on our academic responsibility and there is no doubt that the whole of our edifice and a large proportion of our income going to universities with no strings would crumble if the people got the idea that the universities were lacking responsibility. This is the kind of thing that makes it necessary for any country to have two organizations,—the academy of sciences, which is concerned with the intellectual health of science and the research council which is concerned with the advice and ordering of priorities. How do we bring the two together? If we are going to use both the research institute facilities and the university facilities to the best advantage, we have got to have some *modus operandi* between the academy and the research council. This is probably something that will work itself out fairly well so long as we have clear in our minds what the functions are.

Dr. Brown agreed with Sir Joseph's remarks and said he would spend his time reviewing the organization of science in government in the United States. An argument has gone on for many decades

concerning the advantages of planning and the necessity of anarchy. One of the problems which confronts us is that of achieving within a given culture the most effective blend of anarchy and organization. We have seen this in the USSR where the rise of a Lysenko can ruin a field of science for generations. To have complete anarchy is also bad. Our Academy was formed 100 years ago; it was established by Lincoln to advise the Government, but between the Civil War and World War II, the Academy had one major interest, and that was who was going to be elected. That is one pitfall. When World War I came, the Academy was impotent. The Research Council was formed and later they were united. This was so effective by the time World War II came along we had to establish an office of research and development. After the war, our method of operation changed, and I see now what our really important role is in relation to the way science operates within our government as a whole. Research and development takes place in virtually every one of our government agencies—AEC, NIH, NBS, NASA, Interior, Commerce, Defense. As these grew, there was no coordination between them and we had great imbalances. As an approach to rectifying this balance, the President has an Office of Science and Technology. The President has a science advisor and he is the head of the Office of Science and Technology. This office has no power, but it does have an important and growing coordinating function. It brings representatives from each of the agencies together periodically and they have to justify their budgets, etc. We look on our Academy as a sort of conscience and a mechanism for carrying out studies concerning major government policies. Our Research Council has no funds. We make studies and make recommendations. We are an advisory body and deal not only with the Executive Branch of our Government, but have recently been contracted to advise the Legislative Branch.

Dr. Brown went on to describe briefly the organization of the Soviet Academy, which leaves very little room for anarchy. They have fine research institutes, but there is very little interaction between the institutes and the universities, nor with industry. Brazil also has an Academy and has organized a Research Council composed of high level representatives of each of their agencies which deal with research. The President of their Academy is also a member of the Research Council and there is high-level representation from the Ministry of Planning. This interaction between the planning people and the research people is important. The rest of the membership is appointed from the scientific community by the President of Brazil.

Dr. Edozien asked Sir John to comment on the administration of the research institutes and wondered whether the National Research Council should take on that function.

Sir John said that, in Britain, most of the research institutes were under the four research councils. The technological ones were the exception. In addition, there is a Council on Science Policy which was recently reconstituted to give it more power. As a result, there will be some high-level coordination. It will not deal with details, but will take an over-all look, especially on large increases in expenditure.

Dr. Patterson cautioned against expecting miracles from institutions. The U.S. institutions are the result of years of trial and error and a tremendous amount of confusion. We have been groping toward a national commitment to education as an investment and not as a cost. The barriers are breaking down between various categories of education and research. Private institutions are taking on public functions, etc. The Federal Government is increasingly contributing a major share of the research activities in a great many of our private institutions which suggests that the carrot and stick technique is important. There is nothing perhaps more characteristic of the situations we face than the fact that they are in a constant process of change and reexamination.

Dr. Lambo felt that several important aspects had been brought out during the discussions. One is the question of the nature of the society in which an institution operates; another is the question of academic freedom. Another point was the question of academic responsibility. The effectiveness of any study or recommendations from any academy of sciences will depend so much on the image it has created.

Mr. Ayida said that Nigeria has research within the universities, research in the institutes, and committed research within the universities; the money for this research comes from three sources: the federal government, the regional governments, or from external sources. He asked Sir Joseph what role he thought the Research Council should play in coordinating these major sources of financing.

Sir Joseph referred to Dr. Brown's advocacy of a certain amount of anarchy. We don't want to organize too carefully. We don't want to give the research council a duty to organize the flow of funds to the uncommitted research in universities or to any research in the universities unless there is a contract between the university and the research council to carry out a task for it.

Mr. Okigbo asked for guidelines as to the composition and functions of a research council and spoke of the necessity for "selling" research to politicians and to various private companies which do not realize that they might gain in their enterprises by giving to research institutes and universities.



Sir Joseph described a research council in East Africa which has varied in composition over the years, although it has always had a substantial element of scientists and a considerable element of ministerial or permanent secretary membership. It has also had two or more scientific representatives from the U.K. The difficulty has been chiefly between the ministerial and the scientific membership. The only answer is a steady process of education. Conditions over the years have improved and now the two sides are working more closely together. This is something you can only develop by developing understanding. As to the education of the community to the needs for research, there is another category that we have not mentioned, and that is the associations for the advancement of science. The association brings together the layman and the scientist once a year to discuss what science is doing and what has been discovered and the place of science in the community. I would suggest that this function of appraising the community of what it is doing is not a function of a research council but of an association of this kind.

Dr. Brown agreed with Sir Joseph regarding the composition of a research council, but cautioned that, if the membership is confined to representatives from ministries, there is danger of ending up with a loose federation of people who take provincial attitudes. There has to be on a research council multiple representation composed of people with broad views. It is also important to have representatives from the ministries. You have to put recommendations through the budgeting process and get funds allocated. You have an opportunity to create a situation at the beginning which both we and the Royal Society have had to fight for. We advise the Government, but have to pound on doors to be heard.

Dr. McKelvey asked whether Nigeria's science organizations could be expected to emanate from the scientific community or at the top political level.

Mr. Okiy replied that the government has taken a definite stand so the research council can come into being. The Academy of Sciences would be a concern of the academicians. Dr. Edozien said that, at present, it is uncertain what the government will do eventually.

Dr. Myers spoke of the importance of the scientific associations which Sir Joseph had mentioned. The strong associations perform a very real function in developing the public image of science. Dr. Njoku described the Science Association of Nigeria, founded in 1959, which holds a conference every year, invites speakers from other countries. A journal of the West African Science Association is being published jointly with Ghana and Sierra Leone. Each country has its own association and we meet every other year. A new journal

of Nigerian science is about to be launched. Once the academy is formed, it will deal more with reporting and will continue to bring scientists together.

Mr. Okiy said, regarding the composition of the Research Council, it is hoped to have regional representatives, including representation from the north.

## Public Health

Dr. Edozien said that medicine like education might be regarded primarily as a social service or as an investment item in economic development. For a long time, education was considered a social amenity and this handicapped Nigeria for several decades. Now, however, Nigeria is spending 40% to 50% of its national budget on education. While recognition has been given to the importance of education, it has not yet been given to the public health aspect of human resources. Another thing public health has in common with education is the difficulty of quantitatively assessing its contributions in terms of economic development. Only 6 million pounds per year or 5% of the total expenditures of Nigeria's federal and regional governments is spent on public health. 50% of that is spent on medical education, Only 3 million pounds are spent on research and health services. Most of these health services go to people in towns who can afford to look after themselves, and the villages and rural areas are neglected. The few health centers are built for political reasons--largely before election time, and have no personnel to staff them. Much of the assistance coming to Nigeria is from the U.S. AID programs, but they give low priority to health programs. They say they spend money largely as a result of requests from the Nigerian government. The Ford Foundation has also invested large sums in Nigeria, but it is difficult to get them to invest in the health field. The Rockefeller Foundation has been the major donor in the health field.

What is the situation of health in Nigeria that makes it so important? One of the parameters to measure the health of a community is infant mortality. Taking Nigeria as a whole, the infant mortality is about 240 per 1000. One-fourth die before they are one year old. Many more die of infectious diseases and malnutrition between 1 and 5. 40% of all children die before age 5, and of those who survive, many die between the ages 35 to 40. Then there is the question of morbidity. The incidence of ill health is considerable. The problems are so large that even the entire revenue of the country could not meet them, so we have to set priorities. There are two aspects, the curative services and the public health measures, which are mainly preventive measures. The question is should our meager resources be put into curative measures or public health measures. The answer is obvious that they should be put into public health measures, but this is not a popular concept. It is really a question of creating an enlightened public opinion to make possible a reasonable balance between public health and curative services. Nigeria has between 1500 and 2000 doctors in all categories and this gives a ratio of one doctor to 30 or

35,000 persons. In contrast, Britain has 1 to under 1,000; the U. S. 1-800; Israel 1-450. We need to train more doctors as rapidly as possible in order to reach a level where they can begin to be effective. Using traditional training methods, with the time and expense involved, it would take many years to train enough doctors. It is not felt that standards should be lowered in order to decrease the time and expense. One approach would be to train doctors as leaders of teams of health workers who can give the services to the community. There should be centers for training this auxiliary medical staff. Finally, there is the training of other categories of research workers, nurses, and technicians. These are also essential. In addition, more money should be put into research which could be done in the medical schools. Research should be done on the patterns of illness and the patterns of disease. It is essential to have an inventory of what the people are suffering from. Secondly, it is necessary to have more operational research--the training of new kinds of personnel and how best to use them to become part of the team. Finally, there is basic research. There are types of basic research where we are suited to make real contributions to world medicine. For instance, in the fields of nutrition and mental health, the relation between viruses--all would be suitable research subjects. Very little money came into Nigeria from outside sources for research. Dr. Edozien spoke of a paper he had prepared a year ago for NIH on bio-medical research in developing countries, saying there had been no change in the situation since he prepared the paper.

Dr. Weller commented that he had very little to add to Dr. Edozien's brilliant presentation. He felt Dr. Edozien's paper should be required reading for the group. Very few academic colleagues in the U. S. understand the use of the term, public health. They equate it with low-level sanitation inspection and sewage disposal. Actually, it refers to a philosophy wherein the community or the nation is a patient. The most economical way to provide services is after the patient becomes sick. Prevention at the community level requires a multi-disciplinary approach and this is modern public health, a process of synthesis of knowledge where medical and physical sciences come together for the benefit of man. The end product reflects a high degree of community conscience. As Dr. Edozien pointed out, economic planners have not paid much attention to health. This has been the case, particularly, in AID, because Congress has not been able to quantitate the effects of good or ill health. Recently, economic planners have clouded the issue by bringing in the problem of population growth. However, to stop doing anything about public health and start controlling reproduction is wrong. No community will have an interest in controlling their

reproductive capacity until they are assured their children will survive to maturity. The people are the prime natural resource and Nigeria is wasting between 30 and 60% of its natural resources. Ill health affects school attendance and achievement and the productivity of adults, whether in agriculture or industry. There is justification for devoting a considerable portion of national income to health. In addition, it is a political commodity. The people will demand good health. The highest priority is a better definition of disease distributions and an assessment of its economic and social import. This information is essential if one is to help the mass of people and also if one is to get support from the politicians. If one is going to improve health in Nigeria, it is going to require the application of present available knowledge as well as research to develop new knowledge. Dr. Weller mentioned malaria as deserving priority of effort. An outbreak of malaria could paralyze the economy. The supply of doctors will be inadequate within the foreseeable future. Both from the standpoint of finances and from the standpoint of medical students, there are grave limitations. It is important that the graduates who are turned out be prepared to have a maximum impact on the welfare of the community. No matter what his specialization, he should be impelled by his community conscience to spend a sizeable amount of his efforts in improving the public health of his nation. Medical status symbols will have to be changed. Dr. Weller cited the case of open heart surgical teams, for instance, which are extremely expensive to train and who cannot help more than one or two people a day. He also mentioned organ transplantation in this category. Nigerian medical schools should get away from the British and American curriculum. In addition to the status system, the reward system should be changed so that the public health expert would be higher paid than the surgeon because he is more important to Nigeria. Urbanization will create new problems, such as, possibly, the introduction of filariasis into towns where it has not existed before.

Dr. Lambo mentioned other aspects of public health, namely the relationship of teaching hospitals to government institutes, which is not entirely a happy one, and which should have a great deal of collaboration especially in the field of preventive medicine. The patterning of medical services is similar in most former colonies and none of the planning has been done in reference to the social structure and the flexibility of a new nation. We landed with something which is rigid and difficult to deviate from. There is a great lack of reliable and valid statistical data on all aspects of health. We lack fundamental data on epidemiology in various areas of Nigeria. Nigeria has such a diversity of tribes and social customs that what applied one place will not apply in another. Infant

mortality was mentioned, but there are many other dimensions that could be mentioned. In measuring mental capacity of people in various areas, there is a sharp drop due to worm infestation in some areas. Another very important point is the collaboration with social scientists in the field of health. This could produce close liaison with demographers, sociologists, anthropologists, etc. The concept of public health is part of the social structure of the people.

There followed a discussion of the attitude of medical students toward public health problems; the number of available students qualified to take medical studies versus the numbers which could be admitted; and the attitude of students educated at government expense toward their obligation to Nigeria. Dr. Lambo said the returning students do not want to enter government institutes and use the slogan of academic freedom and the concept of democracy. Mr. Lardner felt there was justification in instituting a flexible machinery that there was some truth on both sides. The government position was: "We made you what you are and you turn around and say that you are elite." Every student wants to become a specialist.

Dr. Lambo pointed out that it is impossible to discuss Nigerian problems--economic, social, medical, public health, etc.--without reference to the neighboring countries in Africa. For example, in the planning of public health services and work on a host of endemic diseases, there are 23 African countries with less than 4 million population, and are 12 with less than 2 million and 7 with less than 1 million.

Dr. Edozien referred back to the attitudes of medical students, saying that the government often doesn't know what they want to use them for. These young men go back and there is no clear plan for what they are to do. They feel they are being punished for having taken government scholarships. There is no justification for a student failing to take a job where he is needed, but the government has no plan of what he is to do. He may be given a job pumping water in a waterworks after having 6 years of training as a mechanical engineer. Every student, whether on a scholarship or not, should, as a requirement for medical training, agree to do some work for his country. This approach would give the student a feeling of satisfaction. It will prevent those on scholarships from feeling they are being punished. The answer lies in the government itself providing a clear plan of how to use these people. Dr. Edozien wondered whether ECA and UNESCO had considered local planning institutes where there could be a multidisciplinary approach with doctors, water people, economists, etc., to look into the problems of each area. He said that, although hospitals, schools, roads, etc.,

have been built, public health had not changed since he was a child. This ought to be planned on a local development scale. We should identify areas in which, by solving problems, we can have the most beneficial effect in terms of the general economy, namely water, schistosomiasis, tsetse fly, human health, animal health, nutrition--the impact would be greater than in a broader field.

Mr. Okiy felt that the situation where scholars leave government service for the universities was not as simple as some had indicated. He believed that the higher salaries offered by the universities were the determining factor; he cited the case of a microbiologist who had trained at government expense for 9 years and left government service after one year to join a university. In comparing funds expended on agricultural research versus health research, Mr. Okiy said that of the 319,000 pounds allocated for agriculture, only 5-10,000 pounds went for research. The rest went to support the entire department.

With regard to student attitudes toward government service, Dr. Weller felt this was not the fault of the students. The student returning from the States or the U.K. knows little or nothing about the diseases he will find in rural villages. He is a specialized product of modern medicine and tends to pattern himself on one of the professors he admires. In looking further, this impinges on research in Nigeria. The expatriate research professor knows his time in Nigeria will be short. He is under pressure to do research that will get him a chair in the U.K. or the States. This rubs off on the Nigerian professor. He is faced with the problem of getting outside support for his research and has to do research that is attractive to the foundations or other donors.

Dr. de Kiewiet endorsed Dr. Edozien's suggestion regarding trained doctors supervising teams of medical assistants. He felt that a request for assistance to AID might be favorably received if it were for training and training facilities for medical assistants, rather than for building still another medical school. He suggested that over-specialization and costly equipment had been contributing factors to passage of the Medicare bill in the United States.

### Research on Industrial and Natural Resources

Mr. Okiy said that agricultural and other research on natural resources is carried out in government departments, research institutes, and by the agricultural faculties of the universities. Although much is done to coordinate this research, what is lacking is an organization which can coordinate the efforts in different disciplines. In the 1950's, a Council on Natural Resources was set up, composed of members of ministries of agriculture and natural resources. Four technical committees were established by the Council. Although the Council itself became moribund, the committees continue to do their work to this day. The agricultural research committee meets once or twice a year with university faculties, and representatives of federal and regional research bodies to examine proposed research programs and avoid duplication of efforts. The President of a national research council would coordinate the efforts of all these bodies.

Mr. Okiy went on to describe the organization of research. The main function of the federal research is to carry out research on food crops and plant breeding to produce new varieties. These new varieties are then sent to the regions for modification and distribution. It carries out research on root crops, rice, maize, etc.; all the rice grown in Nigeria is produced from this source. This department is headquartered in Lagos, but has substations in different parts of the country. Before the last war, very little rice was produced in Nigeria. It now produces up to 300,000 tons per year, and will eventually be able to export rice to other countries. Research on root crops has produced varieties which give 3 or 4 times the yield of former varieties. Yields of maize have also been increased as much as 4 or 5 times over previous yields, but the variety produced so far is more suitable for livestock feed than for human consumption. The universities of Ife, Nsukka, etc., also participate in these research programs, and in some cases assistance has been given by AID and STRC. Apart from plant breeding, there are other functions, such as entomology--insect pests and diseases, which are carried out by federal departments; the results are passed on to the regional institutes. One program concerns yam beetles which are very destructive. Veterinary research is also a federal responsibility as is forestry research. Both the veterinary and forestry organizations have schools for training technicians, not only for the federal government but for the regions as well. There is a fisheries service which does marine research. Aside from these four services, there are research institutes which carry out research on



commodities, such as palm oil, rubber and cocoa. Mr. Okiy described the original organization of these institutes and their subsequent accomplishments. Other research institutes include the Institute for Trypanosomiasis Research; the Nigerian Research Institute which is allied to the Ministry of Trade and is concerned with the storage of food crops; the Institute of Industrial Research which conducts research on the cassava, etc. Fields where research is urgently needed include tropical agriculture, soil fertility, irrigation, food storage, food processing, agrometeorology, animal breeding, animal health, and soil surveys.

Dr. Page said that Mr. Okiy had discussed the subject of renewable resources and that he was going to take the subject of non-renewable resources, which has to do with minerals and construction materials of all types. Geology is very often put off to one side. It uses chemistry, physics, and mathematics and is commonly confused with the term, prospecting. To separate these two items, prospecting is a search for minerals which are exposed on the ground. Very often these are easily found, but in all stages of development, you soon pass the stage where prospecting will produce results; this is probably already the case in Nigeria. Then, the job ahead is to use research in geology to find concealed ore deposits. This is not done easily. Although the United States has been prospected for one mineral or another, and has been examined by a series of geologists, now a brand new gold deposit--perhaps one of the largest in the world--and a new copper deposit and a new phosphate field have been found as a result of geological research. Until recently, the geological maps and information necessary to allow one to probe below the surface of the ground has not been available. I see the problem in Nigeria of training a group of Nigerian geologists in their universities or abroad in such a way that they can find additional ore deposits. The history of oil is a good example of what is to be gained by geological research, and of how long it takes to make that gain. You are all familiar with the fact that the first work by the Shell Oil Company in Nigeria was in 1937. There has been continuous work on oil resources in Nigeria, and only recently can one see oil enough for refineries and the possibility of exporting it. The by-product of gas will serve a petrochemical industry. As I read the reports of the Nigerian Survey, there are some 86 map sheets, and there has only been geological mapping of 44 of these. Possibly only 25 of these have been completely surveyed and these are in the preliminary scale of 1/100,000 or 1/250,000. In the U. S. we consider 1/62,500. After this first look, there is still a large job left to be done before you can begin to assess the

mineral wealth of Nigeria. This presents a large problem. We speak of the Geological Survey of Nigeria as if it is a research institute because it is the place, by its nature, where the best research is carried out. A geological survey must do basic and applied research--all put together--and on a national basis. In the training of geologists, a great deal of effort should be put into the geochemical and geophysical aspects. We are training too many laboratory geologists and what is needed is good field geologists with laboratory backgrounds. After the mapping has been done, greater emphasis must be placed on the laboratory side of things. There are perhaps six Nigerian geologists at Kaduna. Much of the work has been done by expatriates and this may be true for some years to come. I urge that arrangements be made by the universities and the geological survey so that all the geology students spend their long vacations working in the field as assistants in the survey. I do not believe you have regional surveys, so it is primarily a federal problem to get map coverage of the country and to get an inventory of resources. This will change from time to time as new discoveries are made, so it has to be a continuing inventory. By getting students involved in the local area, they will be training and producing at the same time. I cannot stress enough that it is the years in the field that determine how well the geologist can evaluate a new area in terms of its economic interest. With the coming of the oil industry, you are going to find that geologists will be drained off from government posts and teaching. This is good. The more Nigerian geologists that can be absorbed by industry, the better off the country will be. However, I am worried about the few people in the country in this field. In the U.S. the number is roughly 20,000, of which a high proportion is used in industry, particularly in the oil industry. The U.S.G.S. does research ranging from the most basic types to strictly applied work. We are mapping the moon on a 1 to 1 million scale. There are people working on isotope geology, geophysical work related to the thickness of the earth's crust, and work related to the development of economic materials. Geology enters into all aspects of the economic process.

Dr. Lindvall said that electric power is the key to many developments and it generates its own demands. The Tennessee Valley Authority is an example where the availability of power caused people to make use of the power. Nigeria is fortunate in having a hydroelectric development coming along at Kainji. There will be a shortage of industries for a time, but the power will not be in excess. The oil and gas coming along will give you a choice as to whether to go to thermal plants. This gives

a fine operating advantage in that you can build a total system for a minimum cost. There are many things that expanded distribution of electricity into the back country can do, for instance, in the question of food storage, methods based on electrical power can help. As to power for transport, you could be well equipped through oil to provide diesel rail and truck power. You must evaluate the relative economics of oil versus electricity. Dr. Page talked about looking into materials resources of all kinds, and I think it is highly important that careful attention be paid to the chemical content of these resources, not only mineral but agricultural. An example is the work of Jarosse and the Syntax Corporation in extracting important drugs from a variety of Mexican yam. Also, I would urge that a good deal of effort go into ways of finding by-products from the present agricultural economy and ways of utilizing things which otherwise might be wasted. For example, one chemist was trying to find out whether alcohol could be extracted from the apple portion of the coconut. In developing resources, an over-all look has to be taken at the whole marketing aspect. Dr. Lindvall told of the situation in Italy ten years ago, where a population of 50 million did not have sufficient purchasing power to develop local markets and demands until men like Olivetti and Fiat started to take steps toward improving the wage structure so that there would be more purchasing power. Dealing with your natural resources, erosion and flood control, conserving soils, improving the quality of streams are all important. Through our land grant colleges, experiment stations were developed which do local research and are in a sense industrial research institutes. Some are closely related to the agricultural experiment stations. Industrial research support for small industries is highly significant to production, processing, and engineering of the product--from planning the production all the way through to the marketing phase.

Dr. Thomas, on the subject of water resources research, spoke of the visit of members of the Africa Science Board to the Kainji Dam site where Worthington and Kasahara want to establish a lake research institute to deal with hydrology, climatology, limnology, archeology, the economics and sociology of resettlement, etc. The discussions of the proposed research had reminded Dr. Thomas of the situation at Lake Mead thirty years ago, where soon after water had started to back up, it was realized that there was no map of the area. Aerial photographs were taken and a map was made, but there was no comprehensive study of the lake for fourteen years.

Dr. Thomas said he mentioned this because there seems to be no study of the Niger project to compare with the records of the Colorado project where the character of the inflow and the outflow were recorded. The Colorado flows through regions just as arid as the Niger and there will be irrigation schemes which will require far more data than now being taken. Dr. Thomas spoke of the Volta Lake research which depends on contributed funds. Support for continuing research is beyond the purview of international foundations, etc., because they are limited to a few years. Continuing research should be supported by the Government of Nigeria.

Dr. Thomas went on to discuss conservation in various aspects. It can be defined as the utilization of the environment without taking the resources from the area. Conservation is often defined as wise use, but there is often disagreement as to what wise use is. We have already mentioned exploitation, development, manufacture, and distribution, but eventually we have a confrontation with another type of conservation--conservation of matter; we can't destroy matter, but we have a whole category of products that are discarded after use. Many of these waste products are the same products we have worked so hard to develop, such as products found in junkyards. In many instances, we find that recovery is economical and necessary or desirable or prudent to subsidize. In water, a great deal is being done about pollution. Similarly, in a great many other things there is a great deal of research to extend by-products. Sociological research into changing mental attitudes should be considered so that we will not be submerged in our own wastes.

Mr. Ayida felt that the subject of natural resources was one of the most important items for discussion. He had been asked to discuss power and some of the research problems. Among sources of power, he spoke of the situation with regard to coal, which at one time had been considered a dying industry. However, intensive research efforts and a study conducted by teams from Germany and Czechoslovakia have changed the situation entirely. Nigeria is now trying to set up an iron and steel complex to produce about 200,000 tons per year. Although the coal is not coking quality, there are various other processes than direct reduction which can be used. Through research, an industry that had been written off can be developed. A national fuel policy is needed to make basic policy decisions. For instance, as soon as the decision was taken on the Niger Dam, it was found that gas could be produced for

half the cost previously cited by the oil companies, and gas became competitive with hydroelectric power. The dam at Kainji will be the main source of power, but there is a possibility of exporting the gas in liquefied form. This also reinforces the importance of scientific investigations. Other research has enabled Nigeria to produce its own treated wood electric poles rather than importing them as formerly. Other areas in the electricity industry require investigation, such as consumer relations, marketing research, and distribution questions. A question has arisen concerning the relationship between the existing electricity corporations and the new Niger Dams Authority. Eventually, it is likely that the existing company will be the marketing agent and the Dams Authority will handle the generating of electricity.

Economic Planning and the Use of Data from Agricultural Research

Mr. Ayida, as a discussion leader, suggested that he would try to tie economic planning with scientific research in Nigeria and leave the discussion of agricultural research to Mr. Okigbo. He felt that a point raised earlier by Dr. de Kiewiet was very important, namely, industrializing rural development. Mr. Ayida had attended a seminar at Cambridge last year, chaired by Schumaker, where the suggestion was made that what developing countries need is an intermediate technology. As Dr. de Kiewiet said, there has to be a new type of technology. He defined the term, "intermediate technology," as not rejecting the most modern devices, but not depending upon them, and such intermediate level industrialization should satisfy one criteria--the average equipment per work place should not cost more than £100. The types of industry to be tackled would be consumer goods, building materials, agricultural implements, etc. To do this, Mr. Ayida said, we would have to throw the entire program to the scientists to develop a new form of technology to meet these conditions. Intermediate technology should not be a beginning from scratch, but must adopt western technology. He mentioned the difficulties facing Nigerian scientists. For example, the social status of the scientist depends on the result of his work in a period of time. He is affected by such social forces as family responsibilities and tribal loyalties which inhibit his activities and deter him from single-minded pursuit of innovations. Mechanical equipment should be devised by the practical man on the job; however, in Nigeria, the man on the job has no time to reflect and produce anything. In addition, the Nigerian scientist is often completely divorced from the rest of the community and removed from the farmer and his production requirements. There is no tradition of research; in the villages, children are disciplined for asking too many questions.

The planner's job is to determine priorities and attempt to allocate scarce resources. Agriculture is the vital sector of the economy and unless it grows, there is little that can be done in the way of development. There is a language barrier between scientists and economic planners. Seminars are one way to remove this barrier; on the other hand, planning organizations these days contain people with scientific backgrounds, so the planners understand the requirements of the scientists. The Nigerian scientist has to come down from his ivory tower, participate in the community effort, and work together with the planners to solve Nigeria's problems.

Mr. Okigbo said that Nigerian agriculture is based on peasant conditions which existed years ago. During the past few years, social and economic changes have taken place without any change in

agriculture. In planning agricultural priorities, there is a lack of competent agricultural demographic institutes--perhaps connected to the universities. Another need is to reliable agricultural economic data on which to base economic plans. We do have research in Nigeria, some of which is much more sophisticated than required. Extension work in Nigeria is a recent development. Most of the data relates to cash crops rather than food crops and we do not have enough data to transmit to the farmer on many of our food crops. There is often a delay in publishing and releasing research results, and the release of preliminary results may be necessary to help people who are planning work in the same fields. Their release is sometimes far too late to help people working in particular areas. An example is in cassava. Research efforts often have no bearing on national needs. Sometimes research workers spend their time trying to accumulate data in order to get degrees from foreign universities, while, at the same time, we do not actually know a lot about local farming practices. We have no real knowledge of the compositions of the various mixtures of crops or records of real rotations. We need intermediary people who may be involved in looking at research results and seeing how they can be modified to fit different situations. There is a crash program in training extension workers; many of them have trained for only one year, and reducing the training time has not helped the African extension work. You have to deal with illiterate farmers, and it is difficult to change the food habits of the farmer. We have difficulty in running demonstrations of results where we have disease resistant or higher yield crops. Recently, farm settlements have developed in Nigeria, but they develop information only for cash crops. Farming methods are based on simple hand tools; mechanization of the work is based on a capital investment that no small farm can afford. There are a number of large farms around Lagos growing market garden crops and doing research on them on a large scale. It might be good to concentrate on market garden crops for a canning industry. If you have one or two crops grown to support such a factory, then you might be able to run them without losses. At present, we are limited to pineapple and citrus. It may be necessary to have more experimental farms so that regional experiments of a wider scope could be located all over the ecological zones. Until recently, federal research has not maintained statistical data. The computer is not being used to the extent it should. This is one place where a research council could help. There is also a language barrier problem which makes data from French-speaking countries difficult to use in Nigeria. A lot of work done by Belgians in the Congo is not easily available to those in Nigeria for this reason. What has happened in the case of rice and poultry shows that our farmers will utilize research

data where it is easy for them to see the economics of it.

Sir Joseph referred to Mr. Ayida's comments on Schumaker's recommendations concerning an intermediate technology, saying there it is a mistake to say that an intermediate technology is new. It has been going on for a long time. For example, in the vegetable oil industry in Nigeria. As for production per man in this industry, it is far greater in the U.S. than in Nigeria, but Nigeria has men and the U.S. has capital. What Schumaker has really done for us is to bring to our attention that, although the amount of capital in Nigeria is limited, the number of hands is extensive. A great deal can be done, for instance, in small agricultural implements. In looking at the first period of development up to independence the new period since then, the priority in agriculture first was the introduction into the economy of crops that could be sold; secondly, the improvement of those crops by research, and third, sufficient attention to food crops to ensure that the country would not suffer from a famine in bad years. The plan was dominated by the exchange of agricultural products for the products of urban places in other countries. This gave Nigeria a start in the development process. It is interesting to compare this exchange between tropical agricultural regions and temperate region industrial areas. He cited the example of India where there had been a long-standing exchange between towns which had been upset by the British industrial revolution. In Africa there has not been industrial exchange with the rural products to the same extent, but this has now come. The demands are now different and the priorities must be different. We are faced with the virtual saturation of the western markets with the cash crops, such as cocoa and rubber. It is impossible to base economic development on the traditional exchange of agricultural products for industrial goods. Another factor is population pressure and the associated movement of the people from the countryside to town. A third new factor that governs priorities is the nutrition of the human population so that they can make a contribution to society. We are all agreed that agriculture and the human population are the two great resources in Nigeria. The greatest priority in agriculture is its contribution to the feeding of the towns. Nigeria cannot afford the large and increasing burden of foreign exchange for the purchase of food. In the country where people grow their own food it is less difficult to grow children, but when people move to the towns, they cannot afford the protective foods. Adults may stand this for a period of time, but it won't grow children. An urban population eats differently from a rural population; the traditional foodstuffs are not adaptable for mid-day meals for commuters. Home economics teams might



meet this need. Agricultural growth must take place near the towns to provide milk, garden supplies, etc. This will contribute to balancing the exchange between the town and the countryside.

Dr. Patterson spoke of the South in the United States as the "underdeveloped" section of the country, which is now changing rapidly through the adoption of modern agricultural methods and the realization of its manpower potential. He spoke of his early experience at Tuskegee Institute where, in the past, research people spoke of "pure" research instead of going into the problems of the region. One thing which has meant much to the changing picture in the South was when research people started talking of involvement--this matter of a greater involvement of the population under a new set of circumstances in which the responsibilities and the rewards of development are going to be to the benefit of the total population. Another thing is relevance. The educational system has to be subservient to the basic commitment of development. I do not think it is too much of a compliment that Nigerian university standards are so high that only the United States can admit the young people. They are false standards if they are so high that you do not fill the need for trained people. In up-grading education in the South at Tuskegee, masters degrees were offered in a number of fields, but only to people capable of going on for a doctorate. Many of those people were capable, but there were others, in the summer school--people of 35 or 40--who were asked to improve themselves and to do something that had relevance to the situations in which they worked. They too wanted the word, Masters. We added more courses to the curriculum and saw that they took courses related to their responsibilities. Upon completion of these courses, they were a Master of Education degree. This is the flexibility of approach that has to be aimed at here.

Dr. Weller said that, in listening to the discussions, he had become concerned because it wasn't until Sir Joseph mentioned it that anyone said we are dealing not only with quantity of food, but quality. Cassava is the curse of the humid tropics. He stressed that the agriculturist is a public health worker and can cause good or ill health. With the movement to the cities, new disease patterns come into being just because of the change in food habits.

Dr. Edozien was delighted with the emphasis on food crops, rather than cash crops in the discussions. He spoke of the development of palm oil for export to other countries where white oil of low fatty content is desired versus the Nigerian taste for an oil as red as possible. It is important to change these things to meet

local demands. He said that the question of limited technology was interesting to him, but Nigeria has to have both immediate and long-term objectives. Its long-term objective must be to reach the same technological development as the advanced countries. "I would feel happier in our aims to be cautious and limited in our objectives if I could be sure that at the same time we were planning on reaching the levels of the other countries."

Mr. Ayida said the basic thing that developing countries have to face is to look at development in absolute terms and to realize, whether they like it or not, that the rate of growth in developed countries is higher than in the developing countries. In going back to Schumaker, the conflict there is not that what he was saying was new, but the attitude is new. Defined as he did, it is a new concept. It could be as efficient in an economic sense as the most advanced technology; in this definition, it is really new.

In continuing the discussion of food supplies and proper diet, Dr. Edozien said the shortage of protein has been emphasized lately, but studies in Nigeria show that calory shortage is just as serious. All of the rural population have lower calory intake than their requirements. In city diets, fat provides 50% of this requirement, but the traditional diet does not contain this fat. In planning food production, it is important to take calories into account.

Another point Dr. Edozien raised had to do with intermediate technology. He cited the examples of light industries where automation is confused with modern technology, such as laboratories for the analysis of food and the pharmaceutical industry--both require the most modern technology, but with plenty of labor can be done by hand. He spoke of the need for changing status symbols, saying that, at present, the only things that matter in Nigeria are money and political power. There is need to emphasize that a scientist can have a useful career without political power. Until we can educate society to see other aspects of life, our development will be hampered for a long time to come. Dr. Edozien said that Nigeria is one of the few developing countries with an enlightened financial policy toward research; however, the country is not deriving the benefits it should from the research because of the absence of any organization to evaluate it.

Mr. Lardner said that the feeding of urban populations was one of ECA's preoccupations. By supplying the farmer with credit, new varieties, a marketing system, etc., it is not difficult to get him to change his activities, but when you come to dairy products, this is a different picture. Something radical must be applied to anchor

the nomadic herdsmen in order to develop a meat and dairy industry. Land tenure is not a limiting factor in agricultural expansion. We are using diminishing foreign exchange to buy food. The question is how do we make food as much of a cash crop as export crops? For one thing, there must be a workable marketing system together with transportation facilities and the assurance that goods will flow to the farming communities in return for their food.

Mr. Lardner spoke of the necessity for agricultural engineering experiments to be conducted in Africa. We have to build the kind of agricultural engineering training and education to do such work as research on the soil structure of Africa.

Dr. Lambo felt that, while a great deal of attention had been given during the week's discussions, to the physical aspects of Africa, the human problems had been neglected, the study of motivation and incentives in Africa. If you change the economy, you have to change the attitudes of the people. The so-called sociological factors may require attention.

Sir Joseph commented on Mr. Lardner's point about the difficulty of organizing the production of dairy and food products, saying that it is not just a problem of the people who keep cattle. For instance, in Uganda where cattle have been kept as a status symbol, it was not difficult to establish a dairy industry. The chief problem is in processing dairy products and in educating people in the utilization of dairy products. In Uganda, the dairy was set up at a girls' school where there was a woman running a farm and a dietician to show how to use the food.

### Priorities and International Cooperation

Dr. Onitiri began the discussion by alluding to some of the more important priorities. He felt that the most important and immediate problem is the matter of foreign exchange, because no matter how important the other priorities or desirable other measures may be, with the shortage of foreign exchange, it will not be easy to put them into effect. It may be that petrol will become more important still so that this problem will not appear in the next few years, but as has been pointed out, exporting petrol is not like exporting cotton or groundnuts. The full volume is not reflected in foreign exchange in the same way as food products because of the capital costs involved and the profits to those who found the oil. There are two approaches to solving the problem--one is to wait until a crisis develops and then ask for help from AID and other sources; the other, more fundamental solution may be found in several points already raised; such as processing domestic food. The organizing of our priorities should take into account those measures which are likely to contribute with a short period to improvement in foreign exchange.

As for priorities under specific items, the immediate objective should be to make broader use of existing facilities, particularly in those areas where there is the greatest shortage, such as science teaching, using existing equipment and laboratories--perhaps using them 12 hours a day. One of the measures which can quickly and easily be put into effect is the manufacture of simple laboratory equipment. Furthermore, it should not be difficult to have a pilot scheme which attempts to make better use of the long holidays in the universities. Assuming there are 7,000 college students on three-months' vacation, with one month needed for study, then they have two months for vacation employment. One could start a pilot scheme which puts every university student to useful work during those two months teaching short courses in secondary schools. In this way, it may be possible to improve science teaching within a comparatively short period.

As for division of labor, again a lot of effort is required and foreign assistance could contribute. The use of facilities can be worked out between the universities and research institutes. We are already working on methods of diffusing research information, but only in economic and social studies; technical studies could be added. There could be a comprehensive volume of references for those engaged in research and it could be widely distributed. Interdisciplinary research can be encouraged. Most of these are problems

of organization.

In the field of natural resources, the first essential step is to have full knowledge of what we have. There should be geological surveys, fisheries surveys, agricultural products, underground water resources, and then examine their potential. We can use foreign laboratories to test the properties of products, for instance, and later establish our own. In the field of agriculture, we should pay particular attention to food crops. Our agricultural and other raw materials should increasingly be the basis for domestic industries. In this connection, the existing facilities for research into food processing and preservation could make significant contributions within a short period. This ties in with foreign exchange with our neighbors and opens a market which can support a considerable amount of industry. With the necessary capital and the techniques available within a short time we can proceed further with substituting our own materials for imports.

In the field of international cooperation, the needs could be divided into three categories: scientific, technical assistance, and personnel. Technical assistance should be directed as much as possible toward the building up of local institutions which must take increasing responsibility--institutes for medical research, agricultural research, laboratories for testing soils and other materials. Before these institutes can be built to the desired level, arrangements can be made to make use of laboratories abroad. I need not say much about financial assistance--the more we get the better. These programs would be partly bi-lateral and partly multi-lateral. It is not for us to say how a country will give us aid, but we would prefer multi-lateral aid. The Lagos Plan has laid down the principles which African countries should follow in programs of technical assistance to other African countries. Nigeria is in a unique position. Although it is a developing country, and a poor country, it has a large number of scholars who are known and respected in all parts of the world. It also has a number of institutions which can be built up quickly to reach a level where they can contribute to the solution of problems of development in other countries. Given these favorable circumstances, it is desirable that research and technical assistance for research be organized on the basis of more cooperation between local scholars and foreign scholars so that foreign assistance may have more than quantitative results and will improve relations between institutions, between nations, and between scholars. Mr. Onitiri cited an example where AID decided to put more resources into agricultural research in Nigeria and formed a consortium of American universities who have contracts in Nigeria to undertake this program. If we had known of

this beforehand, we might have had suggestions to make, but the AID contract had already been signed and the only thing we could do was accept it. Here was an opportunity to bring Nigerian and American institutions together as partners; we lost that opportunity. There have been a number of breakdowns in communications, such as the one in connection with the marketing study, another on economic development and rural improvement. In both cases, Nigeria had been planning or was already engaged in similar research and AID contracts were signed with foreign institutions without any collaboration with Nigerian institutions. There must be a way of ensuring that money spent on big research should be used as far as possible to build up local institutions. It is here that the main task of research and development will be done. There are series of scholars coming through our offices asking the same questions. We think measures could be taken to remove these problems. I believe foreign assistance exists not only to get quantitative results, but also to improve relations among people. It is only in this way that foreign assistance can contribute its maximum effect to development.

Dr. Jones said it would be hard to find an economist today who wouldn't agree that there is a necessity to plan, not only in developing countries, but also in the industrial nations. What planning means is to assign priorities to actions. However, we should not think that an economist can take a list of 30 or 40 high priorities and assign even rank orders to them, let alone value figures. In the first place, there are technical problems of data, of accurate observations, and necessary quantitative information. The countries with the greatest need for planning are also the countries with the fewest statistics. There are inadequacies of data even in the highest developed countries; until the time of World War II, economists had not devoted much attention to the growth process and there are deficiencies in theory. Debates have been going on for a long time on the basic questions. One is the debate about whether to industrialize or go to agriculture; the question now is how to do both and achieve the most rapid development. There is a deficiency in knowledge of relationships, and there is another problem which may be insuperable. The economist in addressing questions of inputs into all kinds of activities has tried to devise a mechanism for measuring the productivity of these investments in terms of increased outputs of goods and services. There are benefits that cannot be measured in terms of price. For instance, some of the benefits that result from building a dam, such as the benefit people get from fishing in the lake. You are dealing with two different kinds of benefits when you consider investments in a dam, in roads, or in education. What needs to be done in this situation is for the economist to carry his analysis to things that can be priced

through marketing systems or shadow prices, and leave these other things to the citizenry. In road building in Mexico, for instance, there are three classes of roads: the national routes, the economic penetration roads where they attempt to calculate what the increase in agricultural production would be, and roads of another type which cannot be justified on economic grounds, but are considered desirable by society. The burden of what I am trying to say here is that the economist cannot be expected to give detailed assignments of priorities to the tasks that need to be done. I feel that when priorities are set, it must be on very broad lines. Decisions must be made from day to day. Mr. Ayida's introduction of the concept of intermediate technology opens up an important way in which the economist can assist research and development people. This is a question of a combination of factors in production and the objective should be in each how to use the factors in a combination that will give you maximum output versus input. There are liable to be a number of industries where it would be desirable to adopt the most highly automated system because of the shortage of skilled labor. I think the way the economist can reinforce the tendency toward producing desired inventions is by attempting to provide the research and development people with the relative factor cost, not only from a marketing point of view, but from an over-all social point of view, so that the man engaged in developing new devices and new techniques will know what he is doing. As to priorities and the discussion of relative proportions of research expenditure that should go into basic as against applied research, I would like to urge another way of distinguishing research which may be more useful: to classify research according to the estimated time to pay-off. In view of the great need for immediate decisions, a rather high proportion of research money is going to have to go into short pay-off investigations. At the same time, the longer-range studies must not be completely neglected. The distinction between long pay-off and short pay-off research has another implication which is important. That is that the short pay-off research investigations are likely to be loaded with political implications. There needs to be a part of the scientific community in a position to announce and publish findings that may be a little bit unpalatable to government.

I think it was Mr. Onitiri who introduced the necessity for increased communication among scientists. I would place high emphasis on devices to increase the communication of knowledge. Other scientists in Africa and elsewhere need to be apprised of Nigerian research, just as Nigerians need to be apprised of research elsewhere. It is important to recognize too that Nigeria, as a large, powerful, high-potential country, has a great responsibility to the other African states and to other countries in the world.

Dr. Brown said he would like to spend some time talking about an item of highest priority, i.e., the achievement of an appreciation of the time scale that is involved. In the past 20 years, research has been more or less confined to things that would pay off in a two-year period. If a 20-year time scale had been used, we might have something now. It takes 25 years to produce a scientist and about 15 years for a result in the laboratory to be put into practice on any real scale. Our Department of Defense counts on a 15-year time lag between the actual devising of a system and its being put into widespread use. In the United States, the scientific and engineering population has expanded at a natural rate of about ten-fold every half century. It is possible to increase this rate, but to achieve a rate of 30% is virtually impossible. Let us suppose that a system could be devised to maintain a growth rate of 10% a year in Nigeria. Starting off with 500 today, this would mean a doubling time of about 7 years, and in 50 years you could have a technical population of 55,000. In 50 years, at the current rate of growth, your population would be about 200,000,000, which would give one technical person per 3,000 population, which is still much below your needs. It will require a lot of imagination to maintain a 10% growth rate; in the first period, you would want to produce about 100 a year and go up to 1,000 a year. How can one identify the potential candidates early enough and channel them into this kind of university and interest? In the U.S., the kinds of persons who go into this are considerably above average intelligence. Also, they have to have the motivation. Dr. Lambo spoke of the different circumstances in Nigeria which inhibit the development of this kind of curiosity. This is a problem which is faced elsewhere, and I have been impressed by a recent development in Turkey which might be applicable to Nigeria. They are attempting to develop a technical high school, a boarding school, where they attempt to identify, as early as possible, the children with the highest I.Q.'s and those children are given free tuition, room, and board. When they emerge, they have a good scientific and engineering background which equips them to go to the university. If one considers the creation of such an institution, which would produce 500 a year, such a mechanism could conceivably provide the raw material for the first 25 years of your 50-year program. Perhaps you could build several of these. It is going to take an unusual approach to this problem to achieve this 10% growth rate. During the initial stages, there is going to have to be a great deal of importation of technical people from other countries. The question is where these people would come from and what kinds of arrangements are necessary. The question of bi-lateral versus multi-lateral aid has been raised, and I agree we would all prefer multi-lateral aid, yet when we look



at the way UNESCO operates, I cannot imagine your needs being met in this way. I think there will have to be bi-lateral arrangements. The Nigerian scientific community has to fraternize more with the world scientific community so that the world scientific community becomes aware of your problems and so that you can identify those who will become interested in your problems.

Dr. Myers was encouraged by the recognition of the importance of food crops, and spoke of the development of an International Institute of Tropical Agriculture which is about to become a reality through the Ford and Rockefeller Foundations and the Government of Nigeria. Plans for this Institute have been criticized because they do not contemplate any work on industrial crops. This is justified by the fact that food crops have been neglected. However, he did not believe that industrial crop research should be discontinued. Cocoa is still an important economic crop to Nigeria and curtailed research would soon destroy its competitive position with other producing countries. The production of natural rubber can be economically competitive with synthetic rubber. One way to do this is by research on the efficiency of production. You have to make a choice between a number of places to spend your money and all are essential. Referring to Dr. Onitiri's discussion of the institution-building aspects of foreign assistance and the need to build a partnership, Dr. Myers said no one could disagree with this basic viewpoint, but it has to be approached in a less than ideal fashion. While Nigeria has some brilliant young men earning Ph.D.'s, they lack the wisdom that 15 or 20 years of experience will give them. A senior scientist from abroad would be more effective. We should work toward the complete partnership and still recognize that the ideal may not be attainable in the immediate future.

Dr. Page said that, in regard to the foreign exchange problem, the best solution would be to use non-returnable natural resources. It is rare that someone can use the natural products they have in a complete, integrated industry in the early stages of development. Therefore, a little more effort on the production of exportable metals and fuels might be the answer to foreign exchange. Some say they would like to keep their non-returnable resources for the future, but this is wrong because this is the way to earn the money to develop. By selling this material, you do not have it later, but with the development of technology in your country, you will be able to use metals which could not be sold at the present time. Metals will be reworked at an economic profit. I suggest that consideration be given to the possibility of expanding production of high-grade mineral resources at the present

time, knowing that when you are more developed, you will be able to handle the lower grade materials.

Dr. Edozien spoke of the amount of foreign research funds coming into Nigeria, a considerable amount of which is for the benefit of the foreign countries rather than related to Nigeria's needs. He agreed with Dr. Onitiri that wherever possible this should be used to increase Nigeria's research capacity, but felt Nigeria, through some organization, should have a directory of research to give these people a clear picture of Nigeria's needs and priorities. Mr. Ayida did not agree that research unrelated to Nigeria's needs should be acceptable. He said, to the extent that their attention is diverted, Nigerian priorities are distorted.

"Expansion Chamber"

Dr. Patterson asked Mr. Nixon to comment on AID agricultural programs in Nigeria.

Mr. Nixon said the AID-Nigeria agricultural programs started in 1962 as a joint operation with the federal and regional governments. At present, there are about 200 positions, of which about 65 are in the universities. The university contracts are: Michigan State with Nsukka; Kansas State with Ahmadu Bello in the fields of agriculture and medicine; Wisconsin and Ife in agriculture; Colorado State in Eastern Nigeria with the Ministry of Agriculture at a two-year agricultural college concerned with training agricultural workers. These universities are engaged in development, training, and research. Ahmadu Bello has combined teaching and research. Mr. Nixon enumerated various colleges and universities receiving AID assistance, or where contracts are under negotiation, saying that a considerable amount of AID resources in Nigeria are devoted to agricultural education, in training in extension activities, carrying research information to the farmers. He felt more optimistic than his Nigerian colleagues about the research under way on food crops. AID has emphasized research on food crops from the beginning. Research and package demonstrations on three food crops has increased production from 70% to 85%. More research is needed and it is a continuing thing. AID has assisted Moore Plantation; it has provided them with an agronomist, and entomologist, a plant pathologist, and a pasture agronomist. There are people working with poultry, cattle, and swine. There is a horticulturist at Benin. He felt it would be a mistake to discontinue research on cash crops. Work is starting now on a cattle breeding program in the north, primarily through selection and improvement of local breeds. We are helping develop three poultry stations in the north. Poultry is very important as it provides protein and is something the small farmer can do, and there is interest by private entrepreneurs. Agricultural credit is important. Unless the farmer has credit at the time he needs it and is assured he can get a fair price for his product, there is not much use telling him the results of research. In response to that need, AID is bringing in people to help establish a good agricultural credit system. We are starting cooperatives. There is a nine-man team making a feasibility study in the Lake Chad area to see whether it would be feasible to go into irrigation in that area. There are participating agency agreements whereby people come out to work in Nigeria. The Bureau of Land Management has five people in northern Nigeria helping to improve

grasslands. We have a soil conservation team, also in the North, establishing training centers; a six-man team in the North has done work on determining underground water supplies; in the planning stage, there is a request for a team to work on water resources in association with the federal government. Fertilizers are important and are not adequately used at present. There are three men stationed in different types of farming zones in the North to try to develop better kinds of tools and tillage instruments. We have a tsetse fly control program which has been very successful. There is a pilot dairy outside of Lagos. Work is being done on a virus-resistant potato. Mr. Okiy mentioned soil fertility research as a major need, and we have several areas of lateritic soils where erosion has been pretty well controlled. The proper classification and use of the land is tremendously important and will have to be looked at carefully.

Mr. Nixon concluded by saying that AID has a bigger agricultural program in Nigeria than in any other country in the world, and by and large the programs are sound. However, AID cannot do all of them. He felt that a meeting such as this can help people working in Nigeria to sort out the priorities, and he expressed the hope that this would not be the last meeting of this kind. He also expressed appreciation that the Ministry of Agriculture and Natural Resources has been formed in Nigeria and the hope that AID can work closely with the Ministry.

Sir John spoke of the lack of statistics on population growth, and wondered whether the Nigerians consider this a serious problem and whether there was any policy on growth.

Mr. Ayida said they did not know what figures to use in planning, but felt that this is a problem that a demographic institute could solve. Dr. Njoku doubted that any population growth controls would be needed for a long time. It was mentioned that there is to be a population conference in January, 1966, in Ibadan.

Dr. Brown voiced concern over the problem, saying that in other areas growth rate figures were about 2% a year. In view of Dr. Edozien's figures of 40-45% fatalities per thousand people per year, and what has happened in other countries where statistics are good, infant mortality rates can be expected to get cut down very quickly. Then you find yourself with a population growth of 4% a year. In Central America, the food production has been declining, and infant mortality

has declined so that you get a figure where 50% of the population is under fifteen years of age and not able to produce anything. The handwriting is on the wall, and I think the time to do something is now.

Mr. Lardner said there is a population explosion in Africa. He cited the case of India where ten years of propaganda has had no effect on the population growth. The key is that one discusses population without relating it to economic growth and resources. There are dangers in the unrestricted concept of stopping population growth. If you alter the balances without thinking how you can change them later, you are in trouble.

Dr. Lambo said the United States is coping with the problem of aging and S.E. Asia with the population of the younger people. Certainly, the balance will have to shift. Both Drs. Weller and Edozien mentioned the improvement in the health sector. We now have about twenty doctors to 1,000 population, and this contributes to the death rate. The future population of Africa may be doubled by the year 2000; the population of the rest of the world will stay about the same. In the circumstances, the most important question would be development of African resources to keep pace with the growth of the population--or should we think of preventive measures?

Sir Joseph commented on Mr. Lardner's statement that it would take ten years of propaganda to have any effect on birth control. He felt that was a good argument for starting ten years ago. It requires a longer sighted approach than any other problem. There are two sides to the problem--the rate of increase in utilization of resources and the increase in population. We are all concerned with an increase in utilization of resources. The fact is the other side is controllable; it is up to the human race to control its own multiplication. We have to begin thinking now of the population in the future. If we had a population policy, it might be that we should want a bigger population than we have now, but we should be thinking about it to get some idea of what we are aiming for and not waiting.

Dr. Okigbo agreed, saying that an early start should be made because of the cultural and health problems that affect many people. It comes to a matter of education, as well as ensuring the survival of children.

Dr. Weller said he joined with Dr. Brown in stressing that the educated Nigerian has a social responsibility to start thinking seriously about the population problem. We are bringing people into the world who don't have a chance to lead a healthy life and have a proper education. Economic and social development has to progress, but we have a long way to go to catch up with the population problem at the moment. It is dangerous to think in terms of the number of people per square mile.

Dr. Munger said it is implicit in all the discussion that the development we speak of would be undercut if there were political instability. Urbanization is a great threat to the African states. Leopoldville grew from 80,000 to 240,000 in a few years; this toppled the Belgians; it toppled Lumumba. Urbanization breaks down tribalism, but there are areas where it increases tribal friction. Furthermore, if we have increases in urbanization, Lagos might be seen as a fuse for Nigeria which might easily be set off by a rising tide of frustration. Urbanization tends to be a one-way street. Planners have a responsibility to think of long-range political consequences. All Nigerians recognize that Nigeria is really looked up to as a symbol. There is a great chance that ideas and developments that take place in Nigeria will be accepted in other parts of Africa. If things go right, Nigeria could be a whole catalytic force for the continent.

Dr. Lindvall mentioned Mr. Lardner's comments about gaps in the technical education in such things as design engineering, electrical engineering, etc. He said the trend in modern engineering education is toward adaptability rather than specialization. An example of over-specialization was the USSR which has some 170 discrete curricula in engineering. The adaptability of people in terms of fundamental education is significant. During the war, it turned out that physicists were extremely good engineers, and it was the broad, basic education that made this possible. The understanding of how to attack a new problem--to transfer knowledge from one field to another--these are the things we are trying to incorporate in our development of engineering education in the States. One thinks of civil engineering in a narrow context, but there are many broad aspects of civil engineering, with broad interplay of physical and natural sciences. Examples mentioned were hydrology, computer data techniques, structural work and, in tropical Africa, questions of life of structures in terms of long-term engineering. There is erosion control, road construction, and town planning. In mechanical engineering, there are turbines, hydraulic machinery, control systems, automation. Automation is

frequently a matter of competition, but there is another face of it and that is quality control. The relation of engineering to agriculture is the development of suitable equipment. Electrical engineers have broadened out in the past few years into communications, which is a broader term than radio or telephones--in storage retrieval. This field includes lighting and power, designing manufacturing controls, a whole field which requires cryogenics, acoustics, magnetism, application of electronics, etc. Another area is planning and management which need a background in humanities and social sciences as well as engineering.

Dr. Patterson introduced a discussion of training abroad versus training in Nigerian institutions and raised the question of whether a student, having completed his undergraduate work abroad, should return home and have direct contact with the problems and needs there before returning for a higher degree. Dr. Brown felt that everything should be done to give the student training in Nigeria, particularly at the undergraduate level, and that scholarship money should be reserved for post-graduate work which can be obtained in Nigeria, or sponsor professorships. Mr. Okiy said it is sometimes necessary to call a student home before he goes on for his Ph.D. They often specialize in the wrong fields otherwise. Dr. Edozien said it is a very complex problem. Only recently has there been any organized training for Nigerians to study in the U.S. Many students who financed their own studies in the U.S. studied such things as journalism. Now that there is a clearer picture of what they should study and what the priorities are, we have a clearer picture of what the U.S. can do to help. When we get back to Nigeria, this is one of the major things on which we should have our own workshop or seminar. One important factor is that in some fields, such as electronics, there is no place in Nigeria for a student to study. Whatever we do must be a cooperative enterprise with other countries, and wherever possible Nigerian institutions should be built up. Dr. Arikpo said he had recommended to ASPAU that it would be possible to spread the money wider by paying for part of the student's training in Nigeria. Dr. Myers said the demand for scholarships is increasing and resources are declining. There are abundant opportunities for support of students at the graduate level in the form of research assistantships. Dr. Page spoke of another type of grant--the in-job training grant. Trainees come to the Geological Survey to spend a year actually working. This probably happens in other agencies and in industry. Mr. Okigbo said students have been in training arrangements for

many years, where universities submit lists of individuals to be trained. If the emphasis were put into areas where we lack specialists, it is possible more students could be included.



### Regional Cooperation in Africa

Dr. Lambo said there is danger of isolating Nigeria and its problems and not relating them to continental programs. He said he would confine himself to the Scientific Council for Africa and its scientific activities. He remarked that it was fortunate that authorities on particular aspects of science and technology and on economic development were present. Knowledge about growth of population in Nigeria, its biological materials, transportation, communication of knowledge, education, and health are of great importance in attempting to assess what the future will hold. These subjects form an important part of the contribution which, in cooperation with international groups, we must make and make quickly. Why is it necessary to have a single commission dealing with scientific and technical research on a continental basis? Africa is the second largest continent and claims one-fourth of the land surface. Its position in relation to other land masses is interesting; this may be of great strategic and political significance in the future. There are 125 political units in the world and Africa claims more than 50. Despite its size, Africa produces only 2% of the total world output. The income per head is only one-tenth that of the industrialized countries. Forty per cent of the total wealth comes from agriculture. It is estimated that the African farmer produces only 0.5% of the output of highly mechanized agriculture. Africa potentially could produce the equivalent of power produced all over the world; of the 15 river basins on the globe, Africa has 6, and each is shared by a number of political units. International cooperation is needed. The most important question is, will the development of African resources be able to keep pace with the population? Africa must overcome a legacy of social, scientific, and economic separatism. The boundaries which divide African states are so nonsensical that without a sense of unity, they will be a cause of friction. Before STRC there was the CCTA, supported by Belgium, South Africa, etc. Dr. Lambo explained the structure of the STRC, its functions, and the joint projects, and the question of priorities on an inter-African basis. The Scientific Council, which is the advisory body to STRC, is made up of scientists from the African countries who are nominated by the African governments. This means not only that the top scientists provide the advice, but also that they have influence in their governments. The main operations are bi-lateral and multi-lateral programs--usually multi-lateral. CSA functions include research, usually applied of a long-range nature; surveys; training programs; and educational programs--this takes the form of technical and scientific publications. A major area is coordination with ECA through specialized committees on individual programs, and free exchange of technical and scientific information. Commission V

maintains strong liaison with the other Commissions. Joint projects include the Atlas of Africa, analysis of the salinity of sea water, the Guinean trawling survey, psychological testing (a pilot study in Nigeria and Senegal, which has been very successful and will probably be extended to other African countries). Mr. Okoy was chairman of a session to which three African countries sent representatives to plan guidelines for research in STRC in 1966-67, and to carry out projects still in hand. They decided on the following disciplines: agricultural crop research, animal production, soil research, forestry research, arid land research, oceanography, fish research, biological research, aquatic taxonomy, etc.; industrial research, geological and geophysical research, building materials, roads, solar energy and petrology, physical chemistry. The short-term program for 1965-67 included the symposium in 1965 for the promotion of specialists meetings in Africa, the symposium on introduction of plants in arid zones, setting up centers for work on vegetable fibers, improvement of soil fertility, fodder crops, etc. He listed a number of bureaus: the Inter-African Soil Bureau, Inter-African Committee on Linguistics, Bureau of Trypanosomiasis Research, Soil Utilization, Wildlife.

Mr. Nixon spoke of some of the projects in which AID is participating with STRC. The first was the Project 15 on rinderpest control which he described; the second concerned the cereal crop project in Africa, which is concerned with sorghum, millet, and maize. The West African part of the project is a cooperative activity with STRC, AID, and the Nigerian Department of Research and USDA. This project is an effort to bring together the selected varieties of the crops and do work on disease control, geographic tests, control of insect pests, and training of personnel from the operating countries. The project in East Africa is patterned along the same lines. Mr. Nixon described the trawling survey which has gone on for three years. A final report will be finished by December 31, 1965, and will be of special benefit to the commercial fishing industry. A soils map of Africa has been completed and published and some distribution has been made. Mr. Nixon said there were other projects which he was not associated with, such as the regional training center for English-speaking national parks personnel. Going back to the rinderpest project, Mr. Nixon described some of the difficulties of funding the project, which is too large for AID to fund alone. He didn't know whether EEC will fund any of the future phases of the project or not.

Mr. Lambo expressed appreciation for the U.S. AID programs and said there were many more that Mr. Nixon had not mentioned. "We have been worried," he said, "about sources for financial support." Support formerly came from European countries. Discussions have been held with Scandinavian countries to see whether they could be involved

in some multi-lateral projects. They are keen on bi-lateral aid, and because of the nature of our request, they are going to send a commission to examine the possibilities and see what areas they could explore. Most of the small countries cannot afford to participate in major projects.

Mr. Nixon said that, although they are not able to give financial support, the participating countries have given material support and are doing their share to the extent that they can.

Sir Joseph felt the rinderpest project has the prospect of great advances in animal industry in Africa. He likened it to the locust control project which was very successful, but was not maintained, and hoped that, when the "bush fire" of rinderpest was put out, the fire brigade would be maintained. Dr. Weller said he would take a dim view of AID trying to supply the money for maintaining the rinderpest program; unless it is kept up, it might be money down the drain.

Dr. Edozien did not believe there was sufficient coordination between OAU and the UII agencies.

Mr. Lardner described the function of EEC, which is to accelerate economic development. The transformation of economies involves industrial development, but EEC is interested in agriculture with special reference to food. We don't believe that all African countries should become self-sufficient in food or anything else; otherwise, trade would be affected. We have the recommendations of the Lagos plan, the STRC lists, etc., but we must agree on a minimum program. We have to find the techniques of inducing the farmer to change his production habits and patterns without waiting for literacy. I do not think this is a necessary condition to transforming agriculture in Africa; it does involve sociological research. We must promote the expansion of studies of water-borne diseases. In building these big dams, their cost calculations are market cost calculations, not social calculations. These are very often overlooked. Markets require transportation and there is no easier way of increasing the transmission of diseases than by extending transportation systems. From the point of view of the development of the entire African continent, if Nigeria becomes a model, then you have also to forge a link by which there is benefit from Nigeria in other countries.

Chief Deko said the questions of food and population are of great concern to his organization. He felt that it is a global problem. It is difficult to coordinate because powers change so often. In the question of nutrition, for instance, there is a Nutrition Commission for Africa which is a joint body of the FAO, WHO, and CCTA. The CCTA

was changed to the Fifth Commission, and the question is who should handle this function in view of the fact the OAU has a Third Commission which deals with nutrition.

Dr. Lambo said there has been a great deal of effort to intensify coordination. One example is the specialist meetings. Of 31 such meetings 21 were attended by representatives of FAO, WHO, etc. In addition, many of the scientists in Africa also serve on international committees.

Mr. Okigbo felt that plant quarantine regulations should be more seriously enforced, but assistance would be required to fund it. With regard to the STRC meetings, he felt that announcements should go out much earlier to permit more people to attend; and should be scheduled so as not to conflict with university openings, etc.

Dr. de Kiewiet praised the workshop as one of the best meetings he had ever attended. We now want to pull out the items which we know to be important and on which we might need some action or decisions. There are those that must be taken care of now. Where do we go from here? How can we best carry on a dialogue? There are others that are not quite so immediate, but which deal with items on which further discussion might take place. One important item was the manner in which scientists from outside Nigeria can be of assistance. One way would be assisting in the input of qualified, expert men into areas where the need cannot be satisfied by trained Nigerians. What delegation of problems could be made to American institutions?

Mr. Okiy thanked the members of the American Academy of Sciences for bringing the group together to discuss common problems in the development of Nigeria. The workshop brought many things to our knowledge in areas where we did not quite understand or had not attached much importance to them. There has been some misunderstanding between various groups in Nigeria and the workshop has been a great success as far as that aspect is concerned. Nigeria has a very great role to play in Africa. Apart from sending technical assistance to other countries, just by achieving success in our own field of development, Nigeria will be contributing to the development of other African countries. We hope our friends in the National Academy of Sciences will continue to take the initiative in continuing our dialogue.

Dr. Lambo felt one of the most important things in the meeting had been the opportunity to outline a number of areas which need coordinated effort and which should be on a national scale. He said it is obvious that each of them is devoted to a narrow field and they have not been able to coordinate on a national front. One immediate priority is to

organize the National Research Council. Then we shall have a very important forum through which we can act and coordinate within our society. Another short-term priority is the continuous dialogue among Nigerian scientists themselves. Many of the questions discussed here need more detailed examination when we go home. A third point is the question of strategy to be formulated by the Nigerian scientists to get across to our administrators and national leaders. Dr. Weller raised the point that when a person becomes a specialist in one area, he wants to remain in that area. We are not such specialists, but leaders. Our roles must change from time to time to make more effective use of the potential leadership in Nigeria.

Dr. Lambo: I think this has been a wonderful experience for all of us and we are extremely grateful to the National Academy of Sciences. We will need good will and cooperation and give and take and a lot of planning on our side. From the point of view of long-range planning, I feel that much more intensive cooperation between the Nigerian and other communities must take place. It may be, as time goes on-- especially when we have our two organizations (NAS and NRC) in Nigeria--that two committees could go into greater detail. We could form a joint committee of our two scientific communities, with other outside bodies, to explore and discuss and act together on priorities. They could meet once or twice a year. Your group could come to Africa or our group could come to the U.S. and talk again. Joint action in one or two fields may cement our relationship in a more concrete way, and we hope it will grow and go on and will bear fruit in many ways that we do not even imagine now. ...this meeting will form a model for other parts of Africa and other governments in Africa. We believe we shall achieve a great deal through mutual cooperation and exchange of information, and a great deal of cross-fertilization of knowledge. We shall work very hard in Nigeria, not only to start the two institutions, but to get together informally from time to time to review this and to bring our thoughts in line with what should be done in Nigeria.

Dr. Brown: The scientists of our Academy have been groping for some time trying to find some mechanism by which they might devote their energies to some of these serious problems and so that they might cooperate effectively with colleagues in developing countries. We have had discussions between our Academy and AID, and there is a growing awareness in parts of that agency of the importance of research and development in the whole process of economic development. I would hope that we can explore together the possibility of our forming a joint group--much like this group here. At first it might be informal until you are able to formalize it through a research council.

This group would have two major obligations initially. First, it would be useful if such a group could attempt to assess what the research and developments of Nigeria are likely to be as a function of time. These are difficult to assess and should be taken sector by sector. We may wish to form special panels in agricultural research, highway construction, geology, marine research, etc., and to make as realistic an assessment as we can over a two-year period. Then, using this assessment, attempt to formulate recommendations as to how best those needs might be met. I would visualize that this group would also assess the engineering needs of the country. Once these recommendations are made, I would hope that the Nigerian group would attempt to inject this thinking within its own government and that our group could see what our government, the foundations, and universities could do to help meet part of those needs. We would be prepared to put a staff man on this. I hope that each group could have a chairman and a staff man. It is important that the people you put on your committee be close to the government--a high level person from the Ministry of Economic Planning, the Ministry of Education, etc. There is no point in making recommendations unless they are brought to the attention of the highest authorities.

Sir Joseph described the changing attitudes in Great Britain since colonial days, and expressed the hope that Great Britain would be able to start on an equal footing with the U.S. in assisting in the development of the new African countries on an equal partnership basis. He hoped that Britain could make a contribution in young men who would be willing to spend at least part of their lives working in developing countries. The Royal Society has taken the line that one of its functions is to foster the movement of men rather than the movement of money. Overseas work should be on a long-term basis simply because a lot of things cannot be done in a short time. The really important thing is the exchange of people. One way of doing this, for instance is provided by the Leverhulm fund to send Ph.D. candidates out to do research in the developing countries.

Dr. Njoku said he understood that the Royal Society had Leverhulm professorships as well as scholarships, and wondered whether such professorships might be supported in Nigeria. Most research institutes in Nigeria have counterparts in the U.S. and the U.K. who are doing similar work. Could they form some links? As to partnership, in the U.S., for example, there are many research contracts with Nigeria and other countries. Is it possible to ensure that these projects are linked to people in Nigeria so that the training aspects can be fully exploited? These types of links and associations will require that someone in Nigeria initiate them and ask for them. We hope our two new organizations will be useful although we do not expect too much from

them initially. We will require advice and encouragement such as we have had at this meeting and hope we can call on the NAS and the Royal Society for help. We realize that the responsibility lies with us to get our scientists and administrators together to hammer out our program.

Dr. Weller emphasized that we are focusing on people and the production of outstanding people will have more impact than staffing institutions. There must be long-term opportunities for careers in assisting our fellow men around the world. A word of caution is compelled here because it would not be fair to let Nigeria get its hopes too high. Something like 10 to 20% of budgeted faculty positions are vacant because we can't find suitable scientists. The same is true in the public health field. There isn't a developing country in the world that doesn't want help and the supply of people is very thin. Here is where you can help us. We have a dedicated group of young doctors who need to be shown opportunities for a very satisfying career. At Harvard, we have single-minded medical students who have been sent abroad. They can't do much, but if, in a long-term view, you may stimulate them to make a lifetime career, then you are investing in the future.

Dr. Edozien said that, as a result of this meeting, Nigeria could not expect an immediate increase in the amount of technical assistance. However, the meeting has enabled us to see problems in better perspective. We can consider how best to utilize the same amount of aid more effectively, and that would be a great achievement.

Dr. Jones spoke of another resource, aside from AID and the foundations, which the Nigerians might tap, and that was the growing interest and awareness of American universities and scientists in many disciplines with the problems of the rest of the world. We should sell to American universities that this is an activity in which they must engage and a place where there is a real and critical need and that the contributions made to our institutions would equal those made to the Nigerian institutions.

Mr. Lardner said we are not talking about research for the sake of research, but for the benefit of society. If we forget these things, we may waste our resources. With the expansion of technology in the developed countries, we cannot expect a continued supply of skilled people to the African region. Unusual methods have to be found to accelerate the development of scientists and technology.

Dr. Arikpo said he had been interested in the fact that the university people at the meeting had recognized the necessity to adjust training programs. He hoped that the report of the workshop would be made available to Nigerian universities because not all of them were represented at the meeting. My Commission has been very concerned about many of the problems of training discussed at the meeting here, such as special summer courses, teaching at secondary schools during vacations, and changing the pattern whereby 60% of the students are in humanities and only 40% in sciences.

Dr. Munger was interested in Dr. Onitiri's remarks about setting guidelines for visiting scholars and wondered whether one of the Nigerians might discuss this at the forthcoming meeting of the African Studies Association and say something about the possibilities for research.

Sir John said another source of trained people might be among junior research Fellows, such as those at Cambridge. When established, the Academy of Nigeria might establish fellowships to attract these people.

Dr. Brown said he would not like to see the meeting end without coming to a tentative feeling as to where and when the dialogue might continue. He suggested that it might be continued in Nigeria in February or March 1966. Perhaps by that time the Nigerian Research Council will have been established and this could be in cooperation with the Council; otherwise, it could be on an informal basis.

Dr. Munger said there is a lot to be said for not having the meeting in Lagos, but for having it in another African country. Dr. Brown suggested that someone be appointed with whom arrangements could be made for the meeting.

Dr. Lambo said they had already discussed the possibility and felt they should discuss the matter in Nigeria and get the views of the Government when they returned. Then within a few weeks, they would communicate with the Africa Science Board.



APPENDICES

RAPPORTEURS SUMMARIZATIONS  
OF WORKSHOP SESSIONS

Note: None of the following  
rapporteur reports has been  
reviewed by the authors, and  
in some cases, it was not  
possible to identify the author  
with certainty.



Report of Session on "Development of Scientific Personnel:  
Education and Training"

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by Dr. John J. McKelvey, Jr.

During the session on the training of scientists, Dr. Njoku called for action items and recommendations as to what can really be done toward the training of scientists. This led to a discussion of middle-level training, and Sir Joseph spoke of getting freedom from the Sixth Form and allowing Fifth Form students into the universities. This led to a discussion of improving middle-level training, and Dr. Okigbo recommended strengthening secondary school training. Dr. Lambo added to this, suggesting that the institution of summer school and short courses be started. He suggested that junior colleges be developed devoted to science, to replace science courses in the Sixth Form, and the initiation of a two-year diploma course in technical subjects. Dr. Onitiri commented that Nigeria is possibly not using its facilities as well as it ought, and that, during vacation, students should teach in high schools. Dr. Edozien suggested, for the short term, to develop Sixth Form courses, but to have two-year scientific training in the O level for the training of students who would go into middle-level professions. Dr. Ayida compared courses of the Sixth Form and suggested it was three times as expensive to do this in the university. Dr. Edozien urged the establishment of Nigerian post-graduate studies. Dr. Arikpo commented on the brain drain, but subsequent discussion showed it was less of a factor today than it was earlier. Dr. Edozien suggested the creation of more internal fellowship possibilities. Certain schools have an abundance of students.

Mr. Lardner stressed the need to modernize university courses. He emphasized the importance of industry entering into the training field, and spoke of the ECA study on the present curriculum.

Dr. Weller reminded us that we had only talked about universities and research institutes, and that there is another type of organization--the service-type institution dedicated to applied science. Such organizations could give in-training apprenticeships. Dr. Lambo pointed out the problems of degrees and the importance of degrees to Nigerians attempting to find positions.

Returning to the general manpower situation, Dr. Brown suggested that the growth rate in the production of scientists and engineers has been about 10%, and the maximum is about 30% per year. He went on to say that to achieve this, two things are important: importation of teachers and development of post-graduate studies--all perhaps in the field of agriculture. He proposed that a subcommittee be formed to study ways and means.

Dr. de Kiewiet asked for descriptions of Nigerian universities, and Dr. Edozien spoke of the University of Ibadan, saying that it is not as conservative as it might seem. He also pointed out that the University is trying to get around the degree situation in spreading degrees into technical subjects as well as academic subjects. Dr. Okigbo described the growth of the University of Nigeria at Nsukka. A general studies course divided into a four-year program

was in effect. Dr. Njoku described the University of Lagos and expressed his reaction against too much specialization and too small student bodies. He felt there was a trend in the development of a curriculum in the American pattern. There was discussion about the Sixth Form, but no conclusions were reached on where the Sixth Form education would fit into the future.

Dr. Munger brought up the question of what is really the capacity of the universities and whether five universities are sufficient. Dr. Lindvall asked about the fate of Sixth Formers who do not go on to universities. The question of importance of the development of a science policy was mentioned; otherwise, it would be useless to train scientists. There was also discussion of whether research priorities should be in the agricultural field or atomic energy, etc. In this general area, the matter of manpower needs came up. These should be specified and some data from the Lagos Conference was presented. The situation in Nigeria at the present time is that there is about one scientist per 50,000 population. The target would be 11,000 for Nigeria by 1980. There are only 500 at present. Dr. Njoku emphasized the importance of an appropriate climate for producing scientists at all levels of education. The question arose regarding graduate school education, and it was felt it should be supported. The cost factor was raised and it was felt that the development of graduate schools should come about slowly.

Dr. Okigbo said the figure of 1/50,000 is a general average for all of Africa, rather than for Nigeria.

Report of Session on "Division of Labor  
Between Universities and Research Institutes:  
Contributions of Universities to Economic Development

by Mr. A. A. Ayida

Sir John outlined the role of universities in research. He mentioned two categories in basic research and he cited examples, such as nuclear physics, where the results came much later. In the second category, technological interests are paramount. He contrasted the role of the universities with that of the research institutes which covered areas too large in scope for the universities. Sir John spoke of experience in the United Kingdom which showed that new institutes should be located near or inside universities. The advantage of this includes the fact that institute staff could teach and hold honorary posts at universities, while the university staff could undertake research in the institutes; both could share the physical facilities such as libraries.

He spoke of some of the problems in working out the relationship between universities and research institutes. For example, university professors are sometimes reluctant to see their graduate students working in research institutes. He recalled Harwell in this connection. Universities can and do contribute to development. Dr. Onitiri supported Sir John that the primary function of universities was in the field of training and research and that of the research institutes was in applied research. Judging by Nigerian experience, he thought that universities and institutes tend to cooperate and collaborate where the institutes are university institutes, but not in the case of non-university institutes. Dr. de Kiewiet spoke in support of the position taken by Dr. Onitiri and Sir John. There should not be a rigid division of labor between universities and research institutes. The cost of training a student in Nigeria was 50 times the gross national product per head, whereas in the United States it is one to one. He explained the land grant college system. There must be a free flow of personnel and ideas between universities and research institutes and government and the community at large. He advocated continuous dialogue in this field.

Dr. Arikpo agreed there should be no real division of labor between universities and research institutes. Research institute work is often dull and routine. One way of overcoming this is to encourage free flow of staff between the institutes and universities, and each of the five universities in Nigeria should be closely associated or should sponsor one or more existing research institutes. He agreed that new research institutes should be sited at one of the existing universities.

Dr. Page pointed out that in his discipline, the Nigerian Geological Survey Department has done admirable work. The U.S. experience has been that students work in the government departments during vacation. Geological research is too expensive to be divided into pure and applied categories. Dr. Thomas agreed that this also applied to water resources. A water survey could be one of the service institutes. Dr. Brown spoke of experience in India where there are numerous research institutes isolated from the universities and not

doing so well. Dr. Edozien suggested that the Nigerian Universities Commission make funds available to the universities for committed research. Mr. Lardner said subjects in Nigerian universities tended to be on conventional lines. He advocated an intellectual assault against the policy-making elite. Dr. Okiy pointed out that research facilities in the institutes were available to university staff, but had not been fully utilized. The university staff tended to look down on the institutes. Dr. Okigbo added that research stations in rural areas lose staff attracted to the urban areas. Chief Deko agreed that unlike developed countries, Nigerian universities tended to have the men and research institutes the money. Personalities counted a lot in arrangements of this kind, and he recalled his experience in Western Nigeria where a road had to be used to separate the directors of two adjacent institutes. Dr. Myers cited the need for studying the various factors responsible for high costs of education in Nigeria. It was later pointed out that references to research institutes include government research stations and departments and other government research activities.

Report on Session on "Contributions of Academies  
and Research Councils to Development of Academic and  
Governmental Research Bearing on Economic Development

by Dr. Okoi Arikpo

Dr. Njoku, who opened the discussion, said Nigerian scientists were aware of the need for a national organization responsible for the establishment of scientific policy and the coordination of research activities. At present, he said, research activities go on in universities, federal departments, and research institutes without any coordination. The Federal Government of Nigeria has established a Ministry of Research concerned primarily with agricultural research. Medical and industrial research could take care of themselves. Two types of organization are planned: the Government-sponsored Research Council and the Academy of Sciences at a non-government level, with interlocking membership. He said there were some necessary and important features, namely, simplicity of organization in order to avoid complicated structures, that the organization should be acceptable to the centers of power, and that the difficulties were social and political in nature. He wondered whether Nigerian scientists were on the right lines and asked for advice.

Sir Joseph agreed with the two-type arrangement proposed, but said he thought it was good to have a research institute with a director and concerned with directed research, but that an academic body which tried to direct research did so at its peril. Uncommitted research had to have long-time objectives where applied research had to be directed toward specific purposes. The academy would fertilize the work of the research council. On the question of the importance of the academy's being non-government, he referred to a number of examples, referring to the West Indies and India, and showed how the West Indies organization differed from the Indian organization. He then went on to the case of the Royal Society which is in contact with the government and advises them and also the universities because many of the members of the Royal Society are also teachers. He referred to the problem of academic freedom and said that this should go with academic responsibility, and illustrated the damage that could be done where freedom did not take into account responsibility.

Dr. Brown gave some illustrations of how to achieve the most effective relations between the research council and the academy. He thought the problem was how to combine effectively the anarchy of the scientists who do not want control by government with the planning propensities of government organizations. He gave some examples of the organization of the National Research Council of Brazil, and said there was very effective planning representation from the planning ministry and the universities and that the President had the power to appoint a number of scientists representing geographical areas. Then he went on to show the position in the U.S. where the Academy was formed 100 years ago, and was for a long time ineffective because of wrangling about elections. The National Research Council was formed at the time of World War I. Each government agency develops its own research organization, but the Office of Science and Technology which advises the President also helps in coordinating all research work. The Academy itself has no power, but is advisory, and because of its

membership, its advice is listened to both by government and other research organizations. The Academy is a conscience which gives advice whether asked for or not, and has considerable influence on policy. He referred to the organization in the Soviet Union where research is in the hands of the Academy and quite divorced from research in the universities, so there is very little interaction between the two.



Report on Session on "Contributions of Academies  
and Research Councils to Development of Academic and  
Governmental Research Bearing on Economic Development

by Dr. Harold E. Thomas

Sir John pointed out that there are four research councils in the U.K., plus research institutes where suggestions are made by the Office of Scientific Policy. He considered this diversity inevitable. Dr. Lambo agreed with Sir John that academic responsibility is essential. To have autonomy is preferable to regimentation. Results are achieved by administrative effort. Dr. Okigbo asked for discussion on the composition of a research council. Federal responsibility is for basic research and regional research is applied.

Sir Joseph spoke of the organization in East Africa and Sudan which has U.K. advisors. They have an international advisory committee which will possibly be changed to become more in line with the ties in East Africa. He stressed public education by organizations such as the Association for the Advancement of Science. The academy should be represented in research councils and research councils should respect academy achievements. Drs. Ayida, Okiy, and Njoku indicated that scientists are important and they propose government decisions.

Dr. Munger asked what proportion of scientists come from Northern Nigeria. About 250 are Nigerian and the rest from the north. An association of science in Nigeria was established in 1959.

Report on the Session on "Public Health"

by Dr. T. A. Lambo

The main talk was by Dr. Edozien who described the attitude toward health of the Government of Nigeria. He sketched the broad role of medicine in society and as an important investment item. It has been regarded as a social service. He drew an analogy between the attitude toward medicine and the attitude which used to prevail toward education. Education was retarded because of this attitude and now is regarded as essential.

It is not easy to determine the role of health in the economy. He cited the low expenditures in health, which consist of only 5% of the total national expenditure, and this sum is mainly spent on medical education rather than on medical services. Of the £3-million spent on medical services, £2-million is spent on Lagos alone; the rural areas are completely neglected.

Three categories of assistance have come into Nigeria: (1) U.S. AID; it is difficult to get U.S. AID to help with major health problems. (2) Ford Foundation; it is also difficult to obtain help from them with health programs. (3) Rockefeller Foundation, which has been the major source of funds for health programs. He emphasized that one of the contributions the workshop could make would be to reemphasize the investment nature of health to government, private agencies, international agencies, and national agencies (e.g., NIH). He went on to give a picture of the health situation in Nigeria, mentioning the parameter of infant mortality. Taking Nigeria as a whole, 240 per 1,000, or more than one-fourth of all children die before their first birthday; 40% of all children die before the fifth birthday. A second parameter mentioned was morbidity rate; 15-20% of adults have malarial parasites and a greater proportion have worm infestations. All of these sap vitality. The needs are so great that resources have to be shared proportionately to meet the needs.

Dr. Edozien posed the question whether Nigeria's meager resources should be put into curative or preventive services. The needs are great in both areas, but in the long run, the public health, or preventive, services are the most important. In some cases, one doctor can and should be able to integrate the two segments. Public attitudes and political considerations influence the expenditure between curative and preventive services. Enlightened public opinion is necessary to strike a balance.

It is difficult to find out the numbers of doctors in the country. The estimate is about 1,500 to 2,000 doctors, or about one to 30,000 or 35,000 persons. Many of these are concentrated in large towns such as Lagos. We need to train more doctors; anything less than one doctor to 5,000 persons will not be effective. The cost of training medical students is high (£2,500 per annum per student), and it takes five years to train a doctor. There are two approaches to solving this situation: (1) to abandon, for the time being, the orthodox training program and adopt, for example, what the USSR did in giving a short-circuited crash training program of three to four years; and (2) to train students

as auxiliary medical staff to work under a doctor as part of a team to provide health services to the community.

In addition to training doctors, auxiliary medical teams, nurses, and technicians, more money should go into research. You cannot divorce training, research, and service to the community. Research should be undertaken on patterns of diseases, relationship between environment and disease, operational research (a multi-purpose team could be trained and used here), and basic research. Only £102,000 was devoted to medical research in 1963 out of £1,500,000 voted for research in all fields.

Dr. Weller felt the term, public health, should be clarified. The philosophy is to keep a person well within his community. He went into the concept of community conscience. Some economic planners have felt that better public health has led to population pressures; therefore, they prefer not to concentrate on public health. Dr. Patterson felt this point was very important. Those responsible for birth control measures are more willing to function when longevity is assured by public health programs. Dr. Edozien said that, at present, 30-60% of Nigeria's human resources are doomed to die before they can contribute to economic development. It will be important to have figures on the effect of disease on school attendance, on the efficiency of the individual child, and on the educational system. Adults are also affected. Health is a political commodity. Research on disease distribution and the natural history of various diseases is vital in order to obtain help from the leaders and also to put health into its proper perspective. If one is going to improve health in Nigeria, it will require judicious application of available knowledge and continuing research into many areas. With regard to malaria, for example, Nigeria is sitting on a time bomb. If a resistant strain should develop, this could paralyze the entire economy of the country.

Dr. Weller said that each doctor should have the maximum impact on his community in the field of public health. As to medical school curriculum, he felt a compromise should be worked out where necessary, but if possible, it should be predominantly African. New status symbols should be worked out and community health leaders should have equal prestige with surgeons.

Report of Session on "Research on Nigeria's  
Industrial and Natural Resources:  
Water, Minerals, Power, Fish, etc."

by Dr. Joseph C. Edozien

Mr. Okiy opening the discussion, gave an historical account of the development of research on natural resources in government departments (federal and regional), research institutes and university departments. Contrary to the impression which might be created by the large number of organizations involved in natural resources research, much has been done beginning with the Council of Natural Resources in 1950, to coordinate research. Although the Council went moribund, the four technical committees--Agriculture, Forestry, Fisheries, and Veterinary Medicine which were created have survived and continue to meet once or twice annually. It is hoped that the proposed research council will take over the responsibility of coordinating not only the research on all the above sectors, but the total research effort of the country.

Federal agricultural research has been primarily concerned with food crops, mainly plant breeding. New varieties of rice have been produced at the Rice Research Station at Pategi and all rice grown in the region comes from this station. Although rice production was negligible before the war, production now is between 250/300,000 tons/annum. Cassava yield has been increased 2/3 fold and maize 4/5 times by introduction of new varieties, although this high-yield variety of maize was more suitable for animal feed than for human consumption. Entomological research, e.g., work on yam beetles, was also in progress at the Agricultural Research Institute at Moor Plantation. Other federal research institutes or stations include the Veterinary Research Institute, Forestry research, Fisheries, Nigerian Institute for Palm Oil Research (NIFOR), Nigerian Cocoa Research Institute, Trypanosomiasis Research Institute, Stored Products Research Institute, Federal Institute of Industrial Research, Meteorological Research, including Agro-meteorological research.

NAIFO was inherited by Nigeria from the West African Research Organization in 1962. Since 1945, it has been developing new varieties of palm and all the palm oil produced in Nigeria can be derived from 1/10th the area occupied now by the wild varieties. These new varieties start to fruit within 2-3 years, although they take 7-8 years to reach maximum yield. CRIN has also done much to produce higher yield and quicker maturing varieties of cocoa. Creation of a Rubber Research Institute is under consideration.

An International Institute of Tropical Agriculture is now under plan and will be a joint venture between the Federal Government, Ford Foundation, and Rockefeller Foundation.

There are several fields in which research is urgently needed. These include: soil fertility, irrigation, food storage, food processing, animal breeding, agricultural engineering, horticulture, fish culture. Although the Canadian Government assistance has enabled a short survey of a small part of the country, a soil survey of the entire country is very urgently needed.

Dr. Page said he would deal mainly with non-renewable resources, such as minerals, fuels, construction materials. Nigeria has probably passed out of the prospecting stage and to find ore deposits, she must now use techniques which are not easy. Progress is often very slow, e.g., oil prospecting started since 1957 but only recently was oil found in commercial quantities. In the United States new deposits of gold, copper, and phosphates have recently been found in areas which have been gone over several times by geologists. Geology also makes it possible to find underground water. Much remains to be done in geological survey of Nigeria. Only half of mapped area has received some study and only 25% has been completely studied. The work involves both basic and directed research and is best done under aegis of a department of geological survey. Geophysical and geochemical aspects should receive attention.

Nigeria needs many more geologists than she has at present. Emphasis in training should be in producing field geologists with some laboratory experience. Arrangements should be made for Nigerian geology students to spend their long vacation with the geological survey department.

Importance of inventory of geological resources and of water geology were stressed.

Dr. Lindvall spoke about power, especially electric power which he considered to be the key to much of the development process. He pointed out the need for long-range planning in the provision of power since supply often creates greater demand, and from the experience, say, of the Tennessee Valley, it will probably not be too long before we find that hydroelectric generating scheme at Kainji Dam cannot meet all of Nigeria's needs. Oil and gas are alternatives to electricity and in some respects have operating advantages. Special attention should be given to rural electrification: if provided, farmers will use it and it will lead to new developments, e.g., food storage. For transport, he thought that emphasis should be on oil and that electrification should be postponed until the volume of transport increases much beyond the present volume. He also touched on the following points: (a) Need to consider economic problems over longer periods instead of in the short term; (b) Need for study of the chemical content of natural resources, both mineral and agricultural; (c) Need for finding ways of utilizing by-products from natural resources which may otherwise go to waste, e.g., alcohol from the apple parts of cashew nuts; (d) Study of marketing problems and especially the possibilities of expanding local market by improving the people's purchasing power; (e) the problems of erosion, flood control, and soil conservation; (f) Industrial research support for small industries.

Dr. Thomas spoke about water. He opened by describing the proposals for a lake research institute in connection with Kainji Dam. The importance of this kind of work is now well recognized and the aspects of research hoped to be covered are far more comprehensive than was undertaken at Colorado. On the other hand, hydrologic data collected before the project starts is not as detailed or over as long a period as in the Colorado project. He emphasized the need for continuing effort in collecting these data after the dam has come into operation and emphasized that although external assistance may help, the efforts should not be entirely dependent on outside aid. He also spoke about problems of conservation and the need to find various ways of putting waste to useful ends. Disposal of non-organic waste is becoming a serious problem.

Mr. Ayida named the major sources of power as electricity, petroleum, gas, and coal. The Nigerian coal industry had been looked upon as a dying industry, but the decision to start an iron and steel complex, together with recent research which has shown that Nigerian coal, which was not of coking quality, could be used, has changed the picture. He considered that there was need for Nigeria to have a national fuel policy, but pointed out the necessity for periodic review of this policy in the light of new developments. The petroleum industry was growing rapidly and by 1968 petroleum exports will provide about 1/3 of Nigeria's total export earnings, estimated at £300 million. Efforts should be made to develop a petrochemical industry, especially fertilizer production. Attention should be given to the use of Nigeria's natural resources in the development of industries, e.g., a few years ago aluminum electric poles were imported, but now it is possible to meet all pole requirements by treating local wood. Other problems which require investigation are marketing, organization and methods with a view to improving efficiency. He spoke of the relation between ECN and the new Niger Dam Authority and thought that ultimately the Authority may take over all aspects of electricity generating, while the ECN becomes the distributing and marketing authority.

Mr. Lardner spoke about the importance of building up an inventory of natural resources, the need for modern management techniques to be used in public enterprises, and the need for giving urgent attention to increasing local food production. The example of fish was cited where Nigeria was spending 8.5 million pounds of its foreign exchange for fish imports.

Dr. Onitiri emphasized the importance of building Nigerian industries on the basis of the country's agricultural and other raw materials. He said this policy should be undertaken in three directions, namely: (a) processing of purely domestic crops for local consumption; (b) local production of import substitutes; and (c) processing agricultural and other raw materials for exports. He said that economic development implies changes in the structure of production in favor of processing and simple manufactures. If this was to come about smoothly, the structure of foreign trade must also change in the same direction. But there were difficulties in this regard because of the obstacles to the importation of processed and manufactured goods in the developed countries. He said that it was necessary for the developed countries to change the structure of their economies away from agricultural processing and simple manufactures in favor of industries corresponding to a higher level of technology. In this way, he said, it would be possible for the developed countries to give free access in their markets to the processed and semi-manufactured exports of the developing countries. Stressing the importance of this idea, Dr. Onitiri indicated that the developing countries could no longer earn enough foreign exchange from raw material exports and that therefore it was necessary that these countries be allowed to develop their exports of processed and semi-manufactured goods. In this connection, he referred to an idea which he recently expressed at an international meeting to the effect that it may be more helpful to the developing countries if some of the funds available for lending to these countries (by governments and international agencies) were devoted to assisting the shift of industries in the developed countries from processing of imported raw materials to those more complex lines corresponding to a higher level of technical achievement.

Dr. Brown brought the abstracts of Dr. Chapman's paper on fisheries to the attention of the workshop.

Dr. Njoku, referring to the relation of the ECN to the new Niger Dam project, said that new countries must make mistakes and hoped that they would learn from these mistakes. He pointed to the need for basic biological studies which may not have immediate application, but would pay in the long run. He described Nigeria's participation in the International Biological Program which could contribute especially to training of personnel and to standardization of the methods of measurement. There was need for more active participation of young Nigerian scientists in international programs for oceanographic research.

Dr. Arikpo emphasized the need for the proposed research council to coordinate all aspects of research and development and not limited only to research on natural resources.

Chief Deko said that planning should not be in vacuo and effort should be made to relate increased production of agricultural produce to the possibility of alternative uses of materials. The question now being asked about rubber was raised of cocoa several years ago and had heed been paid to this question earlier the present situation regarding cocoa might have been avoided.

Dr. de Kiewiet spoke about the need to look into the problem of foreign trade. He could detect some unexamined assumption that industrialization was a good thing. New factors must be taken into account in looking at this problem. Examples are the capacity of industrialized countries to deliver manufactured goods at low prices, the low investment capital of the developing countries and their unfavorable balance of trade. It should be remembered that industrialization does not necessarily produce jobs. Automation and improvement in managerial skill have made it possible to increase in numbers of persons employed. He cited the example of Venezuela where unemployment was growing despite a steady rise of 6% per annum in the GNDP. Industrialization of the countryside to prevent premature urbanization of Nigeria and methods of incorporation of available low-level technical skill were problems that needed urgent attention.

Mr. Okigbo thought that the outlook for rubber was more optimistic than had been indicated because world production was not likely to outstrip demand for a long time. There was in particular increasing demand for hevea rubber. Cocoa demand, on the other hand, appears to have stabilized and this is why the cocoa problem is so serious. He stressed the need to investigate the problems of land consolidation, the expansion of agro-meteorological studies and the advantages of plant exploration teams visiting other West African countries.

Mr. Lardner, speaking about manufacture of substitutes for natural products, said that recently a sisal substitute has been synthesized, and this threatened the economy of Tanzania. There was urgent need for intensified research on building materials and road surfacing materials.

Report of the Session on "Economic Planning  
and the Use of Data from Agricultural Research"

by Dr. W. M. Myers

Mr. Ayida thought it would be most appropriate to deal with the relationship between economic planning and research in Nigeria.

He referred back to Dr. de Kiewiet's comments concerning industrialization of the rural areas in contrast to urbanization, and recalled the proposal of Schumaker at a meeting in the U.K. that developing countries need an intermediate level of industrialization. Intermediate technology will not neglect most modern devices and machines, but will not depend upon them. A criterion proposed was that the capital investment per work place would not exceed £100. This obviously would not work, for example, for road construction or steel manufacturing. But it will be concerned with small consumer products, agricultural machinery, etc. This throws the problem back to the scientist to develop techniques that increase, as much as possible, the amount of labor required without reducing the efficiency of the machine. In modern industrialized societies, the effort is to reduce labor requirements, which is opposite to the needs in a developing, labor-rich country.

In Japan, in attempts to adopt Western technology, there were colossal failures, but in the process of adopting, they developed intermediate technology.

Mr. Ayida then noted some problems facing Nigerian science: (1) the social and educational climate of the developing scientists is such as to cause their horizons to be limited to problems of climbing the social ladder; (2) social forces, such as extended family responsibilities and tribal loyalties, inhibit the scientist in his work, diverting his attention from single-minded pursuit of science; (3) economic limitations limit the opportunities and incentives for research to be conducted on the job in various kinds of industrial processes, for example; (4) Nigerian scientists are often divorced from the community and cannot appreciate the needs of society--of the farmer for example; (5) the lack of scientific climate causes lack of imagination and of inquiry into the unknown. The child is not encouraged to inquire about things--to ask questions.

The job of the planner is to allocate scarce resources among many urgent needs.

In regard to substitutions for exports, it is not often remembered that the Nigerian economy will soon be self-sufficient in a number of areas, such as textiles, foot-wear, cement, petroleum, and brewery products.

It is very difficult for the planner to have to deny support for some essential job simply because there are more essential jobs. He believes that the narrower the discipline, the more certain the proponent is that it is more important than anything else. Often there are internal conflicts among needs within a group so that all cannot be met.



In 1962-64, the total research expenditure, excluding that in universities, was £3 million. This was 0.5% of the government gross income and 0.14% of the GNP. In view of these figures, it is not a real question whether the government is doing enough for research, but rather whether the support is properly allocated among areas. In 1962-63, 65% of GNP was contributed by agriculture, and this is increasing by 4.3% per year. In contrast, there is a 8.6% increase in the non-agricultural sector.

In considering allocation of available resources, there is an almost insurmountable problem of communication between scientists and the rest of the community. The solution is not simply the creation of an institution, but to bridge the gap between scientists and non-scientists by means of seminars such as this. The Nigerian scientist has to come down from his ivory tower to participate more in the community effort. The planner and scientist must be on the same, rather than opposite, side of the table, seeking solutions to mutual problems.

Dr. Okigbo said agricultural conditions in Nigeria developed many years ago. There have been many changes in social conditions, populations, etc., with exposure to the western world, but agriculture has changed very little. Nigeria suffers from lack of adequate agricultural and demographic data. There is need for a demographic institute or a statistical institute operated, perhaps, by the universities rather than by agencies of government in order to ensure more reliable census data. There is a lack of reliable agricultural economic data on which to base planning. Some of the agricultural research done in Nigeria has been more sophisticated than required. For example, only recently has there been research on how long a cutting of cassava is to be kept before planting. Extension work was intensified only after regionalization. More data are available on cash crops than on food crops. Therefore, there is often not enough information on food crops to transmit to farmers.

Fragmentation of research is caused by lack of contact and planning among research workers. There is need for teams of research workers. For example, for soil fertility research, scientists in soil chemistry, soil microbiology, etc., are needed.

Restrictions on publication and delay in publication and release of research results limits effectiveness of research and extension. Many research departments have annual reports, but these are usually two years behind. There is need to dig out much research information that is now buried in files of various stations.

Research projects often have no bearing on national needs. Some have been research designed to provide data for Ph.D. degrees.

Not much is known about present local farming practices. For example, it is known that farmers practice mixed cropping, but the composition of the mixtures or the continuity of that composition is not known.

Frequent changes of research assignment cause inefficiencies. Liaison is needed between research and extension workers to ensure that the most recent results are interpreted for and available to extension workers.

Insufficient training of extension staff, especially considering that they must deal with illiterate farmers, also limits effectiveness.

Traditional psychological problems limit adoption of improvements--for example, introduction of a yellow, semi-flint, but high-yielding variety of maize failed. Local corns have been floury and introduced types were flint, semi-flint, or dent. There are problems in demonstrating the superiority of varieties, practices, etc., to illiterate farmers. However, they will accept new practices when they can see that they are superior. Farm settlements are a good idea, but little information has been available to give them on growing food crops or on soil management. There is need to start experimental programs along with farm settlement to check on the validity of methods recommended. Agricultural settlements and other programs are often carried out by civil servants, expatriates, etc., without much use of competent people from the universities. Mechanization on a large scale is valuable only, for example, in cooperatives, not to the small farmer. More research is needed on adaptation and development of small tools.

Mixed cropping limits development of a canning industry. There is need to find ways to grow single crops over large areas.

The regional nature of research projects delays availability of research results to farmers. Trials are not located widely over the country or region. Variety trials in some crops are distributed, but crop management experiments may be limited to one or a few locations. French territories research results usually are not available to Nigerian scientists because of language.

Sir Joseph expressed great interest in Schumaker's paper to which Mr. Ayida had referred. He felt that Schumaker's great mistake was in suggesting that intermediate industrialization is something new. It is not a matter of refusing to accept western technology; it is a matter of using what is available, i.e., labor if plentiful; capital if labor is scarce and capital is available. In this regard, he contrasted soya oil in the U.S. and palm oil in Nigeria. Small equipment is needed for agriculture in Nigeria instead of large tractors except in special circumstances.

Nigerian agriculture can be divided into two periods:

- 1) The first period, roughly up to independence, was characterized by:
  - a) Introduction of money into agriculture through producing crops that could be marketed in the metropolitan countries.
  - b) Development of varieties, cultural practices, etc., to improve production of these cash crops.
  - c) Only enough attention was given to food crops to supply the indigenous population.

In India, there had developed a comparable relationship between cities and rural areas. The industrial revolution and textile production in the U.K. upset this relationship.

- 2) The second period is since independence. There has developed a saturation of the western market for the traditional cash crops. Hence, there is the

impossibility of mounting the next stage of development on the traditional market crops. In industrial England, nutritional standards dropped heavily with industrialization. It is much more difficult to provide adequate nutrition to a child in town or city than in the country. When a family moves to the city they buy staples, but not the protective foods required for adequate nutrition of children. This is a major growth potential of agriculture, i.e., provision of adequate nutrition to the urban population. It must be remembered that the food needs of such an urban population are different from the traditional. An example is the sandwich for the person who must carry his mid-day food with him. Concentration of agricultural research staff is needed disproportionately around the cities.

Dr. Patterson spoke of the South of the United States as the underdeveloped area of the United States, and now the area of greatest promise. Among the things that contributed much to the development of the South were greater involvement of the population in a new set of circumstances and greater relevance to the needs. For this group of Nigerian scientists, opportunity is not in specialization, but in laying the broad foundations in research and education. They must develop educational systems and research that are relevant to and subservient to the needs of development. It is not proper, for example, that admissions standards in Nigerian universities are such that some students can only go to America for university training.

He cited as an example the time when teachers were required to have master's degrees. Many were not suited for ultimate study for Ph.D. degrees, and indeed did not need such training for the work they were to do. As a result, they introduced the Master of Education degree. Standards should be applicable to the needs of the community.

In summary, Dr. Patterson said: (1) The present employment of Nigeria's trained talent in the creation of sound relationships which encourage development is the best use of this talent in the present. Extensive specialization is for the future. (2) The long view of talent development requires the orientation of the total population, including schools, to a form of resource use education. (3) Nigerian educational standards should be developed and applied in the context of Nigeria's needs. The talent shortage requires that standards facilitate training objectives.

Dr. Weller said the agriculturist is a public health worker in the sense that he can manipulate the health of people by the kind of agriculture he develops. He discussed the relationship of proper nutrition and disease and referred to the greater susceptibility to amoebic dysentery caused by the diet of white bread and coca-cola.

Dr. Njoku wanted to record his delight at the emphasis on food crops. In the past, they have concentrated so much on export crops that there is little information on food crops. He questioned whether Nigeria can justify continuing such large expenditures on cocoa and oil palm research. Developments in oil palms are such that for continuing export demand, it must be grown in plantations.

Dr. Njoku was uneasy about discussions of intermediate technology. Nigeria wants to catch up to the same kind of technology as advanced countries.

He sees, as the only solution, to have both short- and long-time objectives, and believes long-time objectives must be technologically equal to advanced countries.

Sir Joseph suggested that the uneasiness is caused by Schumaker's insistence that intermediate technology is something new. He did not think there was a conflict. Mr. Ayida suggested that we must concentrate on absolute rate of growth. The absolute rate of growth is greater in advanced countries. He believed that Schumaker's concept is new in the sense of emphasis on the greatest returns from available labor with minimum use of scarce capital, i.e., the most efficient balancing of available resources at any time or place. Sir John wished to illustrate intermediate technology. There have been developed at Bedford such things as a three-wheel tractor, a rice processor, and a rice planter.

Dr. Okigbo replied to Dr. Weller's reference to cassava as a great cause of nutritional problems. Yams are preferred, but are a less economical crop. Cassava, although third after rice and yams in preference, is the most economical producer of starch. Dr. Weller did not wish to condemn work on cassava, but did wish to hear about research on some of the protein-rich foods. Dr. Okigbo said that cowpeas can produce 600 to 1,000 pounds per acre, but the farmers usually get from 0 to 200 pounds due to insect attacks and other problems. Dr. Edozien referred to nutritional surveys which, surprisingly, showed that there is as much shortage of calories as shortage of protein in the Nigerian diet, but the protein deficiency is more dramatic, especially in children.

He also referred to intermediate technology, pointing out that advanced technologies should not be confused with automation. Most advanced technologies can be applied without automation.

There is need for development of new status symbols to replace the only two that are currently considered important, i.e., money and political power.

Machinery must be developed for allocating support for research and evaluating it in relation to development needs. Nigeria is one of the few developing countries that has had an enlightened government policy on the support of research

Mr. Lardner said in regard to import substitution in foods, it is to be noted that the dynamic factors in imports are confectionaries, sugar, wheat, flour, meat, and dairy products. There will be a real problem with meat and milk within the context of a nomadic people who now tend the livestock. In food crops, he believed that there is substantial elasticity within present agriculture. He doubted that land tenure is a serious limiting factor at present in food crop production. The major problem is how to make food crops cash crops to the farmers. This means the need to develop a marketing and transportation system that will facilitate the flow of food crops to the consumers and the flow of incentive goods to the farmers.

In the interest of developing intermediate technology, there is need for facilities for training and research in agricultural engineering in Africa.

Dr. Lambo commented about psychological concepts referred to by Mr. Lardner and Dr. Edozien. He thought we have been concerned too exclusively with physical aspects of development and that there should be more consideration given to socio-psychological aspects.

Dr. Okigbo did not agree completely with Mr. Lardner's statement that land tenure is not a problem. He suggested, for example, the difficulty of producing vegetables for a canning factory, given the small and scattered holdings of farmers. Dr. Arikpo said that the problem of land holdings discussed by Dr. Okigbo is not just a local problem; it is a problem wherever there is a heavy population concentration. Mr. Okiy agreed, but pointed out that the problem is particularly pressing in the eastern region.

Sir Joseph said, in regard to Mr. Lardner's comments, that the problem of organizing milk production is not just a matter of the habits of the people who keep cattle. He referred to experiences in Kampala and suggested that the problem is that processed dairy products (imported) are easier for the people to handle than fresh dairy products. This emphasizes again the need for a dairy products processing industry. There is need to develop better nutritional production and better nutritional utilization together.

Chief Deko referred back to Mr. Ayida's plea that scientist and planner sit together on the same side of the table in economic planning.

Report on Session on "Priorities and International Cooperation"

by Mr. G. E. A. Lardner

Dr. Onititi began by saying that priorities could be derived from the discussions held so far. He would confine himself to the most important. Taking into account statistical and other economic information available in Nigeria, he felt that the problem of utmost urgency was that of foreign exchange, the availability of which was essential to the implementation of all other priorities. While it was true that petroleum exports may increase, it had to be borne in mind that, unlike cocoa and other agricultural export crops, the capital costs of petroleum exploitation would make much less of the foreign exchange earnings available to Nigeria.

It was necessary to distinguish between monetary and real aspects of externally available assets. Like India, we can resort to the World Bank and other sources of financial aid in times of crisis. A real solution, on the other hand, would involve such policies as import substitution, such as food processing, which would have a direct impact on the foreign exchange situation. Priorities must begin with items to improve the foreign exchange prospects.

Among these was training. There was scope for making more intensive use of training facilities. At a cost of perhaps £1½-million, the 7,000 students in Nigerian universities could be employed for two out of the three months of their long vacation on teaching, with consequent improvement in the teaching of science in secondary schools. This could well be Nigeria's first attempt at planned use of scarce manpower. Laboratories could be shared by schools. A good deal of this effort would have to be made by Nigerians, but some help from outside would be required.

A second priority associated with training would be the local manufacture of educational scientific supplies, which had been mentioned earlier. Here also some help would be needed from outside.

As regards the division of labor in research, he suggested that there was a need for reliable information on who was doing what. This could be met by the preparation and publication of a reference book or directory of research. This could be a basis for organizing further research, especially on a cooperative or interdisciplinary basis.

In the field of natural resources, he envisaged two steps: The first was the organization of surveys to determine what resources were available; the second, to determine their potential use. In connection with the latter, action should take two forms: the extensive use of laboratory facilities abroad and the development of local facilities.

In the field of agriculture, greater emphasis should be given to food crops than had been the case in the past. This would include research in food processing and preservation. Similarly, close attention was to be paid to agricultural and other raw materials as the basis for local industry for import substitution and for export. Nigeria had the advantage of size of market over

other countries. What was needed to expand the range of import substitutions were capital and technique.

Under international cooperation, he listed three help aspects: financial, technical assistance, and personnel. In no field of research and development was there a sufficient number of suitable personnel. Priorities in training must, however, conform with the priorities described earlier.

He felt that, as much as possible, technical assistance should be concentrated on the building up of local institutions, e.g., for medical research, agricultural research, soils laboratories, etc.

As regards financial aid, it was clear that the more the better. The preference would be for multi-lateral aid, but the distribution between multi-lateral and bi-lateral depended, of course, on the preference of the donating country. Dr. Onitiri drew attention to the rules for research aid proposed by the Lagos Conference. Dr. Onitiri considered the relations between foreign and local research institutions and the channels through which aid reached local scholars. Nigeria was unique in possessing a relatively large number of well known scholars. She also had research institutions which could be rapidly built up to attain their own momentum and contribute to development. Collaboration could improve, country to country, institute-to-institute, and scholar-to-scholar relations if technical assistance for research should be provided on the basis of partnership. He cited three cases which he considered illustrated the difficulties which arose when adequate consultation had not taken place, chiefly because the partnership principle had been overlooked. This was of little significance in the case of small projects, but he felt that big research should be so designed as to contribute to the building up of local research institutions. If this were done, these institutions would provide centers capable of providing individual scholars with organized data, etc., and save them and the government departments the trouble of repeated demands for the same kind of data from different scholars at different times.

If, therefore, foreign assistance in research was to achieve the maximum benefit in both qualitative and quantitative terms, some effort would have to be made to remove such sources of friction.

Dr. Jones expressed skepticism of the ability of economists to determine priorities, i.e., determine the ranking of competing claims on resources. The reasons for this were: (a) the absence of data for building up reliable growth models, recognized in developed countries, but even more striking in developing countries, where planning was needed; (b) the long neglect, until recently, of the growth process and the investigation of relationships. Accordingly, the debate still rages on the primacy of agriculture or of industry or of both; (c) an insuperable factor, i.e., the limitations of the cost (benefit technique for evaluating projects and determining priorities). It was clear that there were positive values which cannot be measured by the market mechanism. Some economists had made attempts to quantify these values in a way which could only be described as pseudo-scientific. The fact was that these were two quite different sets of values. He concluded that economists should go as far in evaluating priorities on market values as possible, and leave the rest to the community for decision.

Priorities, therefore, should be considered in general terms. Attempts to define them in too great detail merely led to delays, higher costs, and frustrations. Such matters should be left to day-to-day discussions.

He disapproved of Dr. Brown's use of the term "anarchy" which implied total unpredictability--an uncommon feature in human behavior patterns. It was the task of economic planners to enable communities to achieve central goals.

He considered Ayida's reference to Schumaker's "intermediate technology" valuable. The idea was to combine inputs so as to give maximum results at minimum cost. In some cases, this would justify the use of advanced, automated techniques because of lack of skilled manpower and the cost of creating it.

Another of the economist's tasks was to evaluate relative factor costs--as to take account of social as well as market costs--and thus to provide a perspective, using shadow prices over the long term, say fifteen years. He considered that there was a distinction in research more useful for development than that between "basic" and "applied", i.e., a distinction according to the time required for pay-off.

The great pressure for immediate decisions puts a high proportion of research funds into short-term projects. However, to neglect longer-range studies would mean a decline in the quality of short-range decisions as well as in the quality of scientific research efforts. Moreover, short pay-off projects tend to be the most loaded politically, whilst long pay-off projects are less sensitive to political factors.

As regards international cooperation, he would place a high value on mechanisms for exchanging knowledge within Nigeria and between Nigeria and the outside world. It was regrettable that so much research was not published. In some parts of Africa, there seemed to be a feeling that there was something wrong in releasing all sorts of information, e.g., on climate, crops, etc., and this could be extremely injurious.

Nigeria had, as earlier pointed out by Lambo and Edozien, responsibilities toward her neighbors as well as the outside world. This required publication of information available only inside Nigeria. International cooperation was a two-way affair. The Food Research Institute, for example, provided fellowships for Africans to study there, partly to promote the contributions the African scholars can make to U.S. students and the Institute.

Dr. Jones ended by pointing to the manner in which the Belgian Congo had achieved a high level of import substitution in the past by the use of tariffs. The same, coupled with partnership arrangements to mutual advantage, could be of help to Nigeria.

Dr. Brown was concerned with emphasizing an appreciation of the time scale involved in achieving research competence. It took 25 years to produce a research scientist, and companies estimate 15 years from conception to distribution of a gadget, etc. What problems will this time lag imply? On the assumption of a doubling time of 7 years and a base of 500 technical persons now, the technical population would be 65,000 in 50 years, by which time the



population of Nigeria would have become 200-million, i.e., a ratio of 1:3000, which may well not be as satisfactory as required then. How do we effect this step up from 100 per annum to 500 per annum to 1000 per annum? How do we identify these above-average people, channel them into the right courses, and provide them with the right motivations? Dr. Brown then quoted the case of the special high school in Turkey to which children of high I.Q. go on scholarships. Such a mechanism for, say 500 students each, with a faculty of 50 to ensure thorough treatment would be one important method. In any case, unusual concepts and methods were required.

Therefore, in the meantime, dependence would be placed on importation. And this, for a 10% growth rate, would mean as much as 2-3000 foreign technical personnel in Nigeria in ten years, or as much as a flow of 10,000 to 15,000 throughout the period. Where will they come from? Since multi-lateral aid agencies seem incapable of coping, the answer, in spite of Onitiri's plea for multi-lateral aid, must inescapably be bi-lateral. This required fraternization of Nigerians with other scientific communities, a fraternization which, Dr. Brown quoted his experiences with ICSU to show, did not at present exist.

Dr. Munger seized the opportunity to emphasize the spirit of cooperation evident in the NISER outline of the role of foreign scholars and the invitations to them to come to NISER.

Dr. Myers welcomed the increasing emphasis on food crops, but warned against jettisoning research on export crops such as cocoa. To do so was to contract out of the competitive market for a crop of still great importance to the Nigerian export economy. He also did not feel that natural rubber had no future. In U.S. agricultural history there had been times when the price of such crops as wheat and cotton had sunk to unbelievable levels, but had not been abandoned. Peanuts were worth hardly anything when Carver took it up.

A good deal had been done in Nigeria on food crops. He quoted the case of the International Rice Institute and pointed out how much is relative as much to resources as to needs. He felt that no one could quarrel with Dr. Onitiri's point about partnership, in principle. However, in practice, as Dr. Brown's figures showed, a 1:1 relationship would be hard to maintain.

Mr. Ayida wondered whose priorities were at issue. Government departments and scientists differed in their priorities, and may not even know where to start off the inquiry about priorities. It was for this reason that he supported the "anarchy" contained at the margin. Anyone could come in, but not on big-time research. He was also doubtful of the assumption that the Council would solve all problems.

Dr. Page suggested that a major contribution to the foreign exchange problem in the early years of development would be the production and export of high-grade minerals and fuels. At this stage no facilities for local utilization existed. By the time this developed, it would still be possible for residual or poor ore to be exploited using technology developed for the purpose.

There then followed a three-sided discussion between Dr. Edozien, Mr. Ayida, and Dr. Onitiri. The substance of this was to the effect that it was wrong to oppose research planned in Nigeria, sponsored by a foreign government

for its own uses; efforts should be made to find areas or projects of common interest. On the other hand, the shortage of Nigerian manpower ruled out Nigerian participation where such research was outside determined priorities. No obstruction was to be placed in the way of U.S. scholars undertaking such research. The essence was to avoid commitment of Nigerian scarce resources in projects not of high priority to Nigeria. As in the case of NISER, the fullest support in other respects could be provided.

Dr. Edozien felt that any such control would negate the consensus on uncommitted university research.

Report on "Expansion Chamber"

Mr. Nixon gave a review of AID agricultural programs in Nigeria. He emphasized that these were not really AID programs as such, but joint programs between AID and the Nigerian Governments, which are usually defined in project agreements. The program started only in 1962, and thus is only in its third year, but a lot has already been achieved.

The program involves both direct hire personnel and contractors. Of the former there are some 200 positions held by personnel from the U.S. who are really civil servants from the U.S. Department of Agriculture or the U.S. Department of the Interior. There are four contractors: (1) Kansas State University with Ahmadu Bello University in Northern Nigeria; (2) Michigan State University with the University of Nigeria in the Eastern Region; (3) the University of Wisconsin with the University of Ife; and (4) Colorado State University with the Eastern Regional Ministry of Agriculture in an agricultural college in the Eastern Region. Another contract at the agricultural college level is being considered for two agricultural colleges in the Western Region. It is envisaged that this contract will be with an agricultural college in Wisconsin (not the University which is already working with the University of Ife). The work being done by the university contractors involves development, training, and research. The work being done at the agricultural college level through contractors or direct hire personnel also involves the training of agricultural workers through the Ministers of Agriculture. In the north, training in veterinary work is also included through a school in the outskirts of Kaduna. Thus, it can be seen that a considerable amount of AID funds and effort is directed to agricultural education. Unfortunately, because of lack of trained indigenous personnel, some of the U.S. workers have no trainees working with them, but on the whole, the training and educational work is impressive.

Extension work is not neglected. Dr. Nixon is more optimistic than other speakers who have referred to the lack of research data on food crops, and hence the difficulty of fruitful extension work in food crops. He cited the work at Gombe and Gusau in the north where a team of AID-sponsored extension workers are working successfully with some 400 farmers, helping them in the use of fertilizers, disease control, etc., in relation to food crops such as guinea corn, millet, and groundnut. There has resulted a 75-80% increase in the yield of these crops.

Dr. Nixon then gave some more details of the research element, the AID programs outside university contract research. In Western Nigeria, work at Moor Plantation has involved legume breeders, agronomists, nematodologists, as well as pasture and poultry work at Fashola. There is also some plant pathological work on cocoa and horticultural work on rubber. In passing, Dr. Nixon expressed the view that whatever the price position in the marketing of cocoa and rubber, it would be foolish to stop research on them. Other research activities include cattle breeding in the north, ranch work in Sokoto province, poultry work in the Eastern and Western Regions, dairy work, including a station near Lagos, and the domestic production of maize which is particularly important for livestock and poultry feeding. He gave a yield figure for maize of 8-10 bushels per acre, which

is of interest in view of the disagreement between Mr. Okiy and Dr. Okigbo on maize yield figures.

Dr. Nixon then turned to the work being done in the field of agricultural credit. He thought that this has a strong bearing on the question of incentives. All the regions now have agricultural credit systems and AID is assisting them as well as cooperatives.

On the important question of water, Dr. Nixon drew our attention to the work of a nine-man team doing a feasibility study on irrigation in the Chad area; also to the work of a six-man team for the U.S. Geological Survey on underground water supplies in the Maiduguri and Sokoto areas. Water is also important for other parts of the country.

Dr. Nixon said that, on the whole, the activities of AID in the field of agriculture are numerous. Only brief mention could be made of other activities such as soil conservation work in Katsina and Mubi; farm mechanization in Bida and in            important in the light of references in previous discussions to the need to improve local tools; the tsetse-fly program; horticultural work in the north on virus-resistant potatoes; soil fertility and the use of fertilizers of which a woefully small amount of 20,000 tons annually is used in Nigeria.

Dr. Nixon concluded by pointing out that the AID program in Nigeria is bigger than that in any other country in which AID operates. The Agency may not be doing all that it should, and there is no doubt that a great deal still remains to be done and priorities have to be constantly re-defined. He hoped that more meetings of this kind and the formation of the two organizations referred to earlier--the Research Council and the Academy--will facilitate AID's agricultural work. He placed on record his appreciation of the setting up of the Ministry of Natural Resources and Research.

When the "Chamber" resumed its conversation on Tuesday morning, Sir John Cockroft raised the question of population control. He asked whether population problems were serious in Nigeria and whether there was a population policy. In answer, Mr. Ayida said that population is a political word in Nigeria, and it was difficult for his Ministry and other planning agencies to know on what figures to base planning because not only are there no reliable data on actual population figures, but even trends are not clear. He referred to Ghana where they appear to have got around the problem by having political figures for citation and publication and private figures for planning obtained by means of sample surveys.

Dr. Njoku said that as far as he knew there was no overt population policy and no government or political party had population control in its program. Yet figures such as those already put before the meeting by Dr. de Kiewiet show that a serious situation may arise since the difference between the rate of economic growth and the rate of population growth is so small that the net increase on which to base the raising of the standards of living is so small that little progress may result. He referred to his meeting at the University of Lagos about a year ago Dr. John Moss, who is a well known advocate for what he describes as a population stop policy for Africa. He gave a series of public lectures and, although his views seemed intellectually and topically convincing, he made no impression on local opinion. It may well be that, as Dr. Weller pointed out earlier, people will not take population control seriously so long as they cannot

be sure that the children they produce will survive until public health measures achieve greater success. Dr. Onitiri agreed that there was no population policy as such, but said that a conference on population problems in Africa is to be held soon in Ibadan, and would give study to this problem.

Dr. Brown thought that this was an area of more serious concern than seems to be realized. With a decline in infant mortality through the success of measures such as those advocated by Dr. Edozien, population growth will increase to 3% or more per annum at a time when food production seems to be declining. The problem will be accentuated by the resulting assymetry in the population due to an increase in the proportion of the population under 15 years of age, and therefore unproductive. In view of all these factors, action is called for now.

Both Mr. Ayida and Mr. Lardner referred to the low utilization of land and other resources. These uses are capable of so much more expansion that they can ultimately take care of population increases and, therefore, population need not be a serious problem if these resources can be developed. Mr. Lardner thought that there is no question of over-population in Africa, especially when there are such countries as Gabon which has only 700,000 persons. It takes ten years or more for population propaganda to take effect.

Sir Joseph Hutchinson pointed out that because population propaganda takes ten years of more to take effect, as pointed out by Mr. Lardner, this was the very reason why the propaganda should have started ten years ago and is now overdue. There are two sides to the problem--the increase in the utilization of resources and the control of population. Attention seems to be given to only one aspect--increased use of resources. Yet we now know that population is controllable. We ought to begin now to think about what sort of population Nigeria will have in the future. Then we shall know where we are going. He thought that the fact that there are areas of low population in Africa, for example, the interior of Gabon quoted by Mr. Lardner, should not rule out consideration of the over-all problem.

Dr. Okigbo, in support of Sir Joseph, pointed out that, though some countries require immigrants, over-all over-population still exists. He drew attention to unsolved soil fertility problems--fallows becoming shorter and shorter because of increasing population. As an example of the difficulties involved in population control, he referred to the case of a night watchman with fifteen children who could not be convinced of the need for control. More education is required.

Dr. Weller stressed the responsibility which educated Nigerians have in giving serious thought to questions of population increase.

In view of the pressure of other subjects requiring discussion, this interesting subject was closed with a consensus that some thinking in this area is necessary.

Dr. Munger then turned the attention of the meeting to the matter of political stability which is necessary if any of the developments we are discussing are to be carried out. The greatest danger to political stability is rapid urbanization. It is largely, if not entirely, responsible for the troubles

in the Congo. All over Africa, e.g., in Lusaka, in Lagos, urbanization is becoming a serious problem. In Nigeria, it may be claimed that urbanization breaks down tribalism, but there is also ground for thinking that it increases tribalism. Urbanization creates a demand for curative medicine, for large-scale imports. He agrees with those who say that Lagos is a fuse for Nigeria, a fuse which may be set off by the rising tide of urbanization. Nigeria is looked up to by other countries in Africa. It is important that developments in Nigeria should succeed so that they can have a catalytic effect in other African countries.

Mr. Lardner, speaking from the ECA standpoint, continued that while Nigeria is being made a model, other countries should also receive attention; otherwise, for the very reasons of political instability, they may not be able to take advantage of the example of Nigeria.

The Chairman then called on Dr. Lindvall whose views on engineering education were made available to the meeting. Dr. Lindvall pointed out that some of the gaps in subjects of study referred to in earlier discussions by Mr. Lardner involved specialized areas of engineering. Yet the modern tendency in engineering education is toward less specialization. Even highly advanced countries like the USSR are finding that previous policies in favor of specialization were mistaken. Adaptability to new situations is important and depends on broad basic education. Many engineers do not now practice in their areas of specialization and a broader training is necessary. Mere lists of study in university prospectuses do not tell the full story. It depends on what is taught under these headings. Under the usual headings of civil, mechanical, and electrical engineering, it is possible to give broadly based classes which involve an interdisciplinary approach. Areas which appear specialized have broad aspects which can be stressed in training. Dr. Lindvall referred to the realization by many engineering schools that humanities, economics, and social sciences are important in the training of the engineer. In the U.S., the Engineers' Council now insists that there be a substantial component of social sciences in engineering education. This is particularly important in view of the greater use of engineers in management and planning positions.

Mr. Lardner expressed his agreement with the approach advocated by Dr. Lindvall, and hoped to cooperate with him in producing a paper for the ECA on the subject.

The Chairman of the session, Dr. Patterson, then asked for comments on the confused scholarship position. Many countries are interested in scholarships and the amount available is diminishing. There is, therefore, greater need for give and take between countries and those agencies giving assistance. He raised three points which arise from his experience with the Phelps-Stokes Fund. The three points were: (1) Failure of students to return to their countries after training in the U.S. This leads to ineffective use of trained manpower which inhibits sources of support. (2) Lack of reliable guidance as to which fields are in the national interest. (3) Lack of agreement as to the fields in which training should take place locally or abroad.

Dr. Lambo agreed that the three points raised were valid; speaking from his experience in an investigation among Nigerian students in the United Kingdom, he thought that one factor which appeared to affect the continued stay of students abroad was the duration of their studies. Whereas the duration was five years

in the U.K., it was double. After such a long stay, students had absorbed so much of the overseas culture they did not wish to return. Dr. Patterson asked whether it was advisable that students should return for a period after their undergraduate study before returning for post-graduate work. Dr. Lambo said this would be desirable in some disciplines. Dr. Onitiri wished to emphasize the word, "some," as there were fields like electronics in which this would not apply, whereas in others like political science it would apply.

Dr. Brown said that the fundamental point is that everything should be done to give undergraduate training in Nigeria so that students only go abroad for post-graduate studies. It was better to spend the money for undergraduate scholarships in paying professors who would go and teach in Nigeria. Mr. Ayida thought that the money now spent on undergraduate scholarships could also go into the loan fund scheme proposed for university students in Nigeria. There was further support for return home after the first degree from Mr. Okiy, but Dr. Edozien thought that the matter was not as simple as it appeared to some people. It is a complex matter requiring study. There was danger in generalizing. For a long time scholarship and well-supported students went to the U.K., while the poorer ones went to the U.S. where they had to work their way through college, and hence tended to stay longer. Only recently have adequate programs been worked out for training abroad. This workshop and other organizations should now address themselves to the question of how facilities and financial assistance available abroad can be best utilized. He warned that individual opinions and experiences may give a wrong picture. The matter requires further study and assessment and calls for a cooperative evaluation between Nigerian and outside organizations.

Mr. Arikpo said that the matter had passed the individual and personal opinions stage since there is a federal government policy on the matter, viz., no scholarships shall be given for studying abroad subjects which can be studied in Nigeria. This is the policy on the basis of which he has given advice when requested by such bodies as ASPAU. His own feeling was that good students should be identified and given part of their training in Nigeria and part abroad as necessary. He thought that there should be no difficulty with private students who should be free to go on their own and who should receive assistance abroad if they run into difficulties. Dr. Patterson said that it was precisely here that there was most difficulty because there were many more such private students in financial difficulties than the available assistance could cope with; some criteria were therefore required for choosing between such students. Mr. Arikpo thought that the field of study could provide a basis for such a choice, e.g., veterinary science rather than political science. This particular example did not appear to be very helpful to Dr. Patterson, who, being a veterinary scientist, would have made this particular choice anyway.

Dr. Myers referred back to the question of lack of reliable guidance, and pointed out that educational authorities in the U.S. were not always sure whether overseas students were adequately qualified for the courses they wished to take. There was a particular country the students from which are never definitely accepted until they have spent a year in the U.S. so that they can be better evaluated, because evaluations from their own country are unreliable. He appealed for a better evaluation of students being sent abroad.

Dr. Page drew attention to the type of training given on the job, and referred to the experience of the U.S. Geological Survey which had taken geologists from abroad to work with survey groups in the United States.

Dr. Okigbo referred to the participant training element of AID-university projects, which were useful, but were often limited by the need to give quotas to all areas of study in the university with the result that essential areas often failed to get as many as they deserved. The expansion of these programs might get around this difficulty. With regard to students, one of the main problems is that of detecting those in real need and discouraging the many others who normally apply whenever they hear of any financial assistance.

Finally, Dr. Dillon drew the attention of the meeting to the Aggrey Fellowship Program, and asked for views and assistance in identifying four to six persons each year from all over Africa--people in teaching careers in universities or in research careers in universities--who could benefit from this fellowship program. The committee for the program would welcome assistance from heads of universities and heads of research institutes. The fields of interest are not limited, although it was thought at one time that the social sciences and humanities should be encouraged, not only because they appeared neglected, but because they appeared more related to the career of the imminent African after whom the program is named. But in view of the increasing needs in science and technology, the program also covers these fields and, indeed, one of the beneficiaries is in the engineering field. Dr. Dillon appealed for assistance in working out techniques for introducing the right people to the committee. Dr. Patterson endorsed this appeal and asked for people's thoughts on this matter to be transmitted to the committee.



Report on Session on Regional Cooperation in Africa

by Dr. H. Onitiri and Dr. E. Munger

Dr. Lambo gave special thanks to AID for its wide support for STRC, up to 70% of the total costs of STRC projects. There is concern in STRC over sources of funds, and support is being sought in Scandinavia for multi-lateral assistance. They are keen on bi-lateral programs. They will send a mission to the next CSA meeting to identify areas of joint collaboration. The African countries are very poor and it is almost impossible for small countries to provide financing.

Dr. Nixon said AID has been pleased by the degree of material support by participating countries in the rinderpest vaccination program.

Sir Joseph considered that the rinderpest campaign offered prospects of tremendous advances. He likened it to the locust control of the war years and after, which had to be interterritorial. The program was so successful that the locusts disappeared and financing was stopped for the locust teams. There is need to follow up on rinderpest to keep it down by a "fire brigade" after the "bush fire" is out. Uganda has stood ready to go into action at short notice.

Dr. Edozien said coordination of OAU and U.N. agencies is lacking. He sits on the FAO Nutrition Committee, and OAU also has a nutrition committee, but they don't know us and vice versa. Mr. Lardner said ECA also has Africa-wide responsibilities.

Dr. Weller said rinderpest is not eradication, but will require continued supervision and effort. He took a slightly dim view of all investment dependent on AID appropriations year by year. (Cynically, How can one do rinderpest but not vaccinate for smallpox?)

Mr. Lardner spoke of the flexible organization of ECA, which has four subdivisions. He also spoke of the transformation of economies by industrialization. He felt that each country need not be self-sufficient. He mentioned the link between soil and water and the enormous amount of soils information which is needed. We need to find optimum areas for development. (Aside--in Nigeria, yes.)

He referred to the many lists of priorities--the Lagos Plan, the U.N. plans, the STRC list, donor country lists, U.N. Special Fund lists, etc.--saying that a consolidated and evaluated priority list is needed so that such programs as the rinderpest campaign will be followed through. 70-80% of the people in Africa are in agriculture, and there is need to find techniques to change farmers' methods despite their illiteracy. Literacy is not necessary. He considered FAO too literacy conscious.

The large-scale development of river basins leads to expansion of water-borne disease, i.e., bilhariosis. Cost calculations in the design of dams are not sufficiently socially oriented. The development of Africa also means

improved transport, an ideal way of spreading disease. From the point of view of the development of the entire African continent, if Nigeria becomes a model, there must be a link by which there is benefit from Nigeria in other countries.

Sir John asked where the various projects would be carried out, and Dr. Lambo said that depended on the project. JP-1 on the atlas was carried out in South Africa at Witwatersrand; the Guinean trawling survey was in the host countries.

Chief Deko said that coordination in Africa is difficult because priorities change rapidly. For instance, in nutrition, there is a Nutrition Commission for Africa which is a joint body of the FAO, WHO, and CCTA. Then the CCTA was changed to the Fifth Commission of OAU, and now the question is who should handle nutrition problems in view of the fact that OAU also has a Third Commission which deals with nutrition. In the rinderpest campaign, FAO and OAU are not being coordinated.

Dr. Lambo felt the lack of coordination was partly historical. However, effort is made to have coordination. For example, of 52 specialist meetings held in Africa, 47 were attended by CSA, and of 31 called by STRC, 21 were attended by other agencies. In addition, many African scientists serve on international committees.

Dr. Okiy mentioned the Inter-African Phyto-Sanitary Commission, organized to prevent the introduction of pests in Africa south of the Sahara. They meet every two years. Dr. Okigbo felt the STRC meetings should be announced earlier than they are at present and that September was a bad month to hold the meetings because of university schedules. Mr. Lardner thought that there was need to be able to shift STRC programs around. Dr. Lambo said they had been chasing Mr. Lardner around for months around the world, as they would like to shift some STRC programs to ECA.

Mr. Ayida, referring to the development of intermediate technology, said there must be a regional approach, i.e., in a climatic belt.

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Dr. Lambo then proceeded to examine three joint projects as examples of regional cooperation in Africa: Joint Project 1 - Climatological atlas; Joint Project 18 - Psychometric tests for use at the conclusion of primary education; and Joint Project 19 - Guinean Trawling Survey.

With regard to the first, he indicated that the project was Africa's contribution to the Atlas of the World prepared by the World Meteorological Organization. The project, which had been completed, provides a useful work of reference on African climate.

Joint Project 18 was being carried out in cooperation with the University of Pittsburgh. The two centers of operation were Senegal and Nigeria. The primary education phase of the project was about completed, and work would soon start on selection for industry on entry into the universities. The aims of Project 19 were: (1) to assess the qualitative composition of the exploitable fish stocks; (2) to assess and ascertain the size composition of those species

of paramount commercial importance; (3) to compare productivity in different fishing areas; (4) to relate 1, 2, and 3 to the hydrographic climate; (5) to locate areas which seem to be most favorable for commercial trawling in relation to depth, nature of ground, and availability of exploitable fish stocks; (6) to provide reference and study collections of fish of the area for those countries, organizations, institutes, and individuals desirous of receiving them. The work is in progress and preliminary results have been encouraging.

Dr. Lambo next spoke of the priorities established by STRC for future operations. He said these were divided into two parts: long-term guidelines and short-term program for 1965-67. There were five guidelines for the short-term period, namely: (a) agriculture, (b) oceanography and fisheries research, (c) biological research, (d) industrial and technological research, and (e) physical and mathematical research. The short-term program for 1965-67 includes a series of symposia and the regular committee meetings for the three years.

Mr. Nixon told the committee that he was the liaison officer between U.S. AID and the STRC. He explained the relations of U.S. AID with the STRC and invited the opinion of the meeting on the future of the STRC and on how the U.S. AID might still be of assistance.

He spoke at some length on Joint Project 15, the Rinderpest Campaign. He invited the attention of the meeting to a paper prepared on the project by one of the veterinarians stationed in Lagos. Rinderpest was an old disease in West Africa and two years ago the American Academy of Sciences had organized a group to undertake a study of the problem.

He said that Phase I of the rinderpest program had been completed and Phase II was under way. Phases III, IV, and V were being planned for the future. When Phase III of the program was completed, the area which would have been covered would be larger than the United States. The effect of Phase I was already evident. There have been outstanding reductions in the outbreak of the disease. Growing difficulties were being experienced as work was expanding. The program is an ambitious one and would require substantial funds as well as personnel. In the past the EEC and the U.S. AID were the main sources of funds, but there was evidence that the EEC might withdraw, leaving a resource gap to be filled.

Dr. Nixon next spoke on Joint Project 26, Major Cereals. The project was in two parts, East and West Africa. The program in West Africa was being mounted. It would involve maize breeders (to be stationed at Ibadan), entomologists, plant breeders, and soil scientists (to be stationed in Northern Nigeria). The program would involve the training of local personnel and would be activated for as long as ten years.

Dr. Nixon gave a brief account of the Guinean Trawling Survey. He indicated that the survey had been completed. The data was being processed and it was expected that the report would be completed by the end of 1965. He read a brief summary of the findings as published in the Commercial Fisheries Survey, August 1964. He also referred briefly to the soils map of Africa which had been completed and published, the Regional Training Center for English-Speaking Staff

of National Parks, and the work on bovine pleuropneumonia vaccine research.

Speaking generally on the multi-lateral programs within the framework of the OAU, Dr. Nixon emphasized the need to improve the financial system. He referred specifically to the problem of funding Phase III of the rinderpest program. He said there was an impasse with regard to this phase because of the indication that EEC might withdraw financial support and the unwillingness of U.S. AID to bear the total cost of the program.

Report on

Summarization

by Mr. E. Okiy

Dr. de Kieviet said that the success of a meeting is assured when people, on leaving it, still feel they have a lot to say. He called for participants to bring up the following points: (1) Those we must take up now, e.g., how this dialogue can be carried on and the manner in which scientists can help, such as assistance in the input of scientists in areas where there are no trained Nigerians; and (2) Those that may be taken up later.

Mr. Okiy thanked the members of the American Academy of Sciences for calling the meeting of U.K., U.S., and Nigerian scientists to discuss problems of importance to the development of Nigeria. He felt that everyone had benefitted immensely. These discussions have indicated that there are many areas of misunderstanding between people in government, hospitals, and other institutions. The meeting has removed some of the barriers. Nigeria has a great role to play in Africa and developmental progress in Nigeria will benefit her neighboring countries. He cited the example of delegates from the Ivory Coast who came to Nigeria to see advances in the field of agriculture. What they see in their two-week tour will be of benefit to their country. Hence, such a meeting as this has given us a chance for a frank exchange of ideas with specialists from other parts of the world.

It has already been said that the educational system should be subservient to the problems of the country. The Sixth Form should not be the standard for entry into universities, and standards should not be made higher than in foreign countries. It will take many generations to reach any target we may set for producing enough scientific workers. Professor Brown has indicated that, in 50 years, we will need 65,000 scientific and technical men. We may have to depend a great deal on the importation of scientists. It has already been suggested by Dr. Onitiri that university students should be used to teach during vacations. Simple scientific equipment should be manufactured in Nigeria and school laboratories should be put to the best use.

Barriers between universities and research institutes should be broken, and research institutes should, in the future, be sited in universities.

Gratitude was expressed to our British and American colleagues for their advice on the two organizations Nigeria is planning to set up. This has supported the need for such organizations. He said they were also grateful for the suggestions on how we can set up or organize these bodies, and appreciated Dr. Njoku's injunctions on having the organizations started in as simple a way as possible. It was felt that they would be set up within the next few months.

With respect to priorities, Dr. Onitiri has enumerated the priorities in Nigerian development: (1) foreign exchange and how it can be improved; (2) research of food crops has been somewhat neglected, but it was also realized that research on cash crops should continue so that improvements will release more land for food crops; (3) training of specialists was discussed

and indications were given on how this could be done with foreign assistance. Several areas were emphasized as important for needing priority on training. (See Lardner list.) (4) In research assistance, Dr. Onitiri emphasized that, in principle, such projects should be done on a partnership basis. (5) For continuation of the dialogue, we hope that the two bodies to be formed soon will help and function as media for continued dialogue. It still very much depends on the two organizations. (6) We should make more flexible use of our scientists.

In long-range planning, there should be much more collaboration between U.K. and U.S. scientists and Nigerian scientists in the exchange of ideas and good will. Committees should be formed to go into some projects or to go into joint projects with foreign scientific societies. Joint action in one or two fields will cement the relationship that will bear fruit in many ways. This particular joint action has benefitted all of us and may form a model for other countries. We Nigerians are determined to make this work by mutual activities.

Dr. Lambo stressed that the importance of the conference is that many of us from Nigeria and elsewhere have emphasized the points where we need something to be done. Moreover, we now all realize the amount of money being put into development projects. Priorities in development have been asked for and we have, in our various specialized areas, brought together information that has been buried.

The Academy and Research Council will give us important and potent forums for exercising influence on our development programs. Continuous dialogues among Nigerians themselves in Nigeria in examining many of the problems projected should take place. Strategy must be formulated by Nigerian scientists to get across their ideas to planners and politicians or to the community.

Dr. Brown devoted some time to talk of the future. American scientists have been groping for ways of working and cooperating with scientists in Nigeria in projects for the development of Nigeria. He suggested the formation of an informal group of Americans and Nigerians until the scientific organizations are established in Nigeria. Such a joint group should attempt to discuss in as realistic way as possible what the research priorities of Nigeria are, sector by sector--agriculture, geology, marine research, etc.--over a two-year period for the first effort. Engineering requirements should be dealt with as well as research requirements. Use should be made of this assessment in judging how far the needs might be met by importation of scientists, etc. Once these needs are determined, both the Nigerians and the Americans should, with their own governments, examine them to see how the needs could be met. There should be a continuing evaluation of the projects. Once the scientific organizations are established; the U.S. could share in some of the expenses. Each group should have a chairman and staff assigned to it, and meetings should be held in the U.S. and in Nigeria for future planning. The person the Nigerians put on this committee should be close to the government.

Sir Joseph expressed appreciation on behalf of the Royal Society to the National Academy of Sciences and the Rockefeller Foundation for inviting members of the Royal Society. He said that he is an old colonial--a member of a tribe

which is almost extinct--that is trying to change, although outside the countries where they once worked. Most of them will stand back and watch the countries establish themselves as Great Britain has. We are sending out younger men, as the Americans are, to help in the work of development. We in Britain hope to contribute young men who will work in developing countries for the greater part of their lives. The Royal Society has formed a committee for developing countries to foster movement of young scientists, but not of money, e.g., the Leverhulme Trust is sending young men out to do Ph.D. work in East Africa. He hoped they could also make contributions in Nigeria through such links as established here. He invited Nigerians, when in Britain, to contact the Royal Society and meet members of the committee.

Tenure overseas is often too short to profitably do such projects as plant breeding, which are long-term projects. If we want people to do the type of job that needs doing, they must be given time. When you come to England, come to the universities and talk on how we can help in the exchange of people. Talk to under-graduate students and graduate students.

Dr. Njoku spoke of the gap between the personnel available in Nigeria and the magnitude of the problems facing the country. There is shortage of staff in the universities and the research institutes. It is necessary to consider the type of assistance given to India, involving Leverhulme fellowships in Nigeria under the auspices of the Royal Society. Similarly, we hope the U.S., despite what they are already doing, can still help in sending specialists who can help in universities and also in cooperative joint projects between specialists in research institutes in Nigeria and in America. Is it possible to have research project contracts link the problems with young Nigerians who will work with the American specialist and thereby gain experience? All these links and associations require that somebody in Nigeria request them, and we hope that the organizations we will form will assist. We cannot expect much from these organizations in the beginning, but we hope that you will help us with advice, personnel, and other assistance to help launch them. We have come here as individuals, and until we can come as representatives of a body that represents our people and commands the respect of the government and our people, we cannot be really effective.

Dr. de Kieviet agreed with Sir Joseph that people have to be more committed for longer times than the two years which AID provides. Despite their contributions, this is the weakest part of their programs. Dr. Weller agreed and said that America should develop a tradition of overseas service. However, he felt the Nigerians should not have too high hopes of assistance in medical institutions in view of the many vacancies in staff positions in medical schools and in public health in the United States. Apart from these scarcities, it is difficult to find a housewife who is willing to spend five years outside the country. But there are young men who can be given the opportunity for international service where they are shown how to build a long-term life career.

Dr. Edozien said we have talked a long time about the problems, but it is good to consider what we can achieve. The meeting has brought us together to see our own problems in better perspective, at least in transmitting them to the Government. With the U.S. participants we are dealing with men who have weight in their community and if aid is not effective, it may be rectified, and

the amount of aid may be put to optimum use. Societies can be of use in another way. We are growing out of our colonial mentality, but often when our Government requires help, they refer to experts in Britain and America, and through such a meeting of foreign experts and Nigerian planners, are able to realize that there are local experts who can do the job, and can cooperate with foreign experts in doing a good job, e.g., the Ashley Report on Higher Education.

Dr. Jones mentioned a resource which comes from preoccupation of many foreign scholars on certain problems all over the world. For example, Stanford has had a program of international studies for fifteen years. Other universities are in the same position. Cooperative activities, such as envisaged with Dr. Onitiri's Institute, could show what contributions American scholars can make to Nigerian development.

Mr. Lardner said an academy should attempt to effect a change of focus in foundations, AID assistance, etc. It should develop a way to detect people who have ability to do certain things and report it to potential donors. Innovation is the ultimate objective of research, but we should not forget that research may be done just for a paper label, and resources should not be wasted. A large and continued supply of specialists cannot be available to underdeveloped countries. Unusual methods have to be conceived for Nigeria's development and for other parts of Africa.

Mr. Arikpo spoke of some aspects of training. He was glad that representatives from universities were present, and hoped the report of the meeting would be made available to all the universities, as some were not represented. The problem of the shortage of scientific manpower has been recognized for some time, and universities have been asked to enroll 60% in science and 40% in other fields. The Universities Commission has noted that the number of science students still remains small, and I was glad to see university people thinking of organizing summer courses by students. With reference to what Dr. Weller said, we do not expect 200 American scientists tomorrow.

Dr. Munger spoke of Dr. Onitiri's comments regarding conditions of research in his Institute and the possibility of cooperating with others in research, saying that it may be necessary for a Nigerian representative to attend the Conference of African Planning Associations next October.

Dr. Brown suggested that a tentative decision be made regarding when and where to continue this dialogue, either as an informal group, or through the Nigerian academy or research council, possibly planning to meet in Nigeria in February or March. Dr. Lambo said they would report in about six weeks.

Dr. Brown suggested that appreciation be expressed, on behalf of the group, to the Rockefeller Foundation and to Dr. and Mrs. Marshall for their hospitality.

Dr. Nixon said he would report to AID how successful the meeting had been.