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United Nations Industrial Development Organization

IDD

Distribution
Restricted

ID/WG.1/DP.1
March 1967

ORIGINAL: ENGLISH

SOME ASPECTS OF INDUSTRIAL RESEARCH WITH PARTICULAR REFERENCE TO AFRICA*

*Originally issued in December 1965 under the symbol CID/WG.B./3

We regret that some of the pages in the microfiche copy of this report may not be up to the proper legibility standards, even though the best possible copy was used for preparing the master fiche.

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I. INTRODUCTION

1. This paper attempts a general review of industrial research in The African countries that constitute the ECA (Economic Commission for Africa) region. Industrial research is, however, so intimately connected with other development activities that it is better discussed in conjunction with these other activities rather than in isolation. Therefore, although the intention is to focus primarily on industrial research, a good deal of attention will also be devoted to such allied development activities as advisory and consultancy services.

2. As used in this report, the expression "industrial research" will be restricted in meaning to applied research carried out in the manufacturing or processing sector (as opposed to the agricultural, mining, construction, transportation and distribution sectors) of the economy. The research activities of establishments in these other sectors will be considered only to the extent that they involve manufacturing or processing of products. Thus a Building Research Institute or a Gypsum Laboratory will be a proper subject within the coverage of this report if its functions include the development, manufacturing or processing of building materials, such as paint, plywood, veneer, building blocks, etc.

3. The information for this report is drawn largely from papers, particularly the Country Reports, presented at the United Nations Inter-regional Seminar on Industrial Research and Development Institutes in Developing Countries held in Beirut, Lebanon, in December 1964, from other United Nations documents and from literature from miscellaneous sources as well as by direct contact with some of the countries. Even so, information concerning certain countries is extremely sketchy, concerning others, nil.

II. OBJECTIVES AND FUNCTIONS OF INDUSTRIAL RESEARCH

4. In general, industrial research is aimed at achieving some or all of the following objectives, among others: [2]

(a) Discovering local as well as foreign sources of raw materials;

(b) Discovering the various uses to which available natural and agricultural resources could be put;

(c) Developing suitable technologies for the transformation of raw materials into final products;

(d) Quality improvement of produced commodities;

(e) Reduction of unit costs of production;

(f) Increased all-round efficiency of operation;

(g) Better economic intelligence with regard to changing market, supply and demand conditions, prices, labour, credit, etc.;

(h) Determining the technical feasibility and economic soundness of industrial projects;

(i) Providing technical and scientific information and consultancy services for the benefit of industrial enterprises;

(j) Solving *ad hoc* technological problems associated with industrial production;

(k) Undertaking specific technical investigations at the request of industrial concerns;

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[2] For further details consult the papers submitted to, and the report of, the United Nations Seminar on Industrial Research and Development Institutes in Developing Countries which was held in Beirut in 1964.

5. The above objectives are widely reflected in the functioning of research establishments in Africa. The following examples are typical. The recently established Industrial Research Institute of the Sudan, for instance, has the following stated objectives: [7]

(a) Performing tests, investigations, researches and analysis;

(b) Furnishing advice and consultation services on problems of industrial planning, process engineering, production management, efficiency, market development, cost and quality control;

(c) Assisting in the formulation of standards for industrial and commercial products;

(d) Making surveys and studies of natural resources, raw materials and by-products of industry, mining and agriculture and their utilisation;

(e) Maintaining a modern technical reference library and public information service on industrial technology and related matters;

(f) Undertaking or collaborating in the preparation, publication and dissemination of useful technical information;

(g) Cooperation with other bodies and institutions in promoting scientific and technological research and the training of technical experts, craftsmen, artisans and specialised production personnel;

and in general -

(h) Advising and assisting otherwise on scientific and technological matters affecting the development of the natural resources and industries of the Sudan, and on the proper coordination and employment of scientific and technological resources to those ends.

6. In Ghana proposals are under way to expand the functions of the Building Research Institute to include (a) a technical inquiry service on problems relating to building materials and their utilisation and (b) a general industrial information service designed to provide general operational guidance in such matters as possibilities of utilisation of local raw materials, improved operating techniques and procedures, market trends etc.

7. In the United Arab Republic, the General Organisation for Industrialisation (GOI) is designed to play an important role in the country's development programme by:

(a) Determining the economic and technical feasibility of industrial projects and establishing their order of priorities;

(b) Identifying suitable sites for industrial location and selecting suitable equipment and machinery;

(c) Providing technical support in the procurement, construction and installation and testing of plants and equipment;

(d) Recruiting and training workers and managers and providing working capital where necessary;

(e) Controlling the engineering, operating and financial aspects of new government enterprises prior to their transfer to the organisation responsible for the specific industry.

III. ROLE OF GOVERNMENTS IN INDUSTRIAL RESEARCH

8. Industrial research in many countries of the world has assumed the form of a cooperative effort between the government and the private sector of the economy. The role of the government in any particular country may be "indirect" or "direct", but frequently both. It is "indirect" when limited to providing the private sector with technical, financial, legislative and other necessary support for the conduct of industrial research, with the government itself not engaging in the formal activity of organising and conducting such research. On the other hand the government may play a "direct" role by setting up an operating research establishments of one kind or another. These may be organised as autonomous or semi-autonomous public corporations or as units, departments, ministries, etc. attached to the civil service.

9. The picture in Africa is determined more by existing economic realities than by ideological considerations. Although the economies of virtually all the countries involved have each a private and a public sector, the major proportion of industrial research is carried out under the aegis of the governments whose roles often include the following:

(a) Legislation affecting industrial research:

(b) Setting up a department, ministry or statutory body charged with the formulation of industrial research policy and its implementation;

(c) Organising industrial research institutes, centres, laboratories, departments or units;

(d) Providing financial support for industrial research;

(e) Planning for and coordinating industrial research with the overall development programme of the country;

(f) Recruiting and training of research personnel and supporting staff;

(g) Providing incentives to private industrial research establishments;

(h) Promoting the utilisation of research results.

10. It is well known that the number of formal industrial research institutes in the ECA region is quite small. That fact by itself probably conceals another and quite significant fact that applied research activity in general, including explorations aimed at raw materials discovery, product and process improvement, cost reduction, as well as technical trouble-shooting, extension services, testing, standardisation and chemical analysis, etc., is carried on quite extensively by numerous government agencies. Frequently, these and other services are performed by specialised laboratories, testing and standardisation centres. ministries, departments, productivity centres, economic research units, and so forth. In the following sections, research and development activities for individual countries will be discussed under the following categories of functional agencies performing the activities:

(a) National Councils, Boards and Similar Bodies
(b) Government Departments and Ministries
(c) Industrial Development Corporations
(d) Private Industrial Companies

(e) Cooperative Associations
(f) Universities
(g) Industrial Research Institutes

IV. RESEARCH AND DEVELOPMENT ACTIVITIES BY NATIONAL COUNCILS, BOARDS AND SIMILAR BODIES

11. National Councils are generally established by government legislation and assigned responsibility for formulating industrial research plans and policies and exercising central authority in connection with the coordination and implementation of national industrial research programmes. Such bodies themselves generally do not carry out research work.

Algeria

12. In Algeria the Government has established a Committee on Scientific Research whose primary function will include coordination of the research activities of the country's research establishments.

Ghana

13. In Ghana the agency within this category is the Ghana Academy of Sciences. The Academy was reconstituted in January 1963, from two previous organisations by an Executive Instrument of Parliament and charged with the following duties: [2b]

(a) The organisation and coordination of research, both pure and applied, in all branches of knowledge;

(b) The promotion of the study of all sciences and learning;

(c) The establishment and maintenance of proper standards in all fields of science and learning in Ghana;

(d) The recognition of outstanding contributions to the advancement of science and learning in Ghana; and

(e) The discharge of such other functions as may be assigned to it by the President of the Republic of Ghana.

14. The governing body of the Academy is the Praesidium which consists of the President of the Academy, two Vice-Presidents, the Chairman of the Sections of the Academy and not less than four more than seven elected Fellows of the Academy. The Secretary of the Academy serves as Secretary to the Praesidium while a General Purposes Committee serves as its Executive Committee.

15. The two main divisions of the Academy are the Sections of the A ademy and the Research Division. The Sections comprise a Physical Sciences Section, a Biological Sciences Section and the Humanities Section. A Sectional Coordinating Committee is responsible for planning and coordination the activities of the Sections.

16. The Research Division, under the direction of the Research Committee, is responsible for organising and executing research projects and programmes related to the economic and social development of the country. A number of advisory committees have been set up by the Research Committee to deal with and advise the Committee on research matters in their specific fields. The Industrial and Technological Advisory Committee is one of five advisory committees.

17. The Advisory Committees recommend specific research projects to theResearch Committee for approval. They are also empowered to set up ad hoc working parties to study and report on particular research problems. For example, in 1963, the Industrial and Technological Research Advisory Committee (then called Industrial and Technological Research Sub-committee) organised on behalf of the Academy a Working Party for a National Standards Organization.

Nigeria

18. In May 1965, the Eastern Region Government of Nigeria created a body known as "The Industrial Engineering and Geology Committee on Coordination of Research between the University and the Government". The first Head of the Committee is the Dean of the Faculty of Engineering at the University of Nigeria, Nsukka, Eastern Nigeria. Other members include two Chemical Engineers, two Geologists, a Town Planner, an Agricultural Engineer and an Industrial Chemist who is also Head of the Regional Laboratory of the Ministry of Commerce, Enugu (See Paras. 40 and 41).

19. The aims and purposes of the Committee are:

(a) To collect and analyse research information, industrial and otherwise, from all government research establishments in the Federation;

(b) To advise the government on research policies and priorities;

(c) To evaluate from time to time the progress of applied research in the country;

(d) Generally to promote the efficiency of research operations.

Kenya, Tanzania and Uganda

20. Kenya, Tanzania and Uganda have had a close association in the field of industrial research and development since 1942 when the Government of the United Kingdom created the East African Industrial Research and Development Board with laboratories in Nairobi, Kenya. One of the primary functions of this body was the coordination and promotion of industrial research in the three countries and the development of industries based on local raw materials and designed to meet the prevailing war needs. In 1943, the twin functions of research and development were assigned to two separate organizations, the East African Industrial Research Board and the Industrial Management Board respectively. Since then, the responsibility for industrial research has changed hands a few times. The first significant reorganisation took place in 1955 when, following a series of proposals, the East African High Commission took over the direction of industrial research for the three countries, and permanent research laboratories were erected in Nairobi, Kenya.

21. With the prospect of national independence and sovereignty for the three countries in the early sixties, an East African Common Services Organisation (EACSO) was created in 1961 to provide for the three countries, on a cooperative basis, those economic services that would be rather uneconomic to attempt on an individual basis. One of these was industrial research for which a special department within EACSO, known as the East African Industrial Research Organisation (EAIRO), was created. Overall research policy is determined by the Governing Body of EACSO which is advised by the Industrial Research Board. The director of EAIRO exercises executive responsibility.

22. The EAIRO suffers from the two handicaps that are common to industrial research establishments in most developing countries, namely, insufficient staff and insufficient funds. Its total technical and professional staff strength of about eight, consisting of six chemists (one of whom is the Director), one Agricultural Engineer and one microbiologist, is hardly ample for an institute serving one country, let alone three countries. And in 1965 only five of these posts were filled.

23. The annual budget for EAIRO is £60,000, which is derived as follows:

EACSO (out of contributions from the three governments)	£27,000
British Government Grants	£27,000
Fees from sponsored research	£ 6,000
	£60,000

24. Needless to say, there can be no substantial increase in the number of research personnel without a corresponding increase in budget outlay. It is a characteristic of industrial research establishments that professional staff salaries tend to account for a high proportion of total research expenditure.

United Arab Republic

25. In the United Arab Republic there exists within the Ministry of Scientific Research a Consultative Council on Scientific Research. Also attached to the Ministry is a Supreme Council for Consolidation of research. [9]. Information is unavailable on the composition and organisation of these two Councils as well as on their duties and functions other than those that may be inferred from their titles. The Ministry is obviously the substantive agency responsible for scientific and applied research and its role in this connection is discussed below under Government Departments and Ministries. (See Paras.46-49).

V. RESEARCH AND DEVELOPMENT ACTIVITIES BY GOVERNMENT DEPARTMENTS AND MINISTRIES

26. Various government departments and ministries, particularly those responsible for industry, agriculture (including livestock), health, trade, mining, works, aviation and education carry out a considerable portion of the research workload in many African countries and provide other substantive services, such as testing and standardization, usually undertaken by research institutes.

27. Some of these departments have only modest laboratory equipment and technical personnel and confine their research and similar operations to routine tests, chemical analyses and not-too-complicated investigations. Others have research units with fairly extensive resources in men and equipment and can provide expertise in a wide range of technical fields. Still another category is that of the department or ministry created solely to assume overall responsibility for scientific and applied research. Such a department or ministry often sets up a number of research establishments located either in one central research complex or at selected sites in different parts of the country under the central direction, supervision and coordination of the department or ministry.

Algeria

28. The Ministry of Economic Affairs in Algeria has responsibility for the operation of the African Hydrocarbon Centre and the National Training and Research Centre for the Textile Industry. The former Centre, located at Bou-Merdes, about 50 kilometres from Algeria, provides training and conducts scientific and technological research relating to the petroleum and gas industry. The Textile Centre performs similar functions with respect to the textile industry.

Kenya

29. In the Ministry of Works of the Kenya Government there are Materials Testing and Research Laboratories well equipped to conduct research and testing on building materials and buildings. Established in 1949 and occupying a total floor space of some 42,000 square feet, the laboratories are divided into the following departments:

(a) Soil Testing

(b) Chemical Analysis

(c) Building Materials including paint, timber and bitumen.

30. Two smaller laboratories are operated at Nakuru and Mombasa. The laboratories are well staffed. The senior staff include a Chief Materials Engineer, 8 Materials Engineers, a Chemist and a Physicist. Trained assistants and other junior staff number about 102. The services of the laboratories are available to the government and to private enterprises.

Libya

31. An Industrial Research Department was created within the Ministry of Industry in 1963. The purposes and functions enunciated for the Department are as follows:

(a) To carry out research and studies on local raw materials and the technical processes for their exploitation on an industrial basis;

(b) To undertake the study of industrial and technological problems with a view to increased productive efficiency;

(c) To conduct studies on the social aspects of industrialisation;

(d) To carry out market surveys and institute such measures as will ensure that industrial products meet the requirements of the consumer;

(e) To collect, analyse and disseminate industrial and economic statistical data on such matters as domestic production in relation to foreign competition, domestic consumption, capital formation, investment and world financial trends;

(f) To study international industrial development trends and technologies with a view to introducing those that can be adapted to local needs and conditions.

32. The Department exchanges research information with other government departments and ministries, such as the Industrial Development Organisation, the Bank of Libya and the Ministries of Agriculture, Economy, Petroleum and Planning and Development. The results of some of its research work is made available to interested private industrialists.

33. Another agency active in industrial research and development in Libya is the Industrial Organisation Department. It was created at the same time as the Industrial Research Department. Its primary objective is the planning and execution of a coordinated programme of industrial development for the private and public sectors of the economy. Accordingly, the Department undertakes feasibility studies of industrial projects and renders assistance to private industrial enterprises in implementing those projects found to be sound.

34. The Department develops industrial estates, recommends legislation for the promotion and protection of local industries, negotiates and supervises the observance of agreements for the development of domestic mineral resources and carries out the administration of industrial laws, licences and regulations including standards and specifications of quality for raw materials and finished goods.

Morocco

35. In Morocco the "Bureau d'Etudes et de Participation Industrielle" operates a well-equipped laboratory for studies and investigations on various aspects of industrial production.

Nigeria

36. In Nigeria, the Federal Ministry of Industry is responsible for the Federal Institute of Industrial Research which was established in 1956. The Institute conducts research, mainly of an applied nature, on local raw materials and on processes for their exploitation. Within its limited resources it also carries out pilot scale trials of processes developed in its laboratories.

37. The Ministry itself also carries out "industrial promotion, feasibility studies, documentation, technical information, projects appraisal, industrial extension service, administration of fiscal incentives and investigation of applications for loans to indigenous entrepreneurs."

38. The Federal Ministry of Trade, recently separated from the former Federal Ministry of Commerce and Industry, has responsibility for the Nigerian Stored Products Research Institute. This establishment is concerned mainly with investigating the storage problems of Nigerian products, both domestic and imported. It recommends proper methods of storage, transportation and handling, including the types, quality and design of conveying

media to minimise spoilage and deterioration of products. Special research is carried out into the effects on stored products of local climate.

39. Research into the utilisation of Nigerian timber is carried out by the Federal Department of Forestry. The functions of the division for timber utilisation are: [6]

(a) To find uses for timber species, other than the better known ones, which are growing to acceptable sizes and quantities but are not being commercially exploited;

(b) To demonstrate timbers that can be successfully used for specific purposes in lieu of species that may fetch better prices when not so utilised;

(c) To carry out feasibility studies of a number of timber and wood using industries for the benefit of entrepreneurs who may wish to establish such industries;

(d) To encourage silviculture in the light of results of applied research and development in the field of forestry.

40. In the Easter Region of Nigeria, the Regional Ministry of Commerce (which has responsibility for both commerce and industry) maintains a research unit locally referred to as a Regional Laboratory. Established in 1962, the laboratory conducts analytical work for the benefit of industry. It also carries out quality tests at the request of industrial enterprises and without charge.

41. The laboratory is headed by an Industrial Chemist. Other research staff include three Senior Chemists, one Chemist, three Assistant Experimental Officers and three Laboratory Technicians. The laboratory has conducted successful mineral analyses for the government cement factory at Calabar and steel-rolling mill at Emene near Enugu. Its facilities include a small technical library.

Rhodesia

42. An Industrial Development Division was established within the Ministry of Industries and located in Salisbury, Rhodesia, to serve the federation (since disbanded) of Rhodesia and the now independent countries of Zambia and Malawi. The division undertakes feasibility studies, project

appraisals and loan evaluations. It also renders advisory services to industry and carries out such promotional activities as preparation of reports on profitable investment projects and informing potential industrialists and investors of such projects.

Tunisia

43. The State Planning and Finance Secretariat of the Government of Tunisia runs a Central Laboratory in Tunis. Its functions are to exercise control and conduct experiments in the fields of -

- civil engineering and construction materials
- general chemistry
- physical and mechanical tests to determine materials resistances
- mineral analysis
- food technology
- fats
- isotope utilization

44. The laboratory has a staff of 70 technical professional men and assistants and maintains a library and documentation unit. It envisages carrying out applied research in the above areas in the future.

45. The Tunisian Directorate of Industry is organising a Centre of Industrial Studies whose primary function will be the creation of new industries, based on local raw materials, and producing for domestic consumption as well as for export.

United Arab Republic

46. A Ministry of Scientific Research was created by the Government of the United Arab Republic in 1962 as the principal government agency for the promotion of science and technology and the translation of research results into industrial production. This ministry has taken over the functions of scientific and applied research planning, coordination and execution that were formerly performed by the National Science Council.

47. The duties of the Ministry are : [9]

(a) Planning of research, industrial and otherwise, based on the country's economic development plan;

(b) Solution of technological and other problems arising from the development plan;

(c) Research promotion;

(d) Training of research personnel;

(e) Publication and dissemination of research information;

(f) Encouragement of the formation and strengthening of research associations and societies.

48. The Organisation of the Ministry consists of:

(a) The Technical Office of the Minister

(b) A Secretariat

(c) The Consultative Council on Scientific Research

(d) Under-Secretaries respectively in charge of -

(i) Planning and Follow-up
(ii) Technical questions
(iii) Financial and administrative questions
(iv) Scientific Apparatus Centre
(v) Science Museum

49. The Ministry is in charge of the National Research Centre situated at Dokki, Cairo, and of specialised research establishments there and in other parts of the country. (For a discussion of individual research institutes at the National Research Centre and elsewhere in the United Arab Republic, see section below on Industrial Research Institutes).

50. Other functions connected with industrial research and development in the United Arab Republic are performed by the Ministry of Industry. Here the major emphasis is on development. The Ministry is responsible for implementing the law on Organisation and Promotion of Industry (Law No.21). As part of this duty, the Ministry sets quality standards for raw materials and finished products which industrial enterprises must comply with.

It also administers a tax of up to 10% of the value of raw materials used by industrial firms or of the firms' wage bill. The proceeds of this tax are used to finance various aspects of industrial development including industrial research [9]

51. The departments of the Ministry concerned with industrial development include:

(a) The Productivity and Vocational Training Department

(b) The Geological Survey and Mineral Research Department

(c) The Egyptian Organisation for Standardization (E.O.S.)

(d) The General Organization for Industrialisation (G.O.I.)

52. The Egyptian Organization for Standardization was created in 1957 by Presidential Decree No. 29/1957 as the agency to give effect to Law No. 2/1957 on "Standardization". It is the recognized national agency on all matters affecting standardization. Its functions and duties are stated as follows:

(a) Elaborating standard specifications for local materials and products;

(b) Ensuring the existence of standard systems for technical classifications, definitions, terminology and symbols;

(c) Providing the necessary measures for quality control of raw materials and products in conformity with the standard specifications, and establishing central and regional laboratories for metrology and quality control;

(d) Securing reference standards for calibration and verification of measures and measuring instruments;

(e) Coordinating standardization work in the United Arab Republic in accordance with international standardization activities.

53. The organisation structure of E.O.S. consists of a Governing Council and two Permanent Committees. The Governing Council, headed by the Under-Secretary of State for Industry, is responsible for the formulation and implementation of general policy. It consists of fifteen members drawn from different scientific and technical fields.

54. One of the Permanent Committees is concerned with all matters relating to standard specifications and quality control. It has a membership of twelve. The other Permanent Committee, also with a membership of twelve, is concerned with work relating to metrology and calibration of measuring instruments. Sub-sections under the above three bodies include those dealing with (a) Standards, (b) Quality Control, (c) Technical Relations and (d) Administration and Finance.

55. The General Organization for Industrialization (G.O.I.) was established in 1964 as an amalgamation of two pre-existing agencies, namely, the Department of Industrial Planning which came into being in 1956, and the General Organization for Executing the Five Year Industrial Plan established in 1957. As presently constituted, the G.O.I. combines the functions of the two agencies it has superseded, mainly in the fields of organisation and promotion of industries, and the execution of the Five-Year Industrial Development Plan. Specifically, it:

(a) conducts the economic and technical feasibility of projects included in the plan, determining among other things their essentiality and priority rating;

(b) selects the most suitable sites for locating industries determines the proper size, process and/or equipment for industrial plants;

(c) arranges for the construction of factory buildings and structures, purchase, installation and testing of all essential machines and services, recruitment and training of operators and managers and the provision of working capital;

(d) controls engineering, operating and financial aspects until the enterprise concerned is ready to be turned over to the General Organisation having jurisdiction for it.

56. The G.O.I. is directly under the Deputy Prime Minister for Industry and Mineral Resources. Its policy-making body, with the Deputy Prime Minister for Industry and Mineral Resources as Chairman, consists of a Board of Directors with 15 to 25 members. These include a Managing Director as the principal Executive Officer, the four ministers in the field of industry, (Namely, Minister of Heavy Industries, Minister of Light Industries, Minister of Petroleum and Mineral Resources and Minister of Electrical Power); the four Under-Secretaries of State of the

above industries; the ten Presidents of the ten specialized industrial organizations that control all the industrial companies; and four other members.

57. The Managing Director is assisted by four Directors - General respectively in charge of:

(a) Financial Administration

(b) Technological Administration

(c) Construction Administration

(d) Industrial Design Administration

Each administration covers a wide range of functions within its sphere of competence.

VI. RESEARCH AND DEVELOPMENT ACTIVITIES BY INDUSTRIAL DEVELOPMENT CORPORATIONS

58. A number of African Governments have set up semi-autonomous statutory corporations charged with the responsibility of promoting industrial development. Such bodies are normally funded by the government which also appoints the Chairman and members of the Board of Management responsible to the relevant minister.

59. The operations of industrial development corporations normally cover the following areas:

(a) Financing of industrial enterprises

(b) Technical Assistance to private industrial enterprises

(c) Marketing, including export promotion

(d) Research and Development

(e) Training and personnel development

(f) Establishing and operating industrial enterprises.

Ethiopia

60. A public organisation known as the Technical Agency was created on 8 July 1963, by Imperial Order No 29 of 1963. The duties of the Agency are:

(a) To undertake economic and technical feasibility studies looking to the establishment of economic and social development projects and enterprises envisaged in the development plans;

(b) To prepare designs, plans, specifications, drawings and other technical material required for the requesting of tenders and the construction or installation of facilities;

(c) To administer tenders, prepare and negotiate development contracts, supervise construction of plants and installation of machinery and equipment in projects under its jurisdiction and make recommendations concerning the employment of competent management personnel for industrial enterprises.

61. The Agency functions as the technical and implementing organ of the Planning Board and is under the direction of a General Manager as the Chief Executive. The current General Manager holds the rank of Assistant Minister in the Government. There are two departments within the Agency: A Study Department and an Engineering Department. The Study Department evaluates the national development plan and its socio-economic implications. It undertakes specific feasibility studies on selected projects and reports on them to the Investment Bank, the Development Bank or any other appropriate financing institution. Approved projects are referred to the Engineering Department for a technical and more detailed evaluation prior to the preparation of contract documents.

62. The Engineering Department is divided into four sections dealing with civil engineering, mechanical engineering, electrical engineering and services. Some of the studies undertaken by the Agency so far have been carried out by its own staff, a number of whom are experts supplied by foreign governments under bilateral aid agreements. But the Agency's present staff strength is quite limited compared with the scope of its programme. As a result, it has leaned heavily on the use of outside firms of engineering consultants to carry out some of its major studies. In some cases financial assistance of up to 50 per cent is provided by some foreign governments to supplement the Agency's budget for financing the consultant services.

63. The following are among the studies which have been completed by, or under the auspices of, the Agency:

(a) The Expansion of the Glass Industry in Ethiopia;

(b) The Development of Oilseed Industries in Ethiopia;

(c) The Development of the Fishing Industry in Ethiopia;

(d) The Future of the Natural Resin Industry in Ethiopia;

(e) Investigations on the Feasibility of the Ceramic Enterprise in Ethiopia;

(f) Feasibility Study on a Wood and Metalworking Plant in the Region of Bahar Dar, Ethiopia;

(g) Investigation into the Feasibility of the Establishment of a Di-Calcium Phosphate Factory in Ethiopia;

(h) Feasibility Study on a Caustic Soda Plant in Ethiopia;

(i) Feasibility Study on a Building Stone Factory and a Quick-lime Works in the Region of Bahar Dar, Ethiopia;

(j) Feasibility Study and Project Proposal for a Pulp and Paper Mill for the Ministry of Commerce and Industry.

64. The Engineering Department of the Agency plays a key role in the awarding of contracts on government industrial projects, preparation of sites prior to construction of plants, and supervision of work of contractors from both technical and financial standpoints. It also offers assistance to project contractors in such matters as Customs Clearance, Insurance, Transportation, staff training, setting up of an accounting system and final clearance of and payment for work done.

65. After a new plant is handed over to the investing (public) company, the Agency provides the company with technical assistance in the following areas:

(a) Procurement of Materials — information on sources and types;

(b) Technological Trouble-shooting;

(c) Quality Control;

(d) Use of equipment, fuels and lubricants;

(e) Marketing Organisation and Methods;

(f) Accounting Administration and Set-up;

(g) Cost Accounting;

(h) Economic Analysis.

66. The Agency also provides free technical assistance, consultant and advisory services and project evaluations to private industrialists and industrial companies as well as to the Development Bank of Ethiopia.

Kenya

66a. The Kenya Industrial Development Corporation (IDC) is a national corporation established to finance and implement industrial projects in the private sector of the economy and to develop indigenous entrepreneurship. It has a technical branch staffed by technical personnel from France, West Germany and the United Kingdom, obtained under bilateral aid programmes. The branch provides technical assistance to indigenous businessmen in setting up and running small-scale and medium-scale industrial enterprises. Separate sections within the technical branch deal with:

(a) Project evaluation, feasibility studies and programming;

(b) Industrial estates;

(c) Implementation and engineering.

Malagasy Republic

67. In the Malagasy Republic, technical assistance to industry, in the form of feasibility studies, project evaluation and advisory services, is provided by the technical staff of the Bureau du Developpement Industriel, an agency which is separate from the Directorate of Industry. The Bureau is served by a team of technical staff provided by the French Government under a bilateral aid programme.

Nigeria

68. The Eastern, Northern and Western Regional Governments of Nigeria have had in existence for the past several years regional development corporations created to encourage, promote and execute programmes of agricultural and industrial development. With regard to the newly-created Mid-western Region, information on this point is unavailable.

69. In the Eastern Region, the ENDC (Eastern Nigeria Development Corporation) was created by Eastern Nigeria Law No. 7 of 1963. The original agency for this purpose was created in 1954 under the name of the Eastern Region Production Development Board. The name was changed in 1956 to Eastern Region Development Corporation and, on 1st October 1960 (the day the country became independent), the latter name was changed to its present form.

70. The major portion of the Corporation's activities is in the field of agricultural development. But it has invested in a number of manufacturing establishments and in others concerned with the processing of agricultural products. Until 1956 it also provided loan financing and technical assistance to private small agricultural and industrial businesses. The loan operations are now handled by a new agency, FAID (Fund for Agricultural and Industrial Development), established for that purpose.

71. FAID was created under Eastern Nigeria Law No. 6 of 22 May 1963, and became operational on 8 August 1963. Its stated purpose is "to provide a source of credit in addition to existing commercial institutions for the furtherance of the agricultural and industrial development of the Region". Finances for the "Fund" are paid into a reserve fund by the Eastern Nigeria Government. As of August 1965, £250,000 had been paid into the fund, one-third of which could be spent on industrial development. Provision is made for spending £500,000 to finance private industry in the near future and £100,000 of this will have been so spent by the end of the 1965/66 financial year. The "Fund" expects to receive additional contributions into the reserve fund totaling £200,000 from private and semi-private corporations during the 1965/66 year.

72. It operates on a semi-commercial basis, the rate of interest on its loans being only 2/3 of the regular commercial rate. Its industrial loan operations are supervised by the Ministry of Commerce whose staff carry out the pre-loan investigations as well as all follow-up activities. All loans for industrial machinery and equipment are made in kind.

73. Another agency in the Region active in the field of industrial development is the Eastern Investments Ltd., formerly called the INDAG (Industrial and Agricultural Company Ltd.). This semi-public corporation is in the process of being reconstituted to effect a 50-50 shareholding between the regional government and its principal partner, the CDC (Commonwealth Development Corporation). It is strictly an investing corporation operating on a commercial basis. As at August 1965, it had invested in eight industrial enterprises and six other investments were being processed.

With the aid of outside consultants it participates in feasibility studies and economic evaluations of proposed investment projects. Such projects under investigation as at August 1965, apart from those mentioned above included the manufacture or processing of glassware, bicycles, paper products, automotive tyres (reconditioning), nails, nuts and bolts, enamelware, salt, clothing, etc.

74. The NNDC (Northern Nigeria Development Corporation) and the WNDC (Western Nigeria Development Corporation) operate in their respective regions along much the same lines as the Eastern Nigeria Development Corporation does in the Eastern Region. Also in the North is the NNIL (Northern Nigeria Investments Ltd.) whose activities are similar to those of the Eastern Investments Ltd. The Corporation was established under the name of Northern Developments (Nigeria) Ltd. in September 1959 but changed to its present name on December 6, 1963. Its present share capital of £4.6 million is subscribed on a 50-50 basis by the NNDC and the CDC. It carries out pre-investment studies as part of its general investment programme.

Tanzania

75. The NDC (National Development Corporation) of Tanzania is wholly government owned and directed. It was created to provide financial and technical assistance to local small-scale and medium-scale industries. It is staffed with expatriate specialists who are helping to train local counterparts.

Uganda

76. The Uganda Development Corporation has a development division which conducts feasibility studies and project evaluations. It also renders advisory services to UDC clients. The division has a professional staff of eight and is sub-divided into three sections:

(a) Project Evaluations

(b) Market Research

(c) Small-scale Industries

The Corporation operates a small chemical laboratory at Tororo for conducting routine chemical analyses and tests.

Zambia

77. In 1960 the Northern Rhodesia (now Zambia) Industrial Development Corporation Ltd. (INDECO) was formed with an issued capital of £1,015,000 "to act as Government's spearhead in implementing an active policy of industrialisation; to provide financial support to economically viable private enterprise projects; to underwrite or establish projects agreed to be in the national interest until such time as participation of private enterprise can be attracted".

78. Prior to August 1964 a number of private companies owned shares in the Corporation. These included the British South Africa Company, Commonwealth Development Corporation and the Roan Select Trust Group. Since that time, however, the Government has acquired all the private shares and now has full ownership of the Corporation.

79. The Corporation's staff, which includes an Industrial Adviser and a small project evaluation and implementation team made up of industrial engineers and economists, is to be increased substantially in the near future. The Staff maintains contact with overseas industrial research organisations and has special consultancy arrangements with IPEC of London.

VII. RESEARCH AND DEVELOPMENT ACTIVITIES BY PRIVATE INDUSTRIAL ENTERPRISES

80. Some of the larger industrial enterprises in many African countries, owned for the most part by foreign interests, maintain small research laboratories or technical departments for conducting routine investigations, tests and analyses. The majority of them do not undertake extensive exploratory investigations, preferring to rely on the facilities available at their home offices in this area. Information is generally lacking on research activities of private companies. The following companies, however, all of which are located in Libya, may be cited as examples of private enterprises which operate their own small research laboratories. The Macobar Pentonite Co., the General Gas Company (for the manufacture and packing of oxygen), the Libyan Farmer Company (for Canning Fruits and Tomatoes), the Collective Trade Centre at Gurardi as well as companies in the petroleum and petro-chemical industries.

VIII. RESEARCH AND DEVELOPMENT ACTIVITIES BY INDUSTRIAL RESEARCH INSTITUTES

81. The need for industrial research institutes is receiving serious and widespread attention in Africa and the subject is being discussed by national and international bodies with increasing frequency. Many of the long-established institutes are of the specialized variety; in some cases they are no more than specialized laboratories conducting investigations, tests and analyses on a single product or a group of related products, or for the benefit of a single industry.

A. Specialised Institutes

82. African institutes of this kind have been created in the past, and continue to be created, for the primary purpose of developing individual commodities that represent important cash earners for the national economies. The following "institutes", laboratories and centres may be considered "specialised" in some sense or other:

Algeria

83. The African Hydrocarbon Centre and the Textile Research and Training Centre (see Para.).

Ethiopia

84. The Ethio-Swedish Institute of Building Technology - provides training for building supervisors; conducts studies on production of hand-made blocks and use of local materials in construction; provides advisory services.

Ghana

85. The Building Research Institute concentrates its research work on the development and improvement of building materials suitable for the domestic environment.

86. Food Research and Development Unit. This unit was established in 1965 for the purpose of testing and standardisation, training and pilot plant demonstration.

Nigeria

87. Hides, Skins and Leather Research Institute, Zaria, Northern Nigeria. This Special Fund Project was initiated in April, 1964. Besides offering training in leather technology, the Centre conducts research on local tanning materials such as barks, leaves and pods, on ways of improving the quality of Nigerian leather and on marketing of hides, skins and leather. At present it conducts its chemical analyses at the laboratories of the nearby Ahmadu Bello University. Steps have been taken to establish two sub-centres at Sokoto and Maiduguri, also in the Northern Region.

Sudan

88. Hides and Skins Demonstration and Training Centre, Khartoum. This project is similar to the Nigerian one discussed in the preceding paragraph. Also sponsored by the Special Fund, the Centre, which was initiated in November 1963, aims at the improvement of local hides, skins and leather and of products based on them.

89. Food Processing and Research Centre. This project approved by the Special Fund in June 1963, is now operative and is engaged in activities connected with processing of food and food products, development of standards and testing of foods, extension services and training.

United Arab Republic

90. A number of specialized institutes are operated as Units of the National Research Centre at Dokki, Cairo, which in turn is under the Ministry of Scientific Research. Those in the field of industrial research include the following:

(a) National Chemical Research Centre

Activities:
(i) General and physical chemistry
(ii) Inorganic chemistry
(iii) Organic Chemistry
(iv) Glass and Ceramic Technology
(v) Paper and Pulps research
(vi) Fats and Oils research

(vii) Industrial Microbiology

(viii) Leather Technology

(ix) Insecticides and pesticides

(x) Paints research

(b) Electronics Research Institute

(c) Refractories Research Institute

(d) Transport and Communications Research Institute

All of the above institutes except (a) are new projects for implementation during the second five-year plan, 1965/66 - 1969/70.

The following specialised institutes were until 1962 also units of the National Research Centre but have since become independent of it:

(e) Textile Research Institute, Dokki, Cairo:

Activities: (i) Physics and Chemistry of Fibres

(ii) Mechanical Treatment of Textiles

(iii) Chemical Treatment of Textiles

(iv) Manufacture of Man-made Fibres, dyestuffs and auxiliaries

(v) Development of textile machinery

(f) Petroleum Research Institute, Dokki, Cairo:

Activities: (i) Chemical Analysis

(ii) Refining, Process Design and Development

(iii) Petro-chemical and Additives research

(iv) Combustion and Lubrication research

(v) Catalysis, corrosion, and radiation chemistry

(vi) Petroleum production

(g) Metallurgical Research Institute, Dokki, Cairo:

Activities:
(i) Developing processes for ferrous and non-ferrous metals
(ii) Shaping processes development
(iii) Foundry research
(iv) Ore microscopy and ore dressing

B. Multi-purpose Institutes

91. Many experts on the subject of industrial research feel that multi-purpose institutes, as opposed to specialized ones of the kind discussed in the preceding section, are best suited to the needs of the developing nations. Along this line the Beirut seminar commented that "where limited staff and resources are to be employed to offer a wide range of services to multiple types of industry, the multi-purpose institute offers obvious advantages."

92. A number of these "obvious advantages" can be mentioned, and one that readily suggests itself is that of economy of operation. Few people will deny that "staff and resources" are generally "limited" in developing countries, in some countries more so than in others. A wise policy would dictate that these limited resources should be used in such a way as to yield optimum benefit to the country; i.e., in the most economical way. In the matter of research institutes, the multi-purpose type is generally staffed with personnel representing a wide range of scientific disciplines. Since most research problems tend to be interdisciplinary in character, the pool of diversified scientific and technical competence of a multi-purpose institute offers a greater potential for problem-solving than does the "know-how" of the lone researcher or of the small, narrowly-specialized research institute.

93. In terms of available financial resources, research establishments, even those of modest size, generally require substantial investments on buildings, furniture, general laboratory equipment, specialized equipment and apparatus. If such an investment is justified in the interest of the economy, that interest will be served best by an optimum utilisation of the facilities thus acquired, not by their under-utilization. In a multi-purpose institute, the potential for such optimum utilization of facilities is provided by sharing their use among the various research projects.

94. The view is also widely held that a multi-purpose institute provides an intellectual and scientific environment close to ideal, in which technical and other professional personnel have unlimited opportunities for mutual consultation, advice, encouragement andintellectual stimulation. The net effect of this "cross-fertilization" of ideas is that research effort in such an institute tends to be more productive.

95. Multi-purpose institutes provide a wide spectrum of services -- technological, techno-economic or socio-economic -- which industries of all kinds can avail themselves of on a short-term, medium-term or long-term basis. This relieves the individual industries, industry groups or other users of these services, of the need to recruit and train their own research staff, at least until such a time as necessity and their financial capability shall render such recruitment both desirable and feasible.

96. In the field of training of young recruits in the practical aspects and methodology of industrial research, multi-purpose institutes offer definite opportunities. Not only that, but they also help to prepare young scientists and technicians for careers in the technical departments of private industrial organisations and government agencies.

97. Finally, because of the breadth and diversity of the fields they encompass, multi-purpose institutes are likely to have wide-ranging contacts with similar institutes abroad as well as with prominent individuals in the industrial and scientific communities in different parts of the world. From these sources, the institute can import technology and adapt it to local use. It can also serve as a clearinghouse of industrial information between local industrialists and foreign interests.

98. In Africa the number of multi-purpose institutes is still quite small but is expected to steadily increase in the years ahead. In general, as industrialisation progresses, industrial research can be expected not to lag too far behind. Of the institutes now in existence the following may be mentioned.

Nigeria

99. **Federal Institute of Industrial Research**

This Institute was established in 1956 on the recommendation of a World Bank mission that visited Nigeria in 1953/54 and with the help

of a loan from that Bank. It transferred to its present 27-acre site at Oshodi from an experimental location at Bar Beach in 1957 and quickly converted the existing wooden buildings into temporary laboratories, workshops, stores and offices. Although these buildings are still in use, principally as stores, the institute has since constructed four permanent buildings, namely an Engineering Workshop and Store, a Pilot Plant Development Building, Air-conditioned laboratories and an Air-conditioned Administration Block.

100. The major emphasis of the institute's work is on the development of products and processes based on Nigerian raw-materials. It has successfully developed a fully-mechanized process for the manufacture of "gari", a major West African food item from cassava roots and is presently investigating the possibility of fortifying it with protein nutrients from local vegetable products since "gari" is almost exclusively starch. As a result of the institute's work, this item of food which was formerly produced by slow and unhygienic village methods is now being produced commercially and at high sanitary standards.

101. Another significant achievement of the Institute is the development of mattress fibre from the husks of coconuts. A pilot factory for the purpose was built in 1959 and after three months of trial operation was transferred to private industry for commercial production. This has resulted in a sharp increase in local production of mattresses and door mats. Other institutes in this category include the Sudan Industrial Research Institute and the Industrial Studies and Development Centre in Dar-es-Salaam, Tanzania. For a discussion of these institutes see the section below on Technical Assistance to Industrial Research Institutes. (Page 39).

IX. REGIONAL AND SUB-REGIONAL RESEARCH INSTITUTES

102. Regional industrial research institutes have been the topic of much discussion and study in recent years. It is recognized that some developing countries, due to a scarcity of resources, are not in a position to support individual national institutes. For such countries a pooling of effort with neighbouring countries to establish a research institute that will meet the needs of all participating countries appears to be one possible solution. But such an undertaking entails many difficulties. Some regional or sub-regional institutes have indeed functioned fairly

successfully. But as pointed out by the Beirut Seminar "such success depends upon an unusual homogeneity of the peoples, their historic ties, and concurrent programmes of economic integration or common markets".

103. These are not the only obstacles. Legal and administrative implications have also got to be taken into consideration. For instance, the Economic Commission for Africa in a study [13] of this subject published in November 1963 made the following observations:

> The countries of the sub-region are required to subjugate their individual national interests for the general upliftment and greater prosperity of a group, and to jointly and severally assure the autonomy of the institute. The legislation establishing the institute will therefore have to be passed by all the governments in the sub-region in identical form. The countries in which the institute and branches may be sited would have, in addition, to agree:
>
> (a) to import of chemicals, equipment, instruments, vehicles etc. free of customs duty and excise duty;
>
> (b) to exempt the institute or its branches from stamp duty, income tax, etc;
>
> (c) to permit the institute to maintain and use equipment for laboratory and experimental services without any licence, permit or approval;
>
> (d) to permit the institute to negotiate and receive aid in personnel or equipment from other governments, international agencies, foundations, etc.;
>
> (e) to afford such privileges and exemptions to personnel of United Nations and other international organisations as are already in force;
>
> (f) to permit the unrestricted use of exchange for the import of its specialised equipment, books, etc.;
>
> (g) to permit free entry and exit for the members of the Governing Board and the staff of the institute.

104. In the application of research to the solution of technological problems, physical proximity of the institute to the industrial location is an important factor. Certain kinds of laboratory tests and analyses can yield accurate results only if carried out within some prescribed time limits. Beyond those limits chemical changes in the substances to be analysed are bound to interfere with the results. Long distances between the institute and industries located in neighbouring countries therefore tend to impose a disadvantage on such industries thereby diminishing the level of utilization of the institute's services.

105. The above-mentioned discussion illustrates that the subject of regional and sub-regional research institutes should be studied further to determine how best can these institutes be established in order that they may supplement and strengthen the existing national establishments.

X. THE PERSONNEL PROBLEM

106. The view is widely held that one of the most serious obstacles to industrial development is developing countries is the shortage of personnel with the technical qualifications and professional experience requisite for an industrial economy. There is an urgent need in virtually every developing country for more well trained scientists and technologists, engineers, economists, public and business administrators, and other professionals, all of whom help to form the backbone of an industrial society.

107. In the field of institutional industrial research, the personnel problem is accentuated by many factors. In the first place, industrial research in developing countries is still very much in its infancy. As such, it has yet to develop an intrinsic prestige and the capability to attract and hold the high calibre of technical personnel it requires, even when they are readily available -- which often they are not. Secondly, young university graduates in some developing countries tend to favour positions in the administrative branch of the civil service because they consider that such positions offer them a higher prestige, better prospects of advancement and greater social influence than they might get working in a research establishment. Thirdly, other graduates accept positions with private companies in response to higher salary inducements than they are offered by research organizations, most of which are public establishments obliged to operate under civil service salary scales.

Fourthly, due to the absence of paucity in some research establishments of supporting technicians, such as laboratory assistants, chemical analysts, electricians, machinists, instrument men, welders, pipe-fitters, carpenters, etc., top level professional personnel are often obliged to perform routine duties which normally should be performed by the above-mentioned types of skilled technicians. The professional duties are thus poorly attended to with a resultant waste of expert talent.

108. Until such time as the output of qualified indigenous staff is sufficient to meet the demand in African institutes, the current practice is to recruit foreign specialists on fixed term contracts, often renewable, and to have indigenous but less qualified staff understudy them in the hope of eventually taking over the more responsible positions. At the same time, training programmes are being pressed forward more vigorously by increasing the number of fellowships for graduate and post-graduate course work at domestic and foreign universities. In some instances such fellowships have been made available under bilateral, multi-lateral and/or international technical assistance programmes.

XI. ACTIVITIES OF THE UNITED NATIONS IN THE FIELD OF INDUSTRIAL RESEARCH

109. The United Nations Centre for Industrial Development has been engaged in many activities related to industrial research. Among these are the following programmes:

A. Seminars

110. The Centre for Industrial Development organised the Inter-regional Seminar on Industrial Research and Development Institutes in Developing Countries held in Beirut, Lebanon, from 30 November to 11 December 1964. The Seminar brought together a large number of industrial research administrators, managers, workers and policy-makers from various geographical areas. Its purpose was to provide this representative group with the opportunity to discuss and examine various aspects and problems connected with the setting up and operation of industrial research institutes with a view not only to cross-fertilisation of ideas among the individuals and countries concerned but also to the mapping of possible areas for further action in the field of industrial research.

111. The Seminar dealt with three broad subjects, namely Objectives and Functions of Industrial Research Institutes, Industrial Extension

Services, and Organizational Concepts and Problems. The following specific areas, among others, were examined:

(a) research, development and promotion activities to strengthen manufacturing industries in the developing countries;

(b) types of technological and socio-economic studies designed to serve industrial development;

(c) procedure and information necessary to carry out feasibility studies on the economic and technological soundness of industrial projects;

(d) organization and establishment of facilities for laboratory testing and formulating of standards of identity and quality;

(e) responsibility of the industrial research institute for the application of results of scientific and technological progress;

(f) establishment and development of industrial extension programmes and methods best adapted to conditions in developing countries;

(g) overall organizational problems of industrial research institutes.

112. The consensus emanating from the discussion at the Seminar was that: Industrial research is of fundamental significance in laying the foundation of a sound industrial base, and investment in industrial research should be recognised as in fact an investment in industry and even in the future of the nation.

113. The broad spectrum of industrial research should be given attention and the developing countries should emphasise applied research although fundamental research should not be neglected. Research should also provide assistance to all types of industry regardless of size.

114. There is a need to graft indigenous research onto imported technology and to nurture such graft to full fruition to achieve increasing self-dependence.

115. The activities of the institutes should include, inter alia, utilisation of raw materials; development, improvement or adaptation of production methods; processes and equipment; pilot plant trials, quality

control; feasibility studies; design and productivity studies; marketing research; operations research; consultancy and trouble-shooting; and advisory services.

116. Whereas the integration of industrial research and development functions within the same institute was emphasized, it was recognized that under certain conditions some functions can be carried out by other organizations. However, the idea of team-work should be preserved.

117. The selection of industrial research projects should be made in the light of national needs and at the same time the institute should also be in a position to respond to specific requests from industry.

118. With a view to its speedy application, industrial research should not be conducted in isolation, but in relation to the practical needs and requirements of industrial development. An important function of industrial extension services is therefore to provide close contact between the problems of commercial production and the conduct of industrial research, and to promote the closest cooperation and association between research groups and those responsible for industrial production. To do this most effectively, it is necessary to develop the appropriate mechanism, first to get to know the needs of industry, and, secondly, to stimulate interest and generate confidence in research and development on the part of industry.

119. Despite the great value of international and bilateral technical aid, it cannot serve as a substitute for the development of local staff. Thus, training of researchers and research administrators was emphasized.

120. In choosing a pattern of organisation, factors to be taken into consideration will include the level of economic development of the country concerned, type and scale of operation of existing industries, administrative set-up, needs of any predominant raw materials and financial as well as other resources.

121. Multi-purpose institutes, as opposed to specialised ones, offer obvious advantages in countries where resources are limited. As regards regional or sub-regional institutes, these require, for their success, an unusual homogeneity of the peoples concerned.

122. Industrial research institutes should cooperate fully with the economic planning authorities but should retain a measure of freedom to pursue promising self-initiated projects, placing major emphasis on

applied research. Cooperation should exist also with other organizations connected with research or with related fields.

123. Methods of financing industrial research in developing countries includes government grants, taxes or levies imposed on the commodities produced and fees or contract income. The research institute should charge a fee for the work it performs rather than offer it to industry or other users free of charge. Primary responsibility for the financial support of industrial research institutes in developing countries rests with the governments.

B. Management of Industrial Research Institutes

124. During the discussions at the Seminar, it became apparent that in most developing countries the problems of the management of these institutes were acute. In this respect several participants narrated the serious difficulties encountered in their respective countries. The consensus of opinion among the participants was that it was relatively easier to recruit qualified economists, engineers and scientists for the institutes than it was to recruit qualified managers. The success or failure of an institute, it was felt, depended inter alia on the competence, foresight and decision-making ability of the institute's management.

125. To provide guidelines in this matter the Centre for Industrial Development prepared a Report entitled "Managerial Practices for Industrial Research Institutes in Developing Countries," and proceeded to convert it into a Manual on that subject. To do this, the Report was circulated to numerous honorary correspondents throughout the world chosen on the basis of their wide experience in the field of industrial research. Many useful comments, criticisms and suggestions were received from them.

126. A series of meetings of technical experts was then held at United Nations Headquarters in New York to review both the Report and the comments received on it and prepare a first draft of the Manual. The Manual is expected to be ready for distribution in March 1966.

C. Dissemination of Information Among Industrial Research Institutes and Similar Organisations

127. In order to fulfill the need for exchange of information among research institutes as was stressed during the Seminar, the Centre for

Industrial Development sent out a questionnaire to 200 industrial research institutes throughout the world to ascertain the appropriate system and procedure to facilitate such exchange. The replies which have reached the Centre have been analysed and have producted the following consensus:

(a) There is a general desire among the institutes both to receive and to contribute industrial information;

(b) The types of information most favoured are, in that order:

Research Projects and Programmes
Information and Consultancy Services
Staff Training
Organisational Structure
Finance
Problems of Research Management
Other services.

(c) There is need to set up a central clearinghouse to collect, analyse and disseminate information. The Centre for Industrial Development should perform this duty.

(d) A periodical bulletin should be published by the clearing-house twice annually covering the above and related types of information.

128. Based on the response of the institutes, the Centre for Industrial Development will publish a bulletin to be entitled "Industrial Research News" appearing initially in January and June. To be of the greatest value as a news medium, the news bulletin will cover the entire scope of the work of industrial research institutes; their organization and structure, research programmes, relation with industry and government and the variety of services offered or needed.

D. Studies

129. The Centre for Industrial Development conducts studies related to industrial research. The following examples illustrate this type of activity:

(a) Feasibility Considerations for the Establishment of Industrial Research Institutes

130. Many types of investment projects require a pre-investment study to determine their feasibility, the most suitable organizational structure and other related aspects. This is no less essential in connexion with the establishment of industrial research institutes.

131. A developing country contemplating the establishment of an industrial research institute should undertake, as a prior step, a study of its feasibility, taking into consideration a broad spectrum of factors. These include, inter alia, elements of the physical environment, socio-economic conditions, the existing level of technology and projections for the future, the stage of industrial development and planned or projected targets, the manpower situation, financial requirements and resources, the state of present and future facilities for training, etc. The Centre for Industrial Development has initiated a study designed to examine and evaluate those and similar elements in relation to the real needs of a country for an industrial research institute.

132. It is felt that such a document should be useful to developing countries by calling attention to some of the critical areas that demand careful consideration prior to the setting up of research institutes.

(b) Consulting Services

133. The Centre for Industrial Development has conducted a study on the various systems of consulting services, contracts and licence agreements. The report of the study will be made available to all countries.

E. Public Agencies

134. The range of public and semi-public functions in industrial development vary considerably from country to country and may encompass a wide spectrum of activities including industrial planning and programming, finance, research, industrial extension services, industrial legislation, patent control, industrial exhibitions and fairs, purchase or hire purchase schemes for buildings and machinery, industrial estates, training, administration of standards, consultations, industrial cooperatives.

135. All these related activities warrant the establishment and coordination of adequate institutional framework to cater to the demands of industrial development for the formulation of policies, the effective implementation of programmes and projects and the establishment or improvement of industrial enterprises. Improved organizational structure and clearly defined functions, as well as effective linkage of the agencies concerned, will no doubt play an important role in giving impetus and strength to the process of industrialization and in accelerating its growth in many developing countries.

136. A field study is now being undertaken by the Centre for Industrial Development to examine and discuss the aims and objectives of agencies, their functioning, their peculiar characteristics and their potential or actual role in the promotion of industrialization in developing countries. The means for liaison and coordination among the agencies necessary to eliminate duplication of effort and dissipation of resources, the mechanisms for making the agencies sensitive and responsive to the needs of industry, are other matters that will be covered by the study.

137. The following countries have been visited as part of this study by Consultants appointed by the Centre: Ethiopia, Ghana, Guinea, Kenya, Morocco, Nigeria, Senegal, Tanzania, Tunisia, Uganda, United Arab Republic, Upper Volta, and Zambia.

138. The reports of the country studies will be considered by a seminar to be convened either in 1967 and approaches will be suggested for strengthening and improving the effectiveness of the various agencies in promoting industrial development.

F. Technical Assistance to Industrial Research Institutes

139. Since the United Nations is the executing Agency for Special Fund technological research institutes, the Centre for Industrial Development is assisting through guidance in relation to the substantive aspects of these institutes. Many experts and consultants are assigned to the institutes, and equipment as well as fellowships are made available as Special Fund contribution. The following examples illustrate this type of assistance:

Industrial Research Institute, Khartoum, Sudan

140. The establishment of this institute as a Special Fund project received the approval of the Special Fund Governing Council in June, 1963,

and the Plan of Operation, with the United Nations as Executing Agency, was signed on 14 February 1965. The purpose of the Institute is:

> to aid and promote the industrial and economic development of the country through the application of industrial research and technology, its adaptation to the country's conditions and resources, and by the creation of a broadly available local source of practical information, assistance, professional advice and counsel on processes, standards and efficient techniques of industrial production, costing, organization and management technology. The project will also enable the institute to encourage the development of Sudanese technical personnel essential to accelerated economic development of the country.

141. A nucleus of experts is being assembled to organise an information and documentation unit within the Institute. At this initial stage of the Institute's existence, the fellowship programme as originally provided in the Plan of Operation is being expanded so as to provide a complement of counterpart personnel for the later stages of the Institute's operations. At least, during the early years when the Institute is operating on a limited range of activities, provision has been made for cooperation with the Management Training and Productivity Institute being sponsored by the ILO.

142. Eventually it is expected that the research institute will expand its operations to include industrial consultancy and advisory services, feasibility studies, testing, trouble-shooting and a variety of technological and socio-economic investigations.

Industrial Studies and Development Centre, Dar-es-Salaam, Tanzania.

143. The establishment of this institute received the approval of the Special Fund Governing Council in January 1965 for Special Fund sponsorship. Provision for a Governing Council earmarking of $481,300 and a Government counterpart contribution of $170,000 has been made. A project manager was appointed during the latter part of 1965 and discussions on the Plan of Operation of the Centre were commenced shortly thereafter. It is proposed to staff the Centre with specialists respectively in the fields of industrial engineering, chemical engineering and industrial economics.

144. It is expected that the Centre will perform the following functions:

(a) To advise on industrial policy and organization;
(b) To assist in the investigations necessary for better utilization of the country's natural resources;
(c) To undertake or assist in thepreparation and assessment of industrial feasibility studies and advise on the implementation of projects;
(d) In certain limited fields, to provide advisory extension services to private industrial concerns;
(e) To advise on the regional aspects of industrial projects, taking into account the possibility of complementary development in the economies of neighbouring East African countries.

XII. CONCLUSION

145. Judging from the foregoing survey, industrial research and development in Africa is receiving widespread recognition. This augurs well for making it a vital cog in the wheel of technological progress. Obviously the level of activity in this important area is still below what is needed to provide an adequate support and stimulus to industrial development.

146. There is need for coordination of the various industrial support functions — research, testing, standardisation, chemical analysis, extension services, technical advice and consultation, etc. — which are at present dispersed among several governmental agencies. In some instances a number of these functions can be consolidated and made the responsibility of one agency which can thus become the nucleus of a future industrial research institute.

147. National development planning is now a widely used technique in Africa to assign priorities and allocate resources for economic development. To undertake long-range development planning without regard to the long-range techno-economic services that will be required by the economy as a whole, and by industry in particular, is likely sooner or later to create a gap which will prove extremely difficult to correct. Industrial research planning should be made a part of overall national development planning.

148. In the final analysis the answers to domestic problems can best be worked out by the people themselves. By virtue of their conversance with the local environment and its resources, their familiarity with local custom, culture and mores and their close indentification with local goals and aspirations, indigenous staff are in a considerably better position to render more lasting service to their own countries and communities.

149. Foreign experts have rendered and continue to render much needed service to many a developing country, in this and other areas. The need for them is likely to continue and even to expand. But their role is essentially a supplementary one. In order that this source of technical expertise may continue to be available in the future, the machinery for maintaining an effective contact between the developed and developing countries must be continually improved.

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