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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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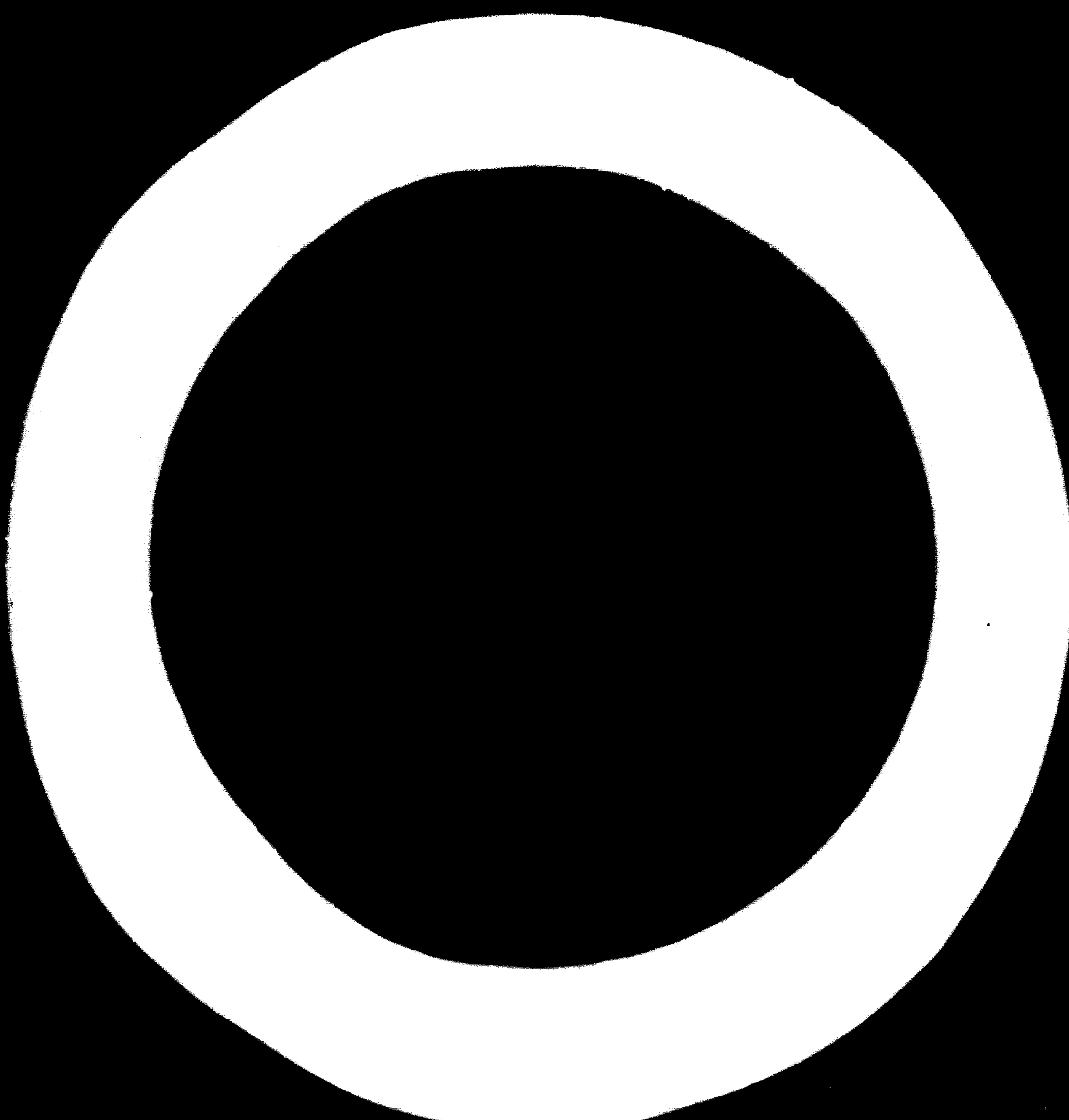

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Spring 1970

Priorities for Industrial Research in Nigeria

By I. A. Akinrele

INDUSTRIALIZATION HAS BECOME accepted in our age as the magic wand for the transformation of societies of traditional simplicity to those of sophisticated affluence. The world is at present divided into developed and developing areas almost solely on the basis of industrial organization. The developed countries base their economies primarily on manufactured goods while the developing countries remain primary commodity producers. In spite of every effort to increase productivity in the developing countries, their exports have been expanding since 1955 at only about half of the total world rate. Manufactured products now account for nearly 60 per cent of the total value of world trade, having increased from 25 per cent in the 1920s.

The growth of trade in manufactured products does not reflect a need to pay more in manufactures for the food and raw materials needed by industrial countries, but is a positive indication of the increase and shift in demand for manufactured products. Hence the economic gap between developed and developing countries has continued to increase and the need for the industrial development of the latter has become more pressing.

Nigeria's potential for industrial development

Nigeria falls within the criteria used to designate an underdeveloped economy, i.e. it has:

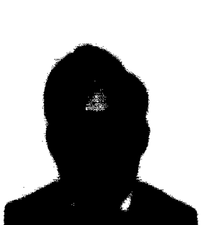
- A low growth rate of 4 per cent in Gross National Product *per capita;*
- A low capital formation level (15 per cent of GNP) because of low incomes and limited availability of domestic savings to apply to the process of capital formation;
- Inadequate technical skill because of the limited number of skilled workers and poor deployment;
- Low levels of training in technical skills relevant to production;
- A shortage of management skills in the private sector.

On the other hand, Nigeria possesses a great economic potential for industrial development. Richly endowed with valuable natural resources and a large potential market for industrial products, the country still derives most of its export earnings from primary commodities. Only in the last ten years or so has a serious effort been made towards industrial development; during this period, the industrial sector has increased at the rate of 21 per cent *per annum* and its contribution to the Gross Domestic Product has risen from under 2 per cent to just over 6 per cent.

A major factor to be noted is that existing industries depend to a large extent on imported raw materials, which account for about 50 per cent of the value of their production. Local raw materials could satisfy nearly all of the demand if the right technology, suitably adapted, were imported. Export commodities, such as rubber, timber, cotton, vegetable oils and seeds, cocoa, hides and skins, tin and crude oil, would earn at least twice their value if converted to secondary products.

Of the total food produced for internal markets, about 50 per cent, valued at over N£200 *per annum* (US \$1.0 = N£0.357), is lost as a result of spoilage and waste, because of poor handling and distribution and inadequate processing facilities.

For all of these reasons, there is a tremendous need for the importation as well as the local development of technology. It is calculated that investment in industry should be doubled during Nigeria's second plan period, 1968 – 1973, in order to achieve an adequate growth rate, that is an investment volume of nearly N£400 million.



The Author: *Isaac Adedayo Akinrele, 35, is acting director of the Federal Institute of Industrial Research, Oshodi, Lagos, Nigeria, and chairman of the National Health Committee on Protein-rich Foods. He has attended a number of United Nations meetings of experts on assessing industrial feasibilities for developing countries. Mr. Akinrele received a Master of Arts degree in Natural Science from Selwyn College, Cambridge, England; a Diploma of Membership of the Imperial College of Science and Technology in Food Chemistry from Imperial College, London; and a Doctorate of Philosophy in Biochemistry from the University of Ibadan, Nigeria.*

Technology requirement

The problem of raising capital is for the economic and fiscal planners to solve, but it should be the responsibility of the research sector to provide guidance in the choice and adaptation of the technology to be used. Technology *per se* is of no value unless it is integrated into the dynamics of productivity. Its importation or development and successful use, therefore, must be subject to a number of economic considerations.

In Nigeria, and probably in most other developing countries, technology should be capable of making the greatest possible contribution to national economic development in order to utilize local resources and facilitate the employment of a large number of workers. The industrial research needed to cope with our specific problems should be conducted at these levels: adaptive, innovative and in-plant research.

Adaptive research is concerned with the problems of the transfer of techniques and know-how from an industrialized to a developing country. Specifically, it should:

- Provide the basic data required for pre-investment studies of industrial projects, particularly realistic costs of raw materials, supplies, fuel, power, water, land, housing, transport, labour machinery depreciation and the like;
- Prepare the modification of processes and operations necessary because of variations in properties of locally available or substitute raw materials, as well as scale-downs imposed by smaller local market conditions and raw material supply;
- Select basic equipment that will accommodate problems of scarcity of capital and skilled labour.

Japan achieved considerable success in this area in its initial phase of industrial development some forty years ago and demonstrated that considerable industrial development can be achieved by using imported technology and doing industrial and adaptive research. The effectiveness of this type of research will depend on the status accorded to it. The research staff should work directly with the planners of the national economy in the elimination of unfeasible projects.

Innovative research should be concerned with the development of native technology, new processes and new products. Food production in Nigeria requires this form of research, with the special aim of finding local foods that can be substituted for imported products. (See tables 1 and 2.) The Federal Institute of Industrial Research has been particularly active in this field in the past few years. It has, for example, developed a fish-drying plant and a mechanized process for the production of gari, a staple food made from cassava. The Institute has recently developed a complete protein food, Soy-Ogi, which will substantially reduce the need for the import of infant milk foods and will substitute for baking flour. It is also investigating the possibility of producing a synthetic substitute for gypsum in making school chalk. Such research can make an impact on the industrial sector only if the results are commercialized.

In-plant research, unlike adaptive and innovative research, which have hitherto been financed solely by the Government, should be available on commercial terms. It should embrace the various technical services offered by an Industrial Research Institute, such as:

- Laboratory analyses and testing of products;
- Consultative services on production management, industrial engineering, marketing, cost accounting, quality

A centrifuge used to process gari from cassava tubers. The centrifuge is a much more efficient way of pressing gari than the old-fashioned press
By courtesy of FAO. Photograph: G. W. A. Baumer

The old-fashioned way of pressing gari
By courtesy of FAO. Photograph: G. W. A. Baumer

A concrete mixer adapted for use as a peeling machine for cassava roots. The metal fins have been covered with wooden shields to avoid slicing the roots. The mixer produces 400 kg of clean peeled roots per hour
By courtesy of FAO. Photograph: G. W. A. Baumer

control, inventory control, in-plant standards, and general engineering technology and production problems;

- Technical information services, based on a specialized library for the purpose of disseminating information on known processes, operations and technologies; and the publication of suitable pamphlets on the characteristics, utilization and industrial possibilities of natural resources;
- Assistance to the Government in the development and formulation of standards for industrial products;
- Trouble-shooting in industries.

Table 1

Economic turnover of commodities requiring adaptive research

Commodity	Value of domestic production per year (million N£)	Value of products imported per year (million (N£)
Cotton	11.6	14.8
Hides and skins	4.3	1.2
Rubber	9.7	3.0
Vegetable fibres	20.0[a]	10.0
Timber	13.2	8.0
Clays and limestone	2000.0[a]	2.4
Wines and spirits	10.0	1.0

[a] Estimated.

Table 2

Turnover of commodities requiring innovative research

Commodity	Value of domestic production per year (million N£)	Loss on storage (percentage)	Value of products imported per year (million N£)
Cereals	464	1—4	6.4 (flour and starches)
Roots	537	10—20	—
Legumes (grains)	63	10	3.7
Palm oil	20	30	—
Vegetables	20[a]	75	0.7 (tomatoes)
Fruits	60[a]	50	0.1 (juices)
Fish	1.5	50	6.0

[a] Estimated.

Problems and suggested solutions

In 1963, eight years after the establishment of the only industrial research institute, the Federal Institute of Industrial Research, Oshodi, a review was carried out. It was found that one of the major problems limiting the effectiveness of the Institute was the difficulty of clearly defining the object of research programmes and allotting priorities. It was felt that this problem could be better tackled if, when considering possible research programmes, collaboration were ensured between those to be entrusted with the actual research work and the representatives of the country's economic and development authorities, the representatives of the business community, and official organizations that have a potential interest in results of the research work.

More formidable problems have been encountered recently in transferring the results of research to the industrial sector of the economy. These are attributed to a number of causes, notably:

- Almost all the manufacturing industries are foreign based and have no interest in refining locally available raw materials;
- A good many of these industries have subsidiary investment interests in traditional raw material suppliers overseas and have no desire to break with such markets;
- The processing plants imported into Nigeria are usually fully amortized in so short a period that they have no need for in-plant research to attain better efficiency; the research and development and sometimes the product analyses are done in foreign laboratories;
- Local financial institutions are sometimes reluctant to grant credit to Nigerian entrepreneurs because of the lack of confidence in the Nigerian's technical and management know-how.

If applied research and development is to attain the main objective of improving local economic and social conditions, an effective mechanism for translating research results into commercial practice must be set up. In agricultural research, such mechanisms are related to extension services. In industrial research demonstration plants or factories can provide the stimulus to confidence and entrepreneurship of the local business community. This phase of development, which is very much needed to bridge the growing gap between the laboratory and the factory, is at present lacking in Nigeria.

The staffing of an industrial research institute presents a peculiar problem in a developing country like Nigeria where the curricula of the universities, fashioned on the British model, do not prepare their graduates for employment in technological research. Post-graduate training is required therefore in the specific technology for which the research worker is being recruited. This raises the question as to whether the current university syllabi are comprehensive enough to cater for the needs of industry. At present, the necessary number of qualified scientists, technologists and technicians cannot be found, even with all the inducements to expatriates. This is probably a good reason for not creating many more research institutes and thereby wastefully diverting valuable but scarce technical personnel into administration.

This problem is further aggravated by the necessity of staffing the five rapidly expanding universities. All high-level technical manpower must be used to the full. The competition for staff among the various research institutes and between the research institutes and the universities must be reduced: by increasing the status of applied research so that it will count towards higher degrees; by

Baling coir-fibre at Badagry demonstration factory established by the Federal Institute of Industrial Research, Oshodi, Lagos, Nigeria, and transferred to a local manufacturing company

Table 3

Estimated R & D expenditure in Nigeria for 1966/1967
(in N£)

Research grouping	Nigerian Government	Foreign aid Bilateral	Foreign aid Multilateral	Universities[a]	Industry	Totals
Industry	273,340	56,250	37,430	160,000		527,020
Natural environment	2,663,945	1,003,150	127,570	60,000		3,854,665
Agriculture (extension)	3,466,851 (2,483,840)	603,800 (246,100)	228,600 (212,500)	110,000	Not available	4,409,251 (2,942,440)
Medicine	203,545	10,000	90,855	275,000		579,400
Social sciences	100,000	11,250	7,800	100,000		219,050
Miscellaneous	164,480	2,680	7,300	9,300		184,260
Total excluding extension	6,872,161	1,687,130	500,055	714,300		9,773,646
Total including extension	9,356,001	1,933,230	712,555			12,716,086

[a] Estimates.

university teachers participating in research, both in the institutes and in the universities; by senior research institute staff lecturing in the universities; and by the appointment of university teachers to governing bodies of research institutes.

It is not considered advisable, however, to bring applied research under the universities, as has been suggested in some quarters. Such an arrangement would interfere with the development of the universities and would not create the best conditions for applied research and for its nation-wide co-ordination. The main duties of the universities are to give higher education and to carry out pure scientific work. Complete integration of applied research (particularly of the short-term nature required in Nigeria) with basic research would place unacceptable burdens on the university teachers.

Financing industrial research and development

The current spending on industrial research in Nigeria is about N£2,840 *per annum* per qualified scientist together with his assistants, materials and equipment. When this is compared with the typical figures in the United Kingdom, estimated at between N£3,000 and N£5,000, and in the United States, between N£5,000 and N£10,000, the Nigerian allocation would appear reasonable. If, however, the position is viewed against the problem of importing personnel, equipment and material with the concomitant additional expenditure, the Nigerian figure becomes grossly inadequate.

The first national development plan (1962 – 1968) budgeted N£1,463,000 for agricultural research but only N£355,000 for industrial research. If industrial research is to be effective in meeting the problems of processing local food products, which have almost no technological history and to which most of the agricultural research work is being directed, there is a clear need for redressing the balance.

Foreign aid, too, has gone almost wholly to agricultural research and development. It is paradoxical that a country like Nigeria, which is already losing as much as 50 per cent of its total food production in waste and spoilage, should plan for increased production without making allowance for the processing and improved handling of the increased harvests.

The economic structure and programmes of development of developing countries are generally related to foreign aid patterns. While it has been relatively easy in Nigeria, for example, to obtain financial support from industrialized countries for agronomic research and for education and environmental studies, the same cannot be said for industrial research leading to manufactured products. The attitudes of the developed countries in this respect may have intrinsic justification on the basis of their own national survival, but the United Nations and other multinational aids need not follow the same pattern. The industrial sector, being the most backward in developing countries, should receive special attention from the international and multilateral assistance agencies. Technical assistance in the form of personnel, without the necessary capital grant to follow through the projects initiated, may appear of questionable value to the national counterpart personnel who remain to carry on the work. In some cases, it has left the assisted country disillusioned as to the value of the assistance given.

The role of industrial research and development in Nigeria should be to provide a solid foundation upon which the Nigerian economy can be built. This can only be realized if facilities for the execution of such work are adequate, and its results implemented. The development will depend on government financial support for a long time to come because of the low level of industrial capital, know-how and operations among Nigerian entrepreneurs. It must be understood that industrialized countries will have a special attitude towards this sector as being traditionally a raw-material-producing economy, and a national effort must be made to correct the imbalance arising from the use of foreign aid. UNIDO has a special responsibility in this respect – to help in establishing the right image for industrial research and development in developing countries.

By J. C. Srivastava

The Author: *Since November 1968 J. C. Srivastava has been an adviser on scientific organization and management at the East African Academy of Kenya, Uganda and Tanzania. Prior to this he was on the staff of the Council of Scientific and Industrial Research and on the staff of the Planning Research and Action Institute, both in India. In 1968 he was a member of the Indian delegation to the second United Nations Conference on Trade and Development (UNCTAD) and also participated in the Conference on the Application of Science and Technology to Development in Asia.*

The Transfer of Technology to Developing Countries

IF THE DEVELOPING COUNTRIES are to reach a stage of self-supporting industrial and economic development, the transfer of technology and know-how from advanced countries is essential. In its wake, however, this transfer raises several problems which have handicapped the effective flow of technological know-how. Though United Nations bodies have held many discussions on facilitating the transfer of technology to the developing countries, the agencies responsible for carrying out this task have not been able to help much. It appears, therefore, that the United Nations agencies must adopt and put into operation practical measures without losing further time.

The technology transfer

Before exploring the question of how the assistance will be provided and by whom, it should first be established what is meant by the transfer of technology.

The transfer of technology, as it applies to the adaptation of the results of research and development to industry, is now attracting widespread recognition. The transfer of technology may be from one country to another and from one enterprise to another, between the developed and the developing countries and among developing countries themselves. Technology transfer can be either the transfer

The author points out some of the major steps taken by the United Nations family in attempting to facilitate the transfer of technology. He also recommends the establishment of regional technology transfer clinics which would have as their basic function storing, processing and disseminating technological information of use to developing countries.

UNIDO has recently put into operation several programmes supplying the type of assistance Mr. Srivastava believes such clinics should give. Among these programmes are the Advisory Service for the Supply of Industrial Equipment (see IRDN, *Vol. III, No. 1, p. 21), the Roster of Consultants (see* IRDN, *Vol. IV, No. 2, p. 42), the Industrial Inquiry Service (see* IRDN, *Vol. III, No. 1, pp. 22–23; IV, No. 1, pp. 31–33; IV, No. 2, pp. 40–41; IV, No. 3, pp. 41–42; and IV, No. 4, pp. 41–42) and the Industrial Promotion Service (see* IRDN, *Vol. II, No. 2, pp. 14–15; IV, No. 2, pp. 8–9; and IV, No. 3, p. 43).*

UNIDO proposed to the UN Advisory Committee on the Application of Science and Technology at its session in December 1968 that priority be given to the development of optimum technology adapted to the particular conditions of the developing countries and to the organization of the flow of scientific and technical information.

continued overleaf

of basic scientific knowledge to technology or the adaptation of an existing technology to a new use.

Technology transfer usually takes place vertically, horizontally and through non-technological interactions. Vertical transfer is the transfer of scientific ideas that flow from research laboratories to manufacturers. Technology is transferred horizontally when expertise moves from one field to another and results in a useful end product. Horizontal transfer is usually followed by additional vertical transfer. The third process is the interaction of technology with the non-technological factors of innovation and diffusion. These three processes are shown in figure 1.

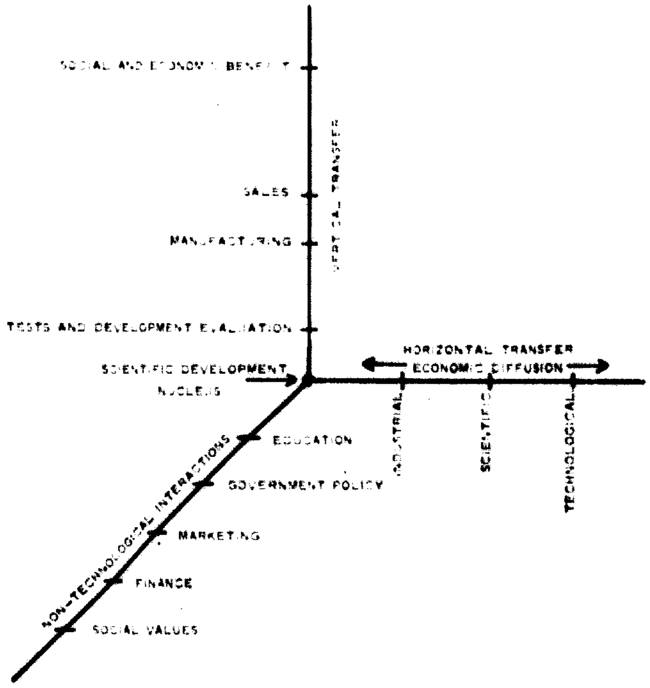
The diagram shows transfer paths interacting upon one another and indicates that the selective diffusion of knowledge is the key point in the transfer of technology.

Present condition

The transfer of technology from advanced to developing countries is directly related to the rate of industrial and economic development of the latter. The industrialized countries and their commercial firms, however, enjoy an advantage because of their strong technical position, when negotiating terms for the transfer of technology in the form of know-how and patent rights. This situation produces problems that stem the easy flow of the technology to the developing countries. One is the ability of industrialized countries to set their own terms. Another is the lack of adequate research and development infrastructure in developing countries that limits their cap..city to adapt, utilize and improve the imported technology. An additional disadvantage is the lack of arrangements for handling information on the availability, suitability and cost of technology from industrial countries.

In spite of these shortcomings, however, most developing countries are effecting the transfer of technology through

Figure 1
Transfer of technology



foreign collaboration, involving the payment of royalties, fees for expertise, design and engineering fees; the import of capital equipment; the training of technicians in the industrialized countries, and the borrowing of experts, including management experts.

The transfer of technology has caused other problems to developing countries, among them a disequilibrium in the balance of payments and the export of sizable amounts of foreign exchange in the form of profits, dividends and share of capital.

The lack of competent guidance and planning often results in the repetitious import of technology, resulting

continued

Assistance in building up local industrial information services is a vital part of UNIDO's programme to facilitate the transfer of technology. In several developing countries UNIDO has helped in the establishment of industrial information services by providing experts. Institutions which could perform the functions of these services have been identified in 53 countries and assistance will be provided as requested. Particular emphasis is being placed on the training and upgrading of personnel through fellowships to centres in industrial countries, training courses and seminars. For example, in 1970 UNIDO is planning a three-month interregional course for the upgrading of industrial information personnel for 30 participants from developing countries in co-operation with UNESCO and has arranged a two-week seminar for 25 industrial information officers from Africa and Asia. A similar two-week seminar will be held in Latin America in 1971.

For information about UNIDO programmes which facilitate the transfer of technology to and within developing countries, write to:

Industrial Information Service, UNIDO
P. O. Box 707, A-1011 Vienna, Austria

in an expenditure of foreign exchange which could be avoided. Technologies are frequently transferred through agreements between private enterprises and such agreements usually have an inhibiting clause stating that the imported technological know-how cannot be shared with other companies, or with other developing countries. This clause isolates the imported technology from the stream of research and development activity within the country.

Patents form an important channel for the transfer of technology, but they can also become a means of preventing industrial growth and invention in the developing countries. Undertakings in industrialized countries register patents in the developing countries without making any effort to set up industrial production based upon these patents. The preponderance of foreign patent rights thus inhibits the developing country from setting up industries through its own efforts because patent holders are likely to challenge any development of know-how even though they have made no attempt to set up production.

Efforts made by the United Nations

These and many associated problems have been a subject of major interest to the United Nations for a number of years. It was only in December 1961, however, that the General Assembly voted a resolution to take steps to facilitate the flow of technology from advanced to developing countries. Since then the United Nations has taken the following action:

- The Secretary-General completed a study (E/3861) in 1964 on "the role of patents in the transfer of technology to under-developed countries". The United Nations Economic and Social Council (ECOSOC) endorsed the findings and requested (resolution 1013 XXXVII) that the Secretary-General explore possibilities for the adoption of the recommendations.

- The first session of the United Nations Conference on Trade and Development (UNCTAD) called on both the developed and developing countries and competent international agencies to undertake appropriate means to facilitate the transfer of technology to the developing countries (A. IV. 26, Final Act 1964).

- At its twentieth session (1965), the General Assembly endorsed the UNCTAD resolutions and requested the Secretary-General to undertake another study on "enterprise-to-enterprise arrangements for the supply of financial, managerial and technological needs of developing countries" (resolution 2091 XX).

- This study went before the ECOSOC Advisory Committee on the Application of Science and Technology to Development (ACAST) at its fourth session, 8–19 November 1965. ACAST made suggestions for improving the study and requested the Secretary-General to undertake another systematic study incorporating the suggestions.

- ACAST also proposed the setting up of a "technology transfer centre" which would assist enterprises to identify their technological needs; inform them on the availability of foreign resources; and help in negotiating agreements and in securing the necessary finance for them.

- In pursuance of the above proposal, ECOSOC undertook a study (TD/37) on the "practical means of reducing the cost of acquisition and operation of foreign technology to developing countries".

- UNCTAD also commissioned a study (TD/28) on "the transfer of technology to developing countries with special reference to licensing and know-how agreements".

- Recent developments have been confined largely to international studies and discussions. The existing United Nations bodies, such as ACAST and UNIDO, which were assigned to look into the subject, have made few practical efforts. This lack of action prompted the second session of UNCTAD (February–March 1968) to adopt a resolution (TD/L. 24) suggesting that "the Trade and Development Board after obtaining the views of ECOSOC consider the establishment of an intergovernmental committee to examine the over-all question of transfer of technology to developing countries". The developing countries attached the utmost importance to this question, believing that this intergovernmental committee might fill the gap in United Nations machinery and provide the developing countries with better access to economic and industrial expertise. The UNCTAD resolution further indicated that the technology transfer centre, as suggested by ACAST, should be set up immediately and should cover science, technology and engineering necessary for economic and industrial progress in developing countries.

- At its ninth session (New York, April 1968), ACAST took note of the UNCTAD draft resolution (TD/L. 24) and indicated that the question of the setting up of a new committee that might duplicate the work of UNIDO and other bodies required careful consideration by ECOSOC.

- The UNCTAD resolution on "the transfer of technology to developing countries" was accordingly discussed (agenda item No. 6) at the 44th session of ECOSOC on 21 May 1968 when a resolution was adopted postponing consideration of the subject (E/AC. 6/L-380/Rev. 1). The Committee requested the Secretary-General to prepare, for submission to the Council at its 45th session, a study to determine the extent of the functions of the proposed intergovernmental committee already included in the terms of reference and the current and planned programme of work of the United Nations, the specialized agencies and other international organizations dealing with this subject. (Refer also to ECOSOC resolution 1312-XLIV.)

- The UNESCO Conference on the Application of Science and Technology to Development in Asia (CASTASIA), 9–20 August 1968, New Delhi, recommended that (*a*) technology transfer and information centres be set up to perform the functions outlined by ACAST and (*b*) the Secretary-General be invited to review the over-all position of the work done in the field of transfer of technology and draw up a comprehensive plan and programme of action for this transfer.

Plan of action

It is of vital importance to developing countries to secure effective access to appropriate technology and to develop their own research and development capacity sufficiently to permit them to participate fully in the creation of advanced technology. International co-operation can help in achieving this objective by accelerating the application of science and technology at all levels of development.

At present no agency provides developing countries with competent guidance on the availability of the most efficient and appropriate technology and on the negotiation of economic deals and model agreements, nor does any forum exist for the exchange of information and experiences on the import of similar technologies. As a result, economic and industrial development in the developing countries is greatly handicapped and consequently international peace and security are threatened. The United Nations as an international body has to take cognizance of such a situation.

The questions that arise are: (*a*) The appropriate approach at the present stage of stagnation? and (*b*) The most effective contribution of the United Nations and its agencies?

The following mode of action is suggested primarily to sieve out the ideas that have been expressed in many of the documents that have come before the various UN agencies and to initiate action:

Studies already undertaken could form a basis for joint discussions between ECOSOC, ACAST, UNIDO, UNCTAD and UNESCO for drawing up the phased plan of action on the basis or the recommendations, suggestions and resolutions made and on the studies and deliberations of international bodies, keeping in view the problems and difficulties confronting the developing countries.

The plan could be carried out in the following manner:

(*a*) Measures unanimously agreed upon between the developed and developing countries that could be implemented without technical and economic difficulties should be initiated immediately.

(*b*) Regarding measures unanimously agreed upon but which might be difficult to implement, action should be taken to resolve the difficulties.

(*c*) Measures parly agreed upon but which may have to be modified or arranged bilaterally are to be given further consideration.

(*d*) Measures that have been the subject of controversy may be postponed or dropped.

The group of organizations may also consider the need for entrusting the over-all control of matters pertaining to the transfer of both industrial manufacturing technology and non-industrial technology to different international agencies. Since the two types of technology differ in their content and operation and relate to different bodies at the receiving end, their transfer may have to be viewed from different angles. While it may be advantageous for non-industrial technology to be dealt with by the organizations concerned, it may also be useful for a single organization to be responsible for the implementation of the plan of action and to deal with matters pertaining to the transfer of industrial-manufacturing technology. This would have the benefit of uniformity of approach, concentration of technical information and speed of implementation. It could be achieved by enlarging the scope and the terms of reference of the organization and ensuring that it would collaborate with specialized agencies, such as the Food and Agriculture Organization of the United Nations (FAO) or the World Health Organization (WHO) in studies, surveys, and training programmes.

It is of the utmost importance that at the same time that the conferences and discussions are taking place a comprehensive plan of action for the transfer of technology to developing countries should be drawn up and implemented.

An approach

Finding a practical solution to the problems of the transfer of industrial technology requires an objective approach. As the United Nations is an international body assisting developing countries through its programmes it could take measures to establish a service for transferring technology to needy countries. The basic elements involved are:

- Identification of needs;
- Location of sources of modern technology;
- Selection of suitable technology;
- Assistance in making initial negotiations, and
- The finalization of terms and agreements.

Technology transfer clinics

The UN body entrusted with the transfer of industrial technology could set up information cells on a regional basis, both in the developed and developing areas, through their regional offices so that prospective users of technology could be helped to obtain the necessary industrial information and be advised on the source, the relative advantages, terms etc.

Such a centre could be called a Technology Transfer Clinic; its work would be the collection, collation and storage of information and its processing and dissemination in a suitable form in addition to serving as a regional extension and service centre.

The Clinic should be able to answer questions on:

(*a*) Resources of the region, availability of industrial inputs, stage of development and the technological needs of the area;

(*b*) Technological and industrial research projects in technical research centres, research laboratories of particular industries and of the government and the dates when the research results will be available;

(*c*) Availability of equipment required to set up a manufacturing unit;

(*d*) List of consulting firms with details of the assistance provided and the projects available; and

(*e*) Facilities for the training of technical, managerial and engineering personnel.

One of the reasons for the problems confronting the developing countries is the insufficient development or absence of domestic consulting organizations and technical information centres. The clinics in developing regions could help Governments to set up consulting and technical information services that at a later date would be responsible for liaison with the regional clinics.

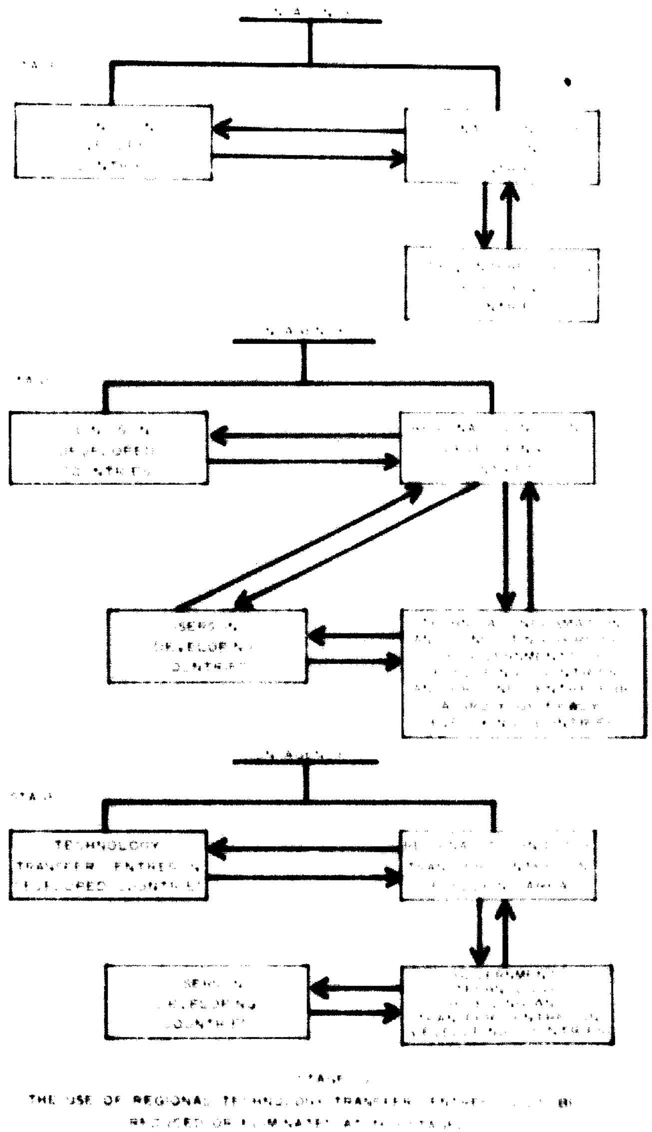
The clinics in developed regions should maintain contact with industrial research institutions and business enterprises and take steps to facilitate contact with clinics in developing regions and to serve as a source of information to them.

After having gained some experience and built up relations with private enterprises, government agencies and research laboratories in industrialized countries, the scope of clinics could be broadened to assist in the choice, adaptation and transfer and utilization of imported technology. Such centres could then assist the developing countries in: identification of areas of economic development; determining the type of technology required; selecting the most suitable and economic technology and scale of operation; working out the terms and conditions of acquisition; advisability of inviting foreign capital investment, collaboration and participation; engineering and technical consultancy series, and arranging for the training of technicians, managers and others.

The object of splitting the programme into three or more stages is not only to help the developing countries to receive technology but also to strengthen them so that they can absorb it. This system will help these countries in their long-term programme of industrialization, increase productivity, reduce costs and introduce effective methods in other nation-building activities.

Figure 2

Proposed organization for the transfer of technology



Comments by the United International Bureaux for the Protection of Intellectual Property (BIRPI) on Transfer of Technology to Developing Countries, by J. C. Srivastava

The **IRDN** *has invited the United International Bureaux for the Protection of Intellectual Property (BIRPI) to comment on Mr. Srivastava's interesting article "Transfer of Technology to Developing Countries"; BIRPI is pleased to have this opportunity to provide some supplementary information on three of the aspects of the problem touched on by the author.*

BIRPI is an intergovernmental organization whose functions include the duties of the International Bureau of the Union established by the International (Paris) Convention for the Protection of Industrial Property. BIRPI has concluded a formal working agreement with the United Nations in relation to industrial property questions particularly in the context of the transfer of technology to developing countries.

The three aspects of the problem examined in Mr. Srivastava's article which directly touch BIRPI's field of activity and experience are:

- *The role of patent laws in technology transfer;*
- *The terms and conditions contained in transfer agreements between private enterprises; and*
- *The efforts made by organizations within the United Nations system.*

The role of patents

Mr. Srivastava mentions that a study, "The Role of Patents in the Transfer of Technology in the Developing Countries" by the Secretary-General of the United Nations, was completed in 1964, and that the Economic and Social Council endorsed its findings and requested the Secretary-General to explore possibilities for the adoption of its recommendations. The study goes into some detail on the problem mentioned by the author in an earlier part of his article, that patents, although they form an important channel in the transfer of technology, can also become a means of preventing industrial growth and invention in the developing countries. This problem arises when the patent laws of a country do not contain suitable sanctions against abuses of the patentees' monopoly rights. The Secretary-General's report pointed out that there was no reason why developing countries should not bring their laws up to date by the inclusion of appropriate systems of "compulsory licensing" which would apply when a patent has not worked, or has not worked adequately, in the country. The Paris Convention for the Protection of Industrial Property deals specifically with provisions of this sort, which are to be found in the laws of most industrialized countries.

In furtherance of the recommendations of the Secretary-General's report, BIRPI convened a Committee of Experts from developing countries to assist in the drafting of a Model Law on Inventions, which was published by BIRPI in 1965. The model law, which is intended to be used with appropriate adaptations as a basis for modernizing patent legislation in developing countries, contains a chapter on compulsory licences. According to the provisions of the model law, the grounds upon which applications may be made for the compulsory licensing of a patented invention include: failure to work the invention, or failure to work it in a way which meets, on reasonable terms, the demand for the product; importation of the patented article in a way which interferes with a working of the invention in the country; unreasonable refusal of the patentee to grant contractual licences; interdependent patents; and declarations by the minister responsible for industrial property that certain products or purchases are of vital importance for the defence or the economy of the country or for public health.

The procedures suggested for the grant of compulsory licences provide sufficient safeguards for the patentee to avoid the discouragement of foreign investment.

Terms in agreements between private enterprises

Mr. Srivastava points out that "technologies are frequently transferred through agreements between private enterprises and such agreements usually have an inhibiting clause stating that the imported technological know-how cannot be shared with other companies or with other developing countries. This clause isolates the imported technology from the stream of research and development activity within the country." This statement calls for two comments.

The first is that the danger referred to by the author is to be found particularly in agreements for the transfer of secret know-how, which is not patented. As the word "patent" implies, patent rights are granted in exchange for full disclosure of the invention to the extent necessary for it to be carried out by a person "skilled in the art". Patent documentation is one of the tools of research and development activity, and is one of the benefits to be gained by a country from granting patent protection rather than encouraging those who invest substantial sums in research to rely on secrecy to protect the results.

To the extent that similar problems do arise in licence agreements for the exploitation of patented inventions, they can be controlled by the provisions of the patent law itself. The BIRPI model law on inventions provides that clauses in licence contracts are null and void in so far as they impose upon licensees restrictions not deriving from the rights conferred by the patent; the object is to ensure that patent rights are not used as a peg on which to hang restrictive business practices.

Similarly, the model law gives power to the minister responsible for industrial property to require governmental approval of the terms and conditions of licence contracts involving the payment of royalties abroad.

Efforts made by the United Nations

Mr. Srivastava recalls that the Economic and Social Council, at its 44th session, in 1968, adopted a resolution postponing consideration of the UNCTAD resolution on the transfer of technology.

There has been further progress since 1968. At its 46th session in August 1969, ECOSOC decided to call for a detailed study on the co-ordination and reinforcement of the United Nations machinery related to the entire question of the application of science and technology to development, but at the same time recorded that it considered that UNCTAD is competent to take any action, including appropriate institutional arrangements within its framework, in connexion with those aspects of the transfer of operative technology that fall within its jurisdiction.

The Trade and Development Board of UNCTAD has the question on the agenda of its tenth session, which will take place from 25 August to 18 September, 1970, as a matter of high priority.

It will be seen, therefore, that there has been considerable activity within the United Nations system, and that action is to be expected soon. If new machinery to deal with the problem is established within the framework of UNCTAD, BIRPI has no doubt that Mr. Srivastava's article will form a valuable contribution to its work.

By Leonard Gratton Wilson

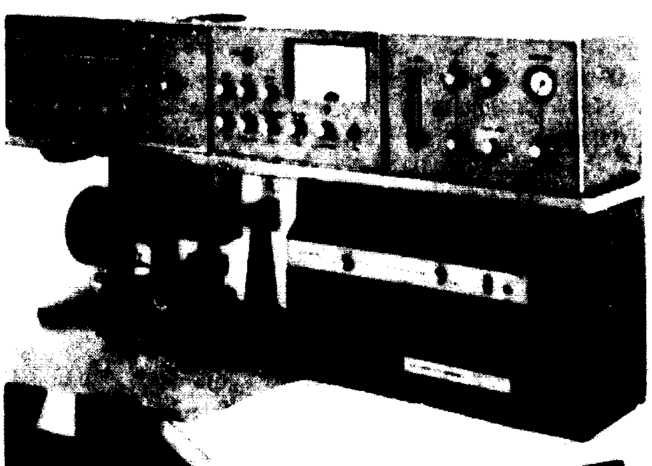
The Author: *Leonard Gratton Wilson is Secretary of the Commonwealth Scientific and Industrial Research Organization (CSIRO), heading the Administration Branch of the Head Office, the Organization's central administrative group. Mr. Wilson joined CSIRO in 1956 after working as a physicist in the Western Australian Government Chemical Laboratories. He was appointed Assistant Secretary in 1961, First Assistant Secretary in 1964 and Secretary (Administration) in 1966.*

Conducting Research Worth Hundreds of Millions of Dollars

Late last year in Sydney a small boy was severely burned in an accident. For weeks he lay seriously ill. Then, for no apparent reason, he began to have violent convulsions and was soon at the point of death.

Tests with a new scientific instrument, an atomic absorption spectrophotometer, disclosed that the boy had suffered a severe loss of magnesium as a result of his burns. The magnesium was replaced, the convulsions ceased and the boy recovered.

The new technique of atomic absorption spectroscopy had been put to another of its hundreds of applications.



The atomic absorption spectrophotometer, which offers quick, accurate and inexpensive spectroscopic analysis of a wide range of chemical substances, was invented in Melbourne in 1953 by Alan Walsh of the Commonwealth Scientific and Industrial Research Organization (CSIRO) of Australia. A simple but effective instrument, it makes use of the absorption of light by elements to analyse their concentrations in compounds. It can be used to analyse more than 60 elements at very low concentrations with a high degree of accuracy. Its efficiency has been improved to the point where the instruments are being manufactured on a large scale both in Australia and overseas. More than 400 are in use in Australia today and sales throughout the world have exceeded 8,000. The value of Australian production alone is more than A$1 million a year. Atomic absorption spectroscopy is now in widespread use throughout the laboratories of the world.

Its use in medicine has greatly simplified measurement of the concentrations of various metals in blood and body tissues. For example, in the investigation of Wilson's disease, a rare condition in which copper accumulates in the body, atomic absorption spectroscopy has enabled more rapid and accurate measurement of this metal in the blood. In another application, the machine is employed to monitor the progress of kidney disease patients being treated with artificial kidney machines. Atomic absorption spectrophotometers are used to measure the amount of calcium and magnesium removed from the blood by the

The latest model atomic absorption spectrophotometer (TECHTRON AA-5), a modular instrument designed for routine measurements or advanced research in atomic absorption, atomic fluorescence and emission studies

machines and to check that no other metals are introduced into the bodies of the patients during treatment.

Other applications of the technique include the measurement of trace elements in soil, corrosion in canned foods, the proportion of metals in alloys, wear in diesel railway engines, copper and lead in wine, and minerals in ore samples. Atomic absorption has caused a revolution in mineral exploration, where the costs of geochemical analysis have been reduced to about a quarter and in some cases a tenth of their former levels. More than 50 absorption instruments are used in Australia to analyse more than half a million mineral samples each year. This has been an important factor in the large increase in geochemical prospecting in Australia in recent years.

Atomic absorption spectroscopy is one of the more striking benefits that have flowed from CSIRO research programmes which range widely over the problems of primary and secondary industry in Australia.

It was claimed a few years ago that savings and earnings resulting from CSIRO research amounted to A$400 million a year. Animal production, pasture improvement, pest control, timber and pulp processing, wool textile manufacture and the minerals industry are areas where particularly valuable national progress has resulted from work by CSIRO scientists.

History and purpose

CSIRO is a statutory body established by the Federal Parliament, governed by an executive, and responsible to Parliament through the Minister for Education and Science. Expenditure for CSIRO work for the year 1968/69 was A$49.5 million, of which A$39.1 million was provided by the Commonwealth Government, the balance contributed by primary industry, individual companies, Australian and overseas government agencies and private foundations. Most of the contributed funds came from trust funds set up by primary producer groups representing the wool, meat, wheat, dairy and tobacco industries. The trust funds are derived from a levy on produce and a Government contribution.

The powers and functions of the Organization, under the Act of Parliament establishing it, are:

- The initiation and carrying out of scientific research related to primary and secondary industries in Australia or any of its Territories, or in connexion with any other matter referred to the Organization by the Minister for Education and Science;
- The training of scientific research workers and the establishment and awarding of research scholarships;
- The making of grants in aid for pure scientific research;
- The support of research associations;
- The maintenance of standards of measurement;
- The dissemination of scientific and technical information and the publication of scientific and technical reports.

The first step towards the establishment of a national research institution was a conference called by the Prime Minister in 1916 on development of Australian agriculture and industry; this led to the establishment in 1921 of the first of CSIRO's predecessors, the Institute of Science and Industry.

After another conference on the constitution of a new body to carry out scientific and industrial research on a wider basis Parliament passed the Science and Industry Research Act establishing in 1926 the Council for Scientific and Industrial Research (CSIR). The Act conferred on the Council a flexibility and freedom in the conduct of its affairs seldom enjoyed by Government-appointed bodies, and these characteristics persisted when CSIR was reconstituted as CSIRO in 1949. In that year CSIRO relinquished all classified work, and its Division of Aeronautical Research was made part of the Commonwealth Department of Supply. The management of CSIRO was placed in the hands of a five-member Executive in place of the previous Council, but the Council was retained in an advisory capacity.

In 1927 CSIR had a scientific staff of 41 and one laboratory—a small chemical laboratory housed in rooms rented from a technical school at Brunswick, Victoria. CSIRO now has a staff numbering more than 6,000, including almost 2,000 graduate scientists, and 38 major research groups with scientists at work throughout Australia and in Papua—New Guinea.

Administrative organization

The governing body of CSIRO is the Executive, which now has five full-time and four part-time members and is chaired by Sir Frederick White, a distinguished physicist. Sir Frederick will be succeeded on his retirement in May, 1970 by Dr. J. R. Price, a distinguished organic chemist. The Executive is responsible to the Minister for Education and Science. It determines the over-all scientific policies of the Organization, including the selection of the broad fields of research; selects and appoints scientists to head the research groups; determines personnel policies; controls recruitment and promotion; and controls the allocation of funds inside CSIRO.

An Advisory Council and committees appointed in each state provide channels for advice and criticism of the Organization's activities. The Advisory Council consists of the members of the Executive, chairmen of the State Committees, and a number of other members representing a wide range of educational, industrial and governmental interests. Special committees of the Council are set up from time to time to advise on specific problems.

The State Committees, established in the original constituting Act to enable the Council to keep in touch with the needs of the various States, are widely representative of industrial and educational interests.

Head Office, the central administrative group of CSIRO, assists the Executive in the development, implementation and administration of its policies. It consists of an Administrative Branch, an Agricultural and Biological Sciences Branch, and an Industrial and Physical Sciences Branch. Scientific liaison offices are maintained by CSIRO in London and in Washington, D. C.

The scientific work is carried out in research divisions and sections, each concerned with a particular area of research. The sections are research groups usually smaller in size or at an earlier stage of development than the divisions. From time to time, as research needs change, new groups are started and established groups are merged with others. At present there are 34 divisions and four sections, and the research effort is divided almost equally between agricultural and biological sciences on the one hand and industrial and physical sciences on the other.

The staff of each division or section usually forms a complete and independent operating unit, consisting of research scientists, experimental officers who give professional help to the research scientists in planning and conducting experimental and theoretical work, other professional staff engaged on service functions, supporting technical and trades staff, and administrative staff. Each division is headed by a chief and each section by an officer-in-charge. Each chief is responsible to the Executive for the development and implementation of his group's scientific programme.

The Executive determines the over-all research programme of the Organization, selecting broad areas in relation to its assessment of national economic needs, but the responsibility for determining specific fields of research is given to the heads of the research groups, and the research scientist himself is given the opportunity to choose his approach to a problem.

No matter what the field, the purpose, or the sources of financial support, in CSIRO laboratories the scientists themselves in large measure devise their own programmes. This long-established policy recognizes that the individual scientist is working at the frontier of knowledge in his own particular field and is the one best fitted to take responsibility for his research.

The chief, and through him the Executive, maintains a continuous watch on the progress of each investigation, and the Executive exercises ultimate control through the withdrawal of support for work which it judges to be misdirected or unproductive.

International contributions

The aim of most CSIRO research is to foster national development and contribute to the solution of national problems; in this sense it is "committed" research. All problems, however, are tackled on as fundamental a basis as is needed for their solution, and although it is committed to definite objectives, much CSIRO research gives the appearance of being "uncommitted" because of its fundamental nature. The Organization's contributions to science and to the welfare of the community would have been greatly reduced if an attitude of seeking immediate and limited answers to problems had been adopted. Some work, such as that on radio-astronomy, is undertaken because of the value of its contribution to international science.

CSIRO contributes, through appropriate governmental agencies, to Australia's foreign aid and technical assistance programmes. Officers of the Organization go overseas from time to time on scientific assignments and are seconded to assist with developmental projects, such as the Chao Phya Research Project in Thailand, which is concerned with studying the agricultural problems of introducing a second crop to the country's central plain and developing suitable farming techniques.

The facilities of CSIRO's laboratories and the scientific knowledge of its staff are made available freely to visiting trainees and scientists from overseas countries.

The Organization has provided discussion leaders and speakers at international conferences and symposia concerned with the scientific and technological problems of development, and in this way members of its staff have

CERES, CSIRO's controlled environmental research laboratory at Canberra. The laboratory is used for studying plants under a wide range of closely controlled climatic conditions

established and maintained contact with research workers throughout the world.

These activities are supplemented by membership on expert panels and working parties established by inter-governmental bodies and international scientific unions. In some cases, long-term associations have been fostered between CSIRO laboratories and similar institutions in less developed countries.

Examples of research findings

It is probably not possible to measure in precise economic terms the value of CSIR and CSIRO research findings to Australia, but there is no doubt that the benefits greatly exceed the costs. An early achievement of vast economic significance was the control of Australia's rabbit population by the introduction of the virus disease myxomatosis. (The rapidly growing rabbit population had been causing increasingly serious losses in the pastoral industries.) Another early achievement was the discovery of a way of producing paper pulp from Australian eucalyptus; this has led to the development of a new Australian industry which produces pulp from short-fibred hardwoods, thus saving millions of dollars a year on paper imports.

Following a long programme of research which has revolutionized tropical pastures, new developments are making possible dramatic increases in beef production in the tropics and sub-tropics. Unimproved native pastures in the cattle country of Queensland support only one beast to 15 or 20 acres and achieve a low calving rate of 50 to 60 per cent followed by a 10 to 15 per cent loss among these calves from malnutrition in the dry season. CSIRO scientists have found that if a legume known as Townsville stylo and an appropriate fertilizer are added to these native pastures, cows can carry calves at a stocking rate of one beast to 6 acres. During the 1965 - 1966 dry year when only half the annual 34-inch rainfall fell, the calving rate on improved pasture was 100 per cent, compared with 19 per cent on native pasture. Cows and calves on the fertilized pasture gained weight well and no calves suffered from malnutrition. Cows on the unfertilized pastures, however, had to be given protein concentrates after calving in order to keep them alive. The Division's programme is being watched with interest by scientific workers in other tropical environments.

A unique and highly effective distance measuring system for aircraft flying over Australia has resulted from research begun in 1944 by the CSIRO Division of Radiophysics. It enables a pilot to determine at a glance his precise distance from a ground beacon within a range of up to 200 miles. The system became operational in 1953 and by 1957 all domestic public transport aircraft were equipped with it. Developments since then include the designing of inexpensive equipment for smaller aircraft which, in addition to showing an aircraft's distance from a beacon, shows its speed of approach.

Maintaining and improving the competitive position of wool in relation to synthetic fibres is of great importance to Australia as the world's chief wool producer, and CSIRO has done much to make this possible. It has developed processes for mothproofing, shrinkproofing and putting permanent creases in woollen fabrics as well as a process that slows the yellowing of white wool. (For further information, see "Australia: Stretch Wool Fabrics", *IRDN*, Vol. II, No. 1, pp. 32 - 33.)

A highly efficient process has been developed for making recombined sweetened condensed milk. This is now being used in factories in Singapore, Bangkok and Manila which make use of thousands of tons of milk solids and milk fat imported each year from Australia.

These are only a few of the research achievements of CSIRO. The Organization has proved its worth, and can be expected to continue to do so with findings of value to Australia's rapidly developing primary and secondary industries. One of its most interesting new projects is a Rangelands Research Programme aimed at developing management practices for the grazing industry in Australia's arid and semi-arid regions. A third of Australia's sheep and cattle graze in these areas, but unless Australia learns to manage them in a way that will ensure permanent

Samples for the determination of the moisture content of leather. CSIRO Division of Protein Chemistry

productivity, the land will eventually deteriorate to unproductive wasteland that cannot be restored.

Research groups

The work of CSIRO groups involved in industrial research is briefly described below.

The Division of Applied Physics is concerned with the maintenance and development of Commonwealth and working standards of length, mass, time-interval, electric current, and standards derived from these. The Division also does research related to standards and methods of measurement.

The Division of Physics is concerned with the maintenance and development of Commonwealth and working standards of temperature, humidity, viscosity, light and radiation, and does research in optical solar astronomy.

The Division of Tribophysics does research on the structure of solids, especially metals, with a view to their more effective utilization, and studies the effects of defects in metal crystals on the bulk properties of the metal and on surface properties such as adsorption and catalysis.

The Physical Metallurgy Section concentrates its research on aspects of the behaviour of metals, particularly during the deformation which occurs in fabrication or in use.

The Ore Dressing Investigations Section studies the treatment of Australian ores prior to the extraction of the prime constituents.

The Division of Applied Chemistry researches areas of chemistry that are important to the Australian economy and that call for the application of advanced organic and physical chemical methods. Its programme includes work on the synthesis of new chemicals and the isolation of naturally occurring chemicals; on the development and use of ion exchange resins for water purification; mechanisms of reactions at normal and high pressures; on organometallic compounds and catalysts; and on the nucleation and growth of crystals.

The Division of Applied Mineralogy studies the geology and geochemistry of ores, including the distribution of elements in mineralized areas, the formation of sulphide ores, mineralogy, and mineragraphy. It is also concerned with industrial treatment and use of mineral raw materials in the fields of cements, concretes, rock aggregates, refractories, engineering ceramics, foundry materials and mineral-organic systems.

The Division of Chemical Engineering is involved mainly in research related to the chemical engineering needs of Australian industry. Its work includes the theoretical design and cost evaluation of processes, fundamental studies of basic chemical engineering operations, the development of new and improved processes, and assistance to Australian companies in the form of advice and the provision of experimental facilities. Research subjects include the physical processing of minerals, the desalting of water, mass and heat transfer, grinding, mixing, fluidized beds, and process metallurgy.

The Division of Chemical Physics studies chemical problems, using methods of modern physics such as X-ray diffraction, electron microscopy and various types of spectroscopy. The Division has developed several novel scientific instruments. Its work includes also solid-state research and theoretical chemistry.

The Division of Mineral Chemistry does research aimed at evaluation of Australian minerals and their utilization through chemical, electrochemical and metallurgical processes. Its work includes studies on mineral exploration techniques, chemical upgrading of minerals, the production of metals, processes with possibilities for application in the exploitation of minerals, chemical aspects of fuel technology, including research on the evaluation of coals from all significant deposits in Australia and their use in power production and metallurgical processing.

The Division of Building Research: The studies of this Division are directed to the better utilization of the properties of building materials, including ceramics, concrete, gypsum, paint, and organic building materials. Its work also covers acoustics, structural design, building operations and economics, temperature control in buildings and the special problems of building in the tropics.

The Division of Forest Products does research aimed at determining the properties of local timbers and showing how to use them more effectively by reducing waste and improving quality in forest, mill and factory, and by reducing losses from decay and insect attack. Research is also carried out on pulp, paper and paper products, and on the engineering of timber structures.

The Division of Mechanical Engineering does research on ventilation and air-conditioning, particularly the development of novel methods for low-cost cooling in hot climates. It works also on grain storage; improvements to agricultural machinery; automatic control equipment; and on utilization of solar energy, especially for water-heating and desalination.

The Division of Protein Chemistry does research on the structure and chemistry of wool fibres as a basis for the development of new and improved methods for processing wool. Projects include recovery of wool from sheepskins, prevention of sunlight yellowing of wool, and improved dyeing methods. The Division also does research on tanning and leather manufacture and on enzymes and muscle proteins.

The Division of Textile Industry directs its research to the improvement of wool finishing methods and manufacturing operations in wool textile mills. Processes have been developed for shrink-proofing, moth-proofing, and permanently-pleating wool fabrics, for dyeing wool at low temperatures and for scouring wool by solvent or detergent jetting. Research is also carried out on cotton testing and processing.

The Division of Textile Physics studies the physical properties of wool fibres to determine their behaviour during manufacture and their performance when made into fabrics. Instruments are being developed for measuring a wide range of properties of wool used in marketing assessment. Studies are made of wool pressing, sampling, drying and dyeing, and of operations research in wool textile manufacture.

The Division of Food Preservation does research to improve the flavour and quality of fresh and processed foods, create new food products, develop new food processing methods, and make manufacturing more efficient. Research covers the storage, processing, transport and packaging of fruit, vegetables, meat, fish and eggs, the physical and chemical properties of food, the physiology of fruit and vegetables, and the microbiology of food-spoilage organisms.

The Division of Mathematical Statistics does research into statistical methods and the application of statistics to agricultural and physical data. It also gives service to scientists from other divisions and sections in the design of experiments and the analysis and interpretation of research results.

The Division of Computing Research does research on the development of new methods of using computers to solve scientific problems, particularly in meteorology, agriculture and ecology, and collaborates with the scientists of other divisions and sections in the application of computer techniques to their research programmes. The Division also provides computing service to CSIRO, the Commonwealth Government Departments and agencies, and universities.

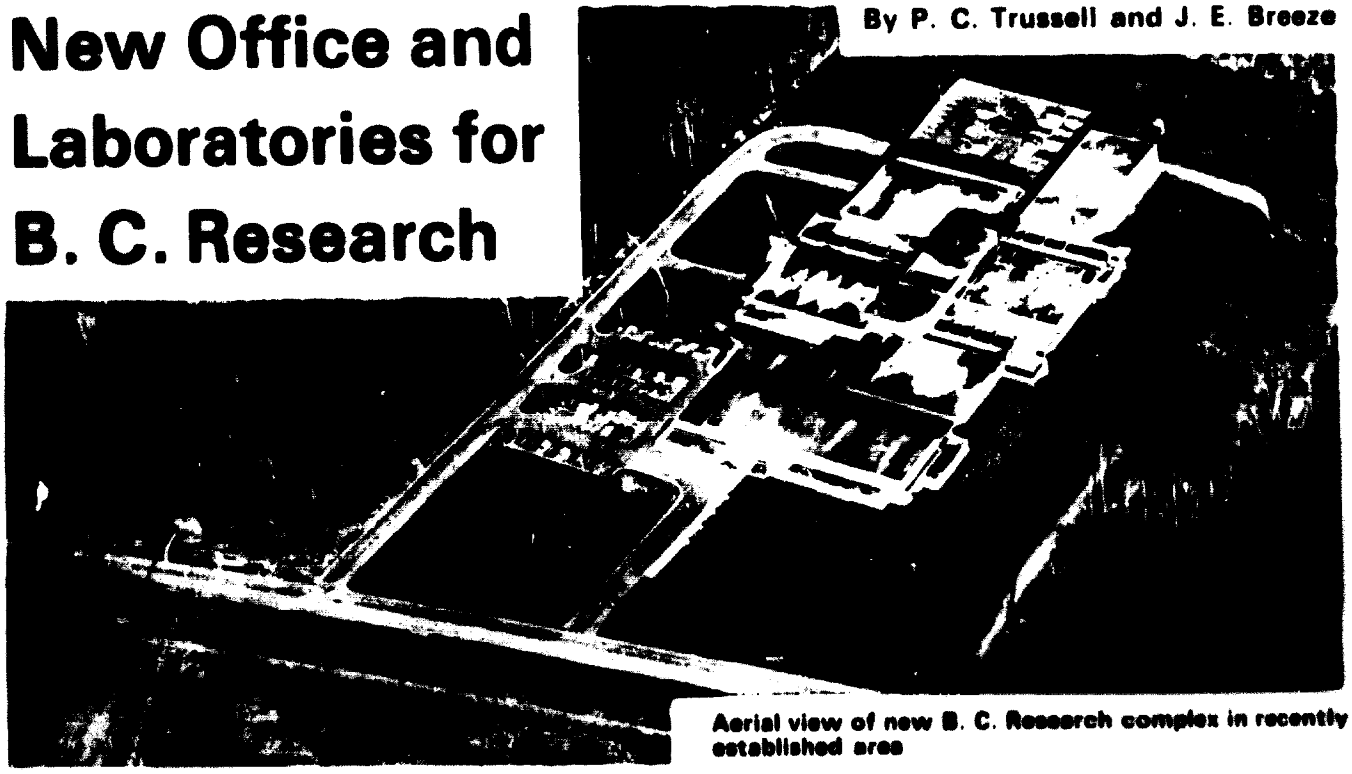
Other research groups are the Upper Atmosphere Section, the Wheat Research Unit and Divisions for Radiophysics, Soil Mechanics, Animal Genetics, Animal Health, Animal Physiology, Nutritional Biochemistry, Entomology, Fisheries and Oceanography, Wildlife Research, Dairy Research, Plant Industry, Horticultural Research, Irrigation Research, Tropical Pastures, Soils, Land Research and Meteorological Physics.

Some of the 96 aerials of CSIRO's radioheliograph, a unique instrument for obtaining continuous radio pictures of the sun. The aerials are 45 feet wide and are equally spaced around the perimeter of a circle nearly 2 miles in diameter

DO2316

New Office and Laboratories for B. C. Research

By P. C. Trussell and J. E. Breeze



Aerial view of new B. C. Research complex in recently established area

ALTHOUGH B. C. RESEARCH, the technical operation of the British Columbia Research Council, Vancouver, Canada, is an independent organization, it has always had its offices and laboratories on the campus of the University of British Columbia. The expansion of this University from about 3,000 students when B. C. Research began operations to more than 20,000 students when, in 1965, it considered expanding, required that B. C. Research relocate its laboratory facilities away from the inner academic campus. Negotiation with the University led to B. C. Research acquiring 8.8 acres of land on a 99-year lease in the southern campus. This area required clearing of timber, draining and, eventually, complete site improvement to bring it to the landscaped standards of the adjoining areas.

The consortium approach

Once a decision had been made to construct a new building, the heads of the Technical and Service Divisions were requested to provide details of the requirements for their respective operations covering floor space, millwork and services. Then, rather than proceeding with the conventional architectural and engineering design procedure followed by bidding, a design competition was called in which consortia of contractor, architect and engineer groups were asked to prepare plans for the proposed laboratory complex and to submit bid prices.

Since laboratory buildings must be designed and constructed to meet special requirements, the senior research

The Authors:

Paul C. Trussell, Director of B. C. Research since 1961, is the author of more than 40 scientific papers relating to research on antibiotics, marine borer control, treatment of industrial wastes, food deterioration and biological leaching of mineral sulphides. He holds patents relating to the production of antibiotics, the chemical control of marine borers, underwater sonic testing of marine piling, and biological leaching of metal sulphides. He was head of the Division of Applied Biology of B. C. Research from 1947 to 1961 and chief microbiologist at Ayerst, McKenna and Harrison Limited from 1944 to 1947. He received his Ph. D. in agricultural bacteriology from the University of Wisconsin (U.S.A.) in 1943.

John Ellis Breeze joined B. C. Research in 1949 as head of the Division of Physics. Since 1964 he has headed the Division of Engineering. From 1940 to 1949 he held various positions with the National Research Council, Ottawa, most of his work involving research on the war- and peace-time use of radar. He has taught university courses and written a number of technical papers. He received a Master of Science degree in electrical engineering from the University of British Columbia.

staff prepared a functional diagram and a detailed programme describing the individual operations and the interrelationships between them within B. C. Research.

Buildings for a complete research institute are constructed so infrequently that few architects or designers have the opportunity to gain adequate experience in their design. To assist the designer, therefore, certain broad concepts were established. The most important of these was the emphasis on functional design throughout and economy of materials and methods of construction to achieve this. Architecturally, this functional outlook included such features as the open-type laboratory which eliminates the need for a network of corridors to connect a series of small laboratories or rooms. An environmental concept was expressed in terms of light level, colour, ventilation and noise level. Over-all, the design concept provided for a preferred relationship between the principal elements of the laboratories and made provision for future expansion capacity to expand to double size any one of the several principal laboratory units.

Lobby and reception, illustrating higher quality finish than most other parts of building

From thirteen submissions, the design was selected which most closely conformed to the above broad concepts. In the judging a selection was made first on a design basis with the names and bid prices removed so that the judging groups could act free from bias. Two groups reviewed the plans; one was comprised of the senior staff of the laboratory and the other was an advisory group of architects and planners. Both groups independently selected the same design as the one that most closely met all requirements. It is also noteworthy that the preferred design turned out to be the second lowest in cost, indicating that the most expensive design is not necessarily the most functional.

The plan

The plan of the main floor provides for the library and auditorium leading off the lobby so that these facilities are readily accessible to clients and visitors. The staff area, where light meals are provided, can be reached from the lobby or the laboratory areas separately.

The main laboratory areas branch off from the main corridor or mall, which forms a spine for the structure, and each laboratory is approximately 110 feet wide by 100 to 120 feet long with rows of offices or small laboratories down each side and an 80-foot wide central working area free of columns. The roof over this central area is comprised of pre-stressed concrete beams 10 feet wide and 80 feet long. The open central area provides for complete functional flexibility in designing and detailed laboratory layout for its particular purpose, whether it be applied chemistry, biology or physics. Each of the four laboratory areas may be expanded to double its initial size in 10-foot steps by installing additional roof beams.

The plan selected allowed for integration with the topography of the land so that a minimum of soil moving was necessary. The slope is from northwest to southeast, the front of the building facing west. The library, auditorium and Applied Biology Division were built on grade. The other parts of the building were constructed with a floor beneath to contain the shipping and receiving departments, the central stores and the workshops. These areas are accessible by staircase and freight elevator to the central area of the mall above and from there to all laboratories. The area below the laboratory for the divisions of Applied Physics and Engineering is used for general storage; that below the Insect Laboratory is available for expansion. Also located on the lower level are building services, including the boiler room, electrical and telephone vaults, mechanical rooms and the photographic laboratory.

The front of the building also has two levels, but here the second level is above the lobby and library. This floor houses the general administration offices, executive offices and board room as well as offices for the staff members in non-laboratory sections, such as Operations Research, Economic and Market Research, Industrial Engineering, Productivity Analysis and the Technical Information Service.

A Pilot Plant wing completes the building complex. It is located at the extreme east end and joins the rest of the building adjacent to the workshops and shipping areas. This unit is 145 feet long and 64 feet wide and has an unobstructed height of 30 feet.

In designing the detail layout, areas with specific functions requiring isolation or installation of special equipment were given a peripheral location. In the library this resulted in giving wall locations to the work-room, the librarian's office and study carrels, the central area being left for stacks and with flexibility for future use. Similarly, in the laboratories, walk-in facilities such as refrigerators, incubators, and sterile areas as well as some offices were given peripheral locations. The central area was thus left available for benches, built-in office carrels, fume hoods and unoccupied areas for future development. The emphasis throughout has been on functional design, and walls, partitions and doors have been left out unless functionally required. The result has been larger areas and a maximum opportunity for mobility and flexibility.

Construction materials

The principal materials used in constructing the building were reinforced concrete, pre-cast concrete, brick and concrete, or pumice blocks. Interior partitions were brick in the mall, brick or pumice block in the laboratory areas, concrete block in the lower level and pilot plant, and dry-wall on the administration level. All interior masonry surfaces, with the exception of brick, were painted to reflect light well and to seal the concrete or masonry block surface from dusting. Except in the lobby and executive offices, which were carpeted, all floors in the laboratories, the mall and administration level were vinyl asbestos tile. The floors of the lower floor and the pilot plant area were sealed concrete.

The front part of the building, including the lobby, library, auditorium and the administration floor, was given a higher quality of finish than the rest of the building. All services were enclosed behind suspended ceilings of acoustic tile or plaster, and the lobby was given a very fine wood-beam illuminated ceiling.

The laboratories received an intermediate level of finish. Doors were omitted unless essential, and the service conduits for hot and cold water, electricity, natural gas and compressed air were left exposed for ready access when changes or additions are required.

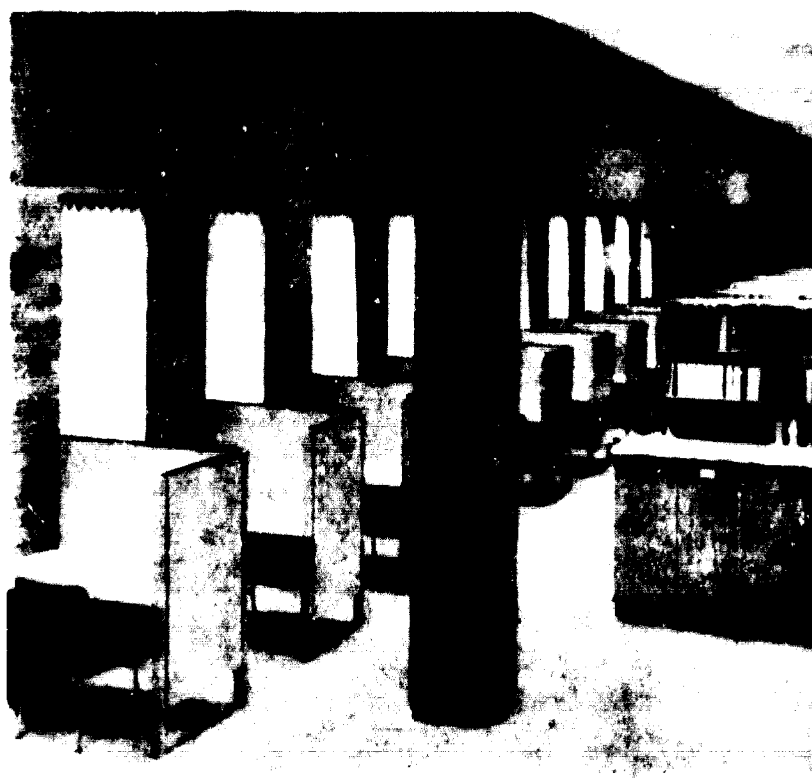
On the ground floor and in the Pilot Plant the finish is of factory grade with concrete floors, concrete and concrete block. All piping and ducting is exposed with service-grade fittings throughout.

Throughout the design, emphasis was placed on the interior environment as a human work area. An adequate glare-free light level has been provided in all working areas, a more subdued level in the mall, lobby and connecting corridors, Coupled with the bold use of colour, this has resulted in a pleasant, bright, fresh appearance in all areas.

The noise level from installed mechanical equipment has been limited by specification, and this also contributes to a pleasant working environment. Forced ventilation provides six changes of air per hour throughout the building by means of six separate systems drawing fresh air from the ground level and exhausting it at the roof top. In this way atmospheric contaminants from one part of the laboratory are not spread to other areas.

Open-type laboratory showing walk-in facilities along the left wall, built-in desks in foreground

Portion of library showing individual carrels



Building schedule and cost

The planning and construction of the building proceeded simultaneously; the design of the footings began in June 1967 and excavation started in August of the same year. The building was completed and ready for occupancy in March 1969, just 22 months from the signing of the contract to proceed with the detailed design.

The gross area of the building is 147,000 square feet. The final cost was 3.34 million Canadian dollars (approximately US$3.61 million), which included site improvement, service road and black-top parking accommodation for 120 cars with provision for night lighting. The over-all cost was thus less than $23 per square foot, compared with $30–$35 per square foot for other laboratory structures completed just prior to this building programme.

Guidelines in designing and erecting research facilities

Because of the high mechanical and electrical costs in providing for their services, research laboratories are comparatively complicated and can be expensive to build. The approach to the design and construction of the B. C. Research building had the elements of an experiment from the outset, and a number of new approaches were used. That the result has been a success has been demonstrated not only in the attractive, functional building that now stands, but also in the subsequent engagement of the Division of Engineering to undertake design-cost studies on buildings now being considered for erection under financing by the Hospital Insurance Service of British Columbia. It was, in fact, some of the novel approaches employed by B. C. Research that encouraged the Government to assist in the financing of this research laboratory building to the extent of 80 per cent of the total cost.

Some of the guidelines resulting from this experiment that might be of use to others considering the setting up of research facilities are listed below.

- The provision of an opportunity for design selection was a highlight of this project. Whether this opportunity is provided by competition or by commissioned assignments, and whether or not a bid price is part of the proposal, are matters of lesser importance. Of prime significance in this project was the early co-operation between the

Shop area

Pilot plant area

client, the general contractor and the design consultants. These two factors, design selection and consortium approach, in this case led to a truly successful and economical functional design.

- The senior technical people of the institute willingly and effectively set forth their requirements in detail for laboratory benches, the number and kinds of service outlets, and requirements for special facilities, such as climate rooms, walk-in refrigerators and fume hoods.
- The institute drew up guidelines for the design group with respect to broad features, such as quality of finish, over-all laboratory layout, requirements for expansion and environmental standards.
- Information relating to the design and construction of the building should be funneled through one man in the institute who serves as spokesman for its members in discussions with the prime contractor, the architect and consulting engineers.
- The institute needs to keep detailed minutes of all meetings between the institute representative and the contractor and design group to record decisions taken and responsibilities delegated.
- The representative of the institute must be adequately experienced and knowledgeable in design and building practices so that in interpreting the functional requirements of the laboratory to the designers and contractors, errors in design and construction will be kept to a minimum.
- A clerk of works representing the institute should be engaged to oversee the construction at site and to check on all materials and methods of construction.
- The participation of the senior technical members of the institute, through their designated representative, should be sufficiently involved so that once the detailed design has been finalized change orders during construction can be virtually eliminated.

(For further information on B. C. Research, see "British Columbia Research Council", IRDN, Vol. II, No. 1, pp. 53 to 54.)

Three UN experts have been assigned to the Fibre Bag Manufacturing Corporation, a State enterprise in Kumasi, Ghana.

FIBRE BAG MANUFACTURING IN KUMASI

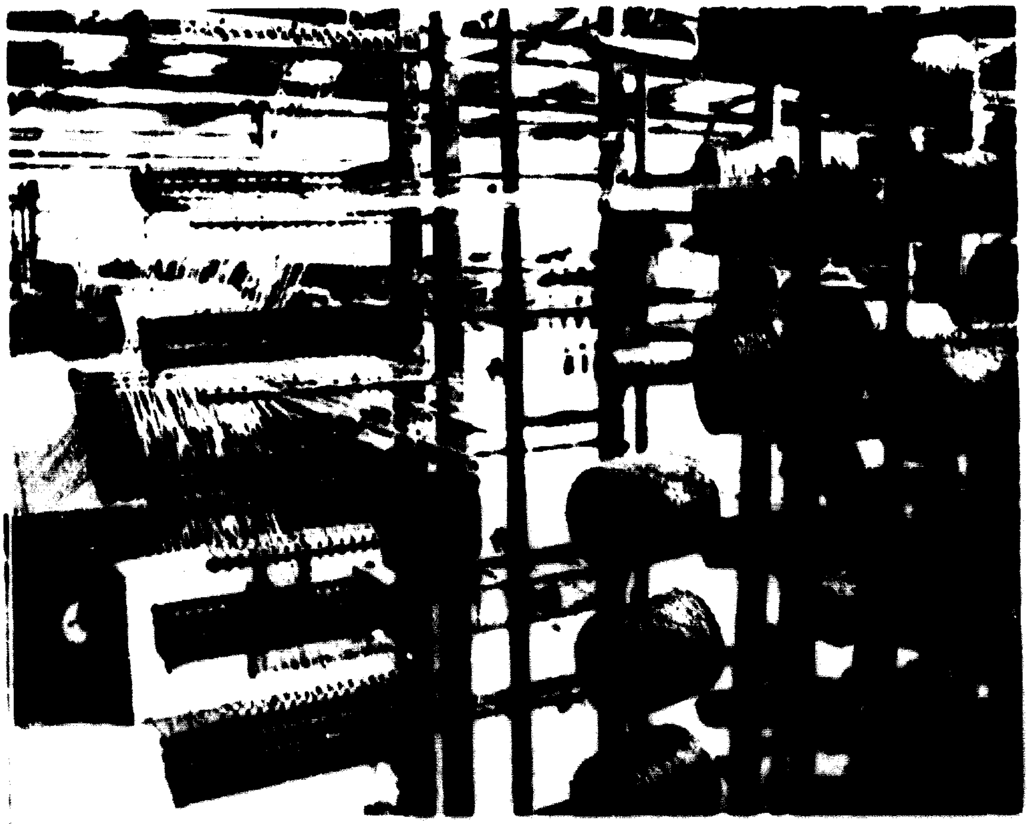
Unbaling jute imported from West Pakistan

The assignment was made at the request of the Government of Ghana under the Special Industrial Services (SIS) Programme of UNIDO which is acting as executing agency for the United Nations Development Programme (UNDP). The SIS programme provides assistance at short notice to governments wishing to promote or carry out new industrial projects and is intended to supplement other UN activities in the field of industrial development. Operating on an experimental basis, SIS is financed from a Trust Fund based on voluntary contributions and administered jointly by the Administrator of UNDP and the Executive Director of UNIDO.

Jute feeding off the crimping machine into storage barrels. The crimping process follows pressing

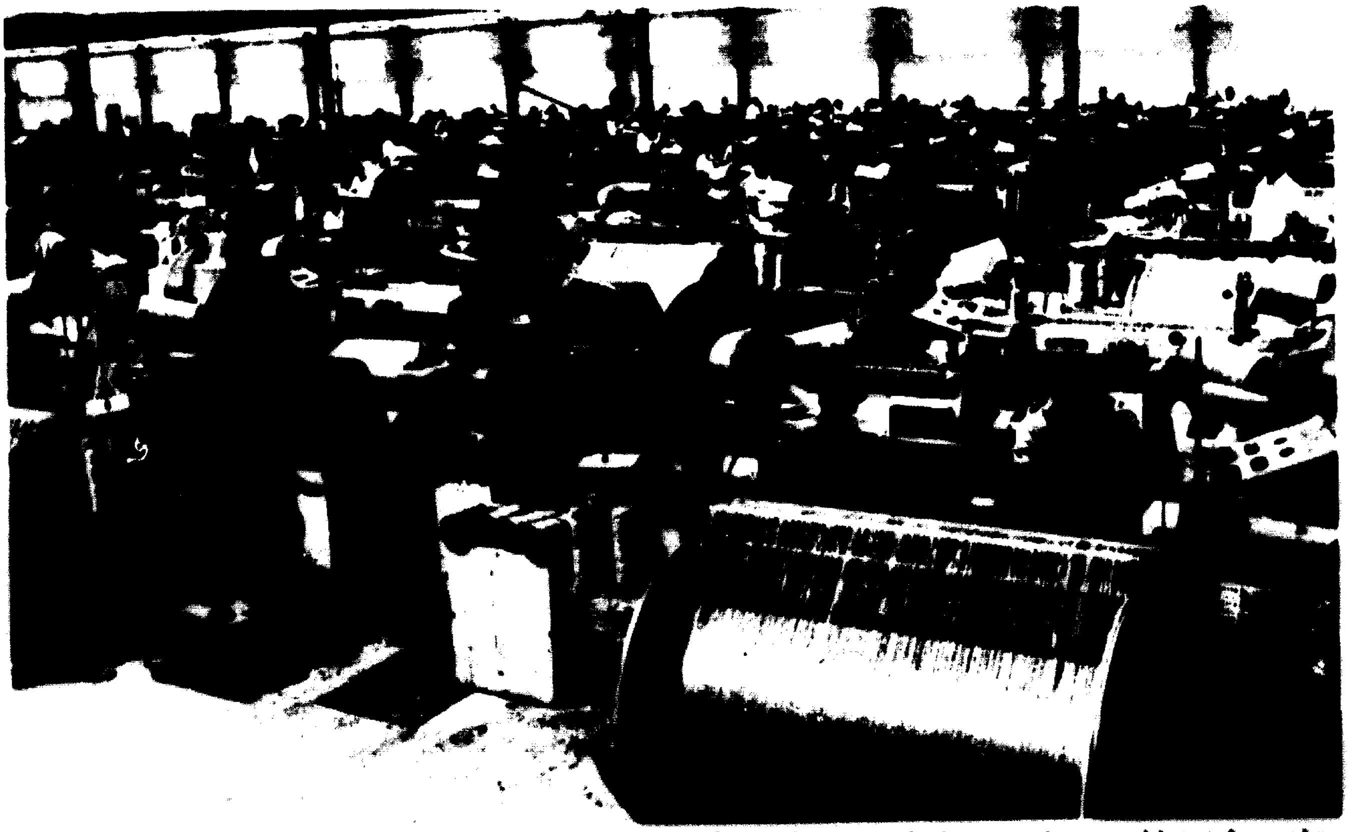
Twining in process

General view of the Fibre Bag Manufacturing Corporation's plant in Kumasi. Spinning is in process in the foreground and crimping, middleground



Imported jute from West Pakistan being spun

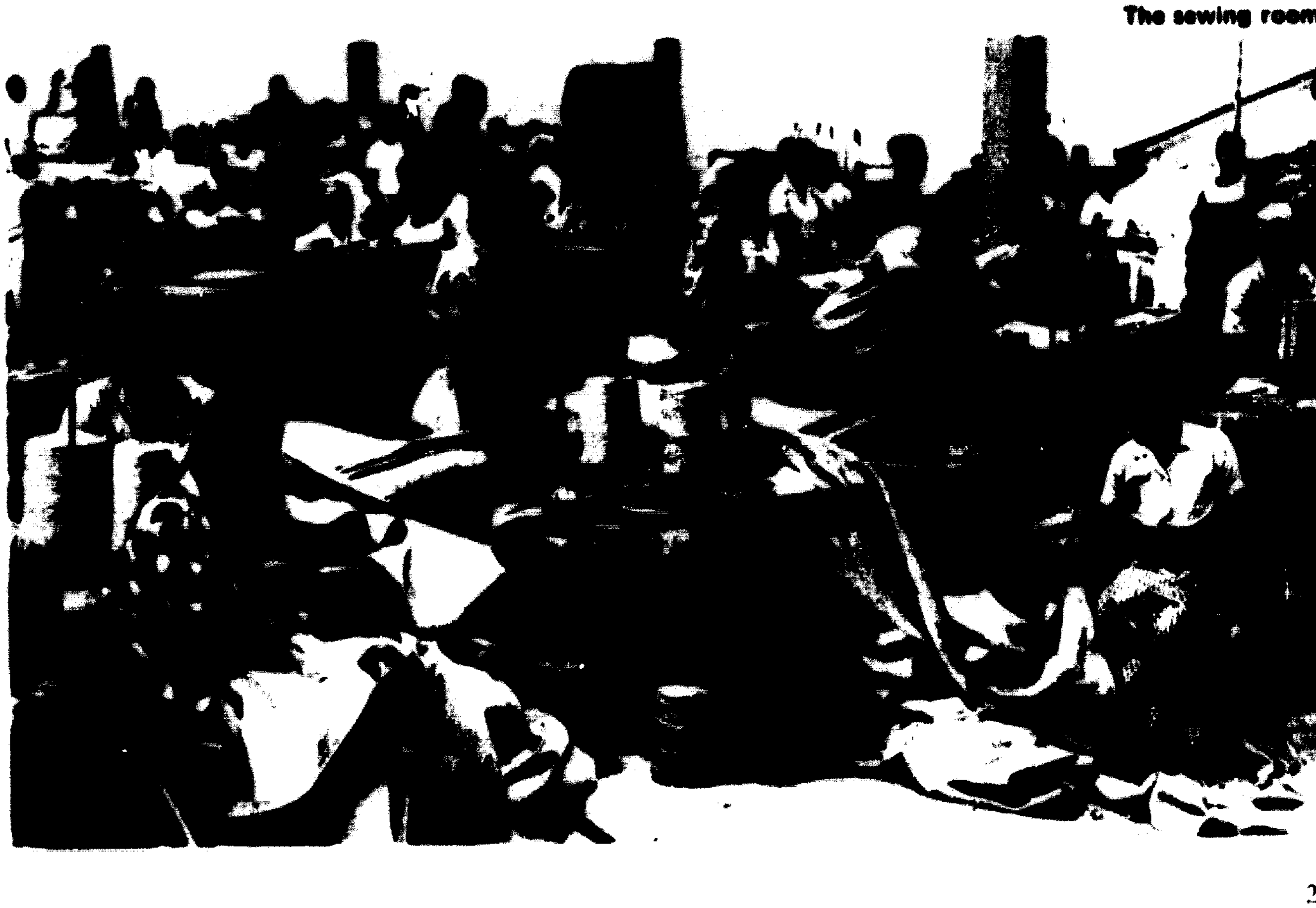
Fibre being transferred from small spools onto which it has been twined to larger spools for weaving



General view of the weaving machines. A worker, right, knots thread after a break

Left: worker re-threading the spinning machine

The sewing room



By Myra Kaye

Selection of Scientific Instrumentation in Developing Countries

The Author: *Myra Ockrent Kaye has served as head of the Research Contracts Programme at the SOREQ Nuclear Research Centre of the Israel Atomic Energy Commission since 1963. Previously Mrs. Kaye was Head of the Commission's Information Department and Library, and her present activities include developing a new scientific information exchange system and a card index system for science information services. Other experience includes being a scientific information officer for the Imperical Chemical Industries, Welwyn Garden City, United Kingdom, and an experimental physicist at the Atomic Energy Research Establishment, Harwell, England.*

NOT MORE THAN three or four decades ago, the principal criterion in scientific research was the creative ability of the scientist. Science was concerned mainly with the development and confirmation of new ideas; the ability to form the new concepts and to devise techniques for testing them was the mark of a good scientist. Such men were the nuclei for the next scientific generation: the young scientist went to R. W. Rutherford, Niels Bohr, or Linus Pauling to learn from such intellectual giants new ways of looking at natural phenomena and to benefit from their depth of approach and comprehension.

It was the age of great men of science. In such a milieu, instrumentation hardly existed as a factor in scientific research and many of the classical experiments in the history of science were performed on primitive (Heath Robinson-type) contraptions, the principal components of which were constructed in the laboratory or at the laboratory workshops.

New Importance of Instrumentation

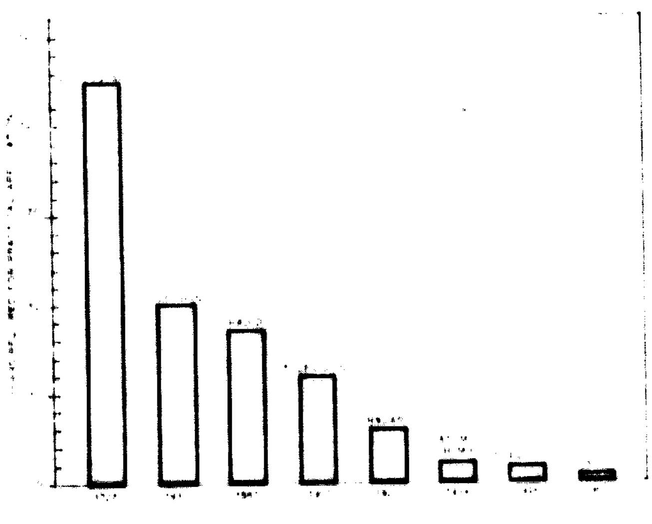
The whole picture of science as a solitary and rather gentlemanly occupation, more in the realm of philosophy than that of the day-to-day business of living, underwent a rude shock when the slow pace of the development of applied science—the application of the newly discovered concepts to practical problems and to the needs of the time—was drastically accelerated in the period between the First and Second World Wars, and especially during the latter.

This accelerated pace received its first stimulation from aeronautics. The use of the aeroplane in the First World War demonstrated in the most unequivocal and exciting way that the principles of mathematics and mechanics were not only exercises in thinking and deduction but could lead to powerful tools for pleasure, practical use or destruction. By the time of the Second World War, two immense movements had been set in motion which were to affect the pattern of science as well as almost everything else. One was the start of the age of the common man, creating a huge demand for progress and advancement in the artifacts that make life comfortable and secure; the second was the realization that the emphasis in the military sphere had changed from the man to the machine, and that superiority in the latter rather than the former might win wars.

These two factors helped to create the great alliance between science and technology and pushed instrumentation into hitherto unknown prominence in the whole conduct of scientific research. For now, most areas in science had been opened up and the pace was becoming rapid and competitive, especially so because of the great effort that had been put into training scientists for the needs of war and by the scientific developments related to the war. These developments were being expressed in technology and the scientists' attention began to be somewhat less concentrated on the exploration of new topics and more on refining ideas and measurements on already known problems. Increasingly important criteria in the choice of the newly qualified scientist as to where he should work were not only "who is the best man in this field?" but also "which laboratory is best equipped for this kind of work?".

Moreover, the scientists were spilling out of the rarified atmospheres of the research institutes and the university laboratories into industries that were exploiting the new technologies and could sometimes offer even better conditions for research than the traditional pure science institutes. These men entered an industrial competetive atmosphere which subtly altered their attitudes and introduced new pressures. The earlier, wartime opportunities for the training of scientists in much greater numbers than heretofore, and the new financial and psychological inducements to youngsters to enter scientific professions had resulted in the recruitment of large numbers of young men and women. Some were more technicians than creative scientists and found their place in conducting measurements and attempting to introduce greater orders of magnitude in the accuracy of recording phenomena. To them increasingly sophisticated instrumentation was of prime importance. Moreover, particularly in the atomic sciences, accurate measurement *per se* had become a new frontier in actually contributing to the theory. Thus, from many aspects, developments in science-instrumentation had become a very important factor in scientific research. Concomitantly, the development of applied science and technology had produced a bewildering variety of instrumentation to meet the most exacting needs.

The increasing pace of this development may be illustrated by the figure below showing the gap between the initial discovery of the underlying scientific principle and the effective technical development of the related instrumentation.



It is apparent that the new economic pressures, as well as the new widespread availability of scientists and technologists willing to work in the practical sphere, have speeded up development of an idea to a point where development is almost simultaneous with the idea itself. The steps from the idea to the drawing board to production follow each other with a rapidity that reflects a competitive situation.

This brief description of the changes in the developing pace and structure of pure and applied scientific research owing to the pressures of the changing society brings us to a present-day picture which has little in common with the scientific situation a few decades ago.

To take an example in nuclear physics, the entire effort of a scientist may be dictated by the sole factor of instrumentation. He may be obliged to work in one of the few laboratories where a cyclotron, or a synchroton, or a particular kind of nuclear reactor is available. A laboratory is not competitive if it does not have the most sensitive and accurate instrumentation that current technology provides and that the bulk of scientific endeavour requires.

Under these circumstances, the situation of developing countries, as of small or poor countries, is a difficult one.

Position of developing countries

The pace of development of a country is geared to the pace of development of its industrial technology, and this in turn is geared to its development in scientific attitudes and practice. The latter cannot be borrowed; no country has succeeded in bringing itself into the mechanical age with the help of foreign experts alone. Such a transition requires a whole cultural change, the first stage of which is the creation of an indigenous scientific elite which can introduce and integrate new concepts based on the scientific attitude into the national cultural pattern. Thus, such countries must develop their own human resources; they must be able to offer scientists trained abroad facilities for work at home, at a proper level, so that the scientists can not only contribute by their own research but can in turn train others and thus influence the whole culture and bring it into the framework of the technological age.

To provide the local scientists with such facilities involves setting up laboratories equipped with costly instrumentation, and for such countries, cost is a vital problem.

Granted the willingness to invest in costly research and industrial laboratories, developing countries, with their restricted budgets, small hard currency resources and tremendous needs, have to think hard about what facilities and equipment they can afford to buy.

Such decisions are complex: long-term and short-term interests may not coincide; national and regional or local interests may be entirely opposed. There may be a large number of interrelating factors to be considered in balancing the needs for standardization and diversity; political considerations, as well as balance of trade and commercial or credit considerations, may weigh in the choice. Finally, there may be differences of emphasis on the weight of these various aspects among those who are making the decisions the administrators, scientists, technologists, industrialists and planners.

How the choice is dictated for any particular country will be based on the local situation. One can, nevertheless, attempt to assess the significance of the various factors. From such an analysis, it may become clearer what kind of guidance would be most helpful at an appropriate level in the choice of instrumentation for laboratories in developing countries.

Question of scale

The size of the problem has a direct correlation with the means used to tackle it. For example, if we consider a problem, "transport of animals", transporting a kitten might not be a problem at all, but transporting an elephant will surely be. Costs, techniques, equipment, all the parameters involved in the two situations are quite different.

In the case of transfer of helpful information on the purchase of instrumentation, more effort is required with respect to low-cost instruments, because more of them are going to be purchased. Though the choice of instruments in the lower price range is likely to be greater, the information transfer process must be less costly to be commensurate with the value of the instrument.

If a developing nation wants to invest in heavy industrial equipment to develop, for example, copper mining resources, the problem is different. Clearly, considerable sums will be allocated to researching availability, suitability, costs, types and performance of equipment, and presumably foreign experts will be involved. The problem of investigation prior to purchase becomes a question of organization and selection where to start, whom to ask.

In a sense, this is much less of a problem than those which arise when a \$500 flowmeter for scientific research is to be purchased, for in the latter case there is a definite limitation on the amount of effort which can be put into the investigation of what model should be purchased. Clearly, one is not going to spend \$5,000 trying to make the best choice of a \$500 instrument.

How much of its budget can a small laboratory in a developing country afford to spend on rigorously checking an instrument purchase? The answer is probably nothing! Moreover, any international organization aiming to help the developing countries in such choices is faced by the same limitation—it is difficult to set up an economically feasible advisory service which can consider and advise in depth on innumerable small purchases. Certainly, the structure of such a service would have to be quite different from that of a service aimed at helping developing countries in their large-scale purchasing problems.

An attempt to analyse the factors involved in the purchase of a scientific instrument in a hypothetical case may indicate solutions or partial solutions and suggest the help that the more advanced communities can offer.

Let us consider the case of a newly established laboratory in a developing country designed to carry out experimental testing of varieties of cotton and pest control of the crop. What considerations are involved in deciding to purchase instruments for soil moisture testing, incubators for bacterial growth experiments, and various recorders for temperature or other fairly general measurements? What level of information is required to facilitate the optimal choice and how can this information be made available most conveniently?

Costs

In any developing country, indeed in any small laboratory, cost is a primary consideration. Such laboratories are usually run on extremely restricted budgets, and unjustified expenditure of even a few tens of dollars may seriously affect the extent of possible programmes by cutting out the possibility of purchasing other necessary instrumentation. While the instrument to be purchased may be common to such laboratories in an advanced country, it may be the only one of its kind in a developing country. With little possibility of borrowing equipment from other sources, such laboratories must aim at self-sufficiency in equipment. On small budgets, the cost per instrument is a vital factor. Unfortunately, however, it may be in conflict with other equally vital factors.

Reliability

Developing countries are generally engaged more in applied than in pure research and their instrumentation needs are often for field instruments, which will be put to rugged use and which will have to be transported over rough terrain. Reliability and cost are generally, but not necessarily, linked; a more expensive instrument may be more soundly constructed or simply more sophisticated and in practice less useful for hard wear and tear. In countries where the main need is for a durable instrument that will seldom break down and that can withstand not only hard working conditions but often unskilled use, the need for economy in expenditure must be balanced against the need for sturdiness and reliability.

Range, versatility, adaptability

As any instrument in small countries is likely to be unique, their laboratories are usually interested in purchasing instruments that can be put to a number of uses rather than those designed for a specific purpose and only capable of operating under special conditions. However, again, broad-purpose instruments tend to be more expensive, and the extensive range may be achievable only at the expense of lower sensitivity.

Versatility and adaptability *per se* introduce first the idea of a wide selection of optional accessory parts and conversion equipment to extend the range of function of the instrument, and to permit it to play a role in a variety of instrument combinations. This is a point in favour of any laboratory dealing with only one firm; presumably instrumentation units from one source have been designed with the possibility in mind that they may have to work together. It would be helpful if designers of instrumentation would give this point more consideration than they do at present, particularly in developing accessory and conversion parts, and also as regards compatibility.

Another perhaps more minor point concerns construction. Industrial competition encourages increasing attention to appearance and this introduces a tendency towards the elegant sealed box encasing the actual device, the casing being more costly than the instrument in some instances. The adaptability and versatility of an instrument relate not only to the basic features that make the instrument versatile for a number of uses and adaptable to other auxiliary equipment, but also to the ease with which the adaptation can be made by experienced technicians, who may understand the principles of how the instrument works, but perhaps within an entirely different conceptual framework from the technological one. Thus it is preferable to substitute simplicity for elegance and produce an instrument in which cannibalized or home-constructed parts can be readily substituted, an instrument that can be disassembled and put together with ease.

Sensitivity

The sensitivity of an instrument is generally linked to its delicacy; in general, a more sensitive instrument is more intricately constructed. Bearing in mind the maxim often known as the Fourth Law of Thermodynamics - the probability (p) of an event is directly related to its undesirability (u) or $p = f(u)$ (This is sometimes expressed: "If it *can* go wrong, it will"), it is clear that in the selection of instrumentation for versatile use in difficult circumstances, the emphasis should be on *adequate* sensitivity rather than on the greatest sensitivity.

Since the bulk if not all of the scientific work carried out in developing countries is likely to be applied, and hence not competitive in the sense that pure research may be, the aim will be not to refine a measurement to its last extreme but rather to achieve an adequate measurement for describing or controlling a process. Here we are in a happier situation than as regards the three previous categories - i.e. in the particular circumstances we are considering, sensitivity is likely to be a less weighty factor than it is in the general area of science.

Service facilities and spare parts

The question of the servicing of instrumentation in countries remote from their place of purchase is surprisingly complex. Theoretically, the question of standardization is involved. If a country decides to buy the bulk of its instrumentation of a particular type from a single supplier, the supplier may be induced to set up an agency and servicing branch in the country, but in practice it seldom works out this way. Servicing facilities are only one of the many criteria involved in the instrument-purchasing decision. Vast areas and difficult terrains may be involved, and a service agent in a town only 100 miles away may be virtually unreachable. The local service agent, however well trained, may be far from adequate in dealing with complex problems when instruments are out of order. An anecdote from the personal experience of a friend living in a country that has reached a considerable stage of development illustrates the point.

Recently, when the spin-dry cycle on a housewife's washing machine did not operate properly, she called in the local service agent for this make of machine. Without careful inspection, he announced, "Madam, we will have to put in a new control dial". "How do you know the control dial is at fault?" she asked. "Madam, believe me, *I know!*" A new dial was put in, but this did not improve the performance of the machine. The service agent was called again, and this time he announced that a new pump was required. The same dialogue was repeated. Installation of the new pump did not, however, bring about any improvement. Indignantly the housewife again called the technician and berated him, pointing out that she had spent a considerable sum of money on replacements; she asked him what he was going to do about the machine now. "The trouble is, Madam," he replied, "what you need is luck!"

It should not be inferred from this that the technician, an immigrant from an Eastern country, was either ignorant or stupid. He was simply expressing a whole cultural environment in which luck and good and evil influences were real concepts and operated on washing-machines as on everything else.

All too often, in developing countries, the onus of servicing and repair is on the scientist himself, and this is a time-consuming activity. Often young scientists who, in a more developed country, would be carrying out their post-graduate work in a team of more advanced scientists, are in their own countries laboratory chiefs with widespread responsibilities, including the training of others. Yet when the scintillation counter or the centrifuge goes wrong, this is the man who will have to spend an hour or a day as repairman. Where it is normally impossible to borrow a similar instrument, service must not only be of adequate quality, but fast and nothing is as fast, or, alas, as time consuming, as doing it yourself.

Certain creatures are known to have the ability to regenerate a limb if one is accidentally amputated. This mechanism in nature is simulated in developing countries by a talent for improvisation. The scientists who have to depend on an instrument often develop considerable talent for fixing it themselves on the spot by ingeniously improvising spare parts. And time without number, this is the way the job is done. When the instrument is more complex, however, this becomes increasingly difficult. At some stage, it just isn't possible to fix something with a rubber band, two screws, and a bicycle part, and at this point we have to worry about a proper system of servicing and spare-parts supply.

While major companies in the field of scientific instrumentation operate sales and service agencies in some of the more advanced of the developing countries, a great many do not. This puts considerable pressure on the would-be purchaser and restricts considerably his freedom of choice.

Even if he purchases an instrument for which there are service facilities in the country, the efficiency of service is geared to local conditions, i.e. the distance of the laboratory from the location of the agency, the technical skill of the agency staff, the numerical ratio of the service staff to the number of instruments potentially requiring service, and even such factors as the efficiency of the interurban telephone service. As noted earlier, the local staff may have certain psychological cultural difficulties in tackling technological problems.

As regards spare parts, even if the part is small enough to justify the expense of having it sent out from the manufacturer by air mail, a delay of some days is involved. Hence the need for the regenerative capacity for improvisation, and particularly for a certain skill in adapting locally available parts to a foreign product.

The situation could be vastly improved if there were a degree of co-operation among manufacturers, but perhaps this cannot be realized in a highly competitive market. Joint agencies representing several manufacturers could have larger and more specialized staffs to deal more effectively with servicing needs.

Much more could be done at the manufacturers' end than is done at present by deliberately aiming at interchangeable universal spare parts, suitable for a number of similar instruments from different sources, as a tire is for different car models. Even the simple agreement of one agency to lend skilled technicians to another would be helpful. There is place for greater co-operation both among instrument manufactuers and among local service agencies, to produce a more easily serviced product and to share servicing facilities.

It may well be, however, that the whole system of servicing and spare parts availability may take on a different complexion in the near future. For the present, manufacturers aim at setting up as dense a network of servicing agencies as is compatible with the economics of any given situation. Cheaper and faster air travel may make local agencies redundant. Jumbo supersonic jets, which will take two hours and carry a spare part at a cost of US$20 from Addis Ababa to New York or Tokyo may remove the necessity for service facilities throughout the world. Thus, the solution to the repair problem may come from current developments in communication technology.

Operating instructions

There is no need to emphasize the need for high standards of the writing of the instructions on setting up the instrument, its operation, the data regarding its construction which are needed for adaptation or simple repairs. Technical writing has become an art-science in its own right; it is taught in universities and considerable attention is paid by manufacturers to putting out their products accompanied by attractive and highly professional brochures describing their essential features and operation, usually in good, simple English, French and German.

If the scientist at the receiving end is not competent in English, French or German, there is some difficulty, but normally the scientist is proficient in one of the major world languages although sometimes his knowledge may prove misleading. For example, "The screw is turned to the left", means to the purist that that is the way it is found, not that you have to turn it to the left, which is probably what is meant. However, the reading of the instructions and the misunderstanding are less likely to be at the scientist's level than somewhere lower on the language proficiency scale the student, the laboratory assistant, the field worker, the man in the construction and repair shop; there must be a check at every level to ensure that the instructions are being interpreted and translated correctly.

Information, the universal requirement

If we try to summarize all these considerations, remembering that what is good for the scientist may not be good for the administrator, and that local requirements may differ from national ones, perhaps all that emerges unequivocally is that if there is one universal requirement which can serve all interests, it is information. Given information, it would be possible to evaluate all the criteria and there would be a reasonable basis for choice in instrumentation; even if the choice may be a hotly disputed one, at least the argument will be knowledgeable. In this age of utility it is perhaps a novel conception how much time and effort are involved in obtaining the simplest information in developing countries. Often an arbitrary choice must be made simply because the information-gathering process is so difficult.

In an industrially advanced country such as the United States, a scientist wishing to buy an instrument can ask his secretary to call up a dozen firms asking them to send over their technical representatives. Generally, the scientist himself has wide experience, based on visits to other laboratories, and will be aware of most of the types available and their performance. He will also have a wide "gossip" circle with other scientists, and be able to make, almost unconsciously, a comparative study and decision as to the type or make of instrument that will best suit his needs.

In developing countries, however, information has to be obtained by mail, and the information derived from first-hand experience often cannot be obtained at all. It is quite likely that no one on the spot knows even what firms to contact, or their addresses. There may be no one to type the letters of inquiry so that they have to be written laboriously by hand. The natural tendency for a scientist is to evade this tedious information-gathering process and to buy the instrument he knows. This may be the one he was taught on, and already several years out of date, or the one he has seen in some other laboratory, not necessarily the best for his purposes. At least he knows what he is getting. The alternative, to buy an unknown instrument solely on the basis of its catalogue specification, sometimes turns out worse.

Possible solutions

To provide the help that is needed, an information system would have to be organized in such a way that the unit cost for the information service would be commensurate with the cost of the problem. A system could be envisaged consisting of consumer-reports, recording first-hand experience, stored on index cards and distributed on a continuing basis in order to keep up with new developments. Developments now in progress in transportation may help to solve many of the problems by bringing, for example, Tel-Aviv as close to New York (or Tokyo) as Chicago is at present. It would then be possible to have a two-way traffic of scientists exploring instrumentation purchases at the source and really skilled technicians servicing instruments from the source.

The existence of the language problem ought at least to be acknowledged. The technical writer must put an even greater effort into simplifying complex material and must make even greater use of illustrative and pictorial techniques than at present.

There may be a future for video recorders, the cost of which is now coming down from the thousand-dollar range to the hundred-dollar range. With the especially high rate of development in communications technology, costs may be greatly reduced before long, making video communication not much more expensive than printed communication. As the cassettes are erasable, we may even envisage an exchange between customers and supplier, so that difficulties can be directly explained and questions asked with a minimum use of language and a maximum use of illustration to demonstrate how an operation should be done and what went wrong. Until this happy day, the technical writer should bear in mind that not all customers speak the same language. There may also be a role for technical translation centres which can provide language experts to collaborate with the manufacturers' technical writing staff in supplying "custom-made" translations in the language of the country to accompany individual instruments.

Perhaps the isolated scientist could also be helped, by travelling exhibitions, again exploiting cheaper and faster communications. Vast instrumentation fairs are impractical as they are costly to plan, prepare, set up and move, but smaller efforts would be useful, displaying a limited number of instruments of less expensive and less specialized types. Such exhibitions could be displayed in the village hall or classroom and should be accompanied by a few skilled technicians.

With the as yet limited number of laboratories in the developing countries, it should not be difficult to link the new laboratories individually with those established in developed countries. Again, contact might be maintained by audio-cassettes and the continuous exchange of such cassettes which are inexpensive, erasable and have about 120 minutes playing time would permit scientists at either end to discuss problems and exchange impressions and advice on various subjects, which could include instrumentation. The parent laboratory in the developed country could then act as a consumers' guide when an instrument is to be bought, as well as contacting manufacturers or answering specific questions. The parent laboratory could also incidentally introduce some friendly warmth into the impersonal and matter-of-fact techniques of science services.

UNIDO Provides Advice on Industrial Equipment

In accordance with resolution 1183 (XLI) of the Economic and Social Council (ECOSOC) and the report of an Expert Group which met in New York in November 1967, UNIDO established the Advisory Service for the Supply of Industrial Equipment to Developing Countries.

Resolution 1183 (XIX) requested the Secretary General to study the feasibility of setting up "an advisory service which could provide information to the developing countries on the sources of supply, the cost and the quality of equipment needed for their development".

In response to individual requests the Advisory Service provides lists of suppliers of industrial equipment from an international collection of industrial directories. Advice can also be sought on such questions as prices, quality and terms of delivery and payment as well as on the formulation of specifications and the assessment of offers and tenders. When specific requests are made through the appropriate national authorities, UNIDO can provide experts for on-the-spot advice.

An inquiry from Turkey is typical of many of those answered. The request was for names of companies and of types of cutter machinery which can make rolls of cellophane 2, 4.2 and 6 millimetres wide for use as opener stripes on cigarette packs. The Advisory Service sent the request to four of the organizations which act as correspondents to the Service and was able to supply the inquirer with more than a dozen companies which supply the major types of the machinery desired.

In another typical query, an entrepreneur in Kenya asked for more detailed information, namely companies producing machinery for the manufacture of cork sheeting and their prices, quality and terms of payment. He also wished to receive information on sources of raw material. Following its usual procedure the Advisory Service forwarded the query to correspondents in several countries and the inquirer has received the facts he requested.

Those who require information relating to the purchase of industrial equipment should prepare a brief but thorough statement of their needs and send it to:

Advisory Service for the Supply of Industrial Equipment
Industrial Information Service
United Nations Industrial Development Organization
P. O. Box 707
A-1011 Vienna
Austria.

D02318

Trends in R & D of Electrical Measuring Instruments in Developing Countries

By R. M. Rowell

THE MANUFACTURE AND CALIBRATION of electrical measuring instruments constitute a somewhat specialized field. There is at present very limited training in this field in colleges and universities and little expertise outside the areas of major production.

In spite of these facts the instrument industry has grown in developing countries almost as a necessity and many small manufacturing units have started in business. This has been done largely by attempting to copy foreign designs with some local improvisation. As one might expect, the general quality has been inferior and stability as well as accuracy under adverse environmental conditions have suffered because of the lack of experience and knowledge of fundamental design.

Approaches to the problem

One of the first and most obvious approaches to the problem was collaboration with foreign instrument manufacturers. These manufacturers have furnished designs, drawings, special tools and information on manufacturing techniques.

A prevailing spirit of nationalism and a growing desire for independence of foreign sources in many cases has resulted in the severing of these foreign ties. This has led to some innovation to permit the use of indigenous components and materials available locally. It is during this step that the greatest problems have arisen, usually because of incomplete knowledge and design experience; thus progress has been slow and somewhat unsteady.

Advisory assistance by international organizations can provide help for these manufacturers. UNIDO is such an agency, and it is now, in co-operation with the Government of India, setting up a Design Centre for Electrical Measuring Instruments in Bombay as there is a concentration of instrument manufacturers in that area. This Centre will provide design assistance, consultation, prototype work, laboratory facilities, tool facilities and personnel training in the instrument field. Fellowships are being provided for training with manufacturers abroad. One of the objectives of the Centre will be to evolve new instrument designs, and for this effort an observation and study of trends is essential.

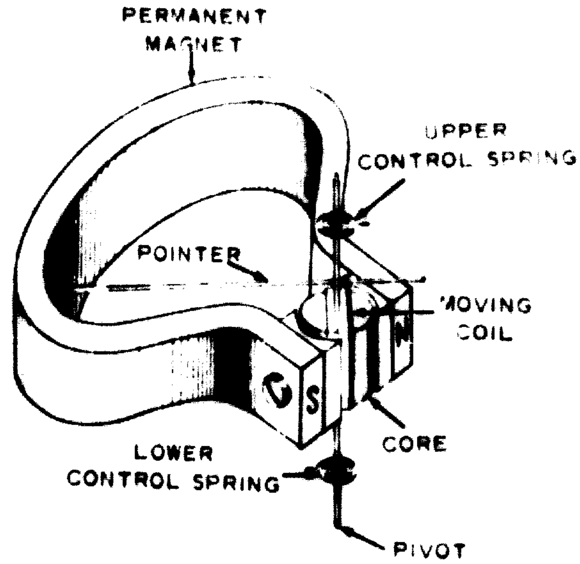
Present trends

Some lapse of time is inevitable in adopting foreign trends in the instrument industry. Some of these foreign trends, however, have found acceptance and use sooner than might be expected. A few of these are noted below.

The use of high coercive permanent magnet materials. The heart of all Direct Current (DC) indicating and recording instruments (and some Alternating Current (AC) instruments as well) is the permanent magnet. Design of these magnets has undergone radical changes in the last decade or so. One rarely sees the long so-called horseshoe magnets in modern instruments. They have been replaced by smaller, more compact designs of the high coercive magnet alloys such as ALNICO V, often with a gain in torque-producing effectiveness. Not only are they in use in such places as India, but facilities have been set up for producing the magnets locally. Local availability tends to result in

The Author: *The holder of 24 patents in the United States, R. M. Rowell worked in design engineering at the General Electric Company's Instrument Department, Lynn, Massachusetts for 40 years. He recently served as the UNIDO Chief Adviser to the Institute for Design of Electrical Measuring Instruments, Bombay. A Fellow of the Institute of Electrical and Electronic Engineering (IEEE), he has served as Chairman of the Standards Association Committee on Electrical Instrument Standards, USA, and has been a member of several IEEE National Committees.*

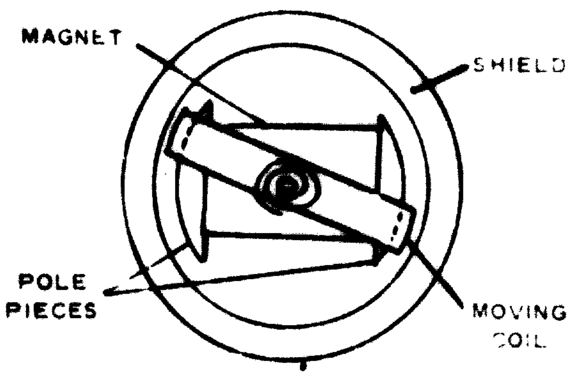
Sketch of permanent-magnet moving-coil instrument with external "horseshoe" magnet



restricted import licences by the government, thus tending to force the use of the new local materials.

The use of internal magnets. In conventional Direct Current instrument design for over 50 years, the permanent magnet was mounted outside the moving coil. This was necessary because of the long magnets required with the original magnet steels. With the new magnet materials now in

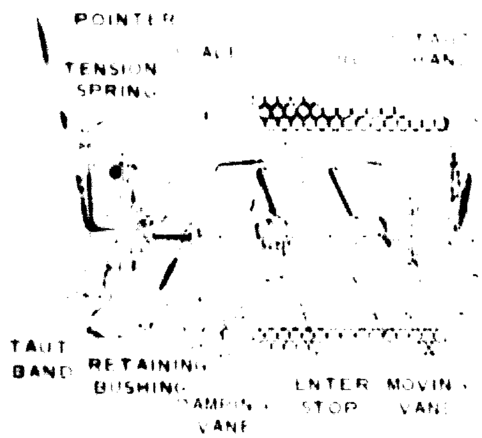
Internal or core magnet



use it is possible to mount the magnet inside the coil with considerable saving in weight and space. This trend is also becoming apparent, particularly with the larger manufacturers. With smaller manufacturers there have been problems of control of magnet flux density, scale distribution and the like. These can be overcome with experience and it is predicted that the internal or core magnet will become the world-wide standard for instruments having a scale range not over 100 degrees.

The use of taut-band suspension. Jewel and pivot bearings are being replaced rapidly in the Western countries and Japan by the more modern taut-band suspension. It has many obvious advantages, notably the elimination of bearing friction (with almost absolute repeatability), the reduction of power losses in the instruments, the elimination of pivot wear and corrosion, and the absence of spiral

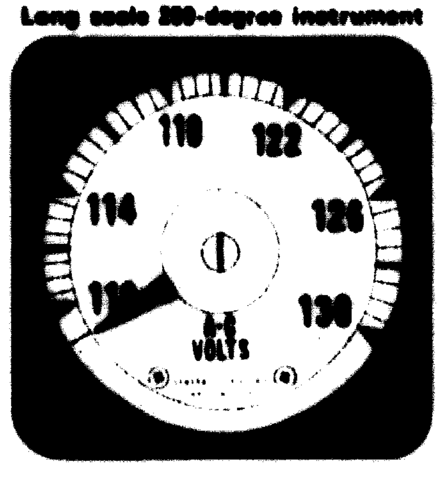
Instrument with taut-band suspension



control springs. The adoption of this new design has been noted in a few instances in India, but as yet it is not widespread. It involves some rather drastic changes in design and often problems are encountered which are difficult to overcome. Here is another instance where international experts can assist manufacturers. Some American manufacturers have changed to the taut-band suspension on all of their instruments, and the system seems destined to find world-wide acceptance.

The use of long-scale (250 degree) instruments. In 1938, the author designed the first complete line of long-scale (wide-angle) instruments. Instrument manufacturers all over the world have since realized the advantages of providing a long readable scale with small panel space requirements. They are being used to only a limited extent in developing countries because of the development expense involved in a radical change of design. One can foresee a more general acceptance of this trend as manufacturers increase in sophistication and in design facilities.

Long scale 250-degree instrument



Long-range trends

Some of the trends in developing countries have been noted. But what about the other trends that are taking place slowly, but surely, in the industry? Some of these are discussed below.

Increased use of electronic components. Transistors, diodes, amplifiers and other components are being used inside instruments in increasing numbers. One can predict with confidence that as the electronic industry grows in developing countries, these electronic components will be used widely in instrument design. They make possible scale ranges and areas of measurement previously considered out of the scope of indicating instruments.

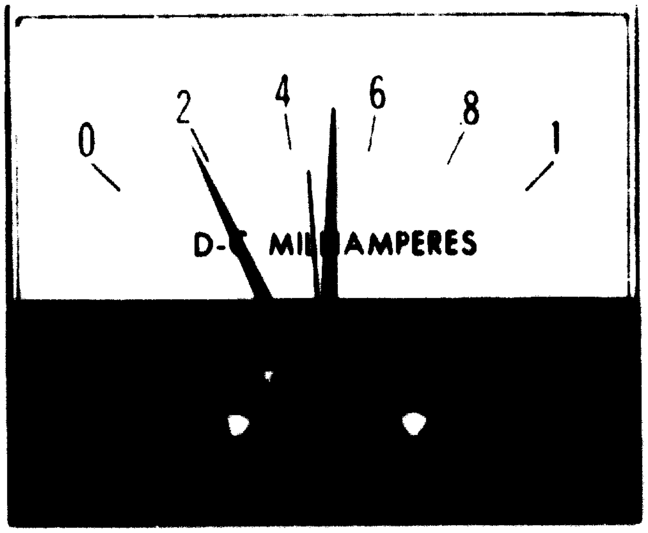
Trends to converters or transducers for AC measurements. A very marked trend has been observed in the United States and some other countries towards the use of converters or so-called transducers for the measurement of the more difficult AC quantities, such as watts, vars, frequency and power factor. This is a natural outgrowth of the use of electronic components. While this trend has not been observed in developing countries, it has distinctive advantages for them. Mechanisms for the measurement of power, power factor and frequency are expensive to design and build and, paradoxically, those costing the most to develop are the ones having the smallest production. Thus, if a manufacturer can build only permanent-magnet moving-coil DC instruments and equip them, either internally or externally, with converters to measure watts and other quantities, he will have saved considerable development expense, particularly in tooling.

Trends to digital instruments. The advantages of a digital presentation, where one reads the numerals directly, are well known. Errors in reading are practically eliminated and measurements of high accuracy are possible. It is doubtful, however, if these will ever replace completely the analog instruments, where one reads pointer positions on a scale. The latter are much less expensive and are often used in power plant or industry control simply by observing pointer position (when once a nominal value has been determined) without taking any numerical readings. It is also a fact that in emergency conditions where readings may be fluctuating wildly, digital presentation will result in a meaningless jumble of numbers. Digital instruments, however, are widely used for steady-state readings, such as voltage and frequency, which normally experience small and slow variations. It is in these areas particularly that the use of digital instruments will grow. Development, however, is relatively expensive and considerable capital expense is necessary for a complete development.

The use of contact-making instruments (instrument relays). Many instrument manufacturers, especially in the United States, are equipping switchboard and panel-type instruments with contact devices for use as instrument relays for alarm signal or control initiation. They may make either direct electrical contact by means of the pointer or direct contact by light beam or electronic means. Their use has not been apparent in India, but the growth of automatic control will necessitate the availability of these devices.

Increased use of automatic calibration consoles. One notable deficiency in developing countries is the lack of facilities for determining the absolute accuracy of testing instruments by comparing them with basic primary standards. Very few laboratories are available with such facilities. The equipment is expensive and can be handled properly only by experts. However, the need for such periodic comparisons may be obviated to a large extent by automatic calibration consoles, which deliver a predetermined value of an electrical quantity to the instrument under test with high accuracy. These consoles can be used in place of the large laboratory standard instruments and make the use of basic primary standards unnecessary. They are also expensive, however, and their adoption will be slow.

Instrument relay with maximum and minimum contacts



Implementation

For many of the trends listed above, realization will be a slow gradual process, but their advantages cannot be ignored. These are areas where the developing countries need design assistance. Since mechanical design and structure depart considerably from previous conventional practice, aid in providing special tools will be important also.

Some manufacturers, particularly those having personnel of high technical competence and those having capital to invest in development, may take a great leap forward and by-pass the slow experience of decades. To these the latest trends will be a notable challenge.

What will bring fulfillment of these trends and objectives? Four things are needed:

- Technical assistance from international organizations like UNIDO;
- Improved technical education, particularly in the field of instrumentation;
- Increased knowledge and experience in the field of electronics;
- The development of expertise in indigenous personnel as the result of training and experience in instrument design and manufacture.

It is only a question of time for these suggested measures to be implemented. The sooner this occurs, the sooner will developing countries benefit.

This article was prepared by the West Cameroon Development Agency.

Cameroon:

A Multi-purpose Agency

AT THE REQUEST OF the Governments of Nigeria and the United Kingdom, the International Bank for Reconstruction and Development organized a mission in 1954 to that part of the Federal Republic of Cameroon now known as West Cameroon, then called the Southern Cameroons, and administered as an integral part of Nigeria. The object of the mission was "to assess the resources available for future development, to study the possibilities for development in the major sectors of the economy and to make recommendations for practical steps to be taken, including the timing and co-ordination of developmental activities".

In its report, under the heading "Development Institutions", the mission recommended the establishment of a separate development agency for the Southern Cameroons to be financed by a grant of £1 million from the Federal Government of Nigeria. The mission also suggested an organizational structure for such a development agency.

Two years later, following constitutional changes in the Federation of Nigeria, the Southern Cameroons Parliament passed a law creating the Development Agency. Further constitutional changes took place and the Southern Cameroons finally seceded from Nigeria and re-unified with the Cameroon Republic to form what is today known as the Federal Republic of Cameroon. The Southern Cameroons became West Cameroon and the Southern Cameroons Development Agency has since become the West Cameroon Development Agency, a corporation set up by statute by the West Cameroon Government.

Work of the Agency

The work of the Agency is to:

- Promote prosperity of producers or areas of production;
- Invest in agricultural, industrial and commercial projects in West Cameroon;
- Encourage agricultural and industrial development, including the promotion of co-operative activities and the provision of technical and managerial advice to entrepreneurs in the country;
- Train citizens of West Cameroon to carry out the schemes proposed by the Agency;
- Make a preliminary investigation of schemes within the provisions of the above.

The Agency plans and finances such projects out of its own or borrowed funds. It promotes, assists or finances development schemes by:

- Financing the implementation of any of the objects of the scheme;
- Making loans or grants;
- Entering into contracts providing for the active participation of the Agency and the Government of West Cameroon or any other body in any project that may be initiated or controlled by the Agency or by the Government and which, in the opinion of the Agency, is likely to aid all or any of the purposes mentioned;
- Investing in schemes approved by the Government of West Cameroon as suitable for investment;

● Providing technical, advisory or managerial advice and assistance and, where appropriate, plant or machinery.

Projects

The West Cameroon Development Agency has contributed to the economic development of the country in various ways. A brief description of its achievements follows.

● *The Cameroon Bank Limited.* Incorporated by the Agency in 1961 with a capital of £120,000, this bank is wholly Cameroonian. Until 1965 it had private interests, but since then the private interests have been bought out and the Bank is now owned by four West Cameroon government institutions. The present share capital of the Bank is 305,000 shares of 1,000 francs CFA[1], each fully paid. Of this, the West Cameroon Development Agency alone holds 144,000 shares of 1,000 francs CFA fully paid, i.e. 47 per cent of the share capital. Although floated as a deposit bank, it subsequently performed the functions of a development bank, granting long-term loans. This placed the Bank in severe financial difficulties. The West Cameroon Government has, therefore, assumed the position of a managing agent with the power of appointing directors and is seeking to put the Bank on a sounder footing. In order to improve the Bank's liquidity, it is necessary for a financial institution, either domestic or foreign, to take over the sound long-term loans and make immediate cash available to the Bank. The Bank has a staff of more than 200.

● *Cameroon Air Transport Limited.* This was floated by the Agency in 1962. Its authorized share capital is 30 million francs CFA divided into 30,000 shares or 1,000 francs CFA each. The issued capital fully paid up is 17,342,000 francs CFA divided into 17,342 shares of 1,000 francs CFA each. The paid up capital is distributed as follows:

	francs CFA
West Cameroon Development Agency	10,446,000
Crop Culture (Aerial) Ltd. (a British Company)	3,460,000
Private Individual Cameroonians	3,436,000

The Company owns four aircraft (two Doves, one Aztec and a DC 3) which earn an average of 54 million francs CFA per year. The main problem of the Company is finding experienced managerial staff. Additional capital would also be welcome.

[1] US $ 1.00 = 246.85 francs CFA (Communauté Financière Africaine).

● *United Cameroon Trading Company Limited.* This company was founded by the Agency in 1963 with an authorized share capital of 40 million francs CFA divided into 40,000 shares of 1,000 francs CFA each. The issued and fully paid capital is 31.5 million francs CFA of which the West Cameroon Development Agency holds 29.5 million francs CFA. There are no foreign interests. The Company is organized into two departments, one for import vehicles and the other for general goods. It employs more than 50 people.

● *A sawmill project.* Run directly by the Agency at Njoke, the enterprise deals in sawn timber for local purposes and also manufactures wood panels, flower vases and bowls. With a direct investment of 10 million francs CFA, the project is very profitable, having an annual turnover of 14 million francs CFA. It has more than 60 employees.

● *The Santa Coffee Estate.* This is a coffee plantation with a cultivated area of 555 acres run by the Agency in the grassland zone of West Cameroon. It exports its raw coffee through the West Cameroon Marketing Board and, through the Board, purchases raw coffee from farmers. Last year it purchased 103 million francs CFA of such coffee for the Marketing Board. Besides dealing in raw coffee, it has a canning department where it roasts, grinds and cans coffee for both the local and the export market. Although essentially a coffee plantation, the Estate also runs a poultry farm and raises cattle which it slaughters weekly for local distribution in refrigerated vans. This project employs over 500 people and is worth 186 million francs CFA.

● *A loan scheme.* The Agency grants loans for agricultural, commercial and industrial purposes to both individuals and groups. On 30 June 1967, the Agency funds tied up in this scheme stood at over 200 million francs CFA. The scheme has not been a complete success because several borrowers failed to repay loans and the projects for which most of the loans were granted had not been assessed with sufficient care, a frequent occurrence with such schemes in developing countries.

Though the West Cameroon Development Agency came into being as a result of a recommendation of the mission organized by the International Bank for Reconstruction and Development at the request of the Governments of Nigeria and the United Kingdom, not all the recommendations of the mission concerning the organization of the Agency were carried out. The result is that the Agency has not always been able to fulfil its functions properly.

The present Government is understood to be taking steps to re-organize and define the functions of the West Cameroon Development Agency so that it may serve the region more effectively.

Research Projects

Shelling the Cashew-nut on an Industrial Scale

Two main products are derived from the tropical cashew-nut: the kernel (accounting for about 24 per cent of a good-quality nut), which is used for food, and the shell liquid, which is used industrially only (about 7 per cent on the first extraction and about 13 per cent on the second extraction, giving a total of about 20 per cent of the original weight of the nut). Less important by-products, such as tannin, can also be obtained from the cashew-nut.

In several countries relatively little or none of the cashew-nut crop is shelled because of the difficulties of the operation and because no suitable machinery has been available. Thus a large part of the harvest has been lost. The same difficulties have prevented the spread of cashew-nut cultivation in sub-tropical countries where climatic conditions are excellently suited to the growth of the tree.

The shelling of the cashew-nut on an industrial scale is highly complex because, in order to extract the kernel, one must first extract the shell liquid, which contains cardol and phenol, taking care that this liquid does not wet the kernel in the least and thus contaminate it.

An Italian manufacturer has developed a cashew-nut processing plant which has been functioning for more than four years on an industrial scale. The company has been operating since 1962 a pilot installation with a daily capacity of five tons and providing facilities for the training of technicians to direct the new industries which have been or are being established in Africa. It is engaged in the manufacture and initial erection of installations with capacities of 3, 6, 9, 12 and 15 thousand tons and is preparing complete economic and financial plans as a guide for the establishment of enterprises to operate the installations it supplies.

The research programme aimed at improving the utilization of the by-products is continuing.

For most cashew-nut producers, the problem of mechanizing the shelling of the cashew-nut was formerly limited and usually still is to that of developing a miracle machine which would open the shell without damaging the kernel.

Experience has shown, however, that the complete operation requires ten stages, namely: (1) cleaning of the raw material and initial sorting by size; (2) moistening of the nuts; (3) roasting, centrifuging and cooling; (4) sorting into eight sizes; (5) opening of the shells; (6) separation of the kernels from the shells; (7) drying; (8) cleaning; (9) sorting and grading by size of the kernels; and (10) canning.

In the new installations, stages 1, 2, 3, 4, 6 and 7 are entirely mechanized; stages 5 and 10 are mechanized with a very limited use of manual labour; for 20 per cent of stages 8 and 9, the operation must be manual.

For any country interested, the manufacturer can carry out a preliminary technical, economic and financial study on the possibilities of establishing a new industry for the production and processing of cashew-nuts, and on its profitability and foreign currency earning potential. In addition to plant, the company provides technical assistance to local personnel so that it will be in a position to operate the plant.

The above information is based on material provided by CEDIMOM, which has consultative status with UNIDO. For further information write to Oltramare, S. P. Q., Bologna, Italy.

Substitute Fibres for Asbestos

The Research Institute of Building Materials, Brno, Czechoslovakia, has developed a fibre known as A-fibre which is capable of replacing 15 – 20 per cent of the asbestos in asbestos cement products. Substitution is made possible by the fact that the A-fibre has a specially good resistance in a cement medium and the mechanical properties required in asbestos cement production. The basic materials for its manufacture are to be found in most countries. A-fibre is produced using ordinary installations for the manufacture of mineral wool. The degree of mechanization and consequently the costs involved during the production process can be adjusted to a certain extent (mainly in regard to handling of raw materials and the finished product), depending on the particular cost relationships in the producing country. The price of the additional plant will not usually exceed 15 per cent of the price of the production line. The price of the A-fibre may vary according to the specific conditions in the producing country. In no case, however, will the production costs for A-fibre exceed twice the production costs for normal mineral wool. This means that the price of A-fibre will not be more than 50 per cent of the price of the average asbestos mixture imported. The economic contribution, therefore, consists in the saving in foreign exchange for countries which import asbestos, in addition to the saving in the cost of the raw material.

A-fibre can be used in the production of asbestos cement coverings, lining plates and non-pressure tubes. Its use in the production of pressure tubes has not yet been tried. It will probably not be possible to use A-fibre when the product is to be subjected to the autoclave process.

Partial asbestos replacement by A-fibre does not call for any changes in the technological installations for the production of asbestos cement. The addition of A-fibre does not give rise to any difficulties in the technological process. In fact, the rate of production will usually improve. The quality of products with 15–20 per cent replacement of asbestos by A-fibre meets the standards for asbestos cement goods. Thus these products can be used everywhere in the place of conventional asbestos cement.

Enlargement showing the artificial roughening of the surface, or A-fibre, resulting in improved cohesion between the fibre and the cementary stove

It is possible to establish a plant for the manufacture of A-fibre or to adapt an existing plant producing mineral wool whenever one can assume an annual output of at least 3,000 tons of A-fibre i.e., where at least 15,000 m² of asbestos cement can be produced annually. With a smaller output, the plant must be planned so that it can produce either A-fibre or mineral wool for insulating purposes. The best location for the plant is in the centre of the region in which the product is expected to be sold. Taking into account the weight of A-fibre per unit volume (120–140 kg/m³), it is preferable to transport the raw materials rather than the finished product. In the developing countries, a single A-fibre plant could supply the smaller consumers of several countries. The weight per unit volume of A-fibre would naturally make its transport overseas more expensive.

Basalt fibre after immersion for fifteen months in a corrosive solution. A thin layer resulting from the reaction of the fibre to the solution can be distinguished

It is probable that the Institute will continue to work in this field and seek to bring about a higher degree of replacement, perhaps up to 50 per cent A-fibre. But such products will probably already have certain technical parameters differing from those of conventional asbestos cement. For example, when they are used in regions with very harsh climates, it will be necessary to provide for cheap and effective surface protection for finished products. In Czechoslovakia this problem is already being studied. An important advantage of these products would be their low price. The high percentage of replacement of asbestos would also help to solve the problem of silicosis, a disease to which workers in the asbestos cement industry are liable. These questions, however, will be the subject of future studies.

A-fibre, saturated in a solution of $Ca(OH)_2$ for fifteen months, shows no sign of corrosion

Do2319

This article has been prepared by two UNIDO experts

Leather Industries in Developing Countries

RECENT REQUESTS from developing countries to UNIDO for more active participation in the field of leather and leather manufacturing industries coincides with the tanning industry's recovery from what may be called the Corfam-shock. This refers to the threat to leather by the appearance of a synthetic polymer, Corfam, as an alternative material to upper shoe leather. Corfam is manufactured by the Du Pont Company, the same concern that invented and developed the synthetic textile fibre, nylon, twenty-eight years ago. Nylon is the first of a series of man-made fibres introduced into the traditional field of natural materials, such as cotton, wool and silk. Today both types of material co-exist being complementary to each other, and are absorbed by an ever growing demand for consumer goods.

Leather has always been a symbol of durability and strength, pleasant and comfortable to wear, regardless of climatic conditions. It is known by its grain, which is characteristically different for each kind of animal skin, by its intimate warmth and feel, and has been familiar to man since the beginning of human history. The footwear industry is the main consumer of leather and in his *Textbook of Footwear Manufacture*, Mr. J. H. Thorston says "The value of leather is that it possesses more useful properties than any other material yet discovered, owing to its unique fibrous structure which is impossible to reproduce artificially. It has achieved and maintained its pre-eminent position through the centuries on sheer merit and modern research has confirmed and explained what the craftsman and his customer have discovered by trial and error during these years".

The only raw material from which leather can be produced is animal skin and, in turn, there is no other use for this raw stock except that of being converted into leather.

Hides and skins are by-products of meat production, the quantity of raw stock depending only on the demand for meat and not on the demand for leather. There has, however, hardly ever been any over-production of hides and skins; in fact, the demand has outweighed supply. At present, raw hide and skin consumption in industrialized countries is increasing, as is evidenced by the latest report on the hides, skins and footwear industry of the Organisation for Economic Co-operation and Development (OECD). This shows that cattle hide production in its 21 member states had increased by 30 per cent during the period 1954–1963. Production of all three types of hides and skins, that is cattle hides, calf skins, sheep and goat skins, increased more rapidly during the period 1958–1963 than in the preceding four years, as a result of a sharp increase in the consumption of meat. While sole leather production declined to almost half its 1954 output, upper leather production rose by 50 per cent, sheep and goat leather by 30 per cent, and leather footwear generally by 20 per cent in the period 1954–1958 and from 1958–1963 by another 35 per cent. In the United States, which has the largest *per capita* consumption of leather footwear (3.5 pairs *per annum*), production in the last four years has remained at about this figure and the increase since 1954 has amounted only to 10 per cent. Owing to increased world consumption, a number of raw stock countries, such as Argentina, have taken restrictive measures against the export of hides and skins, in order to protect their own tanning industry.

The world's livestock population, according to a census in 1963, amounted to 1,078 million head of cattle and buffalo, 970 million sheep and 310 million goats. The annual increase amounts to about 2 per cent. (Stather: *Gerbereichemie und Gerberei Technologie*, 1967, page 55, and Freudenberg: *Häute und Fellmärkte der Welt*, 1955.)

The remarkable growth in world cattle hide supply in recent years is stressed in a report by the United States Department of Agriculture. By 1966, the world production of cattle hides was estimated to have reached 191 million with a further rise in 1967 and an expected rise again in 1968. By adding an estimated 9 million buffalo hides, the total annual cattle hide production may reach 200 million, or expressed in wet-salted weight, about 3.6 million tons, valued at an average price of US$0.30 per kg making $1,080 million. Estimated annual production of sheep skins is about 400 million, valued at $500 million; goat skins about 130 million, valued at $160 million. Thus, the value of annual supply of hides and skins in the world is about $1,740 million. This is more than twice the value of the annual production of natural rubber, estimated at 2.4 million tons. Since the population grows faster than the numbers of livestock and standards of living are rising, it can be expected that there will be ample space for the increased production of both leather and alternative materials to fill the gap between future demand and supply.

Hide and skin approach to leather development

At the meeting of the Economic Commission for Asia and the Far East (ECAFE) in Madras, India, in June 1957, the slogan that emerged "The production of leather and the manufacturing of leather products starts on the grazing grounds and ends on the wearers' feet" pointed to the necessity of an integrated approach from the raw hides and skins stage to leather manufacturing. The meeting drew the attention of participants to the fact that the crucial prerequisites to the development of leather and its manufactures lies in the mobilization of all recorded and latent best quality raw stock sources by applying up-to-date flaying and preservation methods; only when this has been achieved can the establishment of manufacturing units be justified. The best results can be obtained when tanneries can be supplied with indigenous quality raw stock. Developing countries are in the fortunate position of having an abundance of livestock and hides and skins represent an important part of a country's wealth; the procurement of the best quality, therefore, should be a national concern. For instance, the American authorities have placed raw hides and skins seventh on the list of essential strategical raw materials. Most industrialized countries, except the United States, are short of cattle hides, all are short of goat and sheep skins, including the United States. Industrialized countries have insured the production of high quality hides and skins by eliminating flaying cuts and applying proper methods of preservation. They have established an efficient line of supply from the abattoirs to the tanneries through direct sales or through the intermediary of butchers' agents and collecting dealers, or by public auction sales organized by agents of the producers.

There is a considerable amount of information regarding hides and skins that can easily be made available to developing countries. For example, a publication of the Food and Agriculture Organization of the United Nations (FAO): *Flaying and Curing of Hides and Skins as a Rural Industry*, FAO Agricultural Development Paper No. 49, published in 1955, contains practical suggestions from the animal slaughter to the grading and marketing of hides and skins. The US Foreign Agricultural Service of the Department of Agriculture issues periodically valuable instruction pamphlets to encourage developing countries to adopt proper techniques and methods.

In most cases, abattoirs do not employ qualified butchers. Slaughter and flaying are carried out by casual labour brought into the abattoirs by the owners of livestock. Even newly-built abattoirs are seldom provided with flaying machines, which would eliminate flaying cuts and even where such machines exist, they are seldom used.

India's tanning industry

India's booming tanning industry is an example of a successful hide and skin approach to leather development by the concentrated efforts of the Government, research institutes, tanneries and hide dealers. The Government has been establishing an increasing number of carcass utilization centres throughout the country, where animals that have died from natural causes are properly flayed under the supervision of hide experts, and meat and bones are converted into fertilizer, animal feed, industrial fats and a number of other products. In view of the size of India, this success could only be achieved through the support given by the population to the institutions concerned. India has the largest cattle population amounting to about 200 million heads including buffalos, about 45 million sheep and 50 million goats. From this stock 25 million hides, about 90 per cent of which are obtained in carcass utilization centres and only 10 per cent in slaughterhouses, 40 million goat and 20 million sheep skins, are produced annually. Most of this raw stock is processed in hundreds of Indian tanneries into semi-finished leather and exported to industrialized countries for finishing into high quality goods. By this means India's tanning industry earns about 400 million Rs. of foreign exchange, or about $50 million, annually.

Small hide centres in Malaysia

It seems that rural butchers are more receptive to improvements than abattoirs. For instance, the Malaysian Government, through its development institution MARA, has been successful in operating small hide centres in the northern districts of the country by supplying free assistance in the flaying and preservation of hides and skins to rural butchers through the provision of a flaying expert from India. During four years of operation, these centres have produced properly flayed and preserved cattle and buffalo hides that are considered by local tanners to be the best quality hides in Malaysia. The present demand for MARA hides far outweighs the supply.

"Hides and skins improvement schemes may be operated through a general organization or through a private organization directed and controlled by the government", as recommended in the FAO publication, *Flaying and Curing of Hides and Skins as a Rural Industry* (page 121). "The flayer plays the most important role in this scheme, special attention, therefore, must be directed towards his education. Experience has shown that once flayers have been taught the correct methods, have been supplied with proper knives and are given better working conditions and higher pay, they are quick to make the best use of the opportunities presented." In villages, the formation of co-operatives, which may also undertake preservation, grading and marketing, is desirable. The establishment of such co-operatives should be fostered by governments. In abattoirs, pilot projects for the improvement of flaying should be established under the supervision and financial support of the government, until the amount of the financial outlay has been recovered from the hide dealers. The hide dealers will be certainly prepared to allocate cash bonus funds to abattoirs if they receive undamaged hides and skins. As far as preservation is concerned, hide dealers should be taught to apply safer and more economic methods through demonstrations carried out by government experts. There are methods today by which wet-salting can be carried out in 24 hours, instead of in four or more weeks. This will reduce tied-up capital and increase turnover.

Integrating primary production with secondary manufacturing

In developing countries with a prosperous economy, handicraft shoe and leather goods manufacturing has preceded the establishment of tanning industries. Hongkong and the Lebanon have a flourishing leather manufacturing industry, but no local tanneries. Singapore with a modern footwear industry (the Bata Shoe Company) and a large number of small shoemakers, established its first leather factory in 1966. In such countries finished leather has been imported through a few specialized agents from abroad; when local tanneries were established they encountered difficulties in selling their leather, since both shoemakers and the shoe industry preferred to be supplied with imported leather.

Meanwhile production costs were increasing, since the raw hide is the highest cost of any single item, amounting to more than 50 per cent of the manufacturing cost of leather. The shoemakers, however, remained suspicious and continued to import leather. The only winners in this struggle are the hide dealers. They have always preferred to export their raw stock to industrialized countries. Hides and skins are always in demand and even with flaying cuts and other defects they may find customers in Europe, at corresponding prices. The foreign buyer pays through letters of credit, while local tanners are lacking cash and require credit terms. Tanners in industrialized countries know what they buy and can also process lower grade raw stock into quality leather.

Leather is not the only factor determining footwear quality. If the tannage and finishing is adequate, small mechanical defects such as holes and cuts reduce only the usable substance or cutting value, which is a matter of calculation. From the unblemished parts first-class footwear can be produced, provided proper design and appropriate manufacturing techniques are applied with particular emphasis on foot comfort. One of the secrets of footwear and leather goods designing is the ability to utilize every part of the surface of the leather according to the specific requirements of the operations involved in the manufacture.

Assuming that labour, market and capital are available, the integration of primary production with secondary manufacturing would have the following advantages:

- Synchronization of leather production with the programme of footwear manufacturing regarding quantity, quality and assortment;
- Flexibility in supplying the footwear unit with new types and designs of leather to meet fashion trends;
- Utilization of local raw hides and skins, with defects such as cuts, holes, scratches, but otherwise not impairing the quality of the leather;
- Utilization of off-cuts in the manufacturing of the leather products;
- Drastic reduction of tied capital requirements and increase of turnover;
- Supplying leather to the secondary manufacturing plant at manufacturing cost, thus accumulating profit on the final products.

Such a project would not endanger the livelihood of the small shoemaker. The project could, in fact, supply the handicraft industry with cut sole upper and lining leather, take over its production and put it on sale as a handicraft assortment, complementary to factory produced footwear and leather goods. Such co-operation would benefit the handicraft sector by supplying tailored material more cheaply, and increasing productivity and income.

Economic unit, layout and cost

An annual output of 300,000 pairs of leather footwear (1,000 pairs a day), supported by a tannery capacity of 750 tons (2.50 kg for one pair of shoes) wet-salted hides and skins processed into a wide variety of sole upper and lining leather is considered an economic unit, justifying modern equipment. An additional tannery output of 50 tons of hides and skins processed into 100,000 sq. feet of various types of leather can meet requirements of leather goods production included in the project.

On a land area of three acres or 12,000 m^2 a 50 m 125 m (6,250 m^2) ground-floor factory building will provide for the tannery unit (2,000 m^2), the footwear unit (2,000 m^2), the leather goods unit (750 m^2) and for storage of raw materials and finished products (1,500 m^2). The rest of the area will be occupied by ancillary facilities like boiler house, electricity supply, office, laboratory, car park and other premises. The project may consume about 30,000 gallons of industrial water (about 135 m^3) a day and require the installation of 500 kilovoltampere electric energy.

The footwear unit is expected to produce five pairs per worker per day, with a labour force of 200 workers. The tannery, owing to its diversified production programme, would employ about 100 workers and the leather products unit about 50 workers, making a total of 350 workers.

As far as methods of footwear production are concerned, the cemented process seems the most suitable, but the McKay-sewn and the direct moulded process, may be also considered.

Equipment would cost about $150,000 for the tannery and the same amount for the units for footwear and leather goods, including auxiliary and laboratory equipment and installation cost, making a total of $300,000.

The project could be divided into two stages. The pilot plant for the training of a nucleus of workers and technicians, in an improvised building of about 10,000 sq. feet equipped with several key machines and after a year's training the staff and equipment could be integrated into an industrial project. The improvised pilot plant building could be part of the project and could be used later for the storage of raw materials. Such a two-phased project development proved successful in the establishment of General Leather Ltd., in Singapore.

Teaching through production

Extension services organized by industrial inspectorates in developing countries, mostly through desk-type advisory services, have little appeal to producers. They will accept innovation only after they have seen and tested the product that has been processed by the improved techniques, and are convinced of its higher quality, lower manufacturing cost and better saleability. To persuade an industry to accept new processes, the product must be shown first and if it stands the quality and saleability tests, the industry will readily ask for the expertise of the process. Through the establishment of such teaching factory units know-how could be brought into leather and leather manufacturing units in developing countries.

An example of such an endeavour is the famous Leather School in Florence, Italy, that teaches leathercraft including the manufacture of handbags and briefcases, the processes of tooling, modelling, moulding, embossing, gold printing of leather and the production of a large variety of leather goods for the tourist trade in a self-supporting commercial enterprise. The school employs only a few instructors and technicians, the bulk of its labour force being made up of about 50 students attending one of the training courses.

The dissemination of technical know-how to the tanning, footwear and handicraft industries by means of well-equipped teaching factories where workers and technicians could be trained under industrial conditions, could provide a permanent supply of skilled workers and industrial managers to the trade.

Answers to Industrial Inquiries

Processing of sheepskins, lambskins and wool

The UNIDO Industrial Inquiry Service receives requests from developing countries for possible solutions to a wide variety of industrial problems. In order to give readers an idea of the range of the topics covered, each issue of the Industrial Research and Development News *publishes a selected list of questions recently received by the Service, in addition to an answer to a specific inquiry.*

Readers are invited to write to the Industrial Inquiry Service for further information on answers to any of the questions published below, quoting the reference number, or to submit inquiries on similar or other industrial problems.

Information has been requested on the following:

Mechanization and expansion of copper plants in order to improve the copper work in a smelting section (513)
A factory in Turkey

Material on a project for the establishment of a food canning plant for producing jam, quince, guava (526)
An association of consultants in Peru

Austrian, German and Swiss machine tool and diesel engine (20 to 500 HP rating) manufacturers (528)
An industrial adviser in Indonesia

How to plan, organize and co-ordinate the setting up of a new factory and offices mainly for glass processing and mirror manufacture on existing site; technical collaboration and assistance in modern production methods and in compounding existing skills and know-how (533)
A company in Malta

International market prices for various qualities of cotton textiles; the sources of information to approach directly (537)
A bank in Turkey

New ways of desiccation of onion, garlic and leek; suppliers of machines and equipment for such a process; estimated cost of desiccation unit for processing 3,000–5,000 tons per year of raw material (546)
An inquirer from Iraq

The addresses of factories producing machinery for the manufacture of spectacle frames from plastic material (560)
An inquirer from Guatemala

Fading of car/bus brakes; economical design of testing apparatus for such fading accompanied by diagrams, graphs and explanation (561)
An information and documentation centre in the United Arab Republic

Industrial organization, management in general, commercial management, marketing, financial management, operational research, handicrafts, textiles and leather (562)
An information centre in Algeria

An instrument for the measurement of the zeta potential of solids, such as aqueous suspensions of pulp and suspensions of fillers, with or without the addition of anionic and cationic substances (565)
A pulp and paper institute in Yugoslavia

Studies relating to the determination of optimum size of production unit in industrial sectors, e.g., leather and footwear, buildings, public works, wood and furnishings, methods used, criteria for determining unit, size (567)
An institute in Tunisia

Standards and patents of aluminium and aluminium-steel electrical conductors; fabrication of aluminium kitchen, house and office furniture, aluminium foil, screws, studs, nuts and pipes; aluminium extrusions presses and other machinery (568)
A scientific and technical research organization in Turkey

Technology recommended for the production of citric acid (a plant with a capacity of 1,500 tons per year) from sugar beet molasse (569)
A ministry in Syria

The use of dry ice in freezing in small trawler: how to keep the dry ice before use at sea; design of storage in trawler; other techniques or specification standards required (573)
A ministry in Thailand

Names of foreign institutions providing training in international trade and various scholarships and fellowships available (574)
An organization in India

The role of rural co-operative societies, usually based on the agricultural products and related industries and on handicrafts (575)
A rural co-operatives organization in Iran

Design of silos for storage of sugar; tender specifications for transport, air-conditioning and control equipment (581)
An organization in the United Arab Republic

Processing of skins

An inquirer from Cyprus asked for the names of books in English on the latest techniques for tanning lambskins and goatskins and on bleaching and dyeing techniques, as well as for information on chemical agents used in the tanning and bleaching of sheepskins and on methods of dying milky white lambskins, sheepskins and wool (520).

The Wool Industries Research Association (WIRA), Headingley Lane, Leeds, England, provided the following answer to the second part of his query.

We are assuming that your inquiry refers to tanned sheepskins with fleece intact. Before any further processing can be carried out, the skins require scouring with a soap/soda solution or detergent. Again we are assuming that milky white means as white as possible and suggest the following methods:

1. Treat for a minimum of one hour at 40°–45°C in 2 per cent solution of sodium bisulphite, adjusted to pH 7.
2. Treat for a minimum of one hour at 40°–45°C in a 1 per cent sodium bisulphate solution adjusted to pH 4 with formic acid.
3. Treat for 30–45 minutes at 40°–45°C in a solution of sodium hydrosulphite (3–4 per cent on the weight of wool) and acidify by treating in a bath containing 1 per cent of formic acid on the weight of wool, for 10–15 minutes.

Each method should be tried in order to determine which yields the most acceptable result. If milky white is meant to convey a whiter than natural colouring, the following method could also be tested:

The sheepskin should be steeped overnight in a bath of 2–3 volumes hydrogen peroxide adjusted to pH 9.5 using ammonia or sodium pyrophosphate, starting at about 40°C and allowing the bath to cool naturally. It is important that the holding vessel be wood or stainless steel.

After treatment by any of the above methods the skin must be thoroughly rinsed before drying.

If milky white means that in the natural condition the skins are too white and require a blue or creamy appearance, we suggest that the inquirer contact the technical services department of a reputable dyestuffs manufacturer.

For Your Information . . .

The following publications may be purchased from: United Nations sales distributors, through local book dealers, or directly from: Sales Section, Room 1059, United Nations, New York, N.Y. 10017, United States of America, or Distribution and Sales Section, Palais des Nations, CH-1211 Geneva 10, Switzerland. Prices are given in US dollars but payment may be made in other currencies.

The Establishment of the Brick and Tile Industry in Developing Countries,
122 pages (ID/15; Sales No.: E.69.II.B.19; $1.50).

This paper was prepared by H. W. H. West of the British Ceramic Research Association, as consultant for UNIDO, for the Interregional Seminar on the Development of Clay Building Materials Industries in Developing Countries, held in Copenhagen, Denmark in August 1968. The report of the Seminar, *The Development of Clay Building Materials in Developing Countries*, 50 pages (ID/28, Sales No.: E.69.II.B.18; $1.00) was reviewed in *IRDN*, Vol. IV, No. 1.

UNIDO also submitted this paper as a background document at the Workshop on Organizational and Technical Measures for the Development of Building Materials (Moscow, 25 September 19 October 1968).

In the introduction the author traces the development of the brick and tile industry, particularly in Europe and North America. He then discusses such major aspects of the industry as raw materials, winning and haulage of clays, clay preparation and product manufacture, drying, firing and productivity and efficiency.

The last chapter deals with the establishment of the heavy clay industry in developing countries. The author discusses three main points: requirements for building materials, prototype plants and provision of staff.

Factors Inhibiting the Indigenous Growth of the Fertilizer Industry in Developing Countries,
120 pages (Sales No.: E.69.II.B.21; $1.00).

This publication is the report on a meeting of an *ad hoc* group of experts from five fertilizer-deficit countries and consultants from five fertilizer-surplus countries which was held at the headquarters of UNIDO in Vienna from 6 to 10 May 1968. The meeting, organized by UNIDO, reviewed the factors inhibiting the indigenous growth of the fertilizer industry in developing countries.

This publication consists of two parts: Part I, the Group's report and recommendations; and Part II, the working papers presented at the meeting.

The recommendations concerned the lack of capital for the purchase of equipment and know-how, problems relating to raw materials, the inadequacy of infrastructure, the shortage of trained personnel, marketing inadequacies, internal policies, pricing policies and the cost of production, inadequate project planning and execution, and lack of effective regional co-operation.

Among the recommendations were:

- That developing countries explore fully the possibility of regional co-operation with regard to the assurance of a firm supply of phosphate to safeguard themselves against the time when lack of phosphate may become a limiting factor in crop production;
- That UNIDO, in co-operation with the developing countries, take steps to promote the training of personnel in fertilizer technology, plant maintenance, management and the marketing of fertilizers;
- That the local fertilizer industry in each developing country develop its own agronomic research units in order to assess independently the best cultural practices and product mix and promote their application;
- That the pricing policy of government bodies concerned with agricultural products in a developing country include an incentive to stimulate farmers to use more fertilizer, either a bonus for agricultural products or a subsidy for fertilizer.

Experts from the fertilizer-deficit countries of Brazil, India, Mexico, the Sudan and the United Arab Republic attended the meeting. Consultants from the fertilizer-surplus countries of Austria, the Federal Republic of Germany, Japan, the United Kingdom and the United States participated.

The working papers presented by the experts concerned the fertilizer industry in each of the developing countries represented and analyses of some of the factors affecting the growth of this industry throughout the world.

Planning for Advanced Skills and Technologies,
225 pages (ID/Ser.E/3; Sales No.: E.69.II.B.8; $3.50).

This publication contains studies presented at the *Ad Hoc* Meeting of Experts on the Role of Advanced Skills and Technologies in Industrial Development held in New York in May 1967.

The studies are presented in four sections. The first, *Technology and Skills*, presents the problem of the interrelationship between advanced technologies and skill requirements. The papers discuss questions of definition, measurement and classification of skills. The topics and authors are:

- Technology and Skill (John Vaizey);
- Classification and Analysis Based on Know-how and Skills (János Timar);
- Job Evaluation as a Source of Information about Skill Requirements (Lawrence B. Cohen).

The second part, *Choice of Technology and Other Theoretical Issues*, includes studies on: the problem of choice of techniques; a model of growth of a centrally planned economy with surplus labour under possible changing capital-output ratio; and models of optimal growth. The topics and authors are:

- Choice of Technology: A Critical Survey of a Class of Debates (A. K. Sen);
- Investment Criteria in Developing Countries (Kazimierz Laski);

● Technological Knowledge and Economic Growth (Karl Shell).

The next section, *Industrial Manpower Planning*, contains a paper discussing planning for changes in productivity and to meet skill requirements in manufacturing industries; a study on manpower planning; and a report dealing with planning scientific and technological research in a centrally planned economy. The topics and authors are:

● Planning Methods and Skill Requirements and Productivity Change (George Cukor);

● Productivity, Skills and Education in Manufacturing Industries (Manuel Bymelman);

● Planning and Programming Methods Used in the Czechoslovak Socialist Republic in Relating Scientific Research to Industrial Growth Targets (J. Chvátal, J. Nekola, L. Riha, L. Tondl).

The papers in the last section, *Policies for the Adoption of Advanced Technologies*, cover the pattern of dualistic industrial development in China (mainland) where the large-scale, centrally planned industrial sector coexisted with the so-called local sector; the organizational and control aspects in the adoption of advanced technology in the context of recent experience in the Union of Soviet Socialist Republics; and the pattern of industrial development in Latin America in connexion with the training and educational requirements demanded by the industrial development process. The topics and authors are:

● Local Industry and Choice of Techniques in Planning of Industrial Development in China (mainland) (Carl Riskin);

● Business Organization and Transfer of Technology: Experience of the Union of Soviet Socialist Republics (Alexander Woroniak);

● Requirements and Training of Highly Skilled Manpower for Latin American Industrial Development (Zygmunt Slawinski).

For information on No. 4 of the series, *Profiles of Manufacturing Establishments*, Vol. I (Sales No.: E.67.II.B.17; $5.00), see *IRDN*, Vol. III, No. 1, page 45, No. 5, *Profiles of Manufacturing Establishments*, Vol. II (Sales No.: E.68.II.B.13; $6.50), was reviewed in *IRDN*, Vol. IV, No. 1, pages 46–47.

Training for Industry Series, No. 1

Training of Economic Administrators for Industrial Development.

191 pages (ID/Ser.D/1; Sales No.: E.68.II.B.12; $2.00).

In 1962 the United Nations Centre for Industrial Development, the work of which was taken over by UNIDO on 1 January 1967, conducted a survey on the fields of development covered by various training institutes.

The replies made it clear that the focus of training was on problems of economic planning and that industrial development was considered only incidentally. Such policies are far from satisfactory having regard to the enormous need for educating and training government officials in a large number of countries which have introduced or are about to introduce comprehensive industrialization schemes.

Recognizing these needs, the Centre gave serious attention to the problem of training economic administrators in order to accelerate the industrialization of the developing countries. Three main areas were found to be of particular importance in this connexion:

● The establishment of an understanding of the process of industrialization and of the institutional framework within which it takes place;

● The definition of the roles and functions of economic administrators dealing with various aspects of industrial development policy;

● The planning and organization of special training programmes for such administrators, bearing in mind the conclusions reached in considering the issues above.

It was felt that there was a need to examine these three main aspects and their functional interrelationships objectively in order to provide the necessary background against which the requirements for further action could be more clearly defined. The Centre and the Bureau of Technical Assistance Operations, in co-operation with the Development Centre of the Organization for Economic Co-operation and Development, organized the first Interregional Working Party on the Training of Economic Administrators of Developing Countries in Industrial Development; the Working Party met in Paris in September 1965.

The topics of the papers and their authors are as follows:

● Evaluation of training programmes for economic and industrial administrators (the United Nations Centre for Industrial Development);

● Organization of training programmes in industrial economic administration (Yap Kie Han);

● Review of problems involved in the training of economic administrators in the field of industrial development (Francois van Hoek);

● Administration of industrial programmes in developing countries (Celso Furtado);

● Concept and function of economic administrators in industrial development programmes (Richard S. Thorn);

● Improving the training of industrial development planning administrators (Vidosav Tričković);

● Level, duration and location of training programmes (P. Borel);

● Nature, merits and content of academic and in-service types of training programmes for industrial economic administrators (David Carney);

● United Nations training programme in industrial development and planning for African government officials (the United Nations Centre for Industrial Development);

● The experience of SVIMEZ (Association for the Industrial Development of Southern Italy) in the training of industrial economic administrators (Pasquale Saraceno);

● Problems of developing adequate training programmes in the field of project preparation and evaluation (L. J. Zimmerman);

● Review of methods used in the formulation and implementation of industrial development programmes and projects; implications for the formulation of training programmes in industrial development (Morris J. Solomon).

Calendar of Meetings

Institute of Food Technologists, 30th Annual Meeting

San Francisco, California, 24—28 May. Institute of Food Technology, 221 N. Lasalle St., Chicago, Illinois 60601, United States of America.

Conference on Mechanisms of Corrosion and Corrosion Prevention

Liège, Belgium, 28—29 May. Belgian Center for the Study and Documentation of Water, 2, Rue Armand Stevart, Liège, Belgium

Union International des Industries Graphiques de Reproduction, XXIVth International Congress

Zürich, Switzerland, 1—6 June. 117, Boulevard St-Germain, Paris 6^{e}, France.

9th International Galvanizing Conference

Düsseldorf, Federal Republic of Germany, 7—12 June. European General Galvanizers Association, c/o Zinc Development Association, 34, Berkeley Square, London, W. 1, United Kingdom.

Federation of Associations of Technicians in the Paint, Varnishes, Enamels and Printing Ink Industries of Continental Europe, Congress

Montreux, Switzerland, 7—13 June. Christian Bourgery, Secretary General, FATIPEC, 28, rue Saint-Dominique, Paris 8^{e}, France.

11th International Gas Conference

Moscow, 8—12 June. R. H. Touwaide, International Gas Union, 4, Avenue Palmerston, Brussels 4, Belgium.

Seminar on Chemical Processing Machinery and Plants in Developing Countries

Königstein/Taunus, Federal Republic of Germany, 24—26 June. Industrial Technology Division, United Nations Industrial Development Organization, P. O. Box 707, A-1011, Vienna, Austria.

Conference on Scanning Electron Microscopy in Materials Science

Newcastle upon Tyne, England, 7—9 July. The Institute of Physics and The Physical Society, 47, Belgrave Square, London, S. W. 1., United Kingdom.

Industrial Application of Computers, "Compcontrol 70"

Miskolc, Hungary, 7—11 July. Society of Mechanical Engineers, Gépipari Tudományos Egyesület, Szabadság tér 17, Budapest V, Hungary.

1970 International Powder Metallurgy Conference

New York, 12—16 July. Metal Powder Industries Federation, 201 East 42nd Street, New York, N. Y. 10017, United States of America.

2nd Symposium on Creep in Structures, International Union of Theoretical and Applied Mechanics

Goteborg, Sweden, 16—20 August. Professor F. K. G. Odqvist, The Royal Institute of Technology, Torstensonsvägen 7D, 18264 Djursholm, Sweden.

International Wool Textile Research Conference

Berkeley, California, 18—27 August. Doctor Harold P. Lundgren, General Chairman, c/o Wool and Mohair Laboratory, U. S. Dept. of Agriculture, 800 Buchanan Street, Albany, California 94710, United States of America.

Chemical Engineering Conference

Melbourne and Sydney, Australia, 19—21 August (Melbourne), 24—26 August (Sydney). The Secretary, Australian Academy of Science, Canberra City, ACT 2601, Australia.

2nd International Conference on the Strength of Metals and Alloys

Pacific Grove, California, 30 August to 4 September. Dr. J. A. Fellows, Director of Technical Programming, American Society for Metals, Metals Park, Ohio 44073, United States of America.

Iron and Steel Annual Convention and Exposition

Cleveland, Ohio, 14—17 September. Mr. W. C. Friesel, Managing Director, 1010 Empire Building, Pittsburgh, Pa 15222, United States of America.

Symposium on Design of Concrete Structures for Creep, Shrinkage and Temperature Changes (concrete, reinforced and prestressed concrete structures)

Madrid, 17—18 September. International Association for Bridge and Structural Engineering, c/o Ecole Polytechnique Fédérale (Swiss Federal Institute of Technology), CH-8006 Zurich, Switzerland.

43rd Annual Meeting of Water Pollution Control Federation

Boston, Mass., 4—9 October, Mr. R. A. Canham, Water Pollution Control Federation, 3900 Wisconsin Avenue, NW, Washington, D. C., United States of America.

Food and Dairy Processing Expo '70

Houston, Texas, 1—5 November. Dairy & Food Industries Supply Association, Inc., 1145 19th Street, Northwest, Washington, D. C. 20036, United States of America.

American Concrete Institute Fall Convention

St. Louis, Missouri, 2—6 November. Mr. W. A. Maples, Executive Director, American Concrete Institute, Box 4754, Detroit, Michigan 48219, United States of America.

In 1970 the Industrial Research and Development News *will be published in three language editions, English, French and Spanish. For technical reasons, it is anticipated that there will be a time gap between the appearance of the English numbers and those of the other two languages in the first year of tri-lingual publication. The annual subscription rate for each edition is US$4.50. Readers in Africa and Europe who wish to subscribe should write to:*

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