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Industry and Research in India

D03943

*By Stevan Dedijer**

One of the key problems of India's future social development is, to my mind, the relation of industry and research. The growth of the national income depends to a considerable extent on the growth of industrial production and of new industrial capacities. The bulk of the research potential of the developed countries is industrial research potential. Most of the industrial research potential in the developed countries is located in the research departments and laboratories of industrial enterprises. In the most developed countries, thus from 60 to 70 per cent of the annual national research expenditure is spent in companies' laboratories, and from 50 to 75 per cent of the total research manpower of these countries is employed by their industrial enterprises. What is Indian industry's research potential? The first, very preliminary results of a study carried out in collaboration with Mr. R. L. Garg and D. K. Sharma of the Planning Commission are presented in the table on page 62.

As seen from column 3 of the table only 19 out of the 152 Indian companies with a paid up capital of 1 million US dollars and above have their own research laboratories.

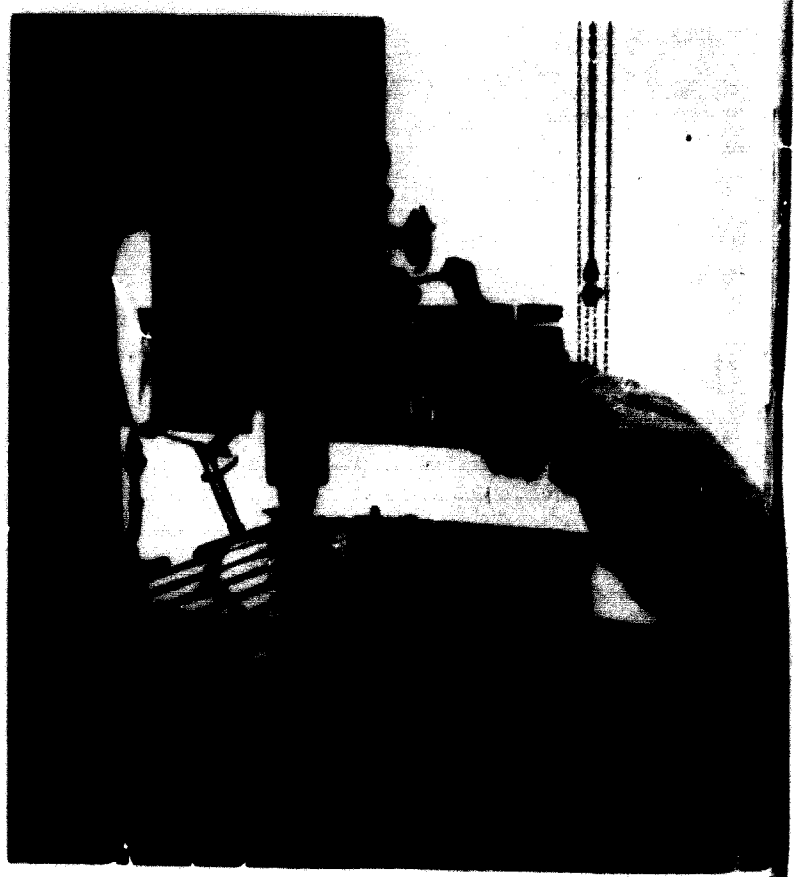
Adding to the total research expenditures by Indian firms the fraction of the expenditure of research associations supplied by companies, we arrive at the conclusion that the total expenditure of Indian industry on research amounts to about 12 million rupees annually. This figure, if correct, indicates that the Indian industry's expenditure on research amounts to about 2.5 per cent of the national research expenditure estimated to be in 1963 about 460 million rupees or 100 million US dollars. Up to now, Indian Government has done most of its research in laboratories outside the industry, and Indian industry spends very little of its own money in research, compared to the industry in the developed countries.

This partial, preliminary result of a limited study on Indian industrial research potential offers the possibility of an important national research policy conclusion. There is no doubt that in the future a much larger fraction of India's research potential must be located and a much larger amount of research work must be performed in industrial enterprises, both private and public. This conclusion, if accepted, has wide implications for those engaged in planning India's economy and its future economic policies.

It has become truism that today planning of industry or of any national sector is impossible without planning the development and utilization of research. The utilization of Indian indigenous research for the growth of Indian industry on the basis of Indian raw materials and resources is an extremely complicated problem. Its solution calls not only for fostering the right kind of research, in the right place, but it also involves economic, financial, foreign policy and political measures in order to develop the right and the proper amount of research effort in the right time and to utilize it to give the maximum economic results of the required kind.

Departing from my rule not to give advice, I want to point out to the Indian economists, industrialists and planners that every practical problem they face in the field of relation of industry and research can be solved only on the basis of a systematic study and not on *ad hoc* decisions, made on the spur of the moment. I would recommend, therefore, that the Planning Commission, Council of Scien-

Scene in Central Mechanical Engineering Research Institute in Durgapur, India—Mechanic making precision die.



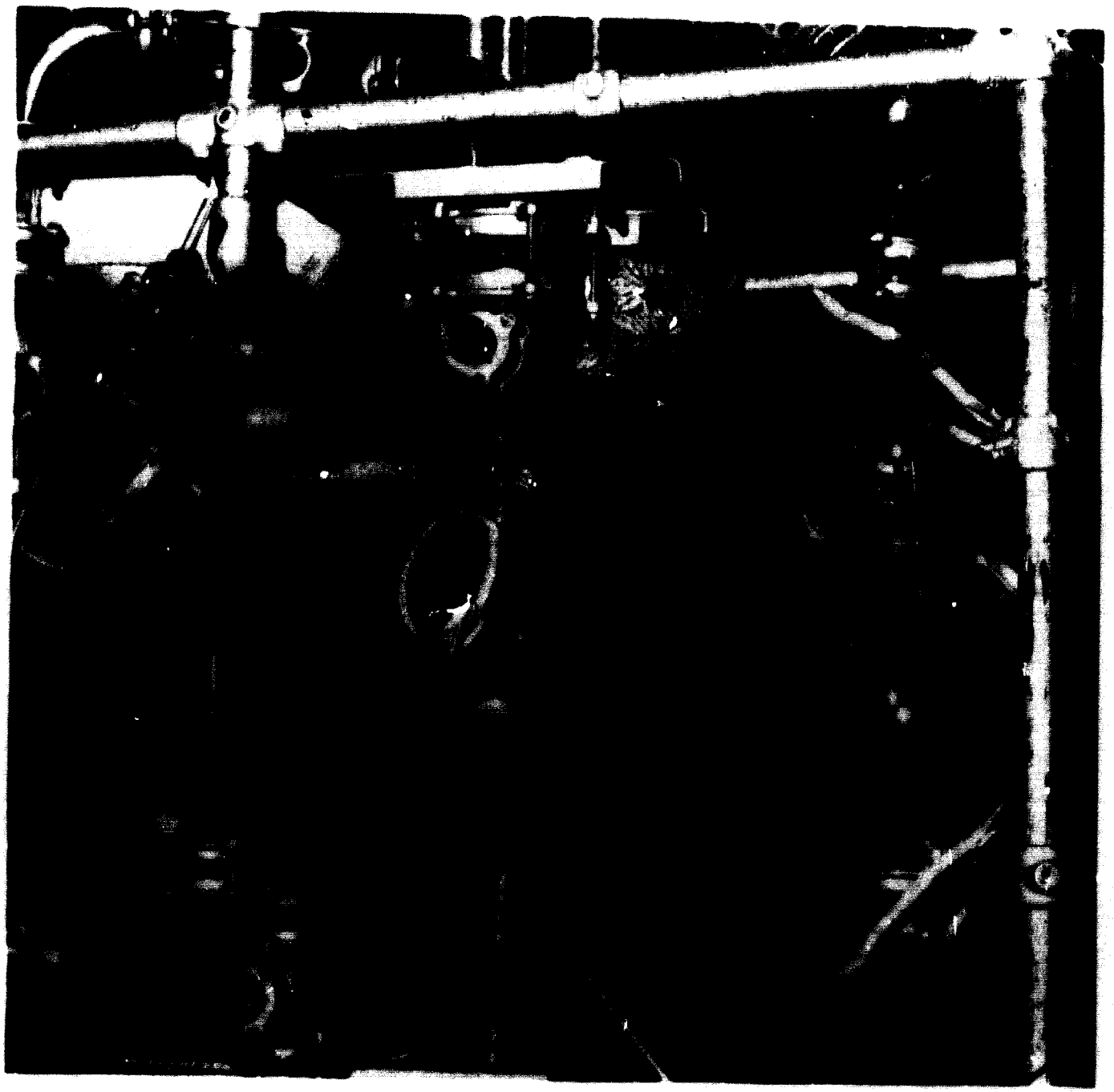
* Formerly Director of the Boris Kidrich Institute of Nuclear Sciences, Belgrade, Yugoslavia. At present a member of the Institute of Sociology, University of Lund, Sweden.

tific and Industrial Research, the various industrial associations, the economic institutes and university faculties, as well as individual research organizations and larger enterprises both private and public give greater attention to such studies within the framework of the practical problems of their organizations. To keep up with the developed countries, the developing countries, including India, will have to develop their own research on their own industrial research problems.

Most of the industrial research potential of India at present is not located in industrial enterprises or in the technical universities as in the developed countries. Most of it is located in the thirty-odd national laboratories of the CSIR and other industrial research institutions like the Shri Ram Institute for Industrial Research. The creation of these laboratories, principally engaged in industrial research, is one of the major achievements of India since its independence.

Often heard voices of criticism and disappointment have posed the questions: What good have these research laboratories done to India? Has their work been worthwhile? My impression gained from a study of all available literature, from visits to a number of them, is that Indian research in general and the Indian industrial research laboratories have produced a much larger number of useful results than is generally believed by the Indian public. To test this, I wrote to a number of heads of Indian research institutes asking two questions, (*a*) During its existence, what has your institute cost India, and (*b*) What has India

Technician at the Atomic Energy Establishment in Trombay, India, installing glass tube for isotope research.



Research by 152 Indian Firms With Paid Up Capital Greater Than 1 Million Dollars

Sl No.	Sector	No. of firms in sample	No. of firms having research laboratories	Research expenditure % of sales			
				India	UK	USA	Sweden
1	2	3	4	5	6	7	8
1.	Food, drinks and tobacco	7	—	—	0.6	0.6	0.5
2.	Textiles	36	2	0.9	0.9	0.3	0.5
3.	Rubber products	2	1	0.7	2.1	3.7	2.5
4.	Paper and wood products	5	—	0.01	0.25	0.9	0.8
5.	Non-metallic products	4	1	0.02	1.1	1.3	2.0
6.	Chemicals and chemical products	26	8	0.8	5.9	4.8	3.2
7.	Mining	7	—	—	—	—	—
8.	Electrical machinery	11	2	0.02	—	—	—
9.	Transport equipment	15	1	—	—	—	—
10.	Engineering and machine building	20	4	—	7.0	12.9	8.5
11.	Metals and primary products	11	—	—	1.15	1.0	2.0
12.	Miscellaneous utilities	8	—	—	—	—	—
13.	All industries	152	19				

got from your institute. The Central Glass and Ceramic Research Institute indicated that the total 1963-64 annual expenditures of this Institute doing most of India's production of the related industries is worth about 400 million rupees. This institute, since its foundation in 1950, has produced the following industrial research results: (*a*) 18 researches compiled and released for utilization; (*b*) 7 investigations completed and under consideration for utilization; (*c*) 11 other completed investigations whose results have been published for general utilization by the entire industry.

Thus it is estimated that the work so far done by this institute, whose total annual expenditure is 2 million rupees, when fully utilized, will save foreign exchange to the extent of 10 million rupees annually. The director of another national laboratory estimated that there is a minimum net return of 15 per cent on the capital invested in his institute.

Thus we see that attempts are being made by Indian industrial research institutes to estimate their output and productivity. It is my considered opinion that if every industrial research institute in India made an estimate of its output by a commonly agreed, well grounded method, then it would be realized that the gain made by India from its investment in these institutes is not as small as it is generally believed.

The principal criticism or dissatisfaction with industrial research laboratories in India arise, in my personal opinion, from another cause. Today, Indian industrial laboratories are expected not only to engage in research and development and to make pilot plants, but they are also expected to develop the design and engineering part in the process of transformation of research results into production. It is too much to expect from Industrial Laboratories not only to plant the research seed of a product, to make it grow into a tree, to harvest the fruits but also to chew them and feed them into the mouths of industrial companies.

Therefore, an effort should be made to consider three important sets of questions dealing with all the problems arising from the chain of interaction of industry and research:

Research—Development—Pilot—Design and—
Demand
Production—Market
Plan Targets

(*a*) how far along this chain should the primary responsibility of research institutes rest; (*b*) by what means, policies and actions should industry, both private and public be stimulated to develop initiative and carry out its own proper activities along that chain, and finally, (*c*) how to stimulate industry both private and public to develop its own research potential.

These questions fall within the scope of tasks of the following existing organizations in India:

(*a*) The planning Commission
(*b*) The Liaison Division of the CSIR
(*c*) The Directorate General of Technical Development
(*d*) The National Research Development Corporation
(*e*) The Indian Chamber of Commerce

It seems to me that a concentrated effort by all of the above-named organizations starting with a systematic exchange of views and opinions is a prerequisite for the development of a sound industrial research policy in India.

I offer no solutions and purposely refrain from doing so as I know yet too little of India's way of doing things. I have merely attempted to raise some issues and provoke thought.

An Example of Industrial Research at the Corporate Level

The General Electric Research and Development Center,

Schenectady, N.Y., U.S.A.

The General Electric Company

General Electric is a worldwide corporation with more than 300,000 employees working in 242 manufacturing plants in 21 countries. Sales of products and services totalled over $6 billion in 1965.

Over the years, the Company's product lines have grown from the electric utility base upon which it was founded to include systems, equipment, and services for the consumer; industrial; defence; atomic; and international markets. General Electric now produces over 200,000 different products—ranging from toasters to turbines and from plastics to computers.

The driving force behind this growth has been a strong and continuing emphasis on research and development. In the decade 1950 to 1959, for example, the Company spent $1.37 billion of Company funds on R & D and during the same period also performed $1.5 billion worth of R & D work for the Government. New products developed since the end of World War II today accounted for nearly half of General Electric's gross sales.

At the foundation of General Electric's technical strength is the fact that the company employs about 27,000 men and women with technical degrees—about one out of every ten employees. Well over 1,000 of these men and women hold doctorate degrees. These 27,000 technical people work in more than 50 laboratories and scores of manufacturing facilities around the world.

The Research and Development Center

At the hub of General Electric's massive technological effort is the Research and Development Center in Schenectady, New York. The Company's resources at this huge laboratory include 1,800 people, 700 of them scientists and engineers. The Center was formed in July 1965, when the Company's Research Laboratory and Advanced Technology Laboratories were combined into a single organization for the performance of corporate-level research and development work.

The Research and Development Center was designed to stimulate more direct co-operation in R & D between scientists and engineers working in their own respective disciplines. The Center serves all departments of the General Electric Company. Its aim is to be a leader in all technical areas in which the Company has an existing or potential business interest; to generate and disseminate advanced technological information; and to help Company divisions develop new products and systems.

The growing sophistication of modern engineering and the increasing specialization of technologies enhance the value of the service the Center can offer. Established, experienced teams of specialists can provide

- The flexible organization of many different technologies in one place, directed to one problem;
- The capacity for designing, building and testing prototypes;
- Consulting and technical audit service ranging from materials and single components to complete product and system analyses
- Facilities for the measurement of physical, chemical, thermal, electrical, mechanical, or other characteristics, in virtually any environmental conditions, accelerated life testing, and reliability analyses;
- Skills and equipment for solving those unusual infrequent problems that would be uneconomical for any individual product department and of the Company to handle; and
- The entire range of skills needed for systems analysis and engineering, including mathematical modelling and computer simulation.

The technical activities of the General Electric Research and Development Center are undertaken in seven laboratories. Each laboratory employs approximately 100 to 125 scientists and engineers under the direction of a manager responsible for the full spectrum of technical work—ranging all the way from the most basic and fundamental research through applied research; feasibility studies; prototype engineering, and the transition stage between development and actual product engineering in the various operating departments of the General Electric Company. The seven technical components of the Center are:

- Chemical Systems and Processes Laboratory
- Electronic Physics Laboratory
- General Chemistry Laboratory
- General Physics Laboratory
- Information Sciences Laboratory
- Mechanical Technology Laboratory
- Metallurgy and Ceramics Laboratory

Other major components of the Center are: The Research and Development Application Service, primarily responsible for the communication of research and development results and their transition to Company operations; Support Operations, including finance; facilities; employee relations and similar services; Research and Development Consulting Service, a Company-wide link with technical activities conducted by decentralized operations; Contract Policy Operation; Legal Operation; and Patent Operation.

Research Institutes Respond to Call for Operational Information

A questionnaire asking for information about Institute operations appeared in the first issue of *Industrial Research News*. To date 17 different Industrial Research Institutes have returned completed copies, giving a very interesting insight into their operations. Answers to the 8 questions asked deal with Institute organization, services offered, services needed, methods being used to develop a following and type of projects now underway in each Institute, and the availability of fellowships. While the total of responses may be too small for a true statistical basis, still the answers given do give a valuable cross-section of operations of Industrial Research Institutes.

Distribution of Personnel

Responses from the 17 Institutes give a total of employment as follows

	Total	Professional	Technical Staff	Clerical
Total Responses	6836	3023	2183	1640
Less U.S. Responses	3997	2097	972	928
Two large Institutes	2839	926	1211	712
Remainder				

It will be interesting to compare the varying percentage of distribution between the three classes of employees of the institutes.

	Professional	Technical staff	Clerical & other
Total Responses	44.2%	31.9%	24%
Large U.S. Inst.	52.02%	24.3%	23%
Other Institutes	32.5%	42.5%	24.8%

Distribution of personnel among the various Institutes varies widely as would be expected. For the professional group (aside from U.S.) the figures range from 28% to 55%; supporting technical staff 20% – 63% and the clerical and other group ranges between 9% and 25%. It is reasonable to assume that classifications are not uniform among the various institutes. The averages given above will, however, serve as rough guides.

Availability of Fellowships

Eight of the Institutes report that Fellowships are available. For a list of Institutes indicating availability of Fellowships, it is suggested that correspondence be addressed to the Editorial Office, *Industrial Research News*, Centre for Industrial Development, United Nations, New York, N.Y. 10017.

Methods of Attracting a Following

Conservation of space recommends a tabulation of questionnaire responses. It is interesting to note the few institutes making use of industrial exhibits.

Methods Used to Attract a Following from Government and Industry

Method	No. of Institutes Using
Seminars and Conferences	15
Visits to Plants	15
Industrial Exhibits	5
Publication of Bulletins	15
Training of Industrial Personnel	11
Technical Inquiry Services	12

Projects Under Way

A great variety of projects was listed, ranging from studies on soluble proteins and polymer reactions to utilization of forest products and problems of tea culture. The great common denominator of the reports was a continuing effort to lift the industries of the various countries to higher levels of technical efficiency, find new uses for raw materials and develop new industries for their use.

Services Offered

Since a chart can sometimes give a story with greater clarity than text, the answers to the question "What Services are you now offering?" have been charted and are shown in table on opposite page.

The Get-Together of Research and Industry

Self-Reliance on industrial know-how was the predominant theme of the Get-Together of Research and Industry held in New Delhi in December 1965. The Conference, organized by the Council of Scientific and Industrial Research, was attended by more than 800 delegates from industrial organizations and national laboratories.

Recommendations of the group on the utilization of research and policy matters are of special significance to *News* readers.

The group recognized the urgent need of improving licensing conditions and industrial promotion whereby indigenous processes and products based upon indigenous know-how are given greater encouragement. They advocated the setting up of an *advisory committee* to demarcate the areas where foreign collaboration is no longer necessary and areas where it is. It was suggested that when an industrial project reaches the pilot plant stage, a team drawn jointly from the industries and research laboratories should scrutinize all economic and technological aspects and work as an action team until the completion of the project and its utilization. The laboratories should forge close links with technical consultancy bureaus for joint project and feasibility studies. There should be step by step elimination of services like project engineering, equipment design and feasibility studies from foreign collaboration agreements. As far as possible, know-how and design should be purchased and engineered within the country.

Services Offered by Industrial Research Institutes (Arranged in Order of Countries)

Name of Institute	Basic Research	Raw Material Utilization	Process Development	Feasibility Studies	Pilot Plant Operation	Plant Location Layout	Plant Management	Productivity Studies	Market Studies	Testing	Personnel Training	Trouble-Shooting
1. **CAMEROON** Ministry of Development & Internal Economic Planning, Buea	X			X								
2. **CANADA** New Brunswick Research & Productivity Council, Fredericton, N.B.		X	X			X	X					X
3. **COLOMBIA** Institute for Technological Research, Bogotá		X	X	X	X	X		X	X	X	X	X
4. **CHINA (Republic of)** Union Industrial Research Institute, Hsinchu, Taiwan	X	X	X	X	X					X		
5. **DENMARK** Danish Meat Research Institute, Roskilac	X	X	X	X	X	X	X	X	X	X	X	X
6. **GERMANY (Federal Republic of)** Battelle-Institute eV, Frankfurt	X	X	X	X		X		X	X			
7. **ISRAEL** Standards Institution of Israel, Tel Aviv		X	X	X	X			X		X	X	X
8. **JAPAN** Tea Research Station, Kanaya, Shizuoka	X	X	X					X			X	
9. **NORWAY** Norwegian Pulp & Paper Research Institute, Oslo	X	X	X		X					X	X	X
10. **SOUTH AFRICA (Republic of)** Leather Industries Research Institute, Grahamstown	X	X	X	X	X	X	X	X		X	X	X
11. **SWITZERLAND** Institut Battelle Centre de Recherche de Genève, Geneva	X	X	X	X	X	X			X			
12. **UNITED KINGDOM** Research Association of British Paint, Colour & Varnish Manufacturers, Teddington, Middlesex	X	X								X	X	X
13. Arthur D. Little Research Institute, Inveresk, Midlothian	X	X	X	X		X	X	X	X			X
14. **UNITED STATES OF AMERICA** Interamer Research Corp., New York		X		X		X	X	X	X			
15. Battelle Memorial Institute, Columbus, Ohio	X	X	X	X	X				X			
16. Battelle Memorial Institute, Pacific Northwest Laboratories, Richland, Washington	X	X	X	X	X				X			
17. **URUGUAY** Instituto de Tecnologia y Quimica		X	X							X	X	

Possibilities for International Co-operation

Walter Hill,
Secretary General
International Chamber of Commerce

The Secretary General of the International Chamber of Commerce, Mr. Walter Hill, visited the Centre for Industrial Development in May and the *Industrial Research News* took the opportunity to explore with him possible areas of co-operation between the Centre and the International Chamber in the field of industrial development.

Mr. Hill emphasized the importance of partnership between government and private enterprise in solving economic problems of the developing world, including industrial development and diversification in production. He pointed out that the Chamber was active in the field of commerce, but considered that it was important to intensify industrial development in the context of economic development of the less advanced countries. He offered full ICC co-operation with the new United Nations Organization for Industrial Development.

The *News* asked his personal views on whether or not governments should subsidize the purchase of patents in order to assist the private sector, or would he advise that governments refrain from such activities. Mr. Hill replied that it was difficult to generalize. So much depended upon local conditions. If the enterprise were entirely government owned, the question wouldn't arise. On the other hand, with respect to joint ventures, the question might not be important. It could also happen that a subsidy might help a new industry in the private sector.

The *News* pointed out that chambers of industry played an important role in the process of industrialization in the developing countries in such matters as training, standardization, industrial legislation, the use of consultants, etc., and inquired as to Mr. Hill's opinion. The latter agreed, and pointed out that the ICC above all included private companies in its membership. He referred to the Chamber's International Information Bureau of Chambers of Commerce, which provided a technical assistance programme for chambers of commerce in developing countries through which—for periods of about 3 months—chambers of commerce in the developed countries received trainees from developing countries. The *News* asked if it would be possible to have a co-operative effort with ICC in this respect. Mr. Hill replied in the affirmative that the Chamber would consider favourably such new programmes. For example, the ICC had a joint commission with the Union of International Affairs on technical assistance for fairs in developing countries. Very possibly this programme could be expanded. Mr. Hill felt that if the United Nations provided the financing, experts could possibly be made available through the co-operation of private firms, in matters related to the organizational functioning of chambers of commerce and industry and marketing and distribution of industrial products.

A discussion followed on promoting the use of consultants in the developing countries. Mr. Hill mentioned that this was an important point which had also been stressed in the Statement of Conclusions at the Tokyo session of the Commission on Asian and Far Eastern Affairs (CAFEA/ICC), from which he had just returned, where the provision of international consultancy services had been stressed. In his opinion, the establishment of local consulting offices was important. There was also a discussion of the ICC's Court of Arbitration in Paris, and its rules which had been incorporated into many business contracts throughout the world, and were utilized by governments themselves. This international system of impartial arbitration can be of value to those who use consulting services in case of any potential contractual misunderstanding.

Mr. Hill elaborated on the Tokyo Conclusions which were relevant to the work of the Centre for Industrial Development. Regarding co-operation between businessmen, the Conclusions recommended that chambers of commerce and industry should function more actively in supplying information about trade and industry and in rendering services to businessmen in their own country and in the region. Other measures included making an increased number of in-plant training facilities available to trainees from the region by businessmen from the developed countries. It was also felt that joint business ventures had an important role to play, but there were problems still to be solved. The decision to set up the Asian Development Bank was welcomed and should lead to a valuable increase in funds available for productive investment in both industry and agriculture.

He pointed out that the next ICC Congress would be held in Montreal in May 1967 and its theme would be "Private Enterprise in a Changing World." He hoped that the partnership approach between governments and private business would develop further in a more practical way and possibly work out policy measures.

Editor's Note

The ICC represents the main economic forces of world business—commerce, industry, transportation and finance. These forces are united in each country by National Committees which number approximately 40 covering five continents. In addition, there are associate members, so that about 80 countries are covered in developed and developing regions of the world.

The governing body is the ICC Council on which all National Committees are represented. A Congress is held in a different world centre every two years. In addition there are about 50 technical commissions. Further, the ICC maintains a Bureau of Information on Chambers of Commerce and Industry which gathers and provides information on their activities.

Officers include a President, Vice-Presidents, Treasurer and Secretary-General. Mr. Hill has been the Secretary-General of the ICC since 1957. For ten years prior, he was with the International Bank for Reconstruction and Development, where he held positions of authority in the Department of Economics, acted as Special Representative in Europe in charge of the Paris office, and later on served again in Washington. A graduate of the London School of Economics, Mr. Hill also served between 1928 and 1946 as Assistant Editor of the London *Economist* and first Director of its Economic Intelligence Unit.

The budget of the ICC is supported by contributions from National Committees, in accordance with the economic importance of the country. Studies and policy statements originate with various technical commissions, on which business experts and specialists sit. These are addressed to governments, inter-governmental bodies and non-governmental groups for implementation.

The ICC was founded in 1919 and has its headquarters and international secretariat in Paris. It maintains liaison offices with the United Nations in New York, with its European office in Geneva and with ECAFE in Bangkok.

Assistance Provided by the United Nations to Industrial Research Institutes

In the previous issue of *Industrial Research News*, a number of Industrial Research Institute projects to which the Centre for Industrial Development provides substantive support, were listed. Since then, the United Nations Development Programme (Special Fund) has approved another project: the establishment of a pilot plant for pyrethrum production in Rwanda. In addition, about thirty requests for assistance in industrial research and development are under evaluation by the United Nations Development Programme (Special Fund). The requests, from about twenty countries, include projects ranging from specialized institutes for applied research in electronics technology, metallurgical research, industrial design, textile research, and construction materials research to multi-purpose Industrial Research Institutes covering a broad spectrum of technological activities and services.

The Use of Consultants in Developing Countries

Introduction

One of the difficulties faced by a large number of developing countries in their industrialization effort is the relative lack of technological "know-how" and industrial experience. In many of these countries a number of steps have been taken to minimize this, including accelerated training programmes for indigenous personnel and the importation of qualified foreign staff.

But it is neither possible nor desirable, for reasons of economy, to maintain a full-time working force that is sufficient at all times to meet all of a developing country's needs for industrialization. Certain needs for industrial services, such as equipment evaluation, project analysis, technical trouble-shooting, etc., are of a short-term character and do not call for the addition of full-time specialists. Such needs, and even those of longer durations, can be met through the use of outside consultants.

The importance of the use of consultants in developing countries was emphasized at the United Nations Inter-Regional Seminar on Industrial Research and Development Institutes in Developing Countries which was held in Beirut, Lebanon, in December 1964. At the Seminar, participants from the developing countries agreed that a most useful purpose would be served if an authoritative document or a manual on the use of consultants were prepared for the purpose of providing guidance on the subject to developing countries.

To carry that proposal out, the Centre for Industrial Development is currently in the process of compiling a manual. A preliminary document entitled *The Use of Consultants in Developing Countries* has been prepared to be used as a basis for it. The report has been circulated to some 220 experts in industrial consultancy throughout the world for criticisms, comments and suggestions.

Purpose

As already indicated, the preliminary report is only a stepping stone to the final document. Its purpose is therefore inseparable from that of the final product, which is, to offer practical guidance to industrial managers and administrators, government officials and others concerned with industrial development problems in developing countries.

This purpose might be stated somewhat differently by asking the question, why the use of consultants? To this the preliminary report in its opening chapter supplies five pertinent answers:

1. To shorten the time involved in obtaining the necessary background, experience, and expertise required to establish new operations or procedures;
2. To secure independent, objective analyses and recommendations regarding project plans and their feasibility;
3. To supplement internal staffs of specialized personnel to handle excessive work loads;

- To obtain fresh views on means of ensuring optimum background for decision making;
- To design and carry out training programmes for internal personnel . . . to increase human resources for continuing development activities.

Scope

The seven chapters of the preliminary report explore all the major aspects of industrial consultancy. The first chapter examines the present status and future possibilities of consultancy in developing countries and illustrates kinds of projects in which consultants are employed.

The second chapter deals with types of consultants, of which seven are identified: individual consultants, consulting firms, universities, industrial research institutes, vendors of equipment, suppliers of materials and suppliers of proprietary information. It points out, appropriately, that local sources of consultative expertise exist in increasing numbers in developing countries.

Chapter three deals with the methodology of selecting a consultant. The stages involved include, first, defining the problem, then securing names and qualifications of consultants from various sources; next, establishing preliminary contact with one or more consultants, exploring the problem with them, and requesting from them estimates or preliminary proposals. Finally, entering into a contractual relationship with the consultant selected. Each of these steps is further developed in some detail.

Contracting procedures are discussed in chapter four. The steps suggested strike a reasonable balance between the interests of the client and those of the consultant. "Salient points of contracts" are discussed, including the scope of assignment, change of terms of definition in successive phases, assignment of responsibility to personnel, etc.

The fourth chapter concludes with summary reviews of different types of contracts, such as consultation on an optional or a fixed basic, turn-key construction projects, guaranteed performance, licences and franchises, continuing licences, etc. A checklist of contract provisions is also appended for convenience.

Chapter five is devoted to a consideration of the financial aspects of consultancy. The various types of arrangements for professional fees examined include *per diem* rates and rates for longer periods, retainers, percentage of total costs and consulting costs plus a fee.

In the sixth chapter the relationship between the client and the consultant is examined, with emphasis on the need for mutual confidence and co-operation. Customary provisions of professional codes of ethics are illustrated.

The seventh and final chapter examines a number of case histories of consulting projects. The various stages of each case are discussed in their logical order: background of the project, feasibility studies, engineering and construction of plant and some financial and production considerations.

The presentation of the report is simple without being prosaic, and concise without sacrificing essential details.

Engineering Consulting Services

In recent years, consulting firms and governments of the industrialized countries have become increasingly aware of the potential demand for consulting services in the developing countries. In response to this growing market, for example, consulting firms in Japan and the United Kingdom, under the sponsorship of their Governments, have formed Engineering Consulting Associations with three major purposes: to facilitate contacts between potential foreign clients and individual consulting firms; to publicize and promote the services of member firms; and to offer a sort of institutional guarantee of competence and reliability.

JAPAN

The Engineering Consulting Firms Association

The ECFA was established in April 1964 under the chairmanship of Mr. Yutaka Kubota. It has a current membership of 21 firms who act as engineering consultants for dams, railroads, highways, harbour facilities, chemical industries, communications systems, mining, agriculture, forestry, geology and fishing.

While the member firms may operate separately and do maintain a strict independence, they have developed through ECFA arrangements for co-operation in the exchange of technical information, in making arrangements for contacts and negotiations with foreign clients, and, in some cases, in the implementation of projects abroad. The Association organizes and dispatches survey missions to investigate project possibilities on site.

ECFA has published a brochure entitled *A Guide to Consulting Engineers in Japan* which describes its organization and the specialties and operations of its member firms.

A copy of the brochure and any further information related to the organization or its members may be obtained by writing to the following address:

Shin-Nitto Bldg., 22
2-chome, Azabu-juban
Minato-ku, Tokyo, Japan

UNITED KINGDOM

The British Overseas Engineering Services Bureau

To help those in need of consultancy services when starting a building project and at the same time to compete effectively in the overseas markets, a group of British professional associations, with the help of the British Government, formed in September 1965 a non-profit organization known as the British Overseas Engineering Services Bureau.

The main purposes of the Bureau is to make better known overseas the wide experience and specializations of British civil, electrical and mechanical consulting engineers; management specialists; architects; and other consultants; and to put clients of all kinds—such as governments, companies or development agencies—and consultants, in touch with each other, thus ensuring clients the consultancy services most adequate to their specific needs.

The Bureau, which charges no fees or accepts commissions, has a membership of approximately 70 consultant firms and is under the direction of Sir Henry Clay. There are no strict rules concerning requirements for membership, and all consulting firms, whether large or small, can become members as long as they are ready to give up-to-date and reliable service to their clients.

The Bureau offers the following consulting services: feasibility studies of all kinds; market surveys; management studies; economic research; industrial and social development; land usage and reclamation; planning, design and management of projects; use of manpower; supervision of work; and drawing up contracts. The Bureau has issued a folder describing the services offered.

All further inquiries may be addressed to:

Mr. C. M. Bernard, Secretary
British Overseas Engineering Services Bureau
237-240 Abbey House
Victoria Street
London, S.W.1, England

Trained Men Needed for Africa

The African Symposium on Industrial Development held in Cairo from 27 January to 9 February 1966, emphasized the need for trained manpower. By 1975, it was estimated, manpower requirements in Africa would be as follows:

Engineers and Scientists	**51,700**
Technicians and Foremen	**111,900**
Managerial Staff	**28,800**
Skilled Workers	**1,722,000**

Governments should use these estimates as a guide in the formulation of training policies in industry. The United Nations and donor countries were asked to help the African countries in long-term manpower planning and in the organization and expansion of their educational institutions.

The Symposium recommended the exchange of manpower in specific areas among African countries and called attention to the need to help each other in solving the skilled manpower shortage.

From the Literature

Scandinavian research information notes (Copenhagen), vol. 1, No. 1, February 1966.

Although the results of scientific and industrial research in Scandinavia are usually published in many of the world's languages, information on organizational changes and other important related matters are often available in the Scandinavian languages only.

To remedy this shortcoming, the Scandinavian Council for Applied Research, NORDFORSK,* decided at its 8th Plenary Assembly in January 1966, to issue a bi-annual bulletin to appear in February and September, with the purpose of disseminating information on major developments within scientific and industrial research in the five Scandinavian countries.

The *Notes* will report on important decisions on science policy, major changes in institutions and programmes, inquiries carried out by governments and central research organizations and related publications in the English language.

The first issue includes a brief book review and sections on science policy, plans for the establishment of new institutes for higher engineering education in all Scandinavian countries, public measures to stimulate the use of research results, new institutes and organizations, selected non-serial publications in English, and serial publications from NORDFORSK.

The Editors invite suggestions for improvement and co-operation from interested individuals and organizations. The bulletin is distributed free of charge and can be obtained from NORDFORSK at:

Ørnetej 30
Copenhagen, Denmark

Research Directories

*Research and science-oriented park** directory, Industrial Research (Beverly Shores, Ind.), 45-50, May 1966.*

The 1966 *Industrial Research* park directory lists one hundred and one developments in the United States and Canada. All of these specialized industrial parks are restricted to research activities or are designed to have a high concentration of scientific enterprises.

The arrangement of the directory is alphabetical by name of the State, then by site; it includes the following information: name of the park, the developer, date of establishment, number of acres covered, percentage of the area already occupied, number of tenants, major occupants, total personnel and the name, address and telephone number of persons or organizations to be contacted if further information is required.

One hundred parks in the United States and one in Canada are included.

*** NORDFORSK was established in 1947, through the initiative and agreement among central research organizations in the five Scandinavian countries, to promote and organize Scandinavian co-operation in scientific and industrial research and in the use of research results. Eleven member organizations form NORDFORSK.**

**** An industrial park is a district planned to ensure compatibility between the operations carried out therein and the existing activities and character of the community in which the park is located. They are also called industrial tracts or districts in the United States; trading estates or industrial estates in the United Kingdom; industrial zones in Italy and industrial subdivisions in Puerto Rico.**

Research Directories (cont'd.)

Scandinavian research guide: a directory of research institutions within technology and physical sciences. 2nd ed. Copenhagen, Scandinavian Council for Applied Research, 1965. 438 p.

The aim of the Scandinavian Council for Applied Research in publishing the *Guide* is to further co-operation between institutions and individuals engaged in scientific and technical research and to serve as a source of information for industrial enterprises and trade organizations interested in making research contacts.

The *Guide* lists governmental, semi-governmental and co-operative institutes as well as private laboratories which undertake sponsored research projects. Information regarding policy on consultation of specialists and on the placing of research contracts is also included.

When the first edition was published in Oslo in 1960 it was the first attempt to cover the whole field of scientific and technical research in the five Scandinavian countries.

Under broad subjects, it provides the following information: name of institution, in the vernacular, followed by the English translation; affiliation; name of the Head of the institution and total personnel; address and telephone number; research activities; publications; and information on contracts when appropriate.

The second edition describes 1,140 research institutions in Denmark, Finland, Iceland, Norway and Sweden; it is arranged in 18 chapters, each devoted to a broad subject field.

The *Guide* is fully indexed by subject, by name of the institution, by membership in international organizations and by persons.

United Nations Publications*

Department of Economic and Social Affairs. Economic integration and Industrial specialization among the member countries of the Council for Mutual Economic Assistance. New York, 1965. 34 p. Doc. ST/CID/7. Sales No.: 66.II.B.4. US $0.50.

Regional economic co-operation, based primarily on industrial specialization and leading eventually to economic integration of a group of countries is an important tool of sustained economic growth. All experience gained through the use of industrialization policies and industrial planning is therefore, of great value to developing countries. The present study is the first step in the programme of research undertaken by the Centre for Industrial Development concerning problems of economic integration and industrial specialization.

Department of Economic and Social Affairs. Industrial estates in Africa. New York, 1965. 82 p. Doc. ST/CID/5. Sales No.: 66.II.B.2. US $0.75.

The publication is divided in three parts:

1) The report of the Seminar on Industrial Estates in the Economic Commission for Africa Region, held in Addis Ababa in December 1964;
2) Planning, design and construction of industrial estates, with particular reference to Africa, by E. D. Mills. It deals with various aspects of overall planning, design and layout, building materials and construction, costs, programming and legislation;
3) Industrial estates plans and projects in African countries. A survey by the Secretariat, based on a number of papers presented to the Seminar.

Department of Economic and Social Affairs. Basic principles and experience of industrial development planning in the Soviet Union. New York, 1965. 136 p. Doc. ST/CID/3. Sales No.: 66.II.B.1. US $2.50.

The study was written by N. A. Lubimtsev, in his capacity as United Nations consultant to the Centre for Industrial Development. It contains the following chapters: organization and system; the planning of industrial production and geological surveys; investment planning; the planning of labour, manpower and wages; the planning of production costs and prices; and planning the supply of materials and machinery.

Inter-regional Symposium on Industrial Project Evaluation, Prague, 11-29 October 1965. Report. New York, United Nations, 1965. 92 p. Doc. ST/TAO/Ser.C/82. Sales No.: 66.II.B.11. US $2.00.

The formulation of sound projects and their thorough scrutiny for feasibility before the commitment of financial and technical resources, are of great importance in industrial development under any economic system. This Symposium was the first international gathering devoted exclusively to the consideration of the issues of problems in industrial project evaluation.

Department of Economic and Social Affairs. Manual on the management of industrial research institutes in the developing countries. New York, 1966. 122 p. Doc. ST/CID/6. Sales No.: 66.II.B.6. US $2.00.**

Inter-regional Seminar on industrial research and development institutes in developing countries, Beirut, 30 Nov.–11 Dec. 1964. Proceedings. New York, United Nations, 1966. 2 v. Doc. ST/TAO/Ser. C/77. Distributed free.**

* **Presently available only in English. Prices given in US dollars or equivalent in other currencies.**

** Reviewed in the January 1966 issue of *Industrial Research News*.

Men Needed for United Nations Projects

In the first issue of the *Industrial Research News*, a number of job descriptions were given for open United Nations technical assistance posts in industrial research and development.

Presently, there are a number of additional openings for which the United Nations seeks candidates, with some typical descriptions given below.

The Government of *Saudi-Arabia* is establishing an Industrial Studies and Development Centre capable of formulating a national plan for industrialization and advising on appropriate policies and programmes and on the implementation of industrial projects. Included in the project will be the planning and construction of a model industrial estate. The establishment of this industrial estate will serve as a focal point for future industrial activity, particularly for establishing industries under the most desirable conditions. There is now need of an Industrial Chemist or Chemical Engineer, who should have broad experience in conducting surveys and feasibility studies and in the implementation and operation of projects in developing countries (Job Description, SAU-052-SD); an Industrial Economist with broad experience in economic analysis, market research, project evaluation and promotion of industrial activities (Job Description, SAU-29-SB).

The Technical Standards National Institute project in *Paraguay* is concerned with the preparation of standards of quality and methods of quality control, with particular reference to major export products (meat, timber, vegetable and essential oils, hides, skins and cotton), which together account for over 70 per cent of exports. The Institute needs a Food Technologist, who has specific laboratory experience in bacteriological testing and in the manufacture and production of food-stuffs and essential oils (Job Description, PAR-052-SB); an expert in Construction Materials, who has practical experience in construction material testing laboratories (Job Description, PAR-052-SC); a Hides and Leather expert, who has extensive experience in hides and leather testing laboratories (Job Description, PAR-052-SD); and a Chemist or Chemical Engineer in Fibres and Textiles with extensive experience in fibres and textiles testing laboratories.

The Technological Research Institute in *Sudan* is being created to aid and promote the industrial and economic development of the country through the application of scientific research and technology and its adaptation to the country's conditions and resources, and by the creation of a broadly available local source of practical information; assistance; professional advice and counsel on processes, standards and efficient techniques of industrial production, costing; and organization and management technology. The work on the project is underway but there is a need for additional experts. A Chemical Engineer, with broad experience in applied industrial research and industrial counsel is needed (Job Description, SUD-052-SD); as is a Mechanical Engineer in the field of Development and Testing, who should have experience in applied research and testing laboratories technique and equipment (Job Description, SUD-05-SE).

The Applied Scientific Research Corporation of *Thailand* has been established by Statute as the principal agency of the Government of Thailand concerned with applied scientific research. The United Nations Special Fund is providing assistance in developing a Technological Research Institute within the Research Corporation. Its programme of research will include work on the use of natural products, industrial chemistry, minerals, metallurgy, construction materials, and textiles. The Institute will have well equipped laboratories and good library facilities. A Metallurgist is needed to carry out the programme of applied research related to minerals and metallurgy, with a view to processing having industrial application. He should have outstanding qualifications as a metallurgist with extensive experience in applied research and the application of science in industry (Job Description THA-052-SE).

For information on these positions please contact the Editorial Office of Industrial Research News, Centre for Industrial Development, United Nations, New York, N.Y. 10017.

Computer-Information Symposium

The Second Symposium on Computer and Information Sciences, concerned with learning, adaptation, and control in information systems, will be held on 22, 23, and 24 August in Columbus, Ohio. A sequel to the first Symposium held three years ago at Northwestern University, the forthcoming international meeting is being jointly sponsored by the Columbus Laboratories of Battelle Memorial Institute, the U.S. Office of Naval Research, and the Ohio State University.

The objective of the symposium is to promote information exchange and to stimulate interest in the engineering applications of contemporary research in information sciences. Topics to be covered at the symposium include: "Trainable and Evolving Systems", "Decision Processes", "Design of Automata", "Pattern Recognition", "Multi-Dimensional Processing", "Mathematical Linguistics" and "Adaptive Control".

The symposium is expected to attract some 500 specialists from companies, universities, and government agencies in the United States and from abroad. The symposium in Columbus will follow by a few days the Joint Automatic Control Conference in Seattle, Washington, thus permitting international participants to attend both meetings. Sessions will be held in the Battelle Auditorium.

Attendance at this unclassified symposium is open to all interested persons. For further information and a preliminary symposium programme, write to: Dr. Julius T. Tou, COINS Co-Chairman, c/o Battelle Memorial Institute, Columbus Laboratories, Columbus, Ohio, U.S.A.

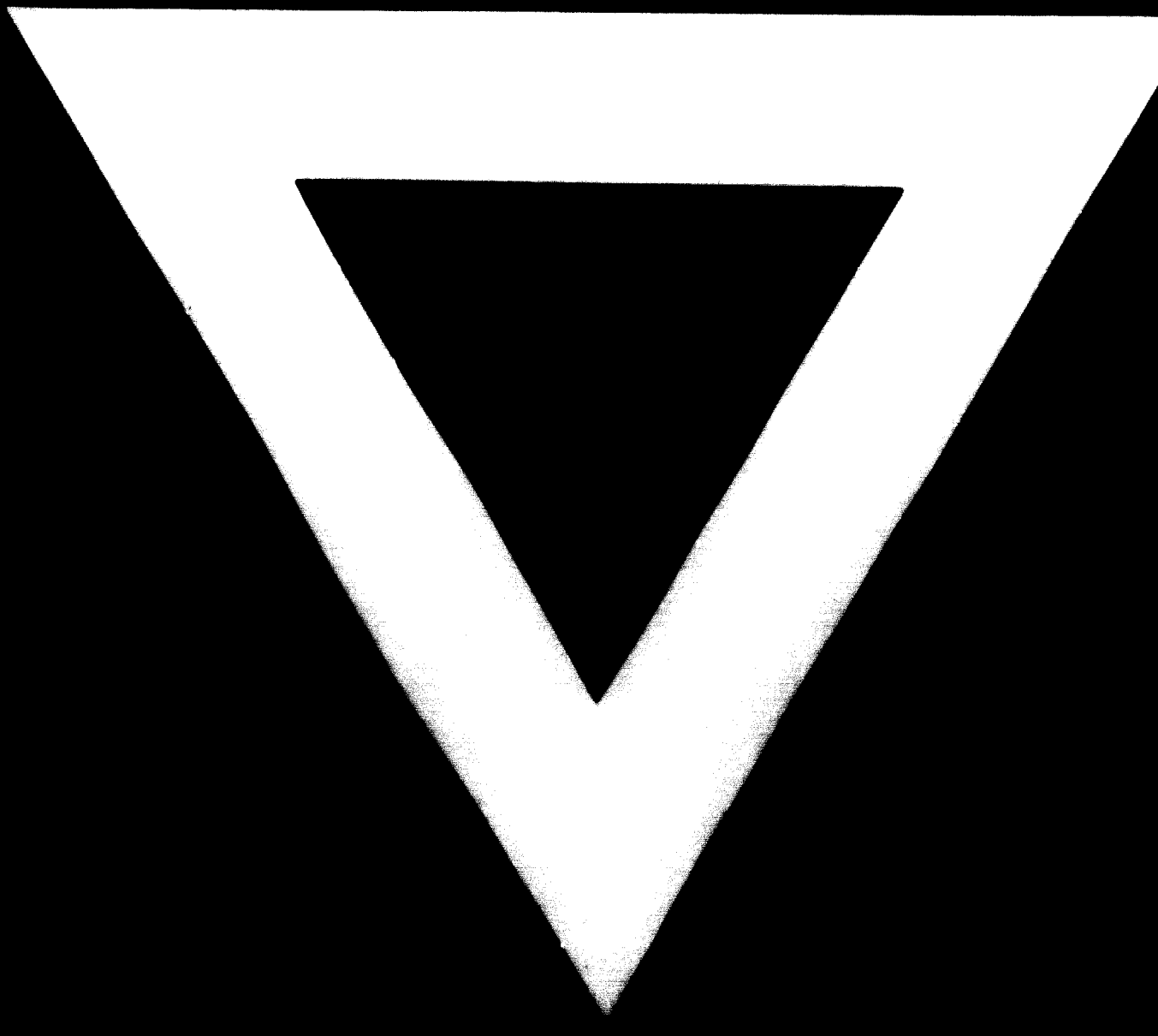
Acknowledgements

Due credit is given *to the following publications from which excerpts were taken for inclusion in this issue:*

Battelle Technical Review, Columbus, Ohio; British Columbia Research Council, Vancouver, B.C., Guidelines to Industrial Progress; East African Industrial Research Organization, Nairobi, Kenya, Annual report; Engineering Materials Newsletter, Metals Park, Ohio; Far Eastern Economic Review, Hong Kong; Federal Institute of Industrial Research, Lagos, Annual report; Federal Institute of Industrial Research, Lagos, Research Reports; The General Electric Company, Schenectady, New York, Annual report; Council of Scientific and Industrial Research, NML Foundry Station, Madras; Iran Press, Teheran; Mechanical Engineering, New York; National Institute of Science and Technology, Manila, The NIST; National Research Development Corporation, London, Annual report; Natural Rubber Producers' Research Association, NR technical bulletin; The Philips International Institute of Technological Studies, Eindhoven, Netherlands; Nigeria Ministry of Information, Nigeria Trade Journal; Scandinavian research information notes, Copenhagen; Tropical Products Institute, London, Training at the Tropical Products Institute; U.S. Department of Commerce, International Commerce; U.S. Library of Congress, National Referral Centre for Science and Technology; West Cameroon Ministry of Development and Internal Economic Planning, Buea.

Illustrations in this issue *are United Nations photos with the exception of the following, for which due credit is given: page 6, General Electric Company, Schenectady, N.Y., U.S.A.; page 9, Ministry of Culture and Information, State of Kuwait; pages 19, 28, 29, 31, Institute for Processing Techniques, Zagreb, Yugoslavia; page 19, Institute for the Support of Scientific Research in Industry and Agriculture, Brussels, Belgium; page 20, National Metallurgical Laboratory, Jamshedpur, India, and Battelle Memorial Institute, Columbus, Ohio, U.S.A.; page 21, Tropical Products Institute, London, England, and British Columbia Research Council, Vancouver, B.C., Canada; page 39, Tea Research Station, Kanaya, Shizuoka, Japan; page 44, Tropical Products Institute, London, England; page 45, Instituto de Tecnologia y Química, Montevideo, Uruguay; pages 52, 53, Central Glass and Ceramic Research Institute, Calcutta, India; and page 66, International Chamber of Commerce, New York, N.Y., U.S.A.*

Information *concerning institute activities and research programmes was provided by the co-operating institutes.*



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