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BULLETIN

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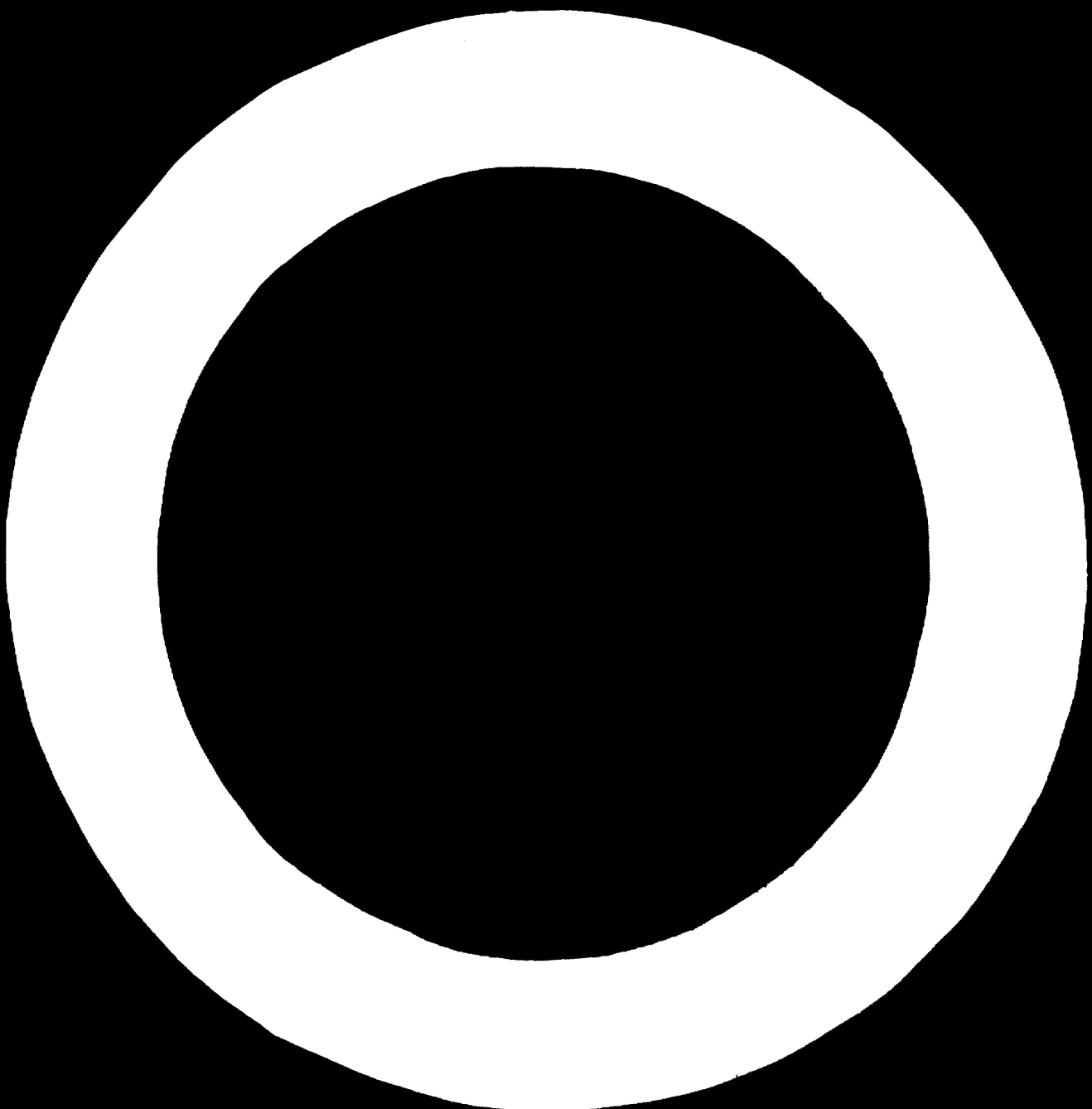

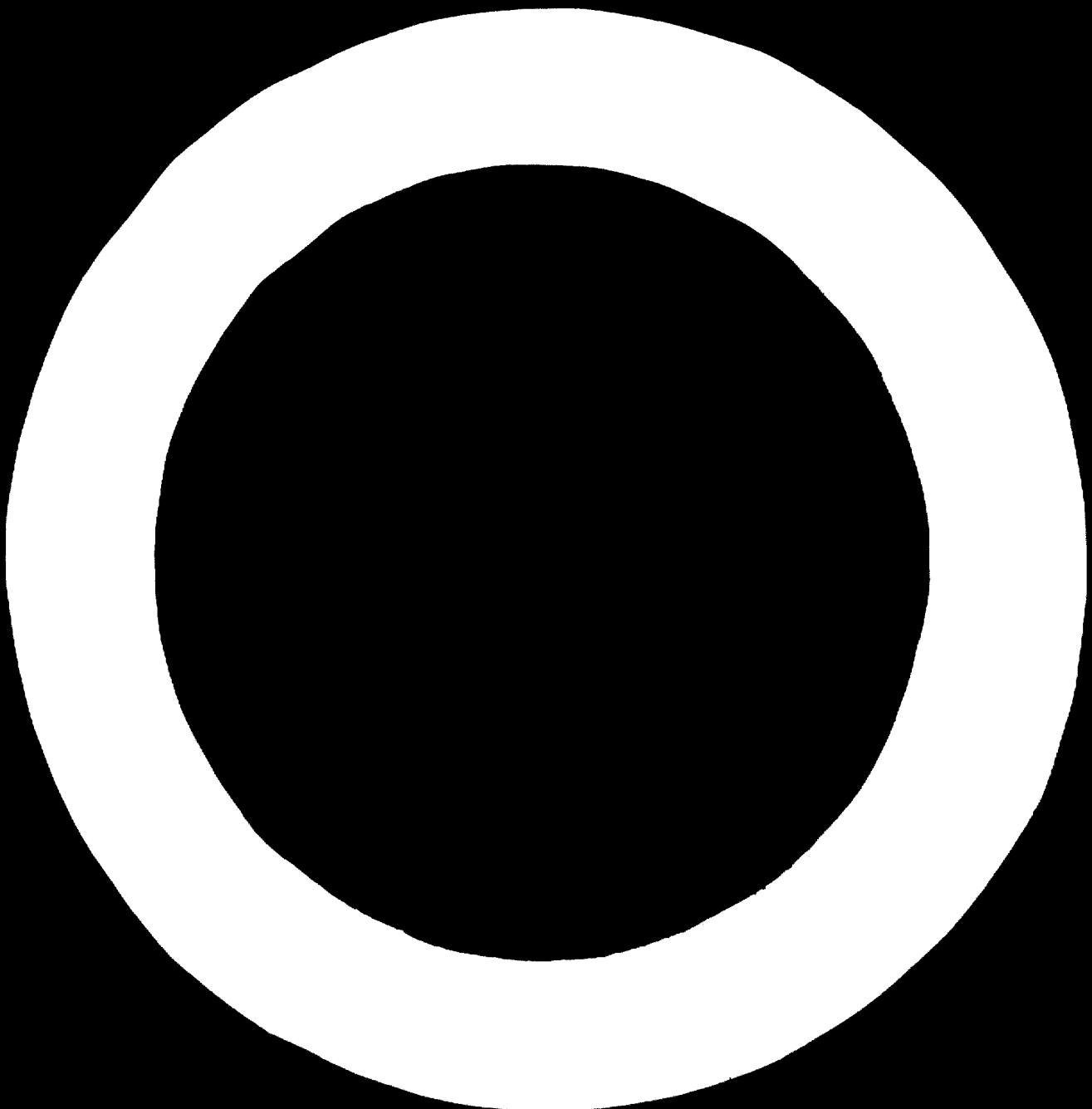

INDUSTRIALIZATION AND PRODUCTIVITY

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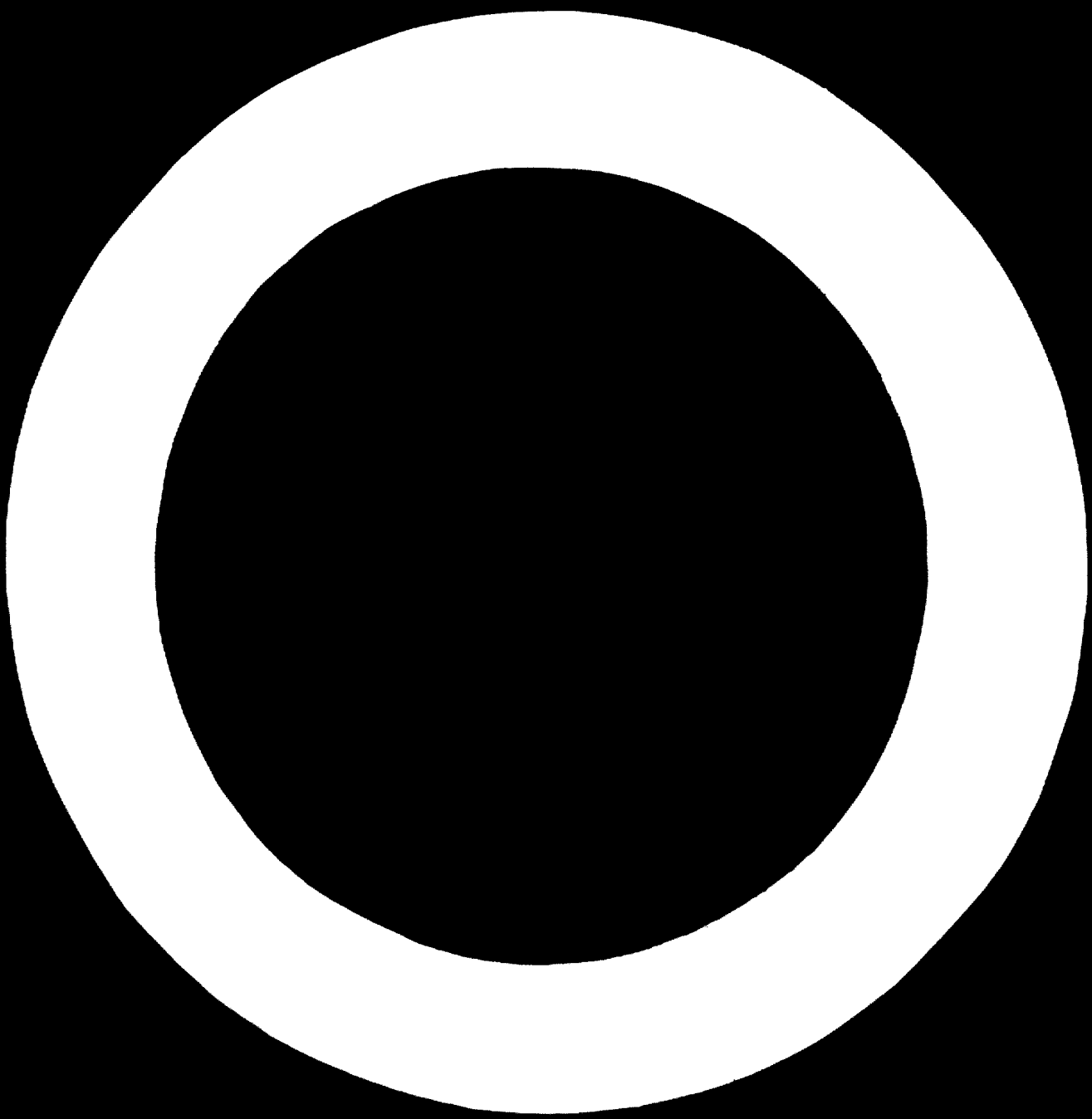

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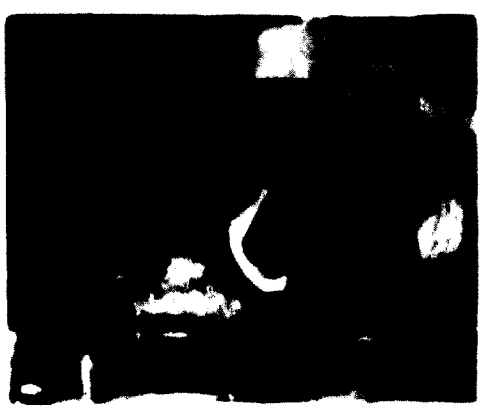
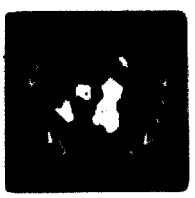


Cover illustration: Basic oxygen furnace being charged with molten iron in a Pennsylvania steel mill. An article in this issue on adaptation of processes, equipment and products refers, among others, to processes utilizing direct oxygen blast in steel making

Department of Economic and Social Affairs



INDUSTRIALIZATION AND PRODUCTIVITY

BULLETIN 6

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Preface

IN THE COURSE of 1961, two major decisions were taken by United Nations organs aimed at promoting and accelerating the economic development and, in particular, the industrialization of the less developed countries.

In a resolution adopted in August 1961, the Economic and Social Council recommended the convening, under the auspices of the United Nations of a conference on the application of science and technology for the benefit of the less developed areas. This conference, which will be held at Geneva in February 1963, is devoted to exploring the challenging opportunities for accelerating economic development through the more effective application of existing science and technology and through research specifically designed to produce new applications of special interest to less developed countries. In the treatment of this theme, special emphasis will be given to problems of transfer and adaptation of industrial technologies developed in the advanced countries for use in the industrializing areas.

In a resolution adopted in December 1961, the General Assembly of the United Nations designated the current decade as "the United Nations Development Decade, in which Member States and their peoples will intensify their efforts to mobilize and to sustain support for the measures required on the part of both developed and developing countries to accelerate progress towards self-sustaining growth of the economy of the individual nations and their social advancement". In the same resolution, the Secretary-General was requested to develop proposals for the intensification of action in the fields of economic and social development by the United Nations system of organizations to further the objectives of the Development Decade.

In accordance with this resolution, the Secretary-General submitted proposals for extending the activities of the United Nations Secretariat in several areas, in particular that of industrial development. Within this area, action will be intensified in four principal directions: support of industrial planning and programming, strengthening of industrial advisory services, promotion of small-scale industries, and extension of industrial training.

The articles contained in this issue of the *Bulletin on Industrialization and Productivity* are concerned with some of the problems of industrial development to which special attention is being given as a result of the decisions of the Council and the Assembly. Since many of these problems present interrelated aspects, several of them are discussed in most of the articles, though in different contexts and perspectives.

The theme of transfer and adaptation of industrial technology is developed in some aspects in the first article—"Adaptation of Processes, Equipment and Products". Its purpose is to draw attention to the need for orienting research relating to technological change or innovation so as to respond to the economic and institutional conditions and resource endowment of the developing countries. The article contains a brief analysis of the objectives sought in adapting in that direction existing processes, equipment and products—or developing new ones—and provides some examples drawn from different industries. Information is also given on recent action of the United Nations in the field of transfer of industrial technology for the benefit of the less developed areas, in particular on the conference referred to above.

The Secretary-General's proposals for intensified action in connexion with the Development Decade in fields relating to industrial development are outlined in some detail in the next article—"Industrial Development in the United Nations Development Decade". Topics in all four fields—training, small-scale industries, industrial advisory services, and industrial planning and programming—are examined in the other articles and material included in this issue.

The article on "Training for Industrial Production of Prototype Machinery" by Professor A. D. Bohra is concerned with some aspects of the first three topics. It describes and analyses the functions of a new type of institution developed in India to provide small-scale industries with training, servicing, assistance and advice—the so-called "Prototype Production and Training Centres". The major function of these institutions is to facilitate the transfer and adaptation of machine building technologies developed in the advanced countries for manufacture and use of the machines by Indian small-scale industries. This is done by developing equipment prototypes and by training managers and workers to produce this equipment on commercial lines.

The article on "United Nations Fellowships for Industrial Development" reviews recent overseas training programmes of the Organization in order to bring out and analyse the problems encountered in this field and in this way provide some guiding lines for a course of action in the future.

Finally, this issue contains two documents relating to the fourth topic—industrial planning and programming. The first is the text of a questionnaire which was circulated by the United Nations Secretariat to Member States early in 1962 to elicit information on the institutional arrangements for, and the methods applied in, industrial planning and programming, as well as on measures and instruments used in the implementation of such plans and programmes and in the promotion of industrial development in general. The questionnaire provides a systematic classification of the problems and economic and institutional factors which are to be taken into consideration at various stages of planning and programming. The other document is the second part of the "Preliminary Bibliography for Industrial Development Programming", dealing with chemical and related industries. The first part of the bibliography, relating to industries in general, was published in the fifth issue of the *Bulletin*.

The first, second and fourth articles and the questionnaire were prepared by the Research and Evaluation Division of the Centre for Industrial Development, Department of Economic and Social Affairs.

Adaptation of Processes, Equipment and Products

THE ADAPTATION OF processes, equipment and products to local conditions is constantly under review by industrial engineers and managers in every country. It is well known that technological change and innovation have primarily taken place under the stimulus of conditions obtaining in the developed countries where the main body of technological knowledge, skilled manpower and advanced equipment exists. The under-developed countries present, in most cases, a different environment with respect to factors of production, availability of managerial and supervisory skills, nature of raw materials, fuel and power supplies and repair and maintenance facilities, climatic conditions, general economic organization, and domestic and foreign marketing opportunities.

For this reason, the means and techniques of production developed in the advanced countries cannot always be directly transferred to the industrializing countries, but have to be adapted in many cases to meet the specific economic, technical, environmental and other conditions which prevail in them.

The purpose of this study is to draw attention to the need for orienting technological change or innovation—wherever feasible—so as to respond to the particular economic and institutional conditions and resource endowments of under-developed countries, in particular their shortage of capital and foreign exchange. The study contains a brief analysis of the objectives sought in adapting processes, equipment and products, and provides some examples of significant adjustments made in certain industries. Information is also given on recent work of the United Nations in the field of transfer of industrial technology for the benefit of the less developed areas.

This article complements two studies already published in a previous issue of the *Bulletin*, which discussed the problem of technological change with reference to two specific industries or industrial operations: wood-working and welding.[1] It also complements a series of studies which discussed these problems from specific points of view, especially those of capital intensity, size of plant and use of industrial equipment,[2] and the establishment of technological research institutes in under-developed countries.[3]

[1] "Choice of Industrial Technology: The Case of Wood-working", by G. K. Boon, and "Use of Welding in Machine-building", by E. P. Unksov, *Bulletin on Industrialization and Productivity*, No. 3 (Sales No.: 60.II.B.1).

[2] "Capital Intensity in Industry in Under-developed Countries", "Choice of Technology in Industrial Planning", "Capital Intensity in Heavy Engineering Construction", *Bulletin on Industrialization and Productivity*, No. 1 (Sales No.: 58.II.B.2); "Problems of Size of Plant in Industry in Under-developed Countries", *ibid.*, No. 2 (Sales No.: 59.II.B.1); "Capital Intensity and Costs in Earth-moving Operations", *ibid.*, No. 3; "Choice of Techniques", "Use of Industrial Equipment in Under-developed Countries", *ibid.*, No. 4 (Sales No.: 60.II.B.2).

[3] *Ibid.*, No. 2.

ADAPTATION OF PROCESSES

IN THE INDUSTRIALIZING countries, changes in the processes developed in the advanced countries, or research on new, specially adapted processes, come into consideration if the following objectives are to be achieved:

(1) Reduction in capital input—a requirement resulting from the scarcity of capital generally prevailing in these countries;

(2) Reduction in input of certain scarce materials, or of imported materials, fuels and power, by the widest possible use of substitutes and indigenous raw materials—a requirement due to the shortage of foreign exchange needed to import them;

(3) Better utilization of waste materials, by-products, low-grade ores and the like, for which special techniques may have to be devised.

The achievement of the first objective may, in some cases, call for adoption of capital-saving techniques. As has been pointed out in an earlier study on the subject,[4] a great deal of research is needed to reveal technological alternatives and determine an appropriate technologically acceptable "factor-mix" in specific industrial operations—a relatively little explored field of study.

Examples of adaptation of techniques to meet this objective are given in some of the studies listed earlier[5] with

[4] "Capital Intensity in Industry in Under-developed Countries", op. cit., page 23.

[5] *See* footnote 2.

respect to a number of industrial operations, such as manufacturing of machine parts, earth-moving, including excavation, hauling, filling and compacting, manufacture of window frames and furniture and others. Well-known examples are the substitution of labour in the ancillary operations in industry, such as internal factory transportation or packaging certain finished products. As a rule, such substitution is less appreciable in "core" operations in industry.

As regards adaptation to achieve the second and third objectives, significant examples of techniques making use of substitute or indigenous materials, fuels and power, and of waste materials, by-products, etc. may be found in the pulp and paper, iron and steel, chemicals, plastics, welding and foodstuffs industries, among others. Some of them are given in the following paragraphs.

PULP AND PAPER

Considerable work is currently under way on the use of local woods and other ligneous raw materials of indigenous origin for the manufacture of pulp and paper. In many under-developed countries situated in tropical regions, there is a deficiency of the long-fibred soft woods which form the base of the pulp and paper industry. A good deal of research has been carried out to adapt for the treatment of hard woods the processes normally used for soft woods, and techniques have been developed and applied—in commercial operations or pilot plants—for processing bagasse, bamboo, rice-straw and other materials indigenous to the tropical areas.

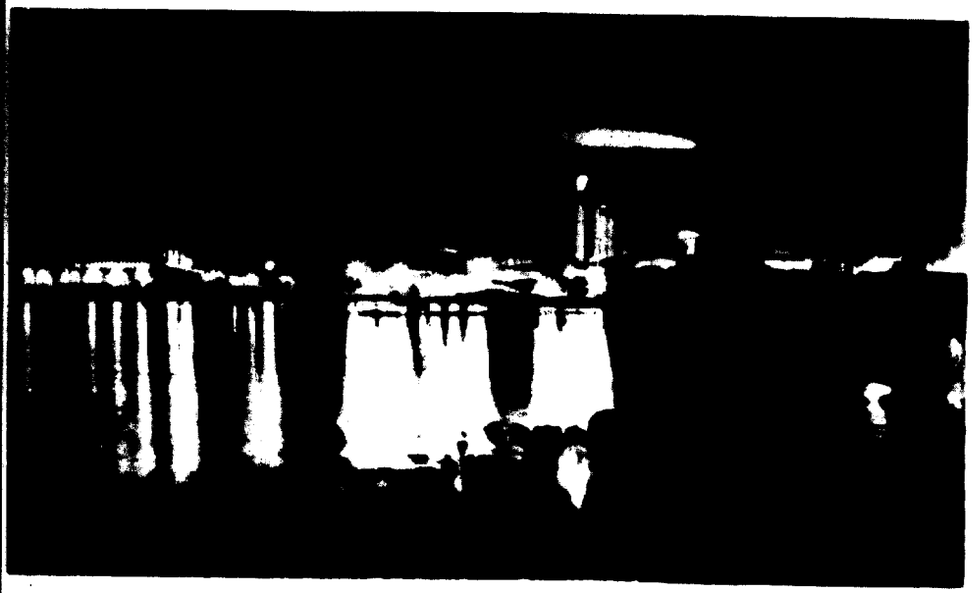
The processes for making pulp from bagasse—the residue from refining of sugar cane—are now well established. It is reported that in India, practically the total production of bagasse is reserved for pulp manufacture instead of being used as a fuel at the sugar mills; the improvements in bagasse processing techniques, as well as in the availability of fuels, especially oil in India, are responsible for this development. The process is also applied in several countries of Latin America, where bagasse is widely available, in particular, Cuba and Colombia.

In India, Japan and Pakistan, processes for treating bamboo for pulp manufacturing have been developed and applied. The Union of Burma Applied Research Institute (UBARI) of Rangoon has recently perfected a technique for making cardboard from bamboo strips which does not involve the use of chemicals.

Processes utilizing straw, especially rice-straw, have also been developed; in Japan, a factory has been built which produces 57,000 tons of paper from this material. The use of straw may be of especial importance for medium-sized pulp and paper mills.

These developments have received considerable attention in recent years in view of the importance of the pulp and paper industry, as a supplier of both intermediate and final goods, in the industrialization programmes of many countries. In 1954, the Economic Commission for Latin America (ECLA) and the Food and Agriculture Organization of the United Nations (FAO) jointly sponsored a Conference of experts on that industry in Latin America. A large part of the discussion was devoted to new technological developments.[6]

[6] The report of the Conference has been published under the title *Pulp and Paper Prospects in Latin America* (United Nations publication, Sales No.: 55.II.G.4). See also *Possibilities for the Development of the Pulp and Paper Industry in Latin America* (United Nations publication, Sales No.: 53.II.G.2).

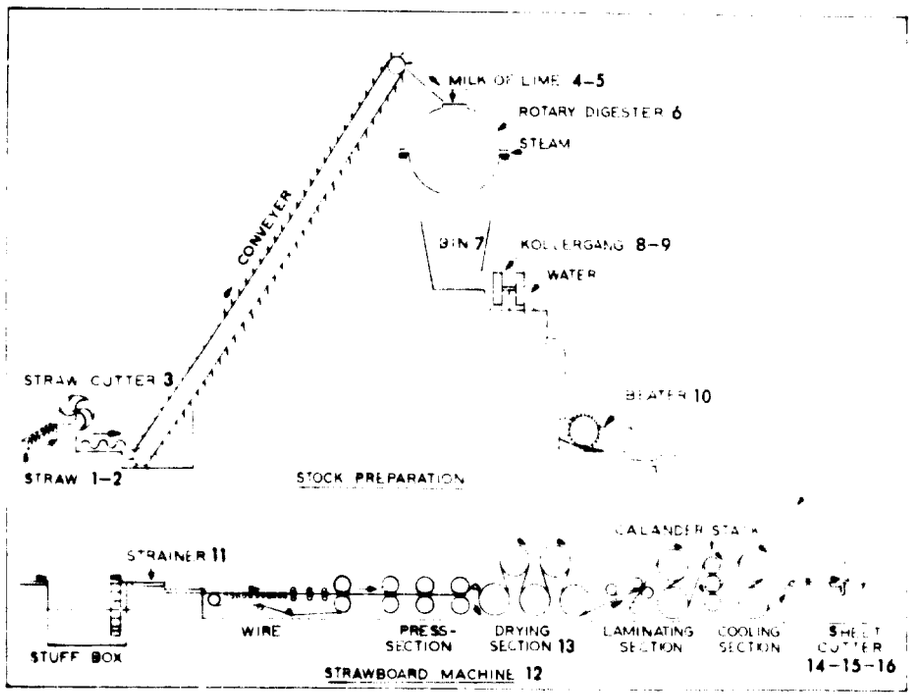


INTEGRATED SAWMILL AND PULPMILL PLANT IN FINLAND

ABOVE: *Tower housing the soda recovery boiler and pulpwood storage area of the same mill*

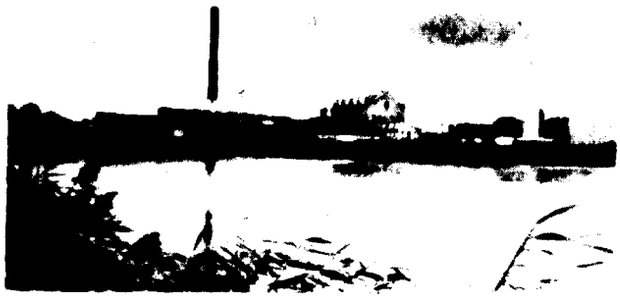
LEFT: *The tower in the background houses the world's largest boiler for soda recovery, with a capacity corresponding to an output of 700 tons of sulphate pulp a day*

MANUFACTURE OF STRAWBOARD

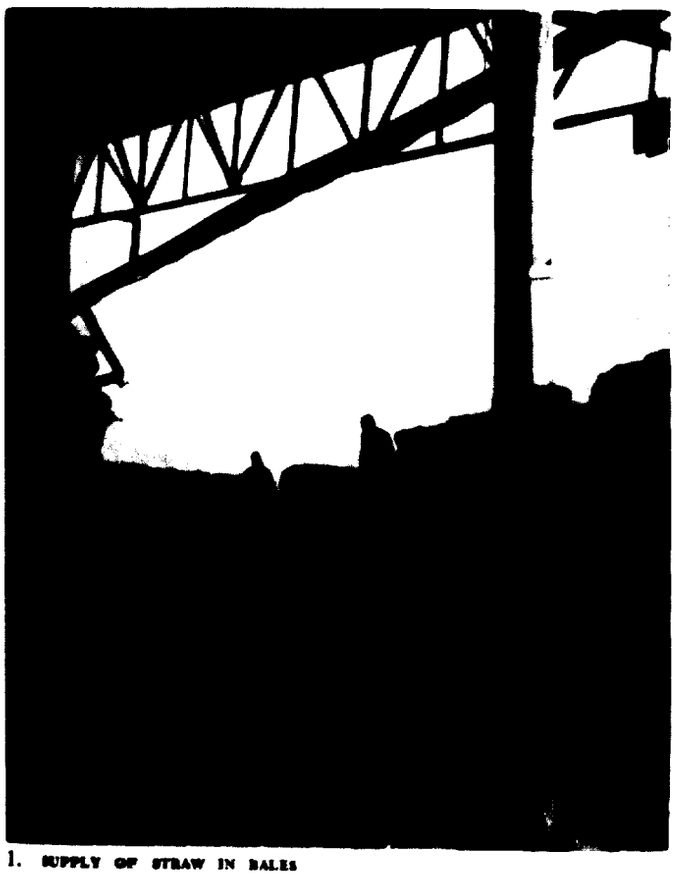


FLOWSHEET OF A STRAWBOARD MILL

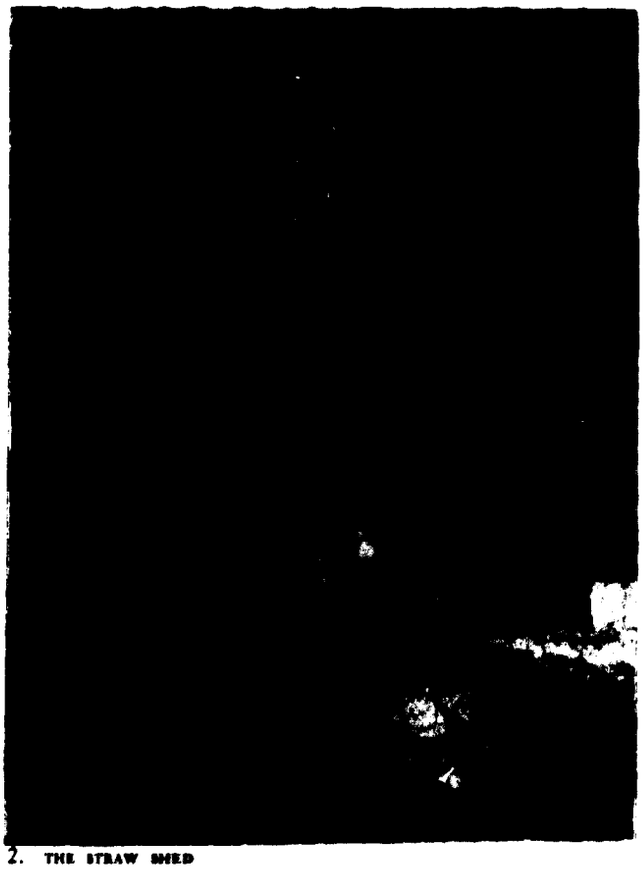
The numbers on the flowsheet correspond to those of the photographs



STRAWBOARD MILL AT HOOGKERK, GRONINGEN, THE NETHERLANDS



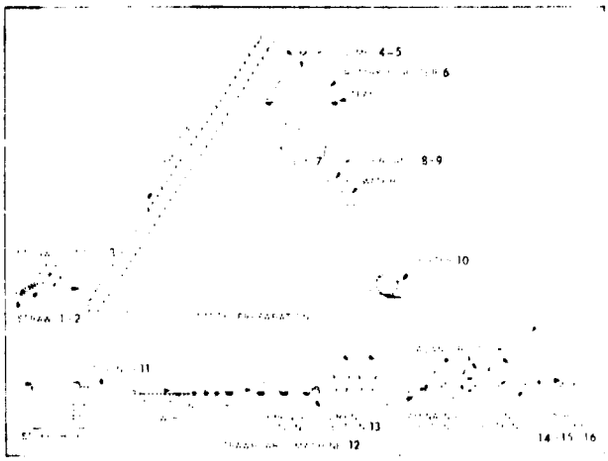
1. SUPPLY OF STRAW IN BALES



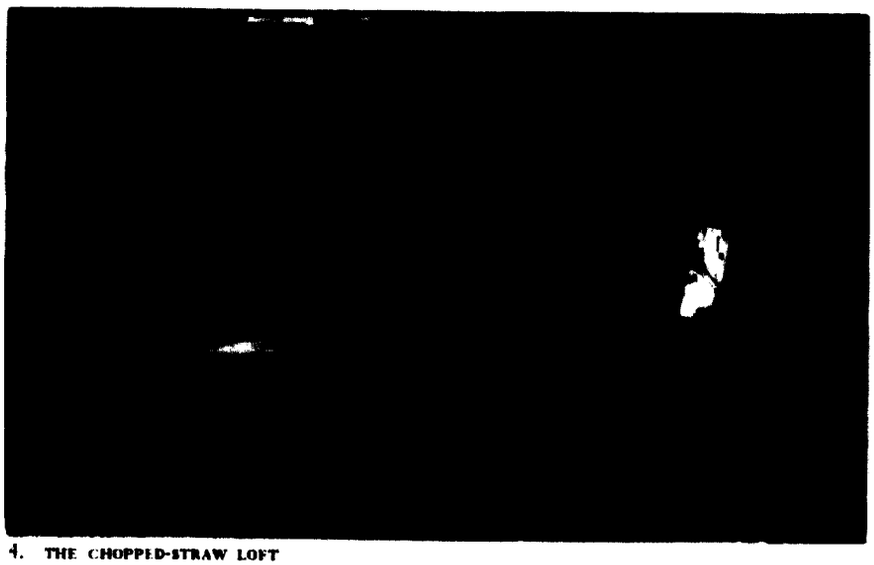
2. THE STRAW SHED

1. SUPPLY OF STRAW IN BALES. *Each bale measures approximately 50 x 55 x 110 centimetres and has an average weight of 52 kilogrammes air-dry. The moisture content of the straw is between 15 and 25 per cent*

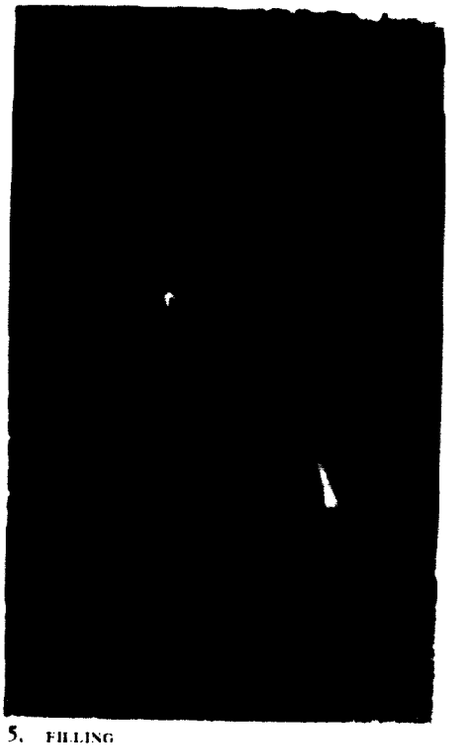
2. THE STRAW SHED. *The straw is usually stored at the farms and delivered to the mill as and when required. However, at certain periods of the year, the farm sheds must be emptied for storage and/or processing of other products. The remaining straw is then transferred to the mills, where it is temporarily stocked in large sheds. The shed illustrated has a storage capacity of 5,000 tons of straw*



3. THE STRAW CUTTER

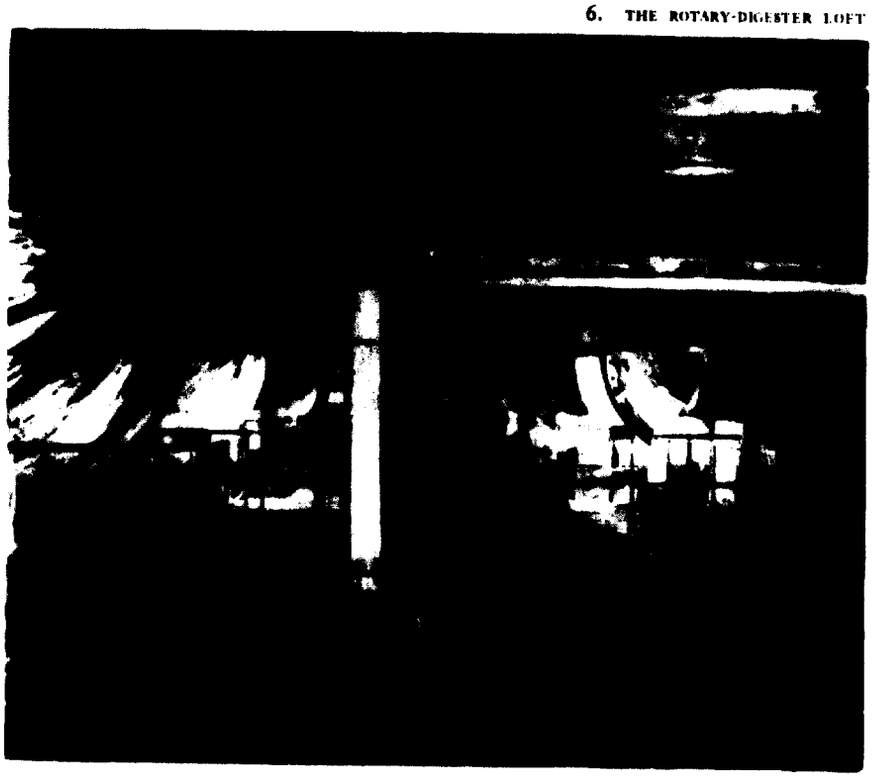


4. THE CHOPPED-STRAW LOFT



5. FILLING

6. THE ROTARY-DIGESTER LOFT



7. THE PULP BIN

8. THE KOLLERGANG (EDGE RUNNER)

9. CLOSE-UP VIEW OF THE KOLLERGANG

5. THE STRAW CUTTER. *After the bales were opened and 200 grammes of iron wire per bale removed from the bales, the straw is cut in pieces of three to five centimetres. The output of the cutter illustrated is seven tons per hour. The chopped straw is freed from impurities such as dust, grains, sand and the like and is then conveyed to the chopped straw loft.*

4. THE CHOPPED-STRAW LOFT. *The loft is located in the upper part of the mill. In the floor are several openings through which the chopped straw and the cooking liquor (milk of lime) are fed to the spherical rotary digesters below.*

5. FILLING. *Straw has a very low bulk density: one kilogramme of chopped straw takes a volume of about twenty litres. During filling of the rotary digester, "filling" steam is supplied to decrease the volume of chopped straw and increase the degree of filling. This is also achieved by use of the automatic stamp device illustrated—a heavy cone-shaped weight, which is dropped fifteen times a minute.*

6. THE ROTARY-DIGESTER TOUR. *After the digester has been closed, rotation begins and the contents are raised to cooking temperature by introducing steam into the cooker via a hollow shaft. Common cooking temperatures are 130 to 160 degrees centigrade, at a pressure of 1.5 to 5 kilogrammes per square centimetre. Cooking time is two to three hours. The complete cooking cycle—filling, stamping, cooking, blowing off steam and emptying the rotary digester—takes about seven hours.*

7. THE PULP BIN. *After cooking, rotation is stopped and the steam blown off. Part of the steam is used as "filling" steam for cooking in another digester. The digester is then opened [illegible] the pulp discharging into a pulp bin.*

8. THE KOLLERGANG (EDGE RUNNER). *From the pulp bin the pulp is fed to an edge runner by means of a conveyor. It [illegible] the dry-matter content of the pulp is approximately 20 per cent.*

9. CLOSE-UP VIEW OF THE KOLLERGANG (EDGE RUNNER). *The edge runner breaks up the lumps, crushes the fibres and effects [illegible] fibrization. Depending on the degree of [illegible] the pulp [illegible] weight of the runners, fibrization time is [illegible] minutes.*

10. THE HOLLANDER BEATER. *From the edge runner the pulp is mixed with recirculation water in the Hollander beaters. In this [illegible] the dry-matter content of the pulp is approximately 3 per cent. The pulp is continuously passed between the beater roll—a roll fitted with knives—and a knived bedplate. The roll may be loaded, thus varying roll pressure. Beating time is from ten to twenty minutes. When a certain degree of beating has been achieved, which is judged by sight, the beaten pulp is discharged to the stuff box. In the box the pulp is diluted further prior to conveying it to the paper machine.*

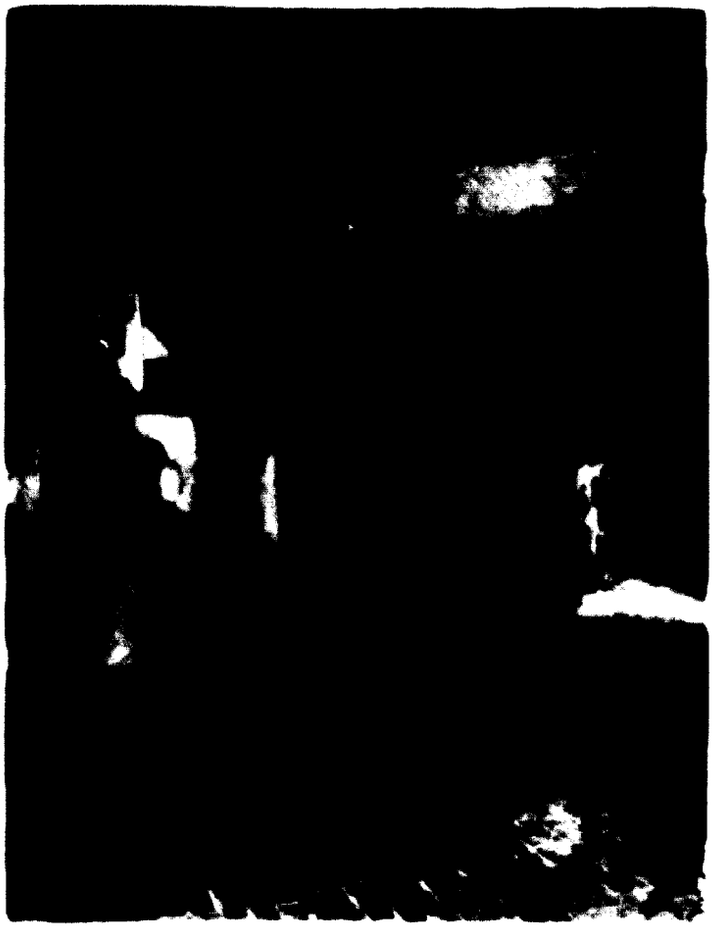
11. THE STRAINER. *By means of a slurry pump, the pulp, dilutes to approximately 2 per cent, is pumped to the machine. A cutter is fitted as a sand trap. The pulp is screened by means of a strainer—a flat shaking screen—and then moved on to the wire of the paper machine. The screened coarse fibres and rejects which must be removed from time to time.*

10. THE HOLLANDER BEATER

11. THE STRAINER

12. THE HEAD OF THE PAPER MACHINE: THE WET SECTION

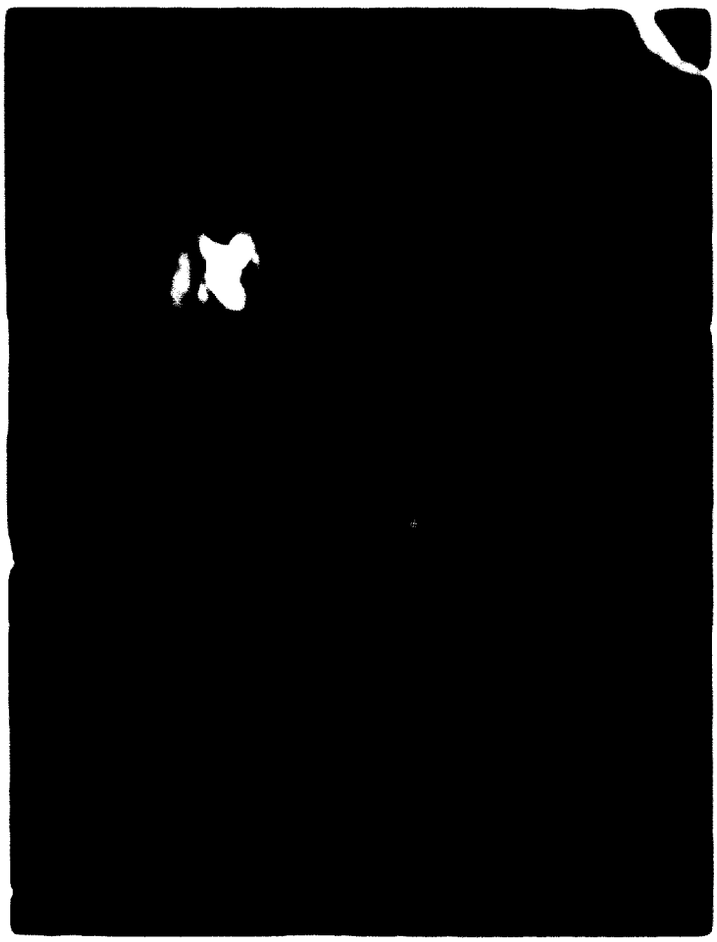
13. THE DRYING SECTION



14. CUTTING I

15. CUTTING II

16. CUTTING III



12. THE HEAD OF THE PAPER MACHINE: THE WET SECTION. After the coarse parts have been screened, the pulp is run evenly on to the wire about two to three metre wide endless belt of wire cloth on which, after the water has drained off, the web is formed. The speed of the sheet on the machine is about fifteen to twenty metre per minute.

13. THE DRYING SECTION. After being dewatered on the wire the web passes through sets of rolls (press rollers) which increase the dry matter content to 35 to 40 per cent. The sheet is then passed over a number of steam heated drying cylinders. After drying the dry matter content is about 90 per cent. The maximum weight of sheet that can be made on the machine is about 1 000 grammes per square metre.

14. CUTTING I. Up to a thickness of about 500 grammes per square metre the strawboard can be rolled up. With longitudinal cutters different widths can be obtained.

15. CUTTING II. Thicker strawboards up to 1 000 grammes per square metre are turned out as sheets. Here a traverse cutter determines sheet length. The sheets are piled and tied up into packets.

16. CUTTING III. Weights above 1 000 grammes per square metre are obtained by gluing several sheets together. After being glued the sheets are cut to size with an adjustable guillotine cutter.

Operators in the control pulpit of the basic oxygen furnaces of a Pennsylvania mill observe closely as iron is refined to steel in a matter of minutes. Extending down through the hood into the furnace (right), a water cooled lance delivers pure oxygen, which is sprayed directly on to the surface of the molten bath

In October 1960, the Economic Commission for Asia and the Far East (ECAFE) and FAO co-sponsored a regional Conference on the subject, which was also largely devoted to the study of the technological and other problems involved in developing the industry and meeting the growing demand for its products. Several Conference papers discussed the new technologies. The Conference noted that there was considerable scope for further improvement in the technologies, outlined areas for further work and drew attention to the need for developing and strengthening research institutions in this field in the region.[7]

IRON AND STEEL

New technologies for the manufacture of iron and steel have been developed in recent decades in western Europe to meet difficulties experienced by the main producing countries as a result of shortages of coke and other solid fuels. Such shortages have often proved to be a major obstacle in setting up the iron and steel industry in the industrializing countries. Some of the innovations developed in the advanced countries may be of immediate interest to the developing ones, taking into account that some adaptation to local conditions will always be required.

Among the new techniques aimed at reducing solid fuel consumption are processes utilizing direct oxygen blast in steel making, and processes eliminating altogether solid fuel inputs; the latter include direct reduction by hydrogen in electrical furnaces, and reduction of iron ore by natural gas. Techniques have also been devised for improving the preparation of raw materials.

Techniques for treating iron ores with a high content of impurities are increasingly used in many countries, developed and under-developed, which may present appreciable advantages in some of the latter.

Recent developments in the iron and steel industry have been under review by a number of units of the United Nations, in particular the Economic Commission for Europe (ECE). A discussion of the economic consequences of technological trends in the industry is contained in a recent ECE report.[8] Many of the developments reviewed in this report may be of use in the industrializing countries. In Latin America, these problems have been considered at conferences organized by ECLA in Bogota, Colombia, in 1954, and at São Paulo, Brazil, in 1956.

Because of the growing interest of the developing countries in various regions in this industry, a working party on new developments in iron and steel technology is being organized under the joint sponsorship of the United Nations at Headquarters and ECAFE, ECE and ECLA. The meeting will be held in the ECAFE region. The principal topics on the agenda are new methods of pig-iron and steel production, which are to be analysed from the standpoint of

[7] The report of the Conference will be published in the course of 1962 under the title *Pulp and Paper Prospects in Asia and the Far East* (United Nations publication, Sales No.: 62.II.F.4).

[8] United Nations, *Long-term Trends and Problems of the European Steel Industry* (Sales No.: 60.II.E.3).

the availability of resources in the developing countries and the recently developed techniques of iron and steel making. In particular, the problem of producing metallurgical coke from non-coking or low-grade coking coals will be among the main items to be discussed.

OTHER INDUSTRIES

Technologies making use of local raw materials, or of substitute or waste materials, by-products and the like, have been developed in other industries.

One of these developments is related to the pulp and paper industry. In India, a United Nations technical assistance mission has been assisting the Government in devising methods for the recovery of caustic soda in the manufacture of pulp. It is estimated that the recovery and re-use of this material would reduce the cost of pulp by more than 5 per cent. While imported equipment will be needed for this process, imports of caustic soda would be reduced, which will entail a net saving in foreign exchange.

The problem of recovery of chemicals in pulp manufacture was discussed at the above mentioned ECAFE–FAO Conference on that industry. Attention was drawn to the fact that such a recovery was economical, at the present time, only in relatively large plants. Research was under way to develop processes and equipment that would permit recovery in smaller establishments, and the Conference recommended, among other things, that efforts be pursued in that direction.

In Japan and Pakistan, techniques have been developed for collecting and processing coal dust in mines and facilities for small-scale manufacturing of briquettes have been designed. In countries of Asia and the Far East, coal resources are generally scarce and of poor quality, and a process of this type may make available additional fuel supplies at relatively low prices.

Examples of the use of waste materials are also found in the food industry. Thus, the Union of Burma Applied Research Institute has patented a process for the manufacture of cooking oil from rice bran and is currently designing a plant for this new industry. In view of the fact that Burma has so far imported practically all of its cooking oil – in 1959, imports amounted to the equivalent of $11.5 million – this development should result in appreciable savings in foreign exchange. The Central American Technological Institute for Industry has investigated the industrial utilization of bagasse resulting from the distillation of citronella oil and lemongrass oil, of coffee waste products, of yucca for the production of starch, etc.

Considerable research and experimentation are being carried out in many advanced countries on general forms of substitution of new materials for the traditional ones, for instance, replacement of steel by aluminium and plastics.[9] Some of these new technologies have already been adopted in the industrializing countries. There has been, in particular, a rapid growth in plastics industries producing such goods as tubing, hardware items and toys, based in many cases on imported plastic materials. These industries serve both the domestic and the foreign market.

Some technological developments achieved in the advanced countries for the processing of low grade ores and other substitute materials have proved to be impracticable in the industrializing countries for economic reasons peculiar to the latter. Thus, proposals have been made to use, in certain under-developed countries, techniques for producing sulphur dioxide from pyrite ores. In Europe, where such techniques have been developed and applied, the competitiveness of pyrite ores with elemental sulphur depends to a large extent on the existence of a market for residuals of pyrite processing. In the European metallurgical industry, such residuals are mixed with other raw materials for production of iron. Adoption of such techniques for the processing of pyrite ores appears to be premature in the industrializing countries where the iron and steel industry is little developed.

[9] Both materials present the advantage, among others, of requiring less complex and less costly equipment for fabrication. Studies on the substitution of other products for steel have been carried out, in particular, by the Economic Commission for Europe.

ADAPTATION OF EQUIPMENT

Modification in the type or use of the equipment employed in the industry of the advanced countries may be indicated in the industrializing countries for the following purposes:

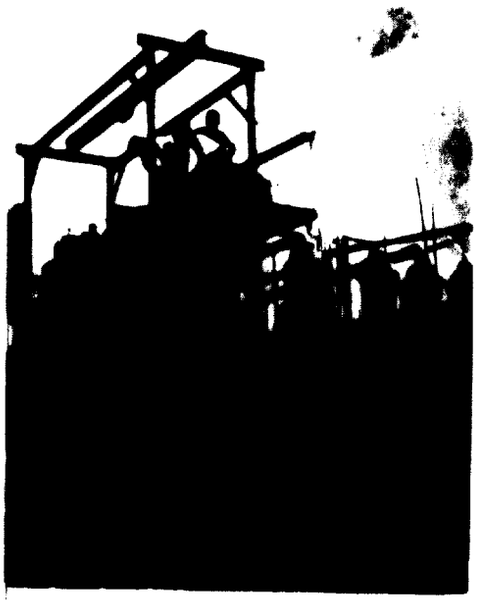
(1) Use of newly adapted processes and of alternative sources of power;

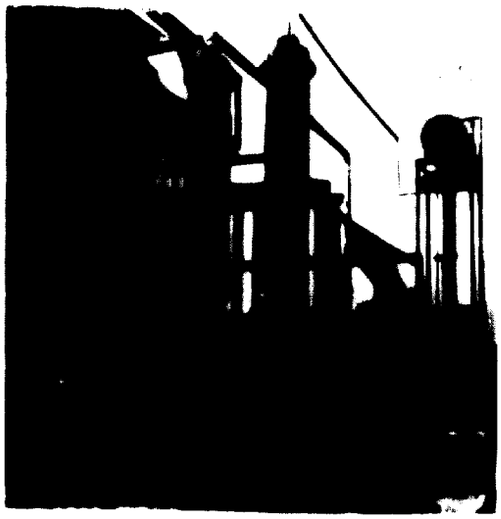
(2) Achievement of a smaller economic capacity than that afforded by conventional types of equipment;

(3) Use of machinery for multiple industrial operations, and development of multi-purpose equipment.

Adaptations in the techniques of production, including the use of alternative sources of power, and the development of new technologies may involve new combinations of machines, modifications in certain parts of the machinery, or the designing of new industrial apparatus. In the advanced countries, such changes, which are one of the expressions of technological progress, tend essentially to raise productivity, improve quality and reduce costs. In the less developed countries, as already mentioned, they may tend principally to achieve optimum utilization of capital, skilled labour and other scarce resources. Examples of combinations of equipment corresponding to alternative techniques are to be found in some of the studies listed earlier. Examples of modifications—most of them of minor scope—introduced in conventional machinery as a result of adaptation of techniques are sometimes found in reports of technical assistance experts. However, new types of equipment often have to be designed and built to apply newly developed techniques, such as those, mentioned earlier, for the processing of waste or substitute materials.

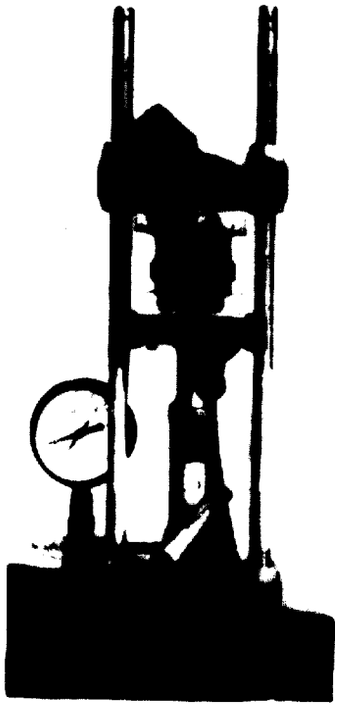
Technical assistance experts frequently observe that the standard machinery manufactured in the advanced countries has a much larger production capacity than that warranted

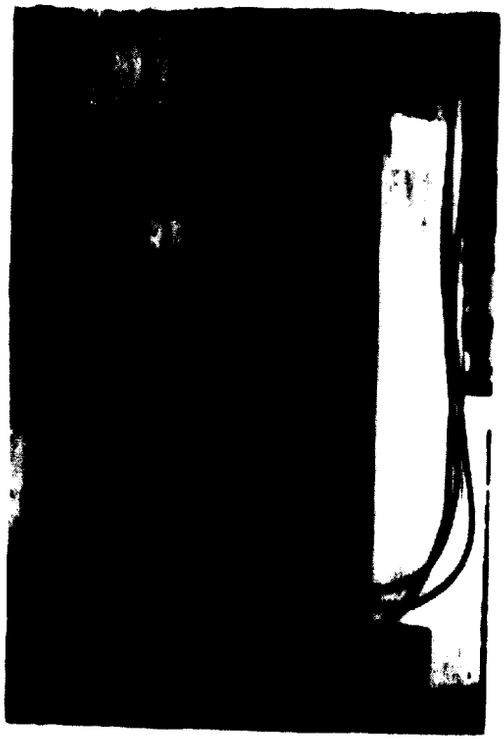




THREE TON RICE BRAN OIL EXTRACTION PILOT PLANT (*patented*) *developed by the Union of Burma Applied Institute* (UBAI), *Rangoon.* LEFT: *The pilot plant.* CENTRE: *View of the condenser system.* RIGHT: *Engineer and technician checking the operation of the plant.*

PROCESS FOR MAKING HARDBOARDS FROM BAGASSE *obtained as a residue from essential oil distillation, developed by the Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI) (Central American Technological Research Institute for Industry), Guatemala City.* AT LEFT: ***The raw material.*** BOTTOM LEFT: ***The laboratory press*** *on which first experiments were carried out; the resulting hardboard is placed on the top of the press.* BOTTOM CENTRE: ***Pilot plant press on which experiments were continued;*** *the suitably prepared raw material is being placed on a mould before pressing.* BOTTOM RIGHT: ***The finished product;*** *the hardboard at right has just left the press, the one at left has been trimmed and is ready for use.*





by the present and prospective size of the domestic and foreign market of the industrializing country concerned. Imbalances in the productive capacities of the equipment layout needed for carrying out a specific industrial operation result in idle production periods and a rise in overhead costs. Experts often consider it preferable to install, for certain essential operations, several small machines rather than a single large one, so that the entire factory would not have to shut down in case of a breakdown of the latter. Here again, it is often found that the minimum size of the standard machine is in excess of the needs of the plant under consideration. Only a few countries, among them Japan, have begun to manufacture certain types of equipment with a smaller economic capacity than is normally the case.

Recent developments in the technology for cement production may be of interest in this respect. In the beginning of the nineteenth century, cement was manufactured in vertical kilns, which presented a number of disadvantages, in particular that of uneven burning of the clinker. Later in that century, these were replaced by rotary kilns, which improved the quality of cement and permitted large-scale production, and these are still the standard equipment in the industry. In recent years, improved small-scale vertical kilns have been designed and built in Switzerland and Australia, and these are being introduced in the United States. These kilns present several advantages, in particular the fact that they can be constructed to be mobile. They may be especially suitable for some countries in the developing areas since they require substantially less investment per unit of output than the conventional equipment and may thus permit cement to be manufacured on a small scale.

There are indications that, in many industries established

ABOVE: *Operator adjusting plastic flat film extrusion die in a United States factory.* BOTTOM LEFT: *Storing polyethylene pipe.* BOTTOM RIGHT: *Extruding polypropylene filament for testing in a United States development laboratory*

in under-developed countries, the use of multi-purpose machinery would permit more economic operation than that of single-purpose equipment.[10] With multi-purpose equipment, the size of plant can be reduced and production of small quantities may become economic. Many plants in the less developed countries are characterized by the use of labour-intensive processes involving short production runs of a variety of items. Market demand is not sufficient in many cases to warrant installation of specialized machinery whose capacity in any single part or product would be excessive. A development which may be of interest for plants of this type is the designing of modular units or "building block" equipment made up of standard component units which can be replaced so as to permit the machinery to be used for a variety of purposes. Modular-constructed machine tools are particularly versatile.

The economic importance of flexibility in the use of equipment is often underlined in the reports of technical assistance experts, and ingenious solutions are sometimes proposed. To give an example, experts have recommended, with a view to saving on the investment costs of a cigarette factory, that the casing machine be used as an "order" machine[11] and the cooling machine as a fluffing machine.[12] While there is only limited scope for expedient solutions of this type, the fact that recourse is had to them suggests that the development of new types of multi-purpose machines for certain industrial operations would be useful.

A problem having some bearing on the matter discussed in this article relates to the use in under-developed countries of old or reconditioned machinery in order to save on investment costs. Conflicting views on this question have been expressed by a number of United Nations technical assistance experts.[13] The prevailing opinion seems to be that machinery which is obsolescent in the advanced industrial countries need not involve "backward technology" and may often be of effective use in the industrializing countries. It appears that large amounts of used machinery are becoming available in the United States and the countries of western Europe as the industry of these countries undergoes modernization. Appraisal of the possibilities offered by such machinery for the developing countries calls for expert knowledge which is often lacking there. The attention of technical assistance advisers might usefully be called to this problem.

[10] *See* "Choice of Industrial Technology: The Case of Woodworking", and "Problems of Size of Plant in Industry in Under-developed Countries", op. cit. It should be noted that the use of multi-purpose machinery is technologically and economically impracticable in certain industries, in particular in the chemical industry.

[11] Machine for moistening tobacco leaves.

[12] United Nations, *Establishment of Industrial Estates in Under-developed Countries* (Sales No.: 60.II.B.4), page 47.

[13] "Capital Intensity in Industry in Under-developed Countries", *Bulletin on Industrialization and Productivity*, No. 1, page 19.

ADAPTATION OF PRODUCTS

THE PRODUCTS MANUFACTURED in the industrializing countries may have to be modified, either in relation to the types previously manufactured in the country or in relation to the types supplied in the advanced countries, for the following purposes:

(1) Use of new materials;

(2) Substitution of imported by indigenous products;

(3) Introduction of standard specifications;

(4) Promotion of exports to certain regions;

(5) Adjustment for climatic conditions, supplying local markets and meeting changes in demand.

The first four considerations are directly related to the requirement of saving capital and, in particular, foreign exchange. The use of substitute or waste materials generally involves changes in the quality specifications of the products. To give a few examples, the following products based on the use of such materials and corresponding techniques of production have been developed by the Ceylon Institute of Scientific and Industrial Research: low-cost shoe soles and rugs from the normally discarded banana tree stalk fibres; seat cushions from coir and hardboard from coir dust; confectionery from desiccated coconut; factice from rubber seed oil, and miscellaneous products from palmyra palm leaves, rubber waste and other materials.

In producing goods to replace imports, efforts are generally made to sustain competition by achieving standards comparable to those of the foreign products. The introduction of standardization, which is being promoted in many developing countries, involves changes both in dimensional standards and quality specifications. Sometimes, dual standards are applied for the domestic and foreign markets, respectively, quality specifications being frequently higher for export goods. In promoting export goods, designs corresponding to the tastes of foreign buyers are sometimes adopted, as is the case, for instance, for oriental rugs. Other export goods may have to be modified on account of changing fashions, in particular in the women's garment and dress accessory industries. Adaptations in packaging design and specifications are needed for certain products, for example, processed foodstuffs.

Adaptation of products is also needed to adjust for climatic conditions. For instance, the Ceylon Institute of Scientific and Industrial Research is carrying out research on paints resistant to microbial growth, a well-known corrosive agent in tropical climates. Some products may have to be designed to meet specific demand requirements in certain areas or localities. In this connexion, it should be mentioned that there is a great need for marketing surveys for industrial products in the less developed countries, which would reveal demand patterns requiring modifications in product design, size and quality. These would be useful not only to domestic producers but also to foreign exporters. An example which may be cited in this connexion relates to a market survey for refrigerators carried out in certain Asian countries which revealed that, in view of consumer preferences and needs—in particular the availability of fresh foods—the large-capacity

refrigerators predominating on the markets of the advanced countries were not suitable for the markets under consideration. There is also much scope, according to many experts, for research on quality standards as related to prices under conditions of income and consumption patterns in the developing countries.

UNITED NATIONS PROJECTS RELATING TO ADAPTATION OF PROCESSES, EQUIPMENT AND PRODUCTS

UNITED NATIONS CONFERENCE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

A PROJECT RELATED TO the subject matter discussed in this study is the organization of a United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas to be held at Geneva in February 1963. Its purpose will be to explore recent advances in the application of science and technology which will benefit the less developed areas, to provide an opportunity for an assessment of the impact of such applications on the processes of economic and social development, to reveal opportunities for research directed towards producing new scientific and technological advances of special utility to less developed areas, and to stimulate and promote scientific and technological development in the less developed areas.

The Conference is intended to bring together at governmental and appropriate non-governmental levels those having responsibility for or experience in the planning and execution of programmes of economic development, those with special expertise in scientific and technological applications which might accelerate the development of less developed countries, and those concerned with the planning and execution of research programmes in branches of science and technology where further advances might be especially useful to less developed countries.

The Conference will focus its attention on practical means for the application of advances in science and technology in less developed areas and will avoid purely academic dissertations. Its proceedings will be in the nature of a stock-taking of progress and an assessment of lines along which future progress could most usefully be sought. The discussions will constitute an exchange of ideas and experience on how science and technology can best serve the needs of less developed countries.

The Conference will examine possible areas of co-operation between the less developed countries themselves, and the applicability of the experience of developed areas to less developed areas in industrialized countries. It will also examine opportunities for assistance from more to less developed countries.

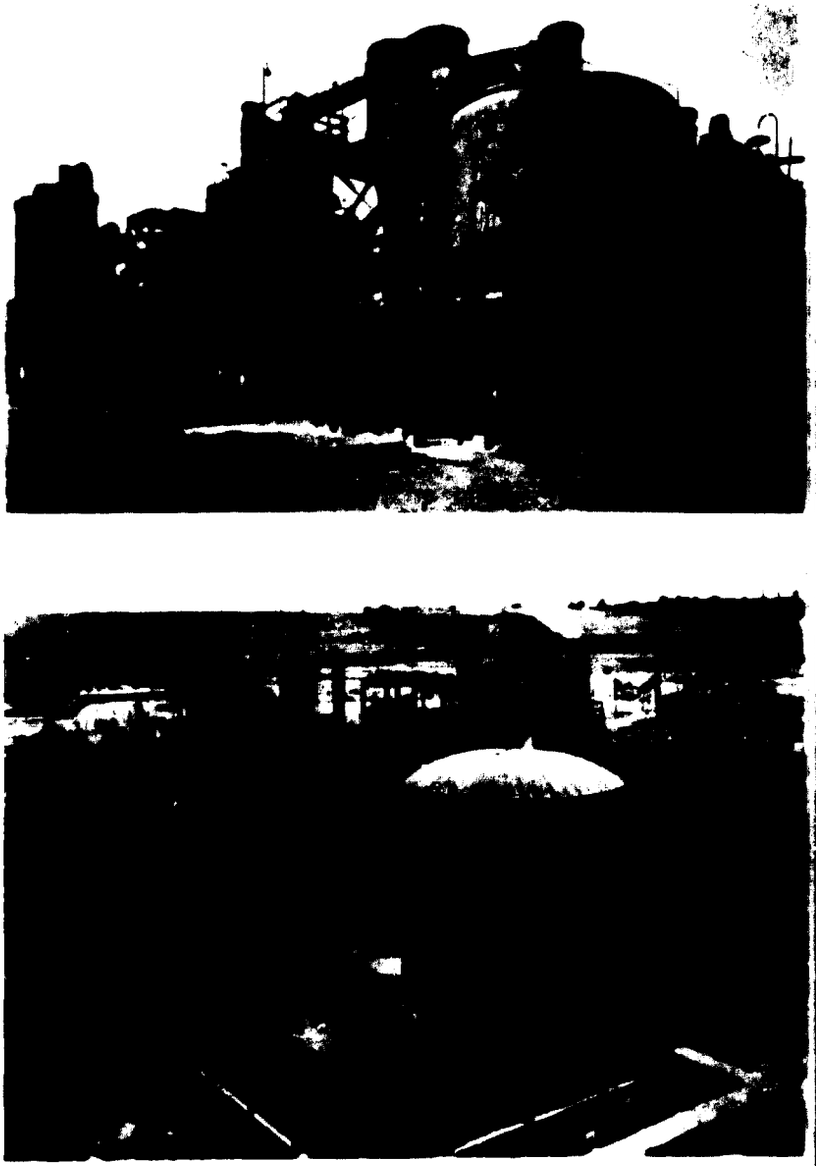
Emphasis will be laid on these new advances in science and technology which can best be utilized for the acceleration of industrial development.

That part of the provisional agenda of the Conference which relates to industrial development is reproduced as an annex to the present article.

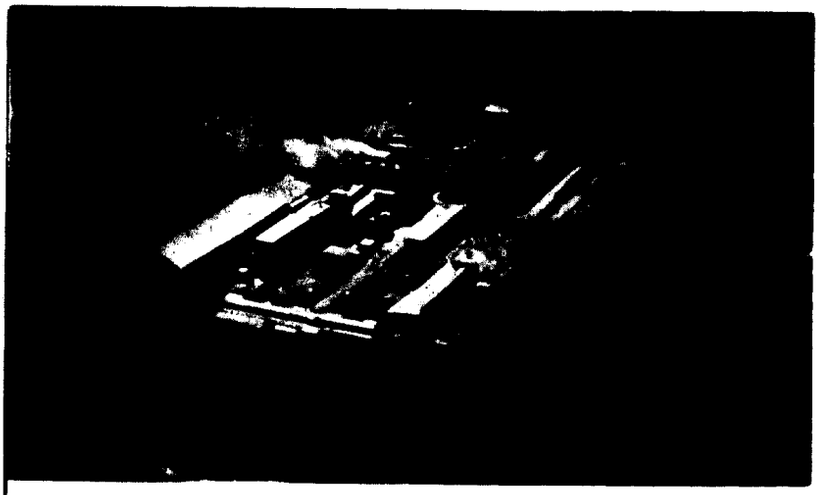
WORKING PARTIES, SEMINARS AND STUDIES

A number of working parties and seminars under the programme of work on industrialization also relate to some aspects of this problem. These include:

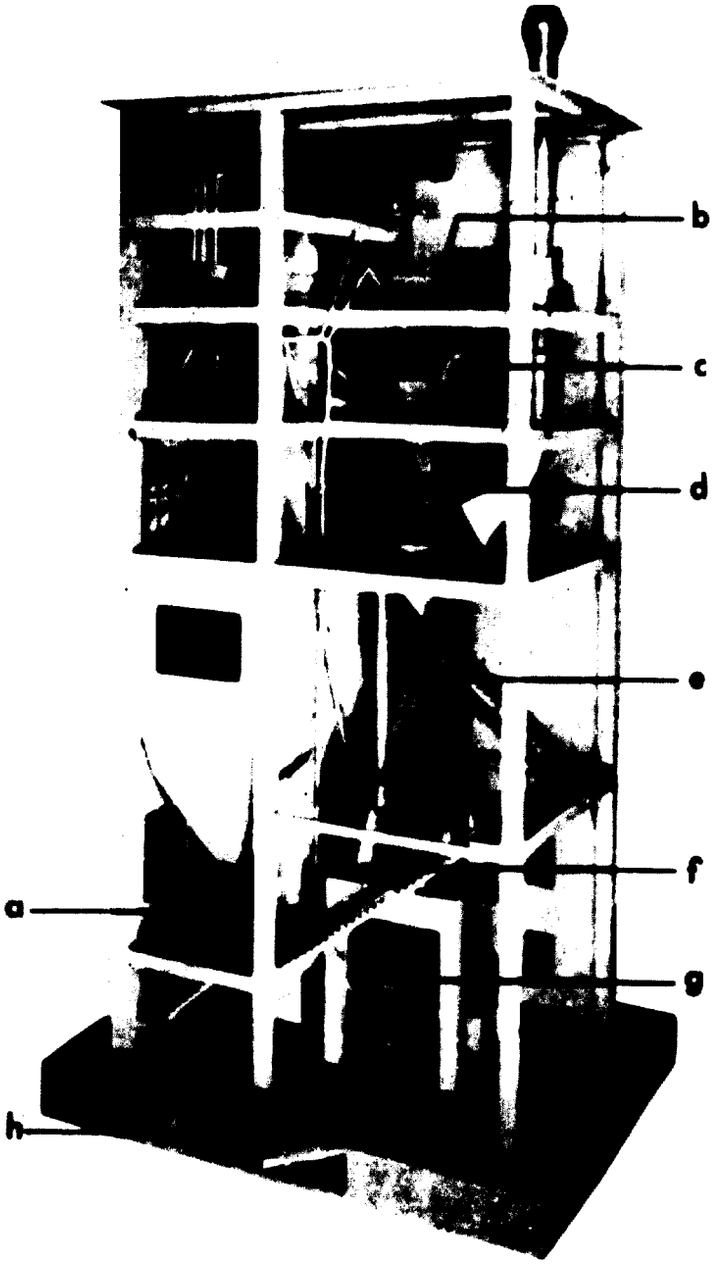
A working party on the establishment of petro-chemical industries based on natural gas. When natural gas is a by-product of crude petroleum production, a large portion of it is usually released as waste. Its equivalent in heat value is estimated at about 50 million metric tons of crude petro-



TWO PYRITE-ROASTING SULPHURIC ACID PLANTS *built in the Republic of South Africa by a United States corporation.* TOP: *View of roaster, purification and absorption sections of a plant with a design capacity of 220 tons per day.* BOTTOM: *General view of a two-unit plant with a design capacity of twenty-five tons per day per unit*



LEFT: *General view of a vertical shaft cement kiln works built in Kenya by a Swiss concern.* RIGHT: *Side view of kiln house showing blowers on the first floor, kiln shafts on the second, burner's platform on the third and nodulizers on the fourth floor*



STANDARD 150-TON CEMENT KILN

Operation of the kiln is as follows:

a. *Raw meal and fuel are charged in exact proportions by weighing machines*

b. *Helical mixer blends the raw meal and fuel into a charge of uniform consistency*

c. *Charge passes to a nodulizing disk where, with the addition of about 12 to 14 per cent water, the charge is formed into nodules, mostly ranging in diameter from about three-eighths to three-quarters of an inch. The few larger nodules that may form are not detrimental*

d. *Adjustable rotary hopper properly charges the nodules into the kiln, maintaining a uniform charge over the entire diameter*

e. *Nodules pass down through the kiln proper. Observations on kilns in use show that most of the nodules keep their shape until actual discharge from the kiln. This means retention of uniform permeability of the charge and consequently uniform gas distribution over the whole section of the kiln, the clinkering zone remaining constantly at the same general level*

f. *Rotary grate breaks up caked clinker. Although the nodules generally keep their shape, they tend to fuse into irregular clinker masses that are broken up by the rotary grate. Speed of the rotary grate can be varied, thus regulating the quantity of clinker extracted and by so doing controlling the burning process*

g. *Discharge chute comprises three discharge gates fitted with airlocks to prevent escape of combustion air, so that continuous discharge of clinker has no effect on burning conditions*

h. *Clinker is dropped on shaker conveyor. Simple jaw crusher, not shown, reduces caked clinker to a maximum size of one and one-quarter inch, ready for finishing department. Blower forces combustion air through rotary grate in adequate volume to maintain proper conditions in burning zone. Introduction of such air at the bottom of the kiln serves also to cool the clinker between burning zone and discharge gates*

An optimum plant consists of either two or four such kilns

(*Source:* Mining Engineering (New York), December 1956.)

OPPOSITE PAGE: *burner levelling charge at kiln-head*

leum a year for the producing countries of the Middle East, Latin America, North Africa and the Far East. An interregional working party will be convened to study ways and means of developing industries based on natural gas waste, with special reference to the economic and technological factors involved in such projects.

An interregional seminar on new developments in iron and steel technology, which will review, among other things, some of the innovations mentioned in the present article.

An interregional working party on machine building and equipment industries, which will discuss such questions as automated methods of production, use of interchangeable parts and other problems of interest to under-developed countries, both as users and potential producers of machine tools, and also to the industrial countries which are the major producers and exporters of such equipment.

A seminar on basic chemicals and allied industries, which will consider, among other things, problems of adaptation of chemical processes and equipment in the developing countries.

The problems of adaptation will be considered, among others, in a pilot project on technological research in Latin America recently undertaken by the secretariat of the Economic Commission for Latin America.

CONCLUDING REMARKS

TODAY, AS IN the past, the major advances in science and technology continue to be made primarily with a view to solving the problems which arise in the already industrialized countries, and relatively little is done to meet the specific needs of the newly developing countries. The realization of the need to orient technological change and innovation in this direction has already led several less developed countries to set up industrial research institutions. The establishment of such institutions—local, national and regional, specialized and non-specialized—should evidently be further encouraged. Assistance for that purpose may be obtained from the United Nations, the specialized agencies and the International Atomic Energy Agency under the programme of technical assistance and also from the Special Fund under its programme.[14]

At the same time, efforts should be made to foster co-operation between the research institutions of the developing countries, as regards both implementation of projects and dissemination of information on the results achieved. Such co-operation would permit duplication to be avoided, thus reducing costs and accelerating industrialization.

Several examples have been given in this article of innovations made in the industrial countries which could meet the needs of the developing countries, even though they may have been prompted by completely different considerations. It is probable that certain innovations achieved in the industrializing countries could also find application in the advanced countries. Co-operation between institutes in both groups of countries might be mutually advantageous. Such co-operation might be obtained without great difficulty between institutions devoted to applied research. It might be more difficult to achieve between institutions engaged in development work, especially those connected to, or controlled by, private industrial corporations, although here, too, practical arrangements could be devised.

The question of dissemination of technological information of interest to the developing countries is part of the more general question of co-ordination, dissemination and application of results of scientific research which, as stressed in a resolution of the General Assembly[15] has become a matter of international concern. A report prepared pursuant to this resolution[16] presents an inventory of current research and a survey of the main trends of inquiry in the field of the natural sciences, and formulates recommendations on the organization of scientific research and the dissemination of its results.

In this report, it is observed, among other things, that

> ". . . there is at present no agency in the United Nations family concentrating on the international aspects of tech

[14] Brief information on technological research institutes in under-developed countries and on the assistance for their establishment given by the Special Fund appears at the end of the article "Industrial Development in the United Nations Development Decade", in this issue of the *Bulletin*.

[15] *Official Records of the General Assembly, Thirteenth Session, Supplement No. 18*, resolution 1260 (XIII). In another resolution adopted at its sixteenth session (*ibid., Sixteenth Session, Supplement No. 17*, vol. I, resolution 1713 (XVI)), the General Assembly stressed that access to knowledge and experience in the field of applied science and technology was essential to accelerate the economic development of under-developed countries and to enlarge the overall productivity of their economies, affirmed that it was in the best interest of all countries that the international patent system should be applied in such a way as to take fully into account the special needs and requirements of the economic development of under-developed countries, as well as the legitimate claims of patentees, and requested the Secretary-General to prepare a report studying the role of patents in the transfer of technology to under-developed countries. This report is to be submitted to the General Assembly in 1963 and to the Committee for Industrial Development and the Economic and Social Council in 1964.

[16] *Current Trends in Scientific Research*, by Pierre Auger, Special Consultant, published by the United Nations, New York, and the United Nations Educational, Scientific and Cultural Organization, Paris, 1961.

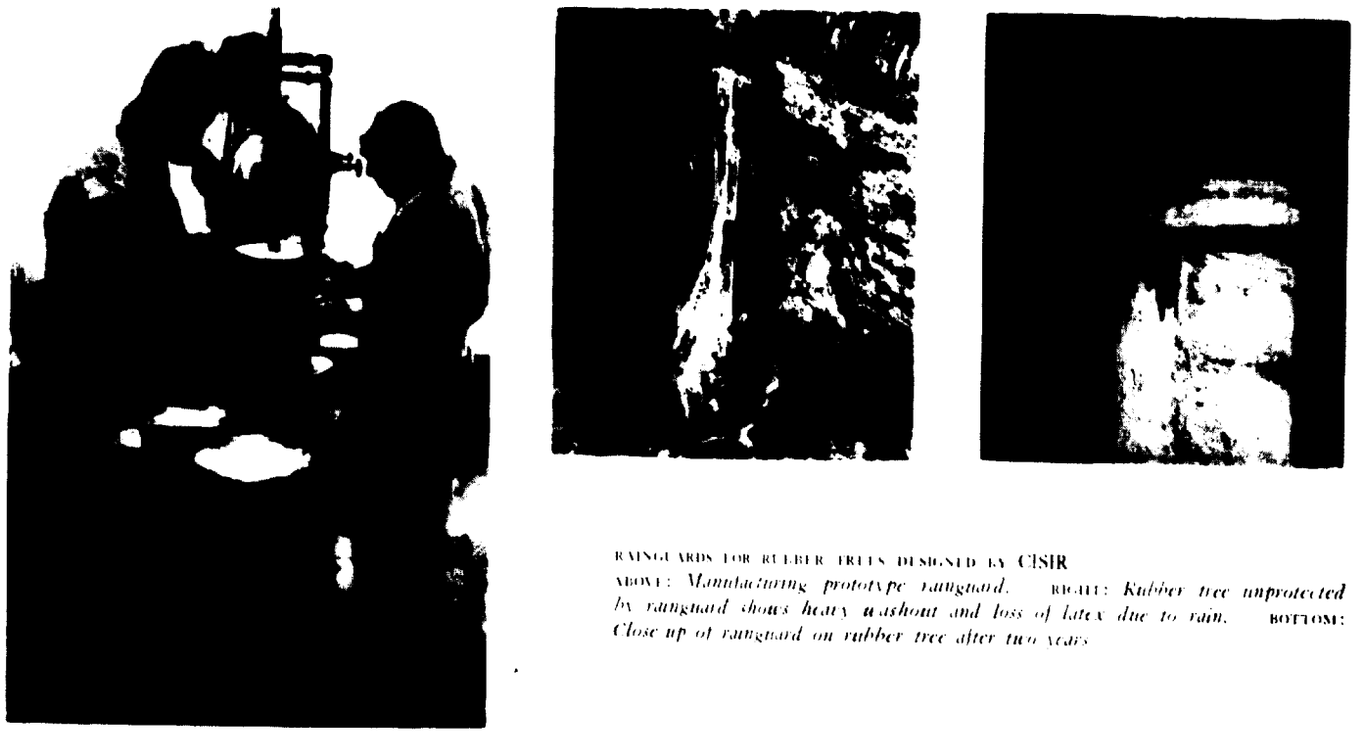
nology, applied research and industrial developments, as distinct from technical assistance in the strict sense of the term. It may be thought that this deficiency is becoming more acute as technology advances, and that specialized organizations set up in this field could not deal with all the problems arising: apart from agriculture, medicine, nuclear science, air transport, telecommunications and meteorology, the subjects to be dealt with include the vast fields covered by the chemical industry; mechanical and electrical engineering; rail, road and water transport; the extractive industries (fuel and metals); building materials; and lastly, optical, electrical and mechanical measuring apparatus and instruments.

"The problem might be solved by establishing either an appropriate service within the United Nations family itself, or a new organization which would concentrate on the technological questions involved in the integrated development of economic and geographical regions."[17]

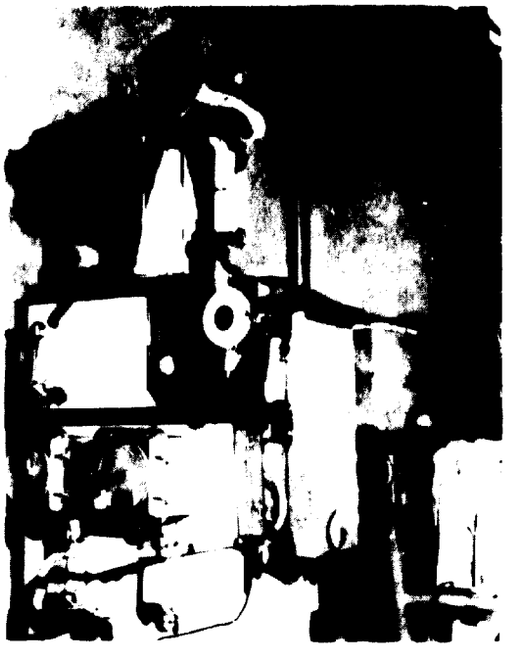
It is to be expected that the interest of scientists and technologists and international co-operation in this field will be further stimulated as a result of the forthcoming United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas.

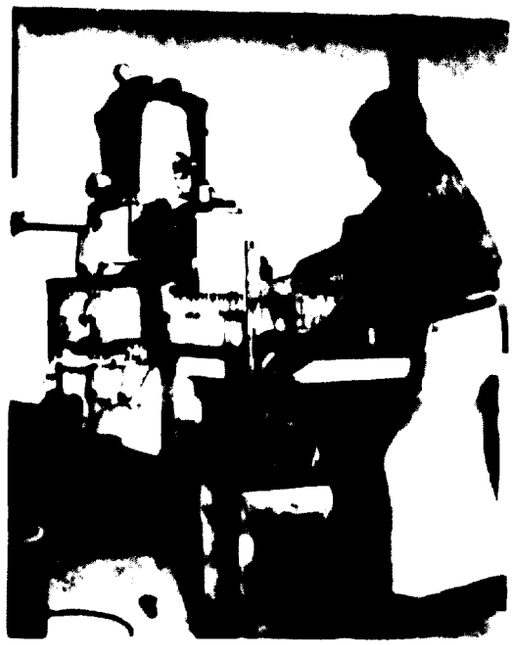
[17] *Ibid.*, page 220.

DEVELOPMENT OF NEW PROCESSES, EQUIPMENT AND PRODUCTS AT THE CEYLON INSTITUTE OF SCIENTIFIC AND INDUSTRIAL RESEARCH (CISIR), COLOMBO



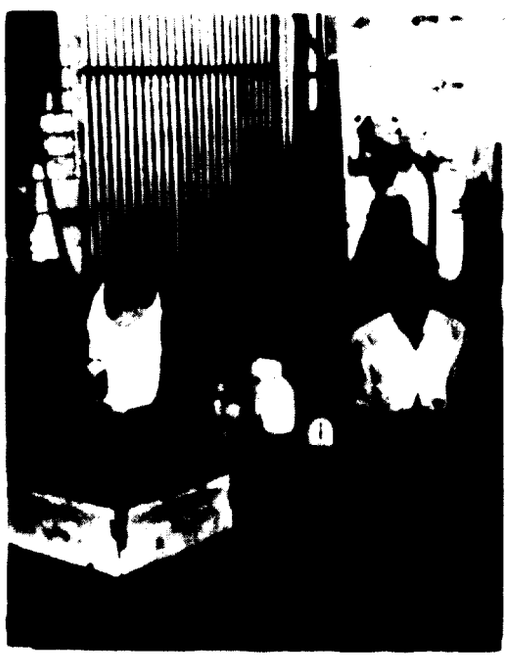
RAINGUARDS FOR RUBBER TREES DESIGNED BY CISIR
ABOVE: *Manufacturing prototype rainguard.* RIGHT: *Rubber tree unprotected by rainguard shows heavy washout and loss of latex due to rain.* BOTTOM: *Close up of rainguard on rubber tree after two years.*





TWO STAGES IN THE PREPARATION OF CONCENTRATED CREAM

LEFT: *Processing the cream in an emulsifier, and pasteurizing unit combined with a homogenizer.* RIGHT: *Boiling the cream*



TWO STAGES IN THE PREPARATION OF LATEX RUBBER CUSHIONS

LEFT: *Spraying rubber latex on treated cotton fibre.* RIGHT: *Candling core and spraying latex*

LEFT: *Improved pattern high-yielding still for the distillation of essential oils from cinnamon bark and leaves, citronella grass, and other plants.* RIGHT: *De-gritting machine designed by CISIR for removing sand and similar foreign matter from rice, kurakkan and other food grains*

Annex

UNITED NATIONS CONFERENCE ON THE APPLICATION OF SCIENCE AND TECHNOLOGY FOR THE BENEFIT OF THE LESS DEVELOPED AREAS

PART D OF THE PROVISIONAL AGENDA: INDUSTRIAL DEVELOPMENT[a]

D.1. Special factors affecting industrial development in less developed areas

(*a*) Scale: minimum size of plant in relation to economic factors;

(*b*) Labour and capital intensity;

(*c*) Management and labour skills;

(*d*) Markets.

D.2. Structural and locational problems of industry

(*a*) Inter-industry relations and integration;

(*b*) Location, urbanization, decentralization (industrial estates, climatic conditions, pollution, etc.);

(*c*) Modernization of small-scale industry.

D.3. Special operational problems

With special reference to those arising within the manufacturing plant or enterprise:

(*a*) Equipment, maintenance, spare parts, standardization;

(*b*) Climatic conditions: effect on equipment, processes and products;

(*c*) Specifications, standards, quality control of raw materials and products.

D.4. Food processing and preservation

(*a*) Food preservation as a means of conserving surplus agricultural and fish eries production for distribution and consumption within the country and for possible export;

(*b*) Latest techniques and equipment for canning, drying, refrigeration, chemical preservation, packing, etc., and adaptation to conditions in developing areas, particularly in tropical climates;

(*c*) Problems of bulk storage and the prospects for new techniques in this field.

D.5. Products of animal and vegetable origin and substitutes

(*a*) Types of raw materials available in different countries, such as hard and soft woods, grass, bamboo, bagasse, straw, etc.;

(*b*) Types of end products required, e.g., newsprint, wrapping and writing papers;

(*c*) Processes adapted to local conditions;

(*d*) Utilization of by-products;

(*e*) Methods of improving the quality and yield of fats, oils and resins and of co-products such as starch, protein, gelatine, glues, etc.;

(*f*) Other significant products such as essential oils, spices, biological products, pesticides, etc.;

(*g*) Soap and detergents: methods of improving quality and efficiency when utilizing indigenous raw materials, production of synthetic detergents as a means of saving fats.

(*h*) Leather and tanning: special attention would be given to the application of known techniques for improving the quality of locally produced leathers, including improvement of the quality of skins, selection of tanning agents and scientific control of the process.

D.6. Textiles

(*a*) Methods of improving the quality of natural fibres through improved methods of processing, with special reference to wool, cotton and bast fibres, possibilities for man-made fibres with respect to available resources;

(*b*) The blending and processing of man-made and natural fibres.

(*c*) The simplification of traditional processes (spinning, weaving and finishing) and adaptation for use in less developed areas.

D.7. Iron and steel

(*a*) Technical and economic factors in setting up an integrated iron and steel industry.

(*b*) Non-integrated iron and steel plants, i.e., plants starting at an intermediate stage and producing finished or semi-finished products;

(*c*) New techniques and processes with emphasis on those which may influence the scale of economic operation, e.g., the use of low electric and direct reduction methods, oxygen blowing, continuous casting, etc.

D.8. Non-ferrous metals

Processing of non-ferrous ores, in particular low grade ores, residues and complex ores, with special emphasis on processes such as fluidization, hydrometallurgical pressure processes, etc.

D.9. Engineering techniques and organization

(*a*) Specifications and standardization;

(*b*) Assembly as the start of an engineering industry;

(*c*) Integration between engineering industries, both national and international;

(*d*) Selection, adaptation and simplification of methods in engineering;

(*e*) New techniques in common engineering processes, e.g., casting, cutting, welding, forging, etc.

D.10. Engineering production

This session will be concerned mainly with the adaptation of engineering production to the special needs of less developed areas:

D.10.1. Heavy engineering industries

Machine tool plants; machine building plants; plants for production of industrial equipment like pumps, blowers, etc., plants for production of heavy engineering equipment like boilers, turbines, etc., plants for production of electrical equipment like motors, transformers, switch gear, generators, etc., and plants for production of transportation equipment, etc.

D.10.2. Other engineering industries

Plants for the production of electric appliances like bulbs, batteries, electro-mechanical home equipment, etc.; plants for production of agricultural implements with special adaptation to local conditions, plants for sheet and metal working; plants for hand tools, cutlery, etc., with special attention to maximum versatility attainable in small-scale plants; plants for processing plastics.

D.11. Fertilizers

(*a*) The scientific factors which determine the choice of fertilizer;

(*b*) The technical factors which determine the choice of raw materials, process, product (nitrogenous, phosphate or compound fertilizer) and location of plant;

(*c*) Adaptation of existing processes, or development of new processes particularly suitable for developing countries.

D.12. Heavy chemicals

(*a*) The role of heavy chemicals in industrial development;

(*b*) Package plants for heavy chemicals;

(*c*) Production of sulphuric acid from alternative sources of sulphur;

(*d*) Development of the uses of chlorine at various levels of production;

(*e*) Natural sources of alkalis.

D.13. Building materials

(*a*) The production of bricks and tiles—the possibilities of mechanical production on various scales;

(*b*) The production of cement and pozzalana—the possibility of small-scale production;

(*c*) The production of glass—the possibilities of small-scale production;

(*d*) The use of local materials and by-products as building materials—including production of hard and soft board, etc.

D.14. Building techniques

(*a*) The use of non-traditional materials and building techniques;

(*b*) Roofing techniques;

(*c*) The design of low-cost housing in relation to local conditions, standardization of door sizes, etc.;

(*d*) Various forms of prefabrication, including pre-stressed concrete;

(*e*) Design and construction of large structures, e.g., schools, hospitals, industrial buildings, bridges, etc.;

(*f*) Provision of services and facilities.

[a] See United Nations document E/CONF.39/INF.1/Rev.1.

Industrial Development in the United Nations Development Decade

On 19 December 1961, the General Assembly of the United Nations adopted a resolution (1710 (XVI)) in which it designated the current decade as "the United Nations Development Decade, in which Member States and their peoples will intensify their efforts to mobilize and to sustain support for the measures required on the part of both developed and developing countries to accelerate progress towards self-sustaining growth of the economy of the individual nations and their social advancement." The aim would be "to attain in each under-developed country a substantial increase in the rate of growth, with each country setting its own target, taking as the objective a minimum annual rate of growth of aggregate national income of 5 per cent at the end of the Decade". In the same resolution, the Secretary-General was requested to develop proposals for the intensification of action in the fields of economic and social development by the United Nations system of organizations to further the objectives of the Development Decade.

The Secretary-General's proposals are set forth in a report entitled *The United Nations Development Decade—Proposals for Action* (United Nations publication, Sales No.: 62.II.B.2), which was submitted to the Economic and Social Council at its thirty-fourth session, in July-August 1962. The Secretary-General's report contains, among other things, proposals for an intensification of action in the field of industrial development. In the present article some of these proposals are outlined in greater detail.

At its thirty-fourth session, the Council adopted resolution 916 (XXXIV), in which it made a number of recommendations to Governments of Member States, as well as to United Nations bodies and specialized agencies, for action in certain areas for the purpose of intensifying the development effort during the Decade. The Council also requested the Secretary-General to take certain measures for securing full participation by the United Nations in this effort. The texts of the resolutions on the Development Decade adopted by the Assembly and the Council are reproduced in an annex.

INTRODUCTION

THE DECADE OF the nineteen fifties witnessed a turning point in the industrialization process of the world's under-developed countries. The rate of growth of the manufacturing sector in these countries during that decade was higher than in the developed ones; consequently, there was an increase in their share in world industrial output. It is estimated that from 1953 to 1960 manufacturing output in the under-developed countries increased by over 60 per cent, while in the developed countries the increase during the same period was less than 35 per cent and the share of under-developed countries in world manufacturing output rose from 10 per cent in 1953 to 12 per cent in 1960.[1]

Assuming that, by the end of the nineteen sixties, the targets for the rate of economic growth of the under-developed countries visualized in General Assembly resolution 1710 (XVI) are achieved, manufacturing output in the under-developed countries will have increased by 130 per cent; at the same time, manufacturing in the developed countries will have risen by somewhat less than 60 per cent. Thus, the achievement of the objectives of the Development Decade is intimately associated with an acceleration of industrial development of the under-developed countries which, in turn, requires intensified international action.

The growth in manufacturing industries in the under-developed countries has been reflected in corresponding changes in their economic structure. The share of manufacturing in their gross domestic product has risen from less than one-fifth in 1953 to over one-fifth in 1960, and it may be expected to reach a still higher level in 1970. At that time, the share of the under-developed countries in world manufacturing output may well amount to over 16 per cent.

In 1958, imports by under-developed countries of equipment for their manufacturing industries amounted to nearly $3 billion, or 10 per cent of their total imports. It is expected that with the anticipated rise in manufacturing output, import demand for such investment goods for manufacturing industries will more than double and exceed $6 billion—taking into account the growth in the capacity of these countries to meet a rising share of these requirements out of their own production.

The need for international action to assist in the achievement of these goals arises at various levels. If import requirements for capital equipment are more than doubled, it will be necesssary for the under-developed countries, among other things, to achieve an adequate level of export earnings to satisfy these requirements as well as those to finance the necessary imports of consumer goods, raw materials and intermediate goods.

It is likely that the required level of exports will also imply an increase in the share of manufactured goods in the exports of the newly developing countries. It is well known that in many of these countries, the limitations of the domestic market, at least in the short run, represent an inhibiting factor in their industrial growth, and the creation of larger markets through such means as economic integration, establishment of common markets and similar types of trade agreements presents an opportunity for encouraging the growth of industrial output.

The experience of the nineteen fifties also demonstrated the importance of the role that international technical co-operation plays in prompting industrial growth. While shortage of capital has often been singled out as the most important factor in preventing acceleration of industrialization, attention has focused in recent years on such factors as lack of trained manpower, including technical, supervisory and managerial personnel. International technical assistance, extended in accordance with the requirements and priorities established by the recipient countries, has played and will continue to play an important role in alleviating these basic shortages.

The experience of the past decade has also brought out the significant fact that the lessons learned from the development of the advanced countries and the techniques used in these countries cannot always be transferred to the newly developing countries without adequate adaptation or adjustment.[2] Consequently, a major effort will have to be undertaken in the nineteen sixties at the international level in the field of transfer of technology to the industrializing countries.

[1] These are provisional data which do not include the centrally planned economies for which comparable data are not available.

[2] An article on problems of adaptation of processes, equipment and products appears elsewhere in this issue of the *Bulletin*. This subject will be discussed, among others, at the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, to be held at Geneva in February 1963, reference to which is made in this article (*see* pages 19 and 24).

RECENT UNITED NATIONS ACTION IN THE FIELD OF INDUSTRIAL DEVELOPMENT

DURING THE NINETEEN fifties, considerable attention was given by organizations of the United Nations family, at the inter-governmental level and at the secretariat level, to the problems of the industrialization of the newly developing countries.[3] In 1956, the Economic and Social Council endorsed a work programme in this field to be implemented by the Secretary-General and, in subsequent years, kept under review the progress of implementation of this programme, broadened its scope and recommended the allocation of increasing resources for carrying it out.

In conjunction with the discussion of the general issues relating to economic development, the General Assembly and the Council debated the need for establishing special bodies to deal with problems of industrialization. In 1966, in response to a mandate of the General Assembly issued at its fourteenth session, the Council set up the Committee for Industrial Development. The Committee's terms of reference are to examine for the Council the work programme on industrialization and make recommendations concerning its further development; initiate, propose and encourage studies and seminars on various topics in this field, and propose and promote the collection, evaluation and dissemination of information derived from these studies and of other information relevant to industrialization.

At its first session, in 1961, the Committee approved a longer-term and expanded work programme and called for an increase in the resources of the Secretariat. The work programme includes research projects, working parties, seminars and related meetings in the following main fields: (i) industrial development programming and policies, including projections for individual industrial sectors; (ii) economic and technological aspects of individual industries; (iii) problems of training and management; (iv) problems of small-scale industry.

A substantial part of the work programme also comprises activities relating to substantive support of United Nations field operations in industry undertaken under the technical co-operation programme and the programme of the Special Fund, the research and operational activities under the programme being largely complementary and mutually supporting. In elaborating the research programme, the Secretariat takes advantage of the body of experience which has accumulated as a result of the operational activities; conversely, the substantive servicing of the field operations is helped by the results of the research and studies which are largely oriented towards that end.

In addition, the Committee recommended the establishment of an Industrial Development Centre within the United Nations Secretariat. The Centre was given responsibility for the collection, analysis and dissemination of experience gained in technical co-operation programmes in the field of industrialization. The Centre would also provide a mechanism whereby the United Nations, the specialized agencies and the International Atomic Energy Agency (IAEA) could obtain full information about each other's activities in this field and could take steps to co-ordinate them. The Secretary-General was asked to submit to the Committee, at its second session, proposals for the operation of the Centre.

The continued concern of the General Assembly for strengthening the efforts of the United Nations in the field of industrialization was further demonstrated at its sixteenth session when it drew the attention of the Council to the necessity for further expanding the action of the United Nations family in that field. It requested both the Council and the Committee for Industrial Development to give consideration to this problem, including the advisability of establishing a specialized agency or other appropriate body for industrial development.

At its second session, in 1962, the Committee for Industrial Development gave its attention to the above request; it made a general review of the work of the United Nations, the specialized agencies and the IAEA in the field of industrial development, including assistance under the programmes of technical co-operation and the operations of the Special Fund. It also reviewed the progress made in the implementation of the expanded work programme and made recommendations for its further development.

The Committee was of the unanimous opinion that there was need for intensifying the activities of the United Nations in the field of industrial development. It felt that the total amount of resources devoted by the United Nations family to the promotion of industrial development was insufficient and that it was necessary to increase the resources considerably. It appealed to the Technical Assistance Committee, the Special Fund, and other interested bodies to take measures to encourage and increase the share of their expenditures devoted to industrial development. The Committee further requested that the Secretary-General consider urgently the problem of providing adequate staff resources to support the relevant activities of the United Nations Secretariat, including the appointment of a Commissioner for Industrial Development. It approved the proposals of the Secretary-General with respect to the terms of reference and the operation of the Industrial Development Centre. In addition, it recommended that the Secretariat examine the possibility of establishing a technical advisory service to provide advice to Governments at their request in the field of industrial development.

Finally, the Committee requested the Secretary-General to appoint an advisory committee of ten experts to examine the question of what further organizational changes might be necessary in order to intensify, concentrate and expedite the United Nations effort for industrial development of the less developed countries, including the advisability of establishing a specialized agency for industrial development, or the strengthening or modification of the existing organizational structure in this field, and to report to the Committee at its third session, in 1963.

The Committee's recommendations were endorsed by the Council at its thirty-third session.

[3] *See* "Current Activities under the Aegis of the United Nations in the Field of Industrialization and Productivity", *Bulletin on Industrialization and Productivity*, No. 1 (Sales No.: 58.II.B.2); "Report of a Group of Experts on the United Nations Secretariat's Work Programme on Industrialization", *ibid.*, No. 2 (Sales No.: 59.II.B.1); "A New Impetus to Industrial Development: the United Nations Special Fund", *ibid.*, No. 3 (Sales No.: 60.II.B.1); "United Nations Activities in Industrialization", *ibid.*, No. 4 (Sales No.: 60.II.B.2); "The United Nations Work Programme on Industrialization", *ibid.*, No. 5 (Sales No.: 62.II.B.1).

AREAS OF EXPANDING ACTIVITIES

In the course of the Development Decade, it is proposed to expand the activities of the United Nations Secretariat in four main areas of work relating to industrial development: support of industrial planning and programming; extension of industrial advisory services; promotion of small scale industries, and industrial training.

With respect to industrial planning and programming, the experience of the Secretariat, particularly with regard to the servicing of technical assistance activities, indicates that there are two main problem areas. On the one hand, there is a widespread need for an evaluation of the experience in the use of planning and programming techniques. On the other hand, there are serious discrepancies between the formulation of industrial development plans and their implementation in the newly developing countries. The question of implementation of planning is further subdivided in two areas. The first relates to the organizational arrangements needed to integrate the planning and programming activities within the government machinery and to ensure the effective implementation of the plans and programmes. The second is concerned with the availability of data on individual industrial branches; it is well known that the general inadequacy of such information deprives planning activities of much of their usefulness.

The recommended programme of expanded action in these areas once again combines the elements of research and support of field operations. Research activities cover the organizational and implementation aspects of planning and the preparation of pre-investment data for industries. The operational activities under the programme will be carried out in greater depth as part of the intensified effort in technical assistance, in particular, in the form of direct technical advisory services, which constitute, as mentioned above, the second major field of expanded United Nations action.

A tutor instructs young students in a training school in Argentina

With respect to promotion of small-scale industries, special attention will be given to assistance in the establishment of industrial estates and of technological and other servicing institutions which render services to small-scale industrial enterprises; these include, in particular, technological research institutes and management service centres.

Expanded action in the fourth area—industrial training—is to be carried out in co-operation with the International Labour Organisation, which is competent in the field of vocational and professional training.[1]

PLANNING AND PROGRAMMING OF INDUSTRIAL DEVELOPMENT

Governments of both advanced and developing countries are increasingly aware of the importance of effective planning and programming for the achievement of accelerated and balanced industrial growth. The need for planning and programming was underlined by the Committee for Industrial Development in its report on its second session, in which the Committee considered that "planning and programming . . . constitute indispensable instruments for the promotion of continued and accelerated industrial development, in view of the fact that unguided industrialization is likely to fall short of an optimum utilization of available resources".

In the nineteen fifties, substantial progress was achieved in developing techniques of plan elaboration and of aggregate projections. Relatively little attention was paid to programming at the project level, to problems of organization of planning and to the methods and procedures of implementation. Because of this, in many countries government plans and programmes, however well formulated, failed to produce a significant impact on the actual development of industry. United Nations action in the Development Decade in the field of industrial development planning and programming is to deal particularly with the following problem areas:

(i) *Techniques of industrial planning and programming*

It is proposed to continue and expand the work of the Organization on methods and techniques of planning and programming, particularly in the light of the experience gained in field operations under the technical co-operation programme. This will involve studies of problems relating to the structure of industry and the sequence of industrialization at various levels of economic development, establishment of priorities for individual industrial branches, including techniques of evaluation of industrial projects, and projections of demand for industrial products. This work is to be conducted to a large extent in co-operation with the regional economic commissions whose programmes of work contain projects in related areas. The need for a unified method of approach is indeed keenly felt in many aspects of this problem, in particular, those concerning projections of demand for individual industrial commodities.

[1] See *The United Nations Development Decade—Proposals for Action*, op. cit., page 58.

(ii) *Organization and implementation of planning*

Many countries have established planning agencies to take care of the planning function. It is increasingly recognized that if this function is to be effectively discharged, the planning agency should be intimately and fully integrated within the rest of the government machinery; another condition in mixed economies is to secure the fullest possible integration of the planning machinery and the operation of the private sector. Research should therefore be carried out into the principles of most effective organization for planning and into the means of co-ordinating planning with incentives to the private sector so as to guide its action into channels consistent with the planning targets.

Related to the previous considerations is the fact that many countries are notably deficient in the implementation aspect of their plans. Implementation relates to procedures intended to ensure that the policies set forth and the projects in the public sector undertaken by the various government departments are properly co-ordinated; to the choice of the most effective policy instruments to influence and guide the activities of the private sector; to a systematic follow-up and comparison of actual achievements and planned targets, and an analysis of the discrepancies thus discovered; to a prompt and effective adaptation and revision of the plans in the light of such analysis and other changing circumstances, and so on.

Since the United Nations supports the efforts of many developing countries to accelerate their economic growth, it is in a position to play an important role in improving the organization and implementation of industrial planning. Its effort in this field in the course of the current decade is to be made along the lines of integrated activities in research and assistance.

(iii) *Pre-investment data*

The experience gained thus far in the field of industrial planning points to the necessity of devising methods for linking the planning on industry and project levels with the over-all economic or industrial sector targets. In some cases, the projections of growth in individual industries are based upon an analysis of current investment programmes in the public or private sectors. These programmes are usually no more than a catalogue of current investment expenditure and of investment programmes of enterprises extending over the next few years, and little attempt is generally made to analyse the extent to which these projects are consistent with the aggregate plan or, conversely, the extent to which the aggregate plan should be adjusted to take into account individual investment commitments. The inadequate linkage of aggregate planning (including over-all sectoral planning) and individual projects is one of the reasons for the difficulties arising in many countries where plan targets go unfulfilled and important bottlenecks and shortages develop in key areas, particularly in that of foreign exchange.

While some studies in this field have recently been made by a number of organizations both inside and outside the United Nations family, an intensive research effort is still needed; in particular, it is necessary to engage in a systematic collection and analysis of data on investment requirements and of labour, raw material and other inputs in a number of key industries of special interest to under developed countries. Substantial work in this field has already been carried out by the United Nations at Headquarters in co-operation with some of the regional commissions under the research programme on industrialization. To meet the needs outlined above, an increasing research effort is to be undertaken.

The availability of such data would go a long way in making present industrial programmes more effective, since it would, in particular, make possible an early identification of potential bottlenecks to industrial growth. The need for such material has been expressed by several national planning agencies which, to remedy its lack, have undertaken on their own account research projects on pre-investment data, for industries of special interest to them. It is clear that duplication of effort could be avoided if a central body, such as the United Nations, would undertake the collection and analysis of the relevant data and their presentation on a comparable basis. To carry out this task, close co-operation of engineers and economists in a spirit of mutual understanding of their respective interests and needs is required to provide for effective integration of the economic and engineering aspects of industrial planning. A nucleus of such combined teams of economists and engineers has been established within the United Nations Secretariat and its enlargement is one of the immediate tasks on hand.

TECHNICAL CO-OPERATION AND TECHNICAL ADVISORY SERVICES

The experience gained in the international co-operation programmes during the past decade has shown that while most operations have successfully met the needs of the recipient countries, in some cases the real priority needs of industry have not been reflected in the governments' requests for assistance. Moreover, because of limitation of resources, assistance has sometimes been dispersed and its effect consequently too diffused to produce a significant and tangible impact. Also, there has not always been adequate co-ordination of the activities of the various aid-giving agencies, so that in a number of cases duplication of effort has occurred. It thus appears that an effort is required to improve the planning of technical assistance, both as regards the programmes of the recipient countries and those of the aid-giving institutions. In this connexion it might be mentioned that an effort has been made lately to provide for a more effective use of the resources available under the technical assistance programmes of the United Nations family by introducing two-year programme exercises and a "project" programming procedure, which provide for greater continuity in the rendering of assistance and a concentration of the assistance effort in the form of impact programmes. The experience which has emerged under the operation of the United Nations technical assistance programmes suggests that assistance to governments is particularly effective when extended in an integrated form, especially in that of multi-expert missions. These survey the needs for specific projects, pre-plan the assistance in the formulation and implementation of projects and, when necessary, institutionalize the assistance extended by the United Nations through the facilities offered by the Special Fund and the programme of

provision of operational, executive and administrative personnel (OPEX). Survey missions of this type in the field of industry, composed of economists, general technologists, and highly specialized technical personnel, have been sent to a number of countries, resulting in the establishment of major industries, on which, in many cases, action was taken by the government concerned.

As to provision of technical advisory services which are already being extended on a modest scale by expert Secretariat personnel, it is proposed to strengthen such services for the following purposes:

United Nations expert examining fibres of pima cotton in an Israeli gin

A Japanese United Nations expert in silkworm culture inspecting the boiling of the cocoons in an Iranian plant

(*a*) To give advice on specific problems of industrial planning, programming and policies, industrial surveys, feasibility studies, choice of processes, plant and equipment, and plant operation;

(*b*) To help in formulating requests for technical assistance from international agencies;

(*c*) To follow up and implement recommendations of earlier technical assistance missions.

It is envisaged that a number of senior advisers, fully conversant with selected industrial sectors of particular interest to less developed countries, will be recruited for that purpose; in addition, outside specialists will be appointed as consultants on a part-time retainer basis to undertake *ad hoc* assignments in their area of competence.

According to the needs, the advisers and consultants would either be directly assigned to operations in the field or provide substantive support to such operations. It is envisaged, at the beginning, that specialists will be recruited in the following major industrial sectors: machine building and mechanical industries; iron and steel; chemical industries; processing of agricultural raw materials; textiles, and silicates, including cement.

PROMOTION OF SMALL-SCALE INDUSTRIES

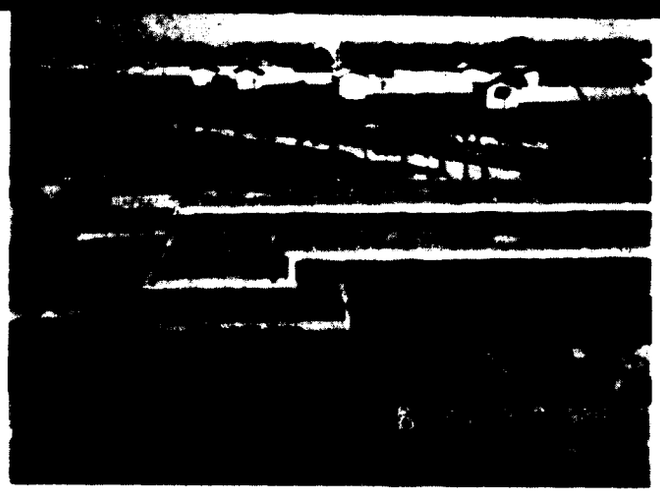
In recent years, measures to promote small-scale industries have, in many countries, tended increasingly to concentrate on two main types of action. On the one hand, efforts were made to stimulate the establishment and growth of small-scale industries by providing them with sites, factories and a variety of services in industrial estates. On the other hand, measures were taken to meet their needs by creating institutions to serve and assist them in the fields of technology, financing, management (including procurement, marketing, accounting and other functions) and labour. It is considered highly desirable that a massive and an increasing effort in these two areas be undertaken by governments in the current decade. This would require a corresponding expansion in supporting activities by the United Nations.

Industrial estates

An industrial estate is a tract of land improved, subdivided and developed according to a comprehensive plan, which usually features ready-made, general-purpose factory buildings and provides a variety of common facilities and services. The plan provides for streets, railroad or other transportation facilities, water and energy supply, and sewers. A choice of general-purpose factory buildings of different types and sizes is usually offered to the prospective occupants. Some common services are provided to the occupants with a view to improving their productivity and reducing their production costs; these may include a maintenance and repair shop, a testing laboratory, a foundry, a forging and heat-treatment shop, a tool room, a technical and managerial advisory service and a training centre. Other services are sometimes provided for the convenience of the occupants, such as canteens and dispensaries.[5]

The nineteen fifties saw, in many developed countries and also in some industrializing countries, a rapid development

[5] *See* United Nations, *Establishment of Industrial Estates in Under-developed Countries* (Sales No.: 60.II.B.4).



INDUSTRIAL ESTATES IN INDIA

TOP: *A view of the industrial estate at Okhla, near Delhi, taken from the administration block; the canteen building is in the foreground.* CENTRE: *A row of factories at the industrial estate of Sanatnagar, near Hyderabad, Andhra Pradesh. The area of buildings of this type is: factory space, 2,376 square feet; office accommodation, 788 square feet; open space, 16,086 square feet.* BOTTOM: *Tenements for workers of the Guindy industrial estate, near Madras*

of industrial estates. Thus, in one of the advanced countries —the United States—their number has grown, in the past few years, from about 300 in 1957 to nearly 1,300 in 1962. In one of the developing countries—India—120 estates were being established in the six-year period 1956-1961, and about 300 medium-sized and large-scale additional estates and 500 to 1,000 small rural estates are to be set up in the next four years. Today, plans for the establishment of industrial estates are devised or carried out in many developing countries throughout the world. It is anticipated that a considerable expansion in such projects will take place in future years.

There is abundant evidence that most of the underdeveloped countries intend to use the device of the industrial estate primarily for promoting small-scale and medium-sized industries, and, at the same time, influencing industrial location in accordance with policies of industrial decentralization. This device appears to be especially effective for attracting small industries when featuring ready-built, general-purpose factories offered for rent. Renting a factory permits the cost of a capital investment in building and facilities to be converted into a recurring operational expenditure, and thus releases resources for purchase of machinery and for working capital. Rents can be kept at a relatively low level, owing to the economies of scale achieved in improving a large tract of land and building a large number of standard factories; as an additional incentive in most of the developing countries where industrial estates have been set up, factories are rented at subsidized rates.

The grouping of small enterprises in an industrial estate makes it practical and economical to provide them with technical assistance in several fields, such as engineering, quality control, maintenance, management and training, with an effectiveness that can seldom be achieved when rendered to individual small enterprises outside the estates. If the estate is sufficiently large, certain assistance and servicing facilities, such as industrial extension and other advisory services, vocational training, etc., may be institutionalized as an integral part of the project. Provision of common repair and maintenance shops, tool rooms, warehouses, and other common services is another particularly effective feature of such services whereby the productivity and quality are improved and the operating costs reduced. The grouping of industries in estates also facilitates the establishment of relationships of interdependence and complementarity among some of the occupants, through inter-trading and inter-servicing. Finally, industrial estates exert economic "radiation" effects on other economic sectors; they stimulate the activities of industrial and commercial enterprises, trade and service concerns in the neighbouring area.

The location of industrial estates is generally selected on grounds of economic and social policies aimed either at decongesting large urban centres, industrializing small towns and rural areas, or rehabilitating depressed regions. Industrial estates thus have an important role to play in programmes of urban development and redevelopment, in particular in the context of slum clearance projects.[6]

The advantages of industrial estates as a policy instrument for industrial development may be summarized as follows:

(i) Greater economic efficiency, resulting from the economies of scale and from the planned and co-ordinated development;

(ii) Greater effectiveness in the use of assistance because they make it possible to deal simultaneously and in a concentrated manner with a variety of problems of the small entrepreneur;

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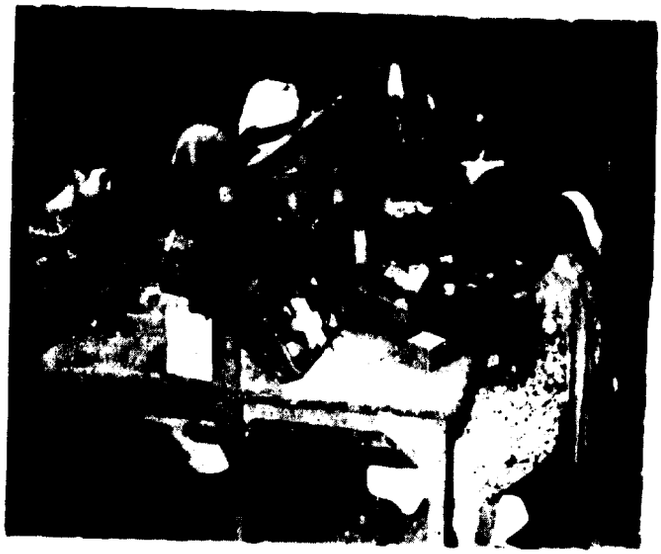
[6] Industrial estates have also been found to be suitable for developing large-scale industrial centres and complexes, including heavy and light industries of all sizes, promoting industrialization projects related to the development of ports and airports, large power plant schemes, petroleum refineries, chemical plants, etc., and for encouraging subsidiary manufacturing activities on a small or medium scale around such projects.



Women workers assembling sound equipment in a small factory in the Okhla industrial estate

(iii) Their usefulness as a means of influencing location of industry (e.g., creating industrial nuclei in rural areas).

The role of the United Nations in establishing industrial estates

Assistance for the establishment of industrial estates is currently made available by the United Nations under its programme of technical assistance and that of the Special Fund.

Projects under the technical assistance programme—which may, sometimes, lead to Special Fund financing—would normally consist of a feasibility survey to ascertain location, basic requirements and development prospects, and estimate over-all costs, and, at a later stage, provision of a team of experts to advise on the planning, construction and initial operation of the estate and procurement of certain specified equipment. Under both programmes, support is restricted to the "pre-investment" aspects of the projects.[7]

If, as is expected, industrial estate programmes expand in the course of the nineteen sixties, requests for United Nations assistance in this field under the technical co-operation programmes and the programme of the Special Fund will correspondingly increase. In particular, it may be anticipated that many of the newly independent countries of Africa and Asia would need such assistance for projects to promote small-scale industries, which figure in their industrialization programmes.

Capital outlays are needed for land purchase and development and for building general-purpose factories and establishing other services and amenities which are part of an industrial estate or community. In addition, considerable investments may also have to be made for certain "social overhead" facilities which are made necessary by the establishment of the industrial community. It is likely that there will be need for substantial financial assistance, in particular from international sources.

[7] Under its statutes, the Special Fund finances projects of a "pre-investment" nature involving relatively heavy budgetary commitments and extending over a period of several years. Its assistance takes the form of provision of experts, equipment—in particular, for common maintenance and mechanical shop and laboratory facilities and other common services—and fellowships. Under its terms of reference, the Special Fund could also finance the establishment of servicing facilities as part of an industrial estate.

Increased assistance in obtaining finance

In his report on the United Nations Development Decade, the Secretary-General took note of the special difficulties of financing small-scale industries and made some proposals for increased assistance in this field.[8]

> "The financing of small-scale industries presents special challenges regarding both external and domestic financing. While direct industrial lending by the International Bank [for Reconstruction and Development] has gone for the most part to large enterprises, the Bank has indirectly financed smaller-scale industry through its assistance to privately-owned development banks. Bank funds thus reach relatively small enterprises for which direct Bank lending would be administratively impracticable and uneconomic. Now that IFC [the International Finance Corporation, a World Bank affiliate] is authorized to make equity investments, the coming years will undoubtedly see joint Bank/IFC assistance to privately-owned industrial development banks, with the Bank providing loan capital and IFC providing equity.
>
> "In some countries governments have established special institutions for assistance to cottage industry and to small entrepreneurs. There may be opportunity for the United Nations system to encourage further action in this direction.
>
> "The specific problem of financing small-scale industries clearly still constitutes a gap. The Secretary-General proposes that in the event of new sources of United Nations financing being opened up during the Development Decade, funds for the financing of industrial estates and other aid to smaller-scale industry generally be considered, preferably as part of more broadly defined purposes. An average 10-acre industrial estate may cost about $250,000 for land development, basic utilities and factory buildings, but this figure does not include the cost of land nor any common facilities. The cost of providing housing and other essential community services for the population attached to the estate could add a multiple of this, if such facilities are required. It will be seen that the financing of even a few estates can be a heavy burden for a small and poor country."

Assistance through the establishment of technological and management service institutions

The well-known institutional shortcomings which are characteristic of under-developed countries—scarcity of capital, managerial and technical skills, and of a generally favourable industrial climate—affect both the large and small enterprises. Small industries, however, are confronted not only with these general difficulties, but also with added obstacles due to their very smallness. They are especially in need of assistance and servicing in all aspects of industrial operations —finance, technology, management, procurement, market-

[8] *The United Nations Development Decade—Proposals for Action*, op. cit., page 58.

ing, administration and training. In addition, they require special legislative and fiscal arrangements to encourage and protect them. Attention is given in the following to two types of institutions, the establishment of which lends itself to the type of support and assistance made available by the United Nations, namely, technological research institutes and management service centres.

Technological research institutes are an important tool of industrial development in the developing countries. Their purpose is to develop or improve production processes in order to promote the establishment of industries and raise the efficiency of existing ones.

Technological institutes carry on tests of raw materials, semi-finished and finished products, engage in pilot plant operations and other types of research in industrial technology; study the possible uses and industrial processing of indigenous raw materials, provide technical and economic advice to improve production methods, reduce costs, promote quality; develop equipment, processes and products for local manufacture. They also advise banks and other potential investors on the technological and economic merits of manufacturing projects and on the establishment of new industries; assist governments in development matters; promote and encourage technical training, and prepare and disseminate technical information.[9]

Technological institutes are either of general scope or especially devised to serve the needs of specific industries. General research institutes exist in Burma, Central America, Ceylon, Colombia, Mexico and other countries. Among specialized institutions, it is possible to mention a rubber institute in Ceylon; chemistry, leather, textile, ceramics, fibre, building materials and material testing institutes in Indonesia; chemical and metallurgical laboratories and research institutes in fuel, glass and ceramics, food technology, drugs, leather, building, road-building, electronics engineering and mining in India, and a silicates institute in Israel.

Management service institutes provide guidance and advice in management to industry, particularly to small scale industrial establishments which cannot afford to employ permanent specialized personnel. Their services are provided in such areas as marketing, accounting, administration and training of managerial personnel, including foremen; they also sometimes provide technical services. These institutes are generally established nationally, except when a regional set-up is considered more appropriate, for example, for reasons of economies of scale.

Assistance in the establishment of both types of institutions has been a regular feature of the activities of the Special Fund. Twenty-two technological research institutes, nine of which are in operation, have so far been assisted by the United Nations Special Fund. Two of them serve industry in general, two others are being set up to assist small scale industries, and eighteen are active in the fields of power, mechanical and aeronautical engineering, building materials, ceramics and silicates, pesticides, leather and food processing. The Special Fund has also contributed to the establishment of centres for management development and training of supervisory and skilled personnel in a Latin American, an Asian and a European country.

[9] *See* "Establishment of Technological Research Institutes in Under-developed Countries", *Bulletin on Industrialization and Productivity*, No. 2 (Sales No.: 59.II.B.1).

Annex

GENERAL ASSEMBLY RESOLUTION 1710 (XVI). UNITED NATIONS DEVELOPMENT DECADE: A PROGRAMME FOR INTERNATIONAL ECONOMIC CO-OPERATION

The General Assembly,

Bearing in mind the solemn undertaking embodied in the Charter of the United Nations to promote social progress and better standards of life in larger freedom and to employ international machinery for the advancement of the economic and social development of all peoples,

Considering that the economic and social development of the economically less developed countries is not only of primary importance to those countries but is also basic to the attainment of international peace and security and to a faster and mutually beneficial increase in world prosperity,

Recognizing that during the decade of the nineteen fifties considerable efforts to advance economic progress in the less developed countries were made by both the newly developing and the more developed countries,

Noting, however, that in spite of the efforts made in recent years the gap in *per caput* incomes between the economically developed and the less developed countries has increased and the rate of economic and social progress in the developing countries is still far from adequate,

Recalling its resolutions 1421 (XIV) of 5 December 1959, 1514 (XV) of 14 December 1960 and 1515 (XV), 1516 (XV), 1519 (XV) and 1526 (XV) of 15 December 1960,

Convinced of the need for concerted action to demonstrate the determination of Member States to give added impetus to international economic co-operation in the current decade, through the United Nations system and on a bilateral or multilateral basis,

1. *Designates* the current decade as the United Nations Development Decade, in which Member States and their peoples will intensify their efforts to mobilize and to sustain support for the measures required on the part of both developed and developing countries to accelerate progress towards self-sustaining growth of the economy of the individual nations and their social advancement so as to attain in each under-developed country a substantial increase in the rate of growth, with each country setting its own target, taking as the objective a minimum annual rate of growth of aggregate national income of 5 per cent at the end of the Decade;

2. *Calls upon* States Members of the United Nations and members of the specialized agencies:

(*a*) To pursue policies designed to enable the less developed countries and those dependent on the export of a small range of primary commodities to sell more of their products at stable and remunerative prices in expanding markets, and thus to finance increasingly their own economic development from their earnings of foreign exchange and domestic savings;

(*b*) To pursue policies designed to ensure to the developing countries an equitable share of earnings from the extraction and marketing of their natural resources by foreign capital, in accordance with the generally accepted reasonable earnings on invested capital;

(*c*) To pursue policies that will lead to an increase in the flow of development resources, public and private, to developing countries on mutually acceptable terms;

(*d*) To adopt measures which will stimulate the flow of private investment capital for the economic development of the developing countries, on terms that are satisfactory both to the capital-exporting countries and the capital-importing countries;

3. *Requests* the Secretary-General to communicate to the Governments of Member States any documentation useful for the study and application of the present resolution and to invite them to make proposals, if possible, concerning the contents of a United Nations programme for the Decade and the application of such measures in their respective plans;

4. *Requests* the Secretary-General, taking account of the views of Governments and in consultation, as appropriate, with the heads of international agencies with responsibilities in the financial, economic and social fields, the Managing Director of the Special Fund, the Executive Chairman of the Technical Assistance Board and the regional economic commissions, to develop proposals for the intensification of action in the fields of economic and social development by the United Nations system of organizations, with particular reference, *inter alia*, to the following approaches and measures designed to further the objectives of paragraph 1 above:

(*a*) The achievement and acceleration of sound self-sustaining economic development in the less developed countries through industrialization, diversification and the development of a highly productive agricultural sector;

(*b*) Measures for assisting the developing countries, at their request, to establish well-conceived and integrated country plans—including, where appropriate, land reform—which will serve to mobilize internal resources and to utilize resources offered by foreign sources on both a bilateral and a multilateral basis for progress towards self-sustained growth;

(*c*) Measures to improve the use of international institutions and instrumentalities for furthering economic and social development;

(*d*) Measures to accelerate the elimination of illiteracy, hunger and disease, which seriously affect the productivity of the people of the less developed countries;

(*e*) The need to adopt new measures, and to improve existing measures, for further promoting education in general and vocational and technical training in the developing countries with the co-operation, where appropriate, of the specialized agencies and States which can provide assistance in these fields, and for training competent national personnel in the fields of public administration, education, engineering, health and agronomy;

(*f*) The intensification of research and demonstration as well as other efforts to exploit scientific and technological potentialities of high promise for accelerating economic and social development;

(*g*) Ways and means of finding and furthering effective solutions in the field of trade in manufactures as well as in primary commodities, bearing in mind, in particular, the need to increase the foreign exchange earnings of the under-developed countries;

(*h*) The need to review facilities for the collection, collation, analysis and dissemination of statistical and other information required for charting economic and social development and for providing a constant measurement of progress towards the objectives of the Decade;

(*i*) The utilization of resources released by disarmament for the purpose of economic and social development, in particular of the under-developed countries;

(*j*) The ways in which the United Nations can stimulate and support realization of the objectives of the Decade through the combined efforts of national and international institutions, both public and private;

5. *Further requests* the Secretary-General to consult Member States, at their request, on the application of such measures in their respective development plans;

6. *Invites* the Economic and Social Council to accelerate its examination of, and decision on, principles of international economic co-operation directed towards the improvement of world economic relations and the stimulation of international co-operation;

7. *Requests* the Secretary-General to present his proposals for such a programme to the Economic and Social Council at its thirty-fourth session for its consideration and appropriate action;

8. *Invites* the Economic and Social Council to transmit the Secretary-General's recommendations, together with its views and its report on actions undertaken thereon, to States Members of the United Nations and members of the specialized agencies and to the General Assembly at its seventeenth session.

1084th plenary meeting,
19 December 1961.

ECONOMIC AND SOCIAL COUNCIL RESOLUTION 916 (XXXIV)
UNITED NATIONS DEVELOPMENT DECADE

The Economic and Social Council,

Recalling General Assembly resolution 1710 (XVI) of 19 December 1961 designating the current decade as the "United Nations Development Decade", in which Member States and their peoples will intensify their efforts to mobilize and to sustain support for the measures required on the part of both developed and developing countries in order to accelerate progress towards self-sustaining growth of the economies of the individual nations and their social advancement so as to attain in each under-developed country a substantial increase in the rate of growth, with each country setting its own target, taking as the objective a minimum annual rate of growth of aggregate national income of 5 per cent at the end of the Decade,

Considering that the economic and social development of the economically less developed countries is not only of primary importance to those countries, but is also basic to the attainment of international peace and security and to a faster and mutually beneficial increase in world prosperity,

Recognizing that, in spite of a variety of efforts, policies, and measures designed to assist the developing countries in their efforts to achieve economic growth through which much has been accomplished, the rate of economic and social progress in these countries is still far from adequate,

Noting the essentiality of strengthening the economic independence of the less developed countries,

Bearing in mind that new problems affecting particularly the developing countries and hampering and delaying their economic and social development, have arisen in international economic relations in the course of the past years,

Having before it the report prepared by the Secretary-General* presenting proposals for intensified national and inter-

* United Nations publication, Sales No.: 62.II.B.2.

national action programmes during the present decade,

Noting:

(*a*) The views submitted by Governments concerning proposals for action in the Development Decade and concerning the role of the regional economic commissions in the Decade,

(*b*) The proposals for action made by the related agencies, and

(*c*) The views expressed during the Council's discussion of this subject,

1. *Expresses appreciation* to the Secretary-General for his work in producing the report and to the agencies and other institutions which helped in its preparation;

2. *Endorses* the emphasis placed in the report on the development process as a many faceted one, based principally on industrial development and a highly productive agriculture and requiring for success determined self-help and careful planning on the part of developing countries;

3. *Calls upon* the Governments of Member States, as well as United Nations bodies and specialized agencies, to give particular consideration, in the first years of the implementation of the Development Decade, in addition to their endeavours in other fields to the following:

(*a*) Industrial development as a most important factor in economic diversification and general economic development;

(*b*) Improved access to the world markets in order to promote export trade of the developing countries, taking into account their foreign exchange needs for development and the effects of deterioration in their terms of trade, including steps for early reduction or elimination of barriers to exports;

(*c*) Appropriate measures, such as international commodity arrangements, to stabilize at remunerative levels the price of primary commodities on international markets, and also sound compensatory arrangements designed to mitigate excessive fluctuations in the export receipts of primary producing countries and to compensate for the harmful effects thereof;

(*d*) The pursuance by regional and subregional economic groupings of economic policies which avoid the introduction and facilitate the elimination of obstacles and restrictions which might hamper the necessary expansion of the trade of the developing and under-developed countries or might discourage the indispensable growth of their economies;

(*e*) A substantially increasing inflow of long-term development capital, public and private, for financing their economic development programmes on terms which take into account the special requirements and conditions of the developing countries so as to benefit them; and for this purpose the continuing need for measures in both developing and developed countries designed to facilitate and encourage its flow to the less developed countries;

(*f*) The development of human resources through adequate programmes for education and vocational training, nutrition, health, sound public administration, housing, urban and rural development, including community development and effective land reform, with particular emphasis on their contribution to overall development objectives and with the co-operation where appropriate of trade unions and other non-governmental organizations in consultative status;

(*g*) Exploration and exploitation of natural resources with a view to establishing a raw-material and energy basis for economic development;

4. *Recognizes* the special significance of international economic relations and looks forward to the report of the working group set up under Council resolution 875 (XXXIII) of 13 April 1962, on the question of a declaration on international economic co-operation;

5. *Emphasizes* that pre-investment activities should be designed to facilitate national efforts towards development;

6. *Urges* the prompt attainment of the present goal of $150 million for the Expanded Programme of Technical Assistance and the Special Fund in the interest of accelerating the development of human resources, natural resources and national and regional institutions, and requests the General Assembly to consider, at an appropriate time, the establishment of new targets, bearing in mind the observations of the Secretary-General in his report;

7. *Urges further* that participating Governments give full support to the Freedom from Hunger Campaign of the Food and Agriculture Organization of the United Nations and invites the Governments of States Members of the United Nations and members of the specialized agencies to take early steps to prepare for the Pledging Conference for the experimental World Food Programme and, in determining their pledges, to bear in mind the necessity of attaining the goal of $100 million in commodities, services and money;

8. *Emphasizes* the need for increased domestic savings and investment in the developing countries, through appropriate policies in the public and private sectors of the economy;

9. *Stresses* the increasingly important role envisaged in the Secretary-General's report for the United Nations, and expresses the hope that resources commensurate with the task will be made available;

10. *Requests* the Secretary-General to submit to the thirty-sixth session of the Council a report on the measures taken to secure the full participation of the regional economic commissions in the work called for in the United Nations Development Decade;

11. *Requests* the Secretary-General in co-operation with the specialized agencies and the regional economic commissions, where appropriate, to provide on request assistance in the field of planning to developing countries; looks forward to the establishment and effective functioning of regional development institutes and the economic projections and programming centre, as provided in resolution 1708 (XVI); and requests the Secretary-General to report to the Council at its thirty-sixth session on progress made towards the goals envisaged therein;

12. *Looks forward* to the results of the United Nations Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas and requests the Secretary-General to make appropriate recommendations for action resulting from the findings of the Conference;

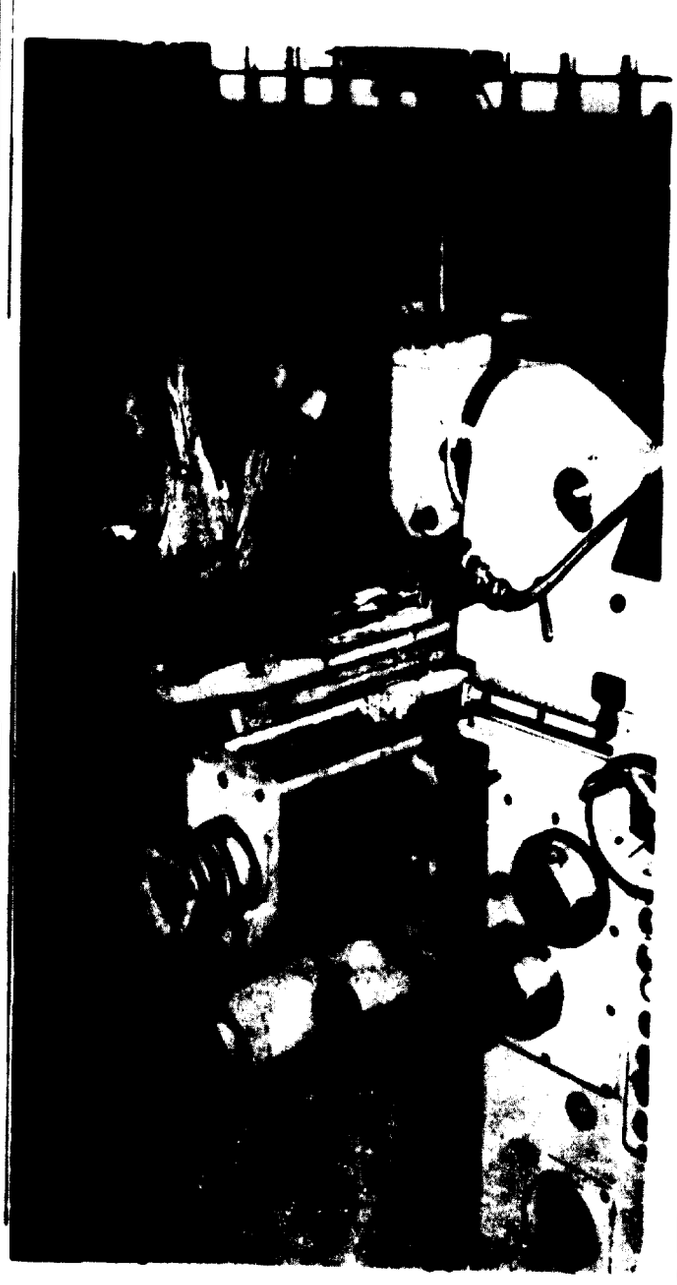
13. *Requests* the Secretary-General to prepare, in co-operation with the regional economic commissions and other bodies and agencies of the United Nations family, and with such experts from outside as he may deem necessary, a programme consisting of detailed phased proposals for action with respect to the basic factors of economic growth in the light of the objectives outlined above and a progress report setting forth achievements in the period ending 31 March 1963;

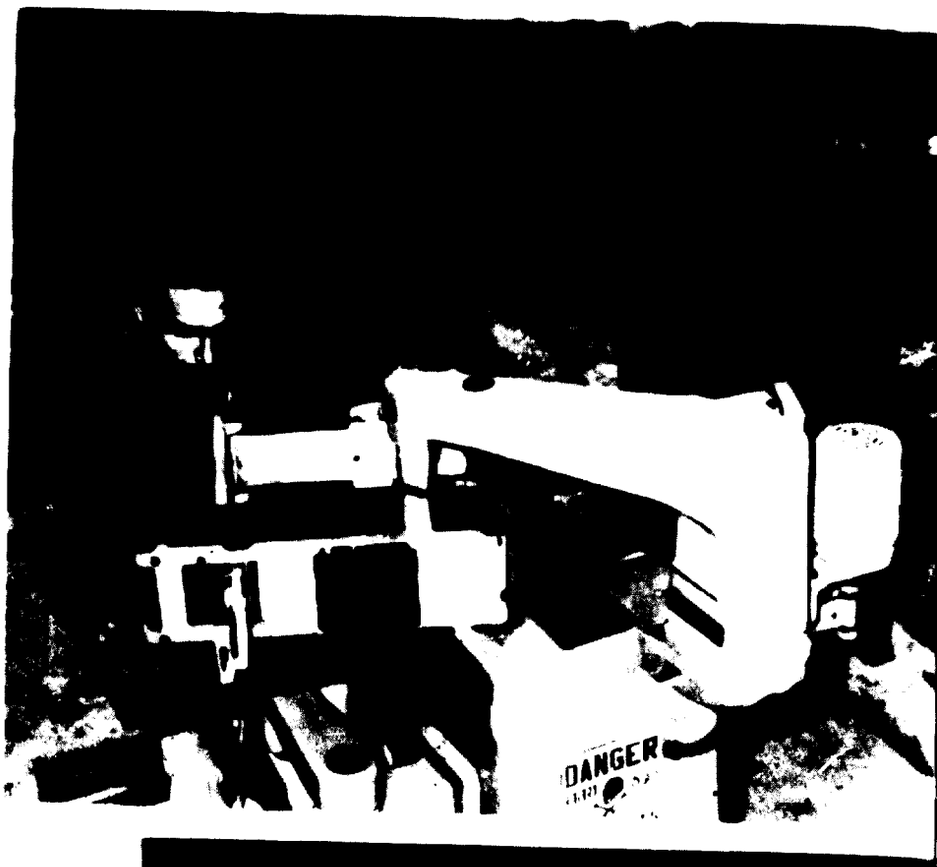
14. *Further requests* the Secretary-General to acquaint all United Nations bodies and the specialized agencies with the present resolution and to transmit the aforementioned studies and reports to the thirty-sixth session of the Council for consideration, when it will review the detailed programme of action in order to adjust them to the changing situation.

1236th plenary meeting,
3 August 1962.

SCENES AT THE PROTOTYPE PRODUCTION AND TRAINING CENTRE AT OKHLA, NEAR DELHI

BELOW: *Trainee for the trade of toolmaker operating a milling machine.* TOP RIGHT: *Workman operating a pantograph machine for stencilling service tools designed at the Centre.* BOTTOM RIGHT: *Foreman instructor checking a trainee's drawing.*





Training for Industrial Production of Prototype Machinery

BY A. D. BOHRA

THERE IS IN India a very large number of small industrial establishments, employing some 3.5 million people and adding 4,550 million rupees (approximately one billion dollars) to the value of the materials they process (excluding textiles). Thus far, their main contribution to the economy has been to help meet the increased demand for consumer articles. Now, they are increasingly taking up the manufacture of simple producer goods for industry and agriculture and of component parts of more complex capital goods produced by large industrial undertakings. Thus, closer relationships are being established among small industries and between them and the rural economy on one side and large-scale industry on the other.

Small-scale industries are defined in India as enterprises having a capital investment of 500,000 rupees (about $100,000) or less, in certain cases even one million rupees (about $200,000) or less. Units of the maximum size may have adequate access to capital and be modern in every respect. Most units are, of course, much smaller. Characteristically they lack bargaining strength in buying and selling and in securing capital. Their internal organization is little specialized, one to three persons carrying out all technical and managerial functions. These weaknesses become particularly evident when new lines of production are to be developed, especially certain lines of producer goods never before manufactured in the country, either by small enterprises or, not infrequently, by large concerns. In view of the fact that the Government is deliberately promoting the indigenous manufacture of goods hitherto imported from abroad, the undertaking of industrial operations completely novel to India is a common occurrence.

PROFESSOR BOHRA, *Principal Director, Small Industry Extension Training Institute, Hyderabad, India, has participated in a number of seminars and working parties on industrialization organized by the United Nations and the Economic Commission for Asia and the Far East. He is currently serving in Ceylon as an expert of the International Labour Organisation in the field of small industry extension services.*

It is the view of the Government of India that small scale industries help to ensure an equitable distribution of the national income, mobilize resources of capital and skill which would otherwise be idle, and avoid some of the socio-economic problems created by industrialization. Consequently, the Government has taken many steps to promote this economic sector, including the extension of advisory services on improved methods of production and management, help with purchase of new machinery, provision of factory space in modern industrial estates and dissemination of modern knowledge through a nation-wide Industrial Extension Service and training institutions. The Government's policy is aimed at helping small-scale industry to become a more self-reliant and self-supporting sector of the national economy.

The fact, referred to above, that small-scale industries are increasingly undertaking the manufacture of new types of producer goods has led the Government to provide them with a new form of assistance. A number of Prototype Production and Training Centres are being set up in different parts of the country, with a view to carrying out the following tasks:

(*a*) The development and production, with foreign collaboration if necessary, of prototypes of machines, implements, tools, accessories, component parts and the like at present being imported but which are suitable for subsequent reproduction on commercial lines by small scale units;

(*b*) The development and production of prototypes of improved types of machines now manufactured in India but not to adequate standards and, at a later stage, of new types of machinery and equipment especially well suited to the needs of small industrial units in India, and

(*c*) The practical and theoretical training of the operative staff of small-scale units and of the technical staff of the Government Extension Services engaged in assisting small industrial units to carry out the above tasks.

As a subsidiary function, the Prototype Production and Training Centres are themselves also intended to undertake the manufacture of such component parts or to carry out such phases of production for which facilities do not exist in the small units; however, this may be done only if it does not hamper the attainment of the three main tasks.

Thus, the Centres are intended to serve a number of small

industrial units as a common development department, providing them with the necessary technical knowledge and training their personnel, to enable them to undertake commercial production of new items of considerable importance for the further development of industry, especially in their own sector. At the same time, it is expected that each Centre would serve as a model for similar training centres to be set up by the Government or other agencies and that the organization and operation of each Centre would be a model both for individual small-scale units and for co-operative groups of such units engaged in complementary industrial operations.

Thus far, three Prototype Production and Training Centres have been established and are functioning. The first Centre, set up at Rajkot (Gujerat) in 1957 with the help of the United States Government, was originally intended to function as a central workshop providing a wide range of services for the establishment of model production units suitable for operation on a small scale, such as manufacture of furniture or wire products. This purpose however, was abandoned when it was considered that the demonstration value of setting up model production units could not outweigh the disadvantage of having these compete directly with existing small commercial units and it was decided that the Rajkot Centre would specialize in training for production of machinery for foundry, wood working and sheet metal manufacturing. A second Centre is at Okhla, a suburb of Delhi. It was established in 1959 with the help of the Federal Republic of Germany and specializes in training for production of prototype machine tools. This Centre is described in some detail below. The most recent addition to the chain of Centres is at Howrah, a part of Calcutta. It has the help of the Japanese Government and concentrates on industrial machinery particularly suitable for small industry and on electrical instruments for switchboards.

Each Centre is an all-India institution in the sense that it services small units all over the country. Present plans envisage the establishment of twelve additional Centres, each specializing in a specific range of producer goods. It is expected that a network of fifteen Centres will be sufficient to meet all the current and prospective development and training requirements of the small-scale industry sector, and will need to be expanded only when new lines of products have emerged from the inventive processes of modern science.

To make the description of the Prototype Production and Training Centres as concrete as possible, the illustrations in this article will refer to the operations of one of them, the Centre at Okhla. This will permit not only the guiding principles common to all Centres to be presented but also some of the problems which confront them in practice.

OPERATION OF THE CENTRES

FOUR MAIN STAGES may be distinguished in the operation of the Prototype Production and Training Centres.

(i) *Selecting the item*

Only those items are selected for prototype development at a Production and Training Centre which are suitable for manufacture by a small industrial unit with the necessary tools and technical qualifications. In the selection, machines at present not manufactured in India enjoy the highest priority, even if production involves collaboration with a foreign firm. Apart from the overriding aim of replacing imported products by indigenous manufacture, the following factors, among others, are considered in selecting the products for prototype manufacture: rugged and foolproof design; accuracy in operation; small power consumption; satisfactory output; interchangeability of parts; ready availability of servicing and spare parts; low cost of maintenance, and low purchase price.

(ii) *Negotiating foreign collaboration*

Once an item has been selected for prototype manufacture, negotiations start with some of its foreign manufacturers. The rights to be acquired need to cover manufacturing according to the original design, and, if necessary, modifications in the design to suit Indian production and marketing conditions. The contract usually includes the import of a few complete sets of ready-to-assemble components with which to start off work in the assembly shops without delay. When necessary, the contract can specify a lump sum payment for technical knowledge and royalty payments for a specific period. In these matters the Centre plays an essential intermediary role, since it is hardly possible for the small manufacturers either to enter into or to complete successfully direct negotiations for a transaction of this type with the foreign manufacturer of the original piece of machinery.

(iii) *Planning design and engineering and setting up the production line*

Once an item has been selected for prototype manufacture, the Centre carries out some or all of the following functions:

(*a*) Design or redesign of the product;

(*b*) Preparation of process schedules;

(*c*) Manufacture of jigs, fixtures and tools for production, and

(*d*) Manufacture of a sufficient number of prototypes to ensure smooth production.

At this stage, the Centre may need to be in touch with some of the technological research institutions in India. It is expected that particularly close relationships will be established soon with the Machine Tool Design Institute now being set up by the Government in Bangalore.

(iv) *Providing training and assistance to the small unit for commercial production*

All of the technological knowledge acquired during prototype manufacture and assembly is then handed as a "package" to selected small units for commercial production. As part of the training, the prototype is handed over to the unit together with all drawings, process schedules and instructions from the original manufacturer. Further advice is extended regarding machinery and other equip-

ment, raw material supplies, and other production requirements.

Specialization and co-operation

Prototype production of any machine at a Production and Training Centre is usually confined to a small number, what might be called a "zero" series. In general, a small-scale enterprise is not expected to manufacture a whole complex machine by itself, since it seldom has the necessary facilities. The trend towards increased specialization within each unit and co-operation between units, which is encouraged by the Government of India—special incentive schemes have been introduced for this purpose—is brought to bear upon the present case. Accordingly, a prototype is split into several component parts, one or several of which are manufactured by different small units and it is then assembled in another small factory.

It may be noted in this connexion that increased specialization helps to overcome other major obstacles. Some of these arise from the basic discrepancies between the general levels of technology in India and those in highly industrialized countries. Others may arise from legal restrictions — for instance, proprietary rights—on the manufacture of certain machine parts. Specialization in a country like India allows production to proceed in progressive stages, from early manufacture of the less complex parts of a machine and their assembly along with imported parts, to indigenous manufacture of an increasing number of parts, and finally to domestic production of the whole item. In this way, specialization does not wait on industrial development but, on the contrary, makes it feasible.

An example may show how this development takes place in practice. At the Okhla Centre, three types of machines, manufactured in the Federal Republic of Germany, were taken up for initial development: a small bench lathe, a tool and cutter grinder and a milling machine. From 1960 to 1962, detailed drawings were prepared for undertaking, in the period 1962 to 1966, the following production programme for these items at the Centre:

Machine	*1962*	*1963*	*1964*	*1965*	*1966*
Precision lathe (Weiler)	100	150	200	—	—
Tool and cutter grinder (Hahn and Kolb)	—	50	125	175	100
Horizontal milling machine (Steinel)	—	100	150	200	—
TOTAL	100	300	475	375	100

The reasons for which a relatively large number of machines are to be produced at the Centre are that it is desired to perfect prototype production and to implement a broad training programme built around a regular production line. Production of these machines by the Centre is to be discontinued in 1967.

The terms of collaboration between the Centre and the German manufacturers allow Indian small units to produce and sell these machines in the country. At the beginning, some complete sets of components were imported, ready to assemble. This allowed the fitting and assembly sections of the Centre to begin working at the same time as the sections manufacturing component parts—that is, the foundry, the forging shop and the machining shop—were starting their own operations. It is envisaged that the imports of component parts will be gradually reduced until finally they comprise only those items which carry proprietary rights or which are not manufactured anywhere in India.

A parallel method is followed for familiarizing small entrepreneurs with the products and processes developed at the Centre. At first, all the components and parts are provided to the unit for study and assembly, and, as the unit begins to manufacture its own parts and other units take up the manufacture of other parts, the Centre gradually fades out of the picture.

An effective form of organization would be to set up a functional industrial estate as a counterpart to a Prototype Production and Training Centre. Such an estate is devised for small enterprises producing parts of a given article, assembly being made in one of the units of the estate. The Centre would provide training and guidance to the small units and, if necessary, would in the beginning manufacture certain parts and undertake the assembly of the product. Later on, these functions would be taken up by some of the occupants of the estate. The Centre would continue to provide technological guidance and, if need be, common design and toolroom facilities.

Modifications in design, raw materials and process schedules

It is to be expected that, because of differences in levels of technology and in available facilities, the collaboration between the Centre and the foreign manufacturer and between it and the small units will be active for a long time. The fact that a few complete sets of components are originally imported from abroad does not usually mean that the product for which manufacturing rights have been obtained can be copied *in toto*. Certain parts may be far too complex to be copied in India, at least for some time, or may be far too expensive to manufacture. Such parts would continue to be imported from abroad.

Modifications of the product are often needed to meet local conditions, and the Centre has an important role to play in devising adaptations of processes and equipment.[1] Minor changes may need to be made in the sizes of such items as screws, nuts and bolts, so that they conform to standards in common use in India. Major changes may, for instance, be effected in raw materials specifications in order to bring them into line with resources available in the country. The case of steel is particularly serious in this respect.

[1] Another article in this issue of the *Bulletin* is devoted to this subject. [*Editor's note.*]

In a highly industrialized country, securing the specified steel may be a matter of lifting the telephone and getting it "off the shelf". In a developing country such as India, where most of the steel alloys required are imported from abroad, this presents a grave and very difficult problem.

Even though the requirements of small units for any particular type of steel alloy may be very small, and even when they are given an import licence meeting their individual requirements, actual supply to the required standard and in the proper time cannot always be guaranteed. Foreign manufacturers of steel alloys are not much concerned over the small requirements of a single importer. Quite often, the types of steels required are not included in their current manufacturing programme and they may be reluctant to accept special orders for small quantities. Moreover, small industrial units are not in a position to carry large stocks of every type of steel required. These difficulties compound others arising for instance from the shortage of foreign exchange, and constitute a serious obstacle to the development of small-scale industries.

For the Prototype Production and Training Centres, the problem breaks down into two major parts. The first question is that of rationalizing the use of steel. In many cases, the wide variety of steels originally specified for the production of a machine can be reduced without affecting to any appreciable extent the quality of the product. Reducing the number of different types of steel to be imported makes it possible to increase the volume of orders for each individual type and so to induce foreign manufacturers to include such orders in their production programme. In the second place, the Centres will need to assure the small entrepreneurs that the substitute materials will be as good as those that they have used thus far, instruct them in the use of heat treatment processes appropriate to the new types of steel, and extend other advice and assistance. The Government is now considering the possibility of setting up, as part of the facilities of each Centre, a raw materials depot with a view, in particular, to importing special steels and supplying them to the small units in the region. Another, perhaps less obvious example of the need for local modification, relates to the type of lubricants to be used for the prototype machine. The basic principle in the area of design or modification of the existing design is to simplify by maximizing the number of standard component parts and minimizing the number of types and sizes of raw materials.

Replanning the process schedules for the manufacture of various components and the tools, jigs and fixtures required for manufacture is another important kind of modification carried out at the Centres. The technical information on this aspect supplied by the foreign manufacturer is at best a good guide. The schedules have to be modified to suit the scale of production and the type of machinery available not only at the Centre, but, more importantly, at the units which will undertake the commercial production. In the most extreme cases, the original methods are practically irrelevant to the developing country, for instance, when the machine to be developed as a prototype is so standard in the country of origin that it is mass-produced on highly productive automated equipment.

TRAINING

Training the staff of the Centres

The third main function of the Centres—training—is closely integrated with their production function. It is, in fact, attempted through supervised production. The staff of the Centres is trained by foreign experts before it begins to provide instruction to the workers of the small enterprises. The experts train the staff of the Centres through day-to-day work, exactly as, at a later stage, the staff will train the workers. To train the staff, the prototype production programme has been phased into three stages providing for progressively advanced instruction.[2] These are:

(*a*) Development of machinery and equipment through foreign technical collaboration with such modifications in design or manufacture as may be required to suit Indian conditions;

(*b*) Improvement of sub-standard products already manufactured in India by modifying design, processes, type of raw material and so on;

(*c*) Design and development of entirely new machines to suit local needs or export markets.

As the staff and the foreign experts take these steps together, they also develop ancillary appliances and tools. Special work benches, cupboards and portable, hand-operated cranes are some of the many items developed in this way at Okhla. While they have been developed in the first place for the Centre's own use, they have attracted the interest of many small manufacturers, some of whom wished to procure the new appliances and tools for their own use, and others to procure the drawings in order to manufacture the items for commercial purposes. Such type of sideline contribution by the Centres may be important enough to affect the planning of their production programmes.

Training the workers of the small units

Training the workers of the small units is the key element in passing from prototype production to commercial manufacture. If training is to be fully effective, it must be preceded by a careful selection of small-scale industrial units promising best to achieve commercial production of new items, a difficult task because many factors may make or mar this promise, such as the experience of the unit, its material resources, and the personality of the entrepreneur.

In spite of these difficulties, the selection of the units should be attempted well in advance of starting prototype production. An early association would yield immediate practical benefits in addition to the obvious long-term ones,

[2] In addition, special courses are organized for qualified technical and other personnel of the nation-wide extension organization in India, who provide technical assistance to small enterprises, and whose need is to keep up to date in their various fields of specialization.

since some forms of training could be provided to the various operating personnel as early as the planning stage, and be continued and developed as production is undertaken by the Centre. Thus, while the processes are being planned in the Centre, the supervisor of the small unit can be brought to the Centre for special training in this phase of the work. When tools are being designed and then manufactured for prototype production, the tool makers may be called in, and the moulders and machinists when the components are being cast or machined. Such a procedure would ensure the participation of the various categories of personnel in every stage of development of the product.

Proper training arrangements should greatly reduce or even eliminate disturbances and difficulties in the units resulting from absence of staff away for training. The problem need not arise significantly or at all in units newly set up for the purpose of producing the prototype machine commercially, provided the units are selected early enough. Their staff can then work along with the staff of the Centre as the latter develops the prototype, and begin work in their own unit whenever a stage of training has been completed. The position need not be different if an existing unit intends to expand into this new line of manufacture, since it will need new staff in any event. Disturbances can affect units which wish to change over from an earlier line of production to the new one, or which request from the Centre modifications in their established designs for reintroduction in the same shops. In such cases, the changes in design may be as upsetting as the training of the staff.

Technical personnel of small-scale units

There are in general three levels of technical personnel in a small enterprise in India: workers, technicians, foremen or supervisors, and superintendents or technical managers. In very small units, these levels are usually compressed into two and sometimes even one. Originally, the Prototype Production and Training Centres were to provide advanced training only to personnel having already acquired basic skills through formal training or experience. Now that some basic training courses have been organized for certain categories of technicians and foremen, the Centres have assumed responsibility for improving the technical skills of all three categories of technical personnel.[3]

To supplement such basic training, the Centres organize separate courses for skilled workmen, supervisors and engineers. Originally, the following qualifications were laid down for selecting trainees in these categories:

(i) *Skilled workmen:* minimum experience of three years, excluding period of earlier training;

(ii) *Foremen:* diploma holders with three years of practical experience; or skilled workers who after finishing the course under (i) above have further experience of about two years; or non-diploma holders with five years of practical experience, possessing prescribed qualifications;

(iii) *Superintendents and shop-masters:* practising superintendents and shop-masters, and foremen with minimum experience of five years.

While these selection standards could not be applied rigidly, minimum standards providing for practical and theoretical tests for all candidates before admission have been prescribed and held to for each course.

Emphasis on practical training

In all their courses the Centres emphasize practical training. Theoretical subject matters are left to be dealt with in vocational schools and colleges. At the Centres, teaching is focused on those aspects which allow the trainees to realize the causes and the advantages of each task. Such training has obvious limits: for instance, while the Centres can provide practical training to design and development engineers, they cannot go so far as to train them in machine construction; this is left to higher technological institutions in the country.

Since most of the trainees are already employed in small units, whether newly established or not, or in the Government's extension organization, both of which find it extremely difficult to spare their personnel for long, the training period must be as short as possible. Originally, none of the training courses lasted longer than six months. A few longer courses have now been organized for special purposes and for trainees who are to be employed in completely new vocations.

At the Okhla Prototype Production and Training Centre, the training courses cover the following subjects: turning, milling, gear-cutting, planing, grinding, fitting and assembly, heat treatment, electroplating, tool room, foundry, forge and sheet-metal work, welding, wood-working, pattern-making, materials testing, inspection and draughtsmanship and maintenance.

In the middle of 1962, there were 150 trainees at Okhla, divided into six categories:

(*a*) Skilled workers from small industrial enterprises in the age group of seventeen to thirty, employed in the engineering sections of their units. These workers have had one to three years' experience in the trade which they have chosen for training. They are able to read, write and understand English. Preliminary selection of the candidates was made by the Small Industries Service Institute which is the Government's extension agency at the state level, and the

[3] Technical education is provided in India by the following institutions:

Technical high schools:
General education with emphasis on technical instruction

Trade schools, junior technical schools and industrial training institutes:
Practical and theoretical training in particular trades, such as turning, fitting, welding and the like

Specialized schools such as those organized by ordinance factories and large enterprises of the public sector:
Practical and theoretical training in certain trades to meet specific requirements of the factories

Schools of engineering and polytechnic institutions (diploma courses):
Practical training with theoretical background in a field of engineering, such as mechanical and electrical engineering, ceramics, etc.

Engineering colleges (degree courses):
Theoretical training with practical bias in one field of engineering.

final selection by the Okhla Centre. The duration of training is six or twelve months, depending on the experience of the trainee. Each trainee is paid a monthly stipend of fifty rupees and provided with free furnished accommodation.

(*b*) Regular apprentices who are "freshmen" having passed matriculation, or an equivalent grade in science and drawing, and who have been recruited from all over India through advertisements in the leading newspapers. The course organized for them lasts three years. During the training, the trainees are paid a monthly stipend of fifty rupees for the first year, sixty for the second year and seventy for the third year.

(*c*) Trainees from Industrial Training Institutes, at the Centre for advanced training for one year. These trainees have had at least one year's experience in the trade, and have been admitted after the nominees of small industrial enterprises have been accommodated. They are subject to the same rules and regulations, and receive the same stipend as the latter.

(*d*) Graduate apprentices, at the Centre for training on an *ad hoc* basis. These trainees have competed for places with those from the Industrial Training Institutes, but do not receive any stipend or hostel accommodation.

(*e*) Assistant draughtsmen in training at the Centre, matriculates with at least twelve months' previous training in draughtsmanship.

(*f*) Junior trainees in draughtsmanship, matriculates in the age group of seventeen to twenty years with at least some basic knowledge in this skill.

It is expected that the total number of trainees at Okhla will increase as follows in the next few years:

Type of course	*Number of trainees*			
	1962	*1963*	*1964*	*Total*
Three years' apprenticeship course	—	—	21	21
Six months' course	207	240	240	687
Twelve months' course	100	200	200	500
Courses for assistant instructors, technical assistants, assistant draughtsmen, junior draughtsmen, etc.	69	140	140	349
TOTAL	376	580	601	1,557

Not included in this compilation are the technical specialists of the Government's extension organization and technical training institutes who come on an *ad hoc* basis for three to six months. They do not receive special stipend or accommodation.

Methods and contents of training courses

A number of broad guide-lines are used in framing the syllabi for the three main categories of trainees, the period of the courses varying with the nature of the trade and the grade of the trainees:

Skilled workmen are given theoretical training covering fundamental principles of different operations, types of machines and tools, blueprint reading, raw materials supplies and manufacturing techniques relating to their trade; and practical training in the operations allied to their trade and in the manufacture of component parts of machines and machine tools;

Foremen are given practical and theoretical training covering machine tools, structure and composition of raw materials, and manufacturing processes; inspection and testing, blueprint reading, design and manufacture of simple tools and implements; and practical training in operations allied to their trade and in the manufacture of parts of machines and machine tools;

Shop-masters and superintendents are given, in addition to the training imparted to foremen, courses in time and motion study, cost accounting, design and manufacture of simple machines, jigs and fixtures, and workshop management, including planning and production control.

In order to ensure that the setting for practical training approximates closely normal production conditions, all production departments of the Centres are organized on regular production principles. After an initial period of a few weeks, trainees are attached to permanent staff members of the Centre who supervise their work. They receive preliminary instructions on the job and are then expected to execute their work according to established standards. Supervision is maintained until such standards are achieved.

SOME OPERATIONAL QUESTIONS

LIKE OTHER ORGANIZATIONS, the Prototype Production and Training Centres have their share of day-to-day operational problems, the effective solution of which mainly depends upon the quality of their staff. In the following, some operational problems special to this new type of organization are examined, and some indications are given concerning the range of material resources required to set up new Centres.

Production-cum-training

The theoretical case for training personnel through actual production processes leading to finished products is a tight one, but such integration has real difficulties built into it. One problem is that production conditions for the manufacture of prototypes are not the same as for commercial manufacture. According to principle, when the two are proximate, the time has come for production to be trans-

ferred from a Centre to a commercial unit. However, if the principle were followed, it would not be possible to operate a Centre on a regular schedule since production schedules would change far more frequently than is sound for purposes of training. To avoid this danger, fewer items have been taken up for prototype production at the Centres than would have been desirable and the production of at least some items at the Centres is being continued well beyond the time needed to develop the prototype for commercial production.

The remedy to the above danger gives rise to another one, namely, that the attention of the staff of the Centre may veer away from the primary goal of manufacturing prototypes and training personnel to the subsidiary one of undertaking commercial production at the Centre itself. Encouragement has been officially given to the Centres to accept job orders on a non-commercial basis so as to put the equipment to maximum use, although it has been clearly stated that such orders could only be accepted if they would not hinder performance of the Centre's primary functions. The operative question is whether commercial production threatens to preoccupy the attention of the Centres' staff. Whether this danger is avoided or not depends to a large extent on the criteria by which higher levels of the Government evaluate the operations of the Centres. It can be minimized if they assess the operations primarily in terms of the original goals of the Centres and do not allow themselves to be sidetracked into assessing these institutions as if they were commercial units.

Staff of the Centres

As in all training institutions, the number and quality of the staff of the Centres are the main factors influencing the speed and quality of the work, both as regards prototype production and training. They determine the "atmosphere" of the Centre and the extent to which the staff can communicate to the trainees important matters beyond immediate technical training, such as, in the management field, record keeping procedures, inventory control systems, costing and financial accounting, and still more generally, standards of good order, cleanliness and punctuality; and, even beyond that, standards of personal responsibility and co-operation.

Persons able to live by such standards and communicate them to others are rare anywhere, and especially in rapidly industrializing countries. One consequence of this shortage is that the best among the trainees tend to be retained by the Centres on their permanent staff, while at the same time the Centres lose experienced staff very frequently. There is no doubt that quick turnover of staff affects the Centres' regular programmes adversely. It seems that the only way of remedying this difficulty is to organize a continuing programme of staff training, once the limitations imposed by the government machinery on recruitment of permanent staff can be relaxed.

Sharing the expenditure

In principle, all three parties to the benefits of training are to contribute to its cost: the Centre, the trainee himself, and the small unit which has deputed him. The small unit may pay the trainee a part of his normal salary for meeting family expenses during the training period. The trainee may cover some additional "out-of-pocket" expenses. In practice, it has been found difficult to enforce this principle rigidly without losing the interest of small entrepreneurs in sending their staff, and that of the staff in coming, to the Centre. This touches major questions relating to the appreciation accorded in rapidly industrializing countries to learning practical skills and to the traditional relations between people and their government. Meanwhile, the stipends paid to trainees are adequate to meet their cost of living at the Centres.

ORGANIZATION OF NEW PROTOTYPE PRODUCTION AND TRAINING CENTRES

THE ORGANIZATION AND working conditions as well as the buildings and campus of each Centre should be so planned that they not only fit into the development programmes but also leave the trainees with a lasting memory of their stay at the Centre and establish and develop ties between them and this institution in the future. Every facet of the Centre's organization and activity should promote better human and professional communication.

Some features of the Okhla Centre

The buildings and their layout can in themselves be prototypes. At Okhla, extensive use has been made of prefabricated components in putting up the structures. The roofs are of light foam-concrete slabs which are both neater and considerably cheaper than other load-bearing materials. Since the Okhla Centre was built, these features of its construction have been adopted by many industrial units.

In view of the fact that no regular production programme is ever scheduled for a definite period ahead, all sheds at Okhla are so designed that the layout of machinery and the sequence of operations can be readily changed. There are no inside pillars. The roof spans and the overall length of individual sheds are great.

Similar considerations have determined the layout of the electric installations. An overhead wiring system has been installed. The distribution lines in the factory sheds branch off from the feeders along the larger walls and are carried on pillars standing on the floor with only light fastening. The arrangement can be easily adjusted to every change in the layout of machinery.

Another special feature of the Okhla Centre is the provision of a visitors' gallery running along the entire length of its main sheds. A production factory would not need this, but a Prototype Production and Training Centre is a place where visitors—officials, technicians, owners and managers of workshops and factories, students, people from all walks of life—come every day. Permitting free access to the Centres is an effective way of demonstrating development work in a stimulating and convincing manner. The gallery provides visitors with an unobstructed view of activi-

A view of the basic training shop of the Okhla Centre

Trainees at work in the forge shop of the Okhla Centre

ties in the shed while preventing them from interfering with the regular flow of work.

Some less important features of the buildings include the following: the administrative buildings and classrooms are away from the workshops, to avoid noise, dirt and gases; stores are at one end of the workshops—though in close proximity, they need to be separate in order to reduce fire risk; workshops liable to accumulate or disperse dirt or dust are situated as far as possible from those requiring freedom from dust; wide traffic lanes are provided in the workshops for floor level transport of materials; inter-shed transport is effected by suitable lift-type carriage and battery-type electric carriage; an overhead travelling crab system is a desirable feature along the entire length of the two transport lanes.

Machinery and equipment

As a rule, small-scale enterprises employ principally general-purpose machines, and it may take a long time before they are able to acquire labour-saving machinery involving high investment. Accordingly, if a Prototype Production and Training Centre is to meet the needs of small enterprises, its equipment and machinery should not be of the very latest and most modern type. If they were, the training received would be of little use to the workmen upon return to their units. On the other hand, the Centre's equipment should be better than the sub-standard machinery usually available in small enterprises. The equipment should therefore be standard and well above the general level of small industry, though within its reach with some effort. Some special equipment to provide common service facilities to small units must also find a place in a Centre. In India, examples of such equipment are gear-manufacturing and jig boring machines.

The selection of machinery for a Centre poses major problems of a special nature inasmuch as the production programme—that is, the nature and quantum of the workload on different types of machinery—is not known in advance. The production programme will vary with changes in the prototype programme, and the latter should be projected in advance so as to have a balanced availability of machinery and equipment. The provision by the Centre of common service facilities (for instance, heat treatment and laboratory testing) and the use of machinery for job orders both help to ensure a balance in the utilization of equipment which might be difficult to achieve in the production of prototypes alone.

The equipment for individual workshops and the inventory of parts and supplies required for carrying out all phases of work and practical training cannot be planned in detail far in advance, and will in part be contingent upon the development of the prototype programme. The Okhla Centre, which specializes in machine tools, has all the sections required in a modern engineering workshop: machine shop, foundry, carpentry, smithy, metal finishing shops, design office, sheet-metal shops, and so on. Each section is well equipped to cater to the normal requirements of all phases of the Centre's activity. In the initial stages, some outside job orders were taken to utilize idle equipment and to organize proper training while the normal work of the Centre gained momentum. The equipment at Okhla cost nearly six million rupees ($1.2 million) for a training capacity of 250.

The lecture rooms are simple but are furnished with teaching aids, such as projectors for films, film-strips, and overhead projection. Extensive use of audio-visual aids helps in reducing the period of training.

Personnel

Since the activities of the Centres are both very important and quite new to India, it is essential to get the best available persons in the country on their staffs. In some cases not even the best available is good enough, and assistance from foreign governments in the form of services of technical experts is needed to support the indigenous talent. In India, specialized assistance from abroad has been obtained in many fields, particularly design, time study, work measurement and job preparation.

While the foreign experts' knowledge in their fields of specialization can safely be assumed, more often than not

their experience of India is limited or nil, and they may not therefore readily fit their knowledge to the actual working conditions. When a foreign expert teams up with an Indian there can be a happy blending of the former's technical knowledge and the latter's local experience. In the Centres, as in other institutions or factories, the foreign experts are placed in positions where they do not have to implement the programme directly, but are expected to provide advice and training. In the Centres, the local staff member is held fully responsible for the working of his section, and foreign experts assist him in doing the job. The key role of the foreign expert is clearly that of training his counterpart to do a job rather than doing the job himself. It is usually possible for the Indian counterpart to take over full responsibility within three years.

There are certain limitations to training Indian personnel at the Centre with the help of foreign experts, particularly as regards technical staff at the higher levels. There are programmes for sending personnel abroad for further training, whenever possible at the foreign firms which collaborate with the Centre in its manufacturing programme. Overseas training is preceded by six months to one year's work at the Centre, as it has been found that only then does the staff obtain full benefit of its stay abroad. Overseas training is granted subject to a guarantee from the trainee that he will serve with the Centre for a specific period upon his return to India.[4]

Financing

The initial investment in each Centre thus far established in India has been about ten million rupees ($2 million). About half of this expenditure has been met by foreign countries—the United States at Rajkot, the Federal Republic of Germany at Okhla and Japan at Howrah. Their contribution includes the foreign exchange costs of equipment, expenditure on foreign staff for an initial period of three years, and training costs of Indian instructors abroad. The rupee costs of the project for land and buildings, Indian staff and other working expenses are met by the Government of India.

[4] The question of industrial training overseas is discussed in an article on United Nations fellowships for industrial development, published in this issue of the *Bulletin*. [*Editor's note.*]

CONCLUDING REMARKS

THE PROTOTYPE PRODUCTION and Training Centres are an important new link in the chain of institutions servicing and assisting small-scale industries. By concentrating on producer goods which can both be manufactured and used by these industries, they contribute directly to the acceleration of industrial growth. By fostering complementary relationships between small-scale industries, they contribute to strengthening this economic sector. Their work is complementary to that of technological research institutes in solving the problem of adaptation of equipment; to that of small-scale industries service institutes and industrial extension centres in providing specialized technological assistance and advice; and to that of educational and training institutions in providing specialized practical instruction.

Since the major function of Prototype Production and Training Centres is to facilitate the transfer and adaptation of technologies developed in the advanced countries, foreign assistance will in most cases be necessary to set up such institutions in the industrializing countries and to provide guidance and training, including fellowships, in the first stages of their operation. In India, such assistance was provided under bilateral agreements. It is suggested that industrializing countries could usefully request it also from international organizations. In some cases, expert advice may be needed to conduct investigations prior to starting a programme of establishment of Centres. In many cases, the supply of funds to meet the foreign exchange costs, in particular those of equipment, would be a useful adjunct to the provision of expert help and fellowships, when permitted by the statutes of the contributing organization.

Trainee receiving his certificate from the Chairman of the National Small Industries Corporation, upon conclusion of his term

A group of thirteen Asian engineers visiting a cement factory at Hagestein, the Netherlands

United Nations Fellowships for Industrial Development

THE GRANTING OF fellowships is a major element in the technical co-operation programme of the United Nations. As is the case of expert advice, training, pilot and demonstration projects, and other activities under this programme, fellowships are granted upon request of Governments, as a contribution to the economic and social development of their countries. Consequently, fellowships are not awarded merely for the pursuit of academic studies leading to degrees or diplomas. They are intended to give persons engaged in development activities the opportunity to broaden their professional knowledge and experience by becoming acquainted with advanced methods and techniques. A particular training programme may include academic studies but the main purpose of a fellowship is to enable the holder to derive from his training an increased ability to solve operational and professional problems upon his return home.

United Nations fellowships, like other technical co-operation projects, are concerned with many fields of economic and social development including industrial development.[1] As will be seen below, the number of fellowships in the field of industrial development has been, in recent years, a relatively small proportion of the total number and, as far as the programme of the United Nations, excluding the specialized agencies, is concerned, even a declining one. Yet, in view of the greater emphasis being placed on industrialization by practically all developing countries, it is likely that requests for fellowships in this field will increase in coming years, a development which is being pressed by the United Nations organs mainly concerned with industrialization—the Economic and Social Council and the Committee for Industrial Development.

The purpose of the present article is to review and analyse fellowship projects in industrial development carried out in recent years in order to bring out certain trends and get some orientation regarding a desirable course of action in future years. The review is principally concerned with the programme of fellowships in industrial development of the United Nations, excluding the specialized agencies and the International Atomic Energy Agency, covering the period from 1956 to 1960, during which a total of about 700 such fellowships were awarded.

[1] Other main fields are economic planning, economic surveys, fiscal and financial matters, natural resources and power development, transport and communications, trade promotion and marketing, productivity, statistics, public administration, social welfare, human rights and so on.

SCOPE OF THE FELLOWSHIP PROGRAMME FOR INDUSTRIAL DEVELOPMENT

THE UNITED NATIONS programme of fellowships for industrial development provides opportunities for training in the following fields: industrial development planning and programming; industrial technology and practice; technological research; development of new industries; special problems of small-scale industries; industrial management, including accounting, marketing and export promotion of industrial products, and productivity. Subjects such as energy, mining, railways and other public transportation, building, social welfare in industry and community development have not been dealt with under the fellowship programme considered. The United Nations programme is not concerned with fellowships for vocational training, which fall within the competence of the International Labour Organisation (ILO).

In the past five years, 1957 to 1961, the number of fellowships in all fields awarded under the Expanded Programme of Technical Assistance and the regular programme of the participating organizations and in the field of industrial development granted under the programmes of some of these organizations has been as shown in table 1.

In the preparation of this article, use has been made of a report prepared for the Secretariat by a consultant, MR. YAP KIE HAN, *President, International Society for Small Industries, The Hague, the Netherlands.*

Table 1

NUMBER OF FELLOWSHIPS AWARDED UNDER THE EXPANDED AND REGULAR PROGRAMMES OF THE PARTICIPATING ORGANIZATIONS, 1957 TO 1961

	All fields		*Industrial development*		
Year	*All organizations*[a]	*United Nations*	*United Nations*[b]	*ILO*[c]	*FAO*[d]
1957	3,589	718	152	290	65
1958	3,638	798	124	222	45
1959	4,259	1,028	180	289	52
1960	4,913	919	139	229	80
1961	5,424	1,095	80	317	48

Source: Official Records of the Economic and Social Council, Twenty-sixth, Twenty-eighth, Thirtieth, Thirty-second and Thirty-fourth Sessions, *Supplement No. 5, Annual Report of the Technical Assistance Board for 1957, 1958, 1959, 1960* and *1961*.

[a] United Nations, specialized agencies and the International Atomic Energy Agency.

[b] Including chemical industries, engineering (machinery and tools), industrial management, primary metal industries, printing, pulp and paper, small-scale industries, textile industries, and others.

[c] Vocational training and, since 1960, manpower organization, which has been combined with this heading, have been excluded from the ILO data in this table, since the article is not concerned with fellowships of this type. In the ILO programme, these amounted to: 1957, 286; 1958, 185; 1959, 276; 1960, 330; 1961, 226. The ILO figures include social security, co-operation, handicrafts and small-scale industries, labour conditions and administration, workers' education, productivity and management development. It is assumed that most of the fellowships in these fields relate to industrial development.

[d] Fisheries and forestry. The Food and Agriculture Organization of the United Nations (FAO) also grants fellowships for land and water development, plant and animal production and protection, rural institutions, nutrition, etc.

The fact that United Nations operations are carried out in response to requests by governments, which, in turn, reflect varying priorities, makes it difficult to analyse the reasons for which the number of fellowships in industrial development awarded by the United Nations has not only been small, but has also declined in recent years. Even if such an analysis were possible, it would not be essential to the present study, which is especially concerned with changes in the scope and typology of the fellowship programme and training methods in the industrial field. It should be remarked, on the other hand, that modest as each annual programme may be, its cumulative impact over a period of years may be appreciable, especially if account is taken of the "multiplier effect" of the diffusion of the acquired knowledge which often takes place through the contacts of the fellow with his associates and subordinates upon return home. Nevertheless, the above figures show that much progress is necessary, and the attention of governments requesting technical co-operation is drawn to the desirability of availing themselves to a greater extent of facilities offered by the United Nations in this important field.

In the two two-year periods 1956-1957 and 1958-1959, the governments of nineteen and twenty-six countries, respectively, requested United Nations fellowships in industrial development for their nationals. Since the number of developing countries receiving aid from the United Nations is today in excess of seventy, it might be expected that when the value of fellowships is better realized, the number of requesting countries will substantially increase.

The greater part of the fellows in the field of industrial development were trained in a relatively small number of host countries, in many cases in the form of group training (sometimes called "batch-training"). An analysis of group training does not, however, reveal clearly the training needs of the different types of fellows. In order to analyse the structure and types of fellowship awards, a sample was selected of seventy fellowships, excluding group training, granted in the period 1955 to 1960 under the programme administered by the United Nations.

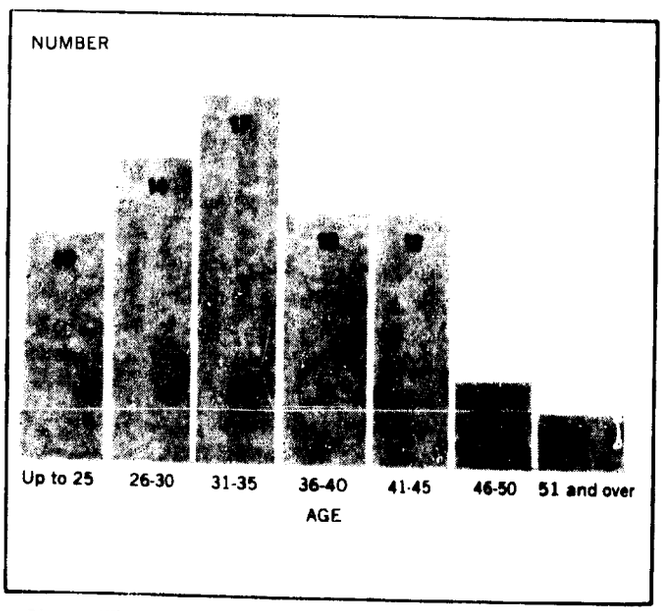
Table 2 and figure 1 which show, respectively, the distribution of fellows among home and host regions, and their age distribution, are based upon this sample. Table 2 shows that the majority of the fellows obtained their training in the industrially advanced countries of Europe and North America. Placement in Europe is relatively high for fellows from European, Middle Eastern and African countries. There is some training of fellows within the region in Latin America, but very little in Asia and the Far East.

A number of fellowship holders have an academic education equivalent to a bachelor's degree. Ten per cent of the fellows from Asia and the Far East, the Middle East, Latin America and Africa had studied previously in North America or Europe. For the majority, the fellowship provides a first confrontation with the different institutional and operational set-up of the industrially more advanced countries.

As regards the countries of origin of the fellows, the sample indicates that, within each main regional group, only a few countries make extensive use of the industrial fellowship programme. As a rule, these countries are those having already reached a relatively advanced level of economic development. The more under-developed countries avail themselves of the facilities offered by the fellowship programme only to a small extent.

Figure 1

AGE DISTRIBUTION OF THE FELLOWS



Note.—The age indicated is that of the fellow when starting his fellowship programme.

Table 2

DISTRIBUTION OF FELLOWS AMONG HOME AND HOST COUNTRIES

Home region	Host region						Total	
	North America	Europe	Middle East	Asia and the Far East	Australia, New Zealand	Latin America	Number	Percentage
Asia and the Far East	16	20	—	1	1	—	38	53
Europe, Middle East and Africa	4	14	2	—	—	—	20	29
Latin America	4	4	—	1	—	3	12	18
TOTAL	24	38	2	2	1	3	70	100

Figure 1 shows that more than 60 per cent of the fellows are in the age group of 31 to 45 years and 7 per cent in the age group over 46 years; about one-third of the fellows are less than 30 years old, many of them less than 25. The predominance of fellows in the middle age group appears to be a desirable feature, inasmuch as advanced specialized training of people having already some professional experience is a basic purpose of the fellowship programme. The requirements of certain newly independent states, particularly those in Africa, may, however, necessitate the training of larger numbers of relatively young persons.

The duration of the fellowships in the sample under consideration is shown in table 3.

Table 3

DURATION OF FELLOWSHIPS

	Percentage
Less than 3 months	15
3 to 6 months	35
6 to 12 months	45
More than 12 months	5
TOTAL	100

An essential factor determining the duration of the fellowship is the length of time during which the fellow can leave his job. For obvious reasons, the higher the occupational level of the candidate, the shorter the duration of the fellowship. The relationship between duration and type of programme is not clearly apparent, except when a fellow is sent to training institutions with fixed schooling terms.

There are three main types of fellowship programmes: study tours; training in universities and educational centres, and training in industry. In the sample considered, the distribution of fellows according to these programmes was as shown in table 4.

Table 4

PLACEMENT ACCORDING TO TYPE OF FELLOWSHIP PROGRAMME

	Percentage
Study tours	60
Placement in universities and training centres	37
Placement in industry	3
TOTAL	100

Although the curriculum of certain training institutions provides for some practical work in industry, placement in factories is very small and should evidently be increased.[2] On the other hand, training by study tours is largely practised. In view of some shortcomings, discussed below in the section on training methods, the organization of study tours and their role in the programme require improvement.

[2] On the subject of training in factories, *see* "In-plant Training of Graduate Engineers", by Yap Kie Han, *Bulletin on Industrialization and Productivity*, No. 4 (Sales No.: 60.II.B.2). *See also* the recommendations contained in the report of the Committee for Industrial Development on its second session in *Official Records of the Economic and Social Council, Thirty-third Session, Supplement No. 2*, paragraph 56.

PROFESSIONAL STATUS OF THE FELLOWS IN INDUSTRIAL DEVELOPMENT

THREE GROUPS OF fellowship holders may be distinguished according to their professional status, taking into account the tasks which they expected to assume upon their return home and which, in most cases, are closely related to their career pattern. These are:

(1) Engineering and managerial personnel of public, mixed and private industrial enterprises;

(2) Officers of industrial training, extension and research institutions;

(3) Officers of government administrations and industrial development and planning agencies.

Some typical examples of background, functions and training needs of fellowship holders in these three categories are given in the following paragraphs:

(1) *Engineering and managerial personnel of industrial enterprises*

Within this group of fellowship holders, two categories may be distinguished according to the occupational level of the holder in his enterprise—middle management and general management. Training requirements vary from one category to the other. Each category includes not only factory technical and administrative personnel already discharging functions at each level, but also personnel scheduled to occupy such functions in the near future.

Middle management

The training requirements of middle management personnel are mainly of a specialized nature. They need advanced specialized training or skill upgrading in such fields as technology, production organization and management, cost accounting, marketing, and so on.

The following two examples illustrate the methods adopted to provide the necessary training.

A fellowship is granted to a university trained electrical engineer, thirty years old at the time of the award, having several years' experience in a radio factory, and recently engaged by a television company to carry out laboratory work and prototype production. A factory is being set up in anticipation of the introduction of television in the country. The company has great difficulties in finding personnel informed and experienced in this new industry, and the request for the fellowship mentions specifically a factory in an advanced country where in-plant training is desired.[3] This factory agreed to provide a four month in-plant training course to the fellow.

A fellowship is granted to a chemical engineer, thirty-six years old, having an advanced degree obtained in a United States university, who has practised for several years in a chemical plant in his own country, and has recently been appointed works manager in a new DDT plant. A six-month study tour consisting of three two-month fellowships in an eastern European, a western European and a North American country, respectively, was arranged to enable him to observe closely the latest technological developments in his field of study.

General management

The training requirements of general management personnel are usually of a broader scope. Fellowship holders in this category occupy functions at director's level in large plants or are owners or partners of medium-sized or small-scale enterprises. Training is generally needed in several of the following fields: study of new products, manufacturing processes and technological developments; conditions affecting industrial organization and promotion, such as legislative, institutional and other measures; marketing, in particular, export promotion, and general management.[4]

Fellowships providing for training of this type have taken the form of study tours of factories, institutions, government services, and so on, and have included, in a number of cases, provision of academic training in certain branches of economics and technology. They have been awarded to owners of small industrial enterprises—for example, a proprietor of a small lumber business with no college education who was given the opportunity of studying the lumber industry in Scandinavia, upon request of his government, which was interested in developing this sector by encouraging private enterprise; technical directors of large plants—for example, a university educated mechanical engineer who, after having worked for eight years as technical director of a medium-sized concern with 250 employees producing hospital equipment, was entrusted, by the same concern, with planning the establishment of a new large plant producing different articles; managing directors, and other high-level factory personnel.

(2) *Officers of industrial training, extension and research institutions*

Within this group, three categories of fellowship holders with different training needs may be distinguished: instructors and trainers for industry; plant consultants and industry inspectors, and research workers.

Instructors and trainers

The objectives of study abroad for instructors and trainers are mainly to refresh and enlarge their theoretical and practical knowledge, and to learn new teaching methods. Many of these officers have no university education and the training required is usually specialized. Their needs are often not only for more advanced training in their specialty, but also, in some cases, in management and administration of training centres. To give an example of the latter case, a fellowship was awarded to a teacher of mechanical engineering in a trade school, forty-six years of age, who, after eighteen years of teaching, was promoted to inspector and served in that capacity for seven more years. The latter function included responsibility for planning school curricula. In the course of his career the candidate had obtained a degree in mechanical engineering. The fellowship was requested in anticipation of his appointment to the managerial staff of an institute of technology which was to be set up in the near future. He obtained a fellowship for studying curriculum planning and administration of technological institutes in a Scandinavian institute of this type.

Plant consultants and industry inspectors

In general, this group consists of officials of government services and institutions who are in need of advanced specialized training for advisory or inspection work in industry. These officers are usually college graduates. Some belong to industry service centres. Others work in railroads and other public utilities. As an example, a fellowship was awarded to a mechanical engineer, forty-five years old, who, in the years following the Second World War, had obtained an extensive practical training in a large steam boiler plant in a European country. Upon his return home, he did not, however, engage in work in this field, but obtained a technical teaching job. A few years ago, he was appointed as chief inspector of steam boilers, with duties which included revision of the standard boiler inspection manual, for which specialized training was required. A six-month fellowship providing for training in a country in his own region, a country in Europe and a country in North America was awarded for this purpose.

[3] The company has had contacts with this factory, but no business connexions. It should be mentioned in this regard, that where contractual business relationships exist, training is normally provided under the contractual arrangements, rather than under fellowship awards.

[4] In this connexion, *see* United Nations, *Management of Industrial Enterprises in Underdeveloped Countries* (Sales No.: 58.II.B.5).

Research workers

As a rule, research workers are provided with fellowships which enable them to acquire highly specialized technical knowledge on a post-graduate and often post-doctoral level. Another objective is to study methods for dissemination of the results of research. The research workers may belong to public or publicly-sponsored research institutes and laboratories and sometimes to private industry.

To give a few examples, a fellowship was awarded to a chemical engineer, forty years old, who had been engaged for twelve years in research activities at a national chemical research institute. After this period, he was appointed head of section, with the following responsibilities: (i) to make recommendations to government authorities on industrial development policies; (ii) to recommend measures for developing chemical industries in the country; (iii) to supply technical assistance and advice to chemical engineers and research workers of institutions and industrial enterprises, and (iv) to supervise his research section at the institute, and to provide guidance to his associates in their research work.

A field of study of special interest to the candidate was high-pressure and radiation chemistry. A programme was devised at a university with the required research facilities which covered the study of this field and also topics relating to some of the duties above.

Another fellowship was granted to an electrical engineer, forty-six years of age, who had started his career in industry and had worked for several domestic electrical equipment companies before being appointed chief of the technical department of the Bureau of Standards of his country. The six-month fellowship provided under the United Nations technical co-operation programme covered a study tour of factories and standards institutes and selected courses in quality control and management techniques at a university in a North American country.

A third example relates to the case of a chemical engineer, thirty-nine years old at the time of the award, graduate from a European university, who, after several years' employment in an industrial enterprise in his country, was appointed to a post in the industrial department of the government. One of his functions was to serve as counterpart to a United Nations expert in plastics and rubber technology. To enable him to take over the expert's duties at the expiration of the latter's assignment, a fellowship was granted to acquaint him with the newest developments in plastics technology and methods for standardization, quality control and inspection in that field.

(3) *Officers of government administrations and industrial development and planning agencies*

The fellowship holders in this group are technical and economic planning officers in charge of the preparation and implementation of industrial development plans and programmes, and senior officers in charge of general administration of industrial development plans and projects. These officials usually come from the industrial and planning departments of the government and from autonomous development agencies, such as development banks, corporations and the like. Many of the administrative officers achieved senior functions in development and planning agencies—a field frequently new to them—through a career of an administrative rather than substantive nature; not all of them have had university education, even though they usually have a thorough knowledge of their country's economic structure and of national legislation and procedures.

The training provided to the fellowship holders in this group is aimed at acquainting them with the relevant theoretical knowledge and the methods and administrative techniques related to planning as practised in government departments and agencies in some advanced countries.

To give a few examples, a thirty seven year-old assistant to the chief of the industry department in the Ministry of Economic Affairs of a newly independent country, where a great shortage exists in qualified personnel, received a fellowship to enable him to take up duties relating to administration of foreign technical and financial assistance. The fellowship provided for a one-year study of industrial economics. The fellow had no university education and, prior to his recruitment in the department, had been employed for several years as a police inspector.

Another case concerns a chemical engineer, thirty six years old, employed after his graduation from university as an official of his country's Ministry of Industries. After several years, he was transferred to the bureau of technical-economic studies at the National Industrial Bank. The fellowship was aimed at acquainting him with the practices of industrial banks in neighbouring countries in the field of techno economic studies and industrial programming.

As another example, three fellowships were requested by a government for senior officers in charge of industrial development administration in different regions of the country. All three candidates were between forty-five and fifty years of age, had had no university education, although they had a long-standing record in government service. The purpose of the fellowships was to acquaint the holders with regional industrial planning policies and measures in industrially more advanced countries, and a joint study tour was arranged to that end.

A group of twelve Asian specialists watch a miner working a drill at the Degtyarsk copper mine in the Soviet Union

METHODS AND CONTENTS OF FELLOWSHIP TRAINING IN THE INDUSTRIAL FIELD

As indicated by the examples given earlier, in many cases specific study programmes have to be arranged for the fellows. The programmes will vary with the age, educational level, and occupational responsibility of the holder and the duration of the training. The specificity of the programme will also depend upon the requirements of the institution in which the holder makes his career. At the same time, the programmes are expected, in most cases, to provide the fellow with broader insights into the different institutional environments, business and administration policies, techniques and practices of the more advanced countries in which he will sojourn. To some extent, the latter purpose will be automatically fulfilled by virtue of travelling and staying in foreign countries; yet, special arrangements must often be made to ensure full achievement of this objective.

Thus, the training scheme will be programmed with a view to giving the fellowship holder knowledge, skill and experience of immediate use in his work upon his return home and, at the same time, to laying a foundation for the further development of his career. A prerequisite for a proper training programme, both in the short and the long run, is that the future tasks of the candidate be known in advance, at least in their broad lines.

The following methods, some of which are sometimes combined, are generally used to achieve this dual objective.

Briefing and induction-training

An effective means of enlarging the scope of the training programme is to give the fellow a comprehensive briefing—more exactly, some induction-training—prior to his arrival in the host country. Such briefing aims at giving the holder an appreciation of the problems of industrial development in his country and in other regions, to acquaint him with the work of the United Nations and affiliated organizations in this field, and, whenever possible, with developments in the broader area of which his specialty is a part. Such briefing is occasionally given at United Nations Headquarters or in the regional offices in Europe, Asia and the Far East, Latin America and Africa. When it is possible to organize small groups of fellows, such induction-training could frequently be carried out in the form of brief seminars.

Study tours

Study tours are valuable to acquaint fellows with different types and methods of industrial organization and practice. It is essential that such tours avoid superficiality, either through lack of well-defined objectives, or because of too short duration. It is necessary to develop a precise programme at the programming stage so as to ensure the full and systematic co-operation of the host institution.

An example of a highly successful study tour, organized for a group under the fellowship programme, is to be found in the visit by metallurgical experts from Asia and the Far East to western European iron and steel mills and technological institutions. The subject, which related to the applicability of certain production techniques to the conditions of this region, and to industrial processing on a small and medium scale, was clearly defined, and effective co-operation of the plants and institutions was obtained. A valuable feature of the project was the drafting, at the end of the tour, of a joint report on the results achieved. Such a report, followed by its publication for wider circulation in the country or region concerned, would be a useful part of study tour projects, especially those conducted on a group basis.

In-plant training

In nearly all newly industrializing countries young engineers graduate from universities without having acquired much practical industrial experience. In-plant training programmes are aimed at providing systematic and closely supervised guidance to the graduates in engineering by showing them the application of the academic knowledge acquired at the university to the practical problems arising in the factory. As has been stressed in a study on the subject,[5] in-plant training should be of particular interest to newly industrializing countries where scientifically-trained personnel with practical experience is scarce and where, because of this, responsible functions have often to be entrusted to recently graduated, newly recruited engineers. A few training programmes of this type are being conducted in certain countries, and it is highly desirable, as has been repeatedly recommended by United Nations organs,[6] to expand, both in the developed and the industrializing countries, provision of such facilities. To achieve this, close co-operation among the industries and educational institutions of the host country is required and, to fulfil the purposes of an international fellowship programme such as that of the United Nations, it is also necessary to have some co-operation between the universities and the industries of the host and home countries.

While much of the training would be provided in plants in the industrial countries, efforts to organize it in the more advanced among the developing countries, whenever possible on a regional basis, would be desirable, since engineering practice would be acquired by the trainees under conditions closer to those prevailing in their own countries. A regional set-up, which in most cases would involve group training, would also present the advantage of being considerably less expensive.

Research work

The highly specialized type of advanced training required for research workers is best imparted when the fellow is placed under the direct supervision of a competent scientist in the field. In general, the candidates for fellowships of this type are themselves aware of the persons and facilities involved, and satisfactory arrangements may often be made by the fellowship programming agency.

[5] *See* footnote 2.

[6] *See*, in particular, the reports of the Committee for Industrial Development on its first two sessions (*Official Records of the Economic and Social Council, Thirty-first Session, Supplement No. 2 and Thirty-third Session, Supplement No. 2*).

Training courses

As indicated earlier, obtaining a degree is not a necessary feature of fellowships that provide for regular attendance of standard university courses. Fellowships are often granted for regular university training of this type but, with the recent increase in the number of courses especially devised by universities and similar institutions in a number of countries of Europe and America for persons from industrializing countries, placement is increasingly being made in institutions providing courses of this type. Some of these courses provide for academic instruction as well as supervised practical experience in industry adapted to the specific needs of overseas students.

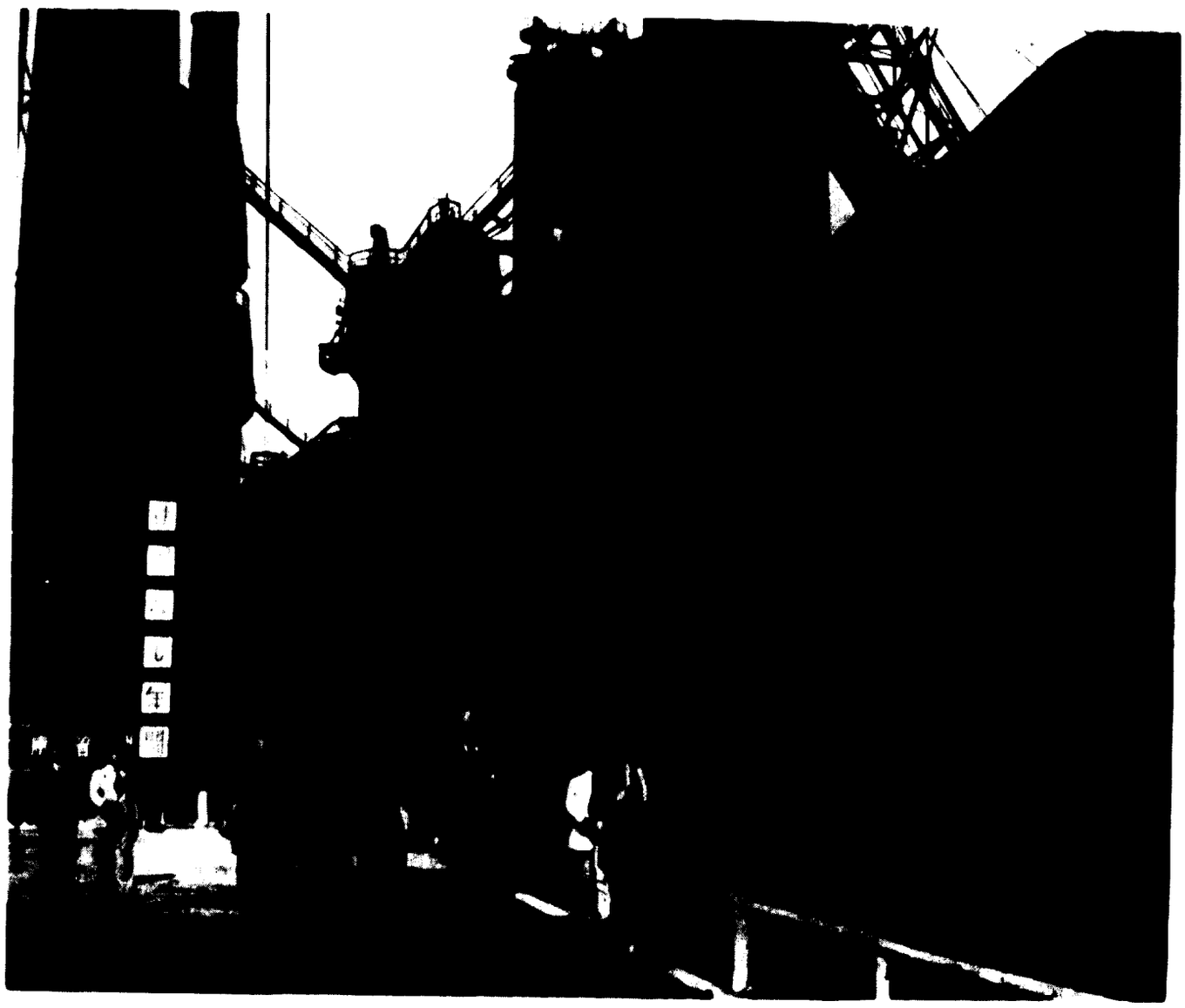
Expansion of special facilities of this kind to serve the needs of technical personnel, skilled workers, economists and administrators from the developing countries has also been strongly recommended by United Nations organs. In the case of vocational training, however, it has been considered desirable that the main emphasis be given to training in the country itself while training the instructors abroad. This procedure is obviously less expensive and more practical than providing foreign training to the students. The "multiplier effect" of such training is very large.

Expert tutorship, reporting and follow-up

In view of the advanced levels of education and seniority of the majority of fellowship holders, independent activity under some guidance is the normal procedure in carrying out each individual programme. Supervision and tutorship are a general feature of training courses, of programmed research assignments and in-plant training. It is not always provided in the case of study tours, although it would also be desirable.

A highly useful element of the training programme is the submission of reports: a progress report during the award period; a final report at the conclusion of the programme evaluating the work accomplished, and a follow-up report, prepared six months to one year after return, which provides information on activities in the home country and the use which has been made of the experience acquired during the fellowship.

A study tour in Japan included a visit to a large iron and steel mill



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A PRELIMINARY ASSESSMENT OF TRAINING NEEDS

A PRELIMINARY ANALYSIS and assessment of training needs according to the level of economic development of certain countries and as between broad geographical regions, has been made by a consultant on the basis of United Nations experience. Its main findings are given here to provide some orientation for further, more thorough research.

TRAINING NEEDS AND LEVEL OF DEVELOPMENT

The main emphasis of training objectives appears to vary, broadly, with national levels of development. The following four groups of countries are distinguished in this connexion.

1. Countries with an advanced level of engineering and management development (for example, China (Taiwan), Israel and Yugoslavia). The fellowships requested by such countries aim primarily at training specialists with a view to keeping them abreast of the scientific and technical progress achieved in the more developed countries.

2. Countries with a relatively advanced level of industrial development (for example, Brazil, India and Mexico). In this group, fellowship training is more often co-ordinated or combined with expert work under the United Nations technical co-operation programmes than in the preceding one. In many of these countries, expert work in industrial development is particularly concentrated in certain fields, and there is some tendency to request fellowships either connected with this work, or in areas related to it. Increased co-ordination between the two types of programmes should undoubtedly be encouraged.

3. Countries in early stages of industrialization (for example, Bolivia and Indonesia). In countries of this group, industrial development policies have usually been formulated, and programmes provide for a variety of industrial projects. However, many difficulties are encountered in initiating and carrying out such projects. In these countries, the greatest training need appears to be for high-level and intermediate-level technical and managerial cadres. Apart from fellowships to develop national counterparts of foreign experts, special instruction programmes, including in-plant training, for the above groups would be of special value.

4. Newly independent, non-industrialized countries (as is the case of many African countries). Among the innumerable needs of countries in this group, high priority should undoubtedly be given to formation of high-level personnel to provide the backbone of the government administrative apparatus, and to contribute, mostly with foreign expert assistance, to the planning and programming of development in the different sectors of the economy. A high priority should also to be given to the training of persons able to undertake entrepreneurial tasks themselves and to government personnel whose task is to stimulate, guide and channel local entrepreneurial initiative.

In-plant training in an automobile assembly plant in Mexico City: groups of apprentices learn the construction and operation of a motor

TRAINING NEEDS BY REGION

1. *Middle East, Asia and the Far East*

The already mentioned analysis of the United Nations fellowship programme over the five-year period 1956 to 1960 tends to indicate that increased counterpart training is urgently needed. In this period, technical assistance by experts in the field of industry amounted to a total in excess of 300 man-years. Only eighty fellowships with an average duration of well less than one year were awarded during this period, most of them in fields unrelated to the experts' work. As far as is known, fellowships granted under other multilateral and bilateral programmes were also limited in number and did not always relate directly to the assignments of expert advisers.

The training needs within the Middle East and Asia and the Far East differ from country to country, but the following types of programmes appear to be of common interest: in-plant training of young engineers; management development, especially on the senior and upper-middle levels (in such fields as accounting, quality control, production and plant maintenance); training of extension workers for assistance to small-scale industries and, to a less extent, of industry inspectors for larger industrial establishments; training of specialists in product-and-process development and applied industrial research to meet the personnel needs of the specialized institutes and laboratories recently established in the region, and training in planning and programming of industrial development.

In all these fields, the need for fellowships does not necessarily arise from the undertaking of new projects, since the requirements of existing institutions seem often to be equally pressing.

2. *Latin America*

Only fifty fellowships in all fields of economic and social development were awarded to countries of the region over the period 1956 to 1960. In 1960, among the recommendations made by the Economic Commission for Latin America to its members, one, in particular, drew their attention to the need for increased fellowship training for national counterparts of United Nations experts. These recommendations received a favourable response from Governments and in the 1961-1962 programme increased provision was made by nearly all countries for counterpart training. A total of ninety fellowships in all fields of economic and social development was requested, mostly for counterparts.

An important step in promoting training in regional industrial planning and programming has been the establishment, in 1962, of the Latin American Institute for Economic and Social Planning in Santiago, Chile. Training fellowships in planning and programming of industrial development are an integral and important aspect of the activities of this Institute. Activities in training are also being carried out in the sub-regional group of countries, Central America. The Central American Integration Programme calls for fellowships in various areas of industrial development of special importance to the six member countries; these provide, in particular, for specialized training in certain industrial technologies and in management engineering to support the relevant activities under the programme.

3. *Africa*[7]

In the following paragraphs, a brief review is made of the needs for training engineers and other technicians and managers from Africa, which might call for United Nations assistance.[8]

As a starting point, fellowship awards in industry should be associated with the United Nations expert missions under the technical co-operation programmes, the objective being to provide national counterparts to sustain and follow up the results of the experts' work. However, in view of the considerable scarcity of industry-experienced local personnel in that area, in certain cases, fellowship training might precede rather than follow the expert missions.

Two areas seem to be of special importance in the field of manufacturing, as regards both expert missions and fellowships: development of small industries and of certain large industrial complexes based on African resources. In the small-scale industry sector, training would be particularly needed by prospective entrepreneurs and extension workers and should preferably be organized on a group basis.

As regards large industries, the following are likely to be of particular importance: fertilizers, textiles, plantation-based industries, such as sugar, cocoa and copra processing, cement, pulp and paper, pharmaceuticals, iron and steel transforming plants, aluminium and energy-based chemicals. Since it is probable that, in the short run, the activities in these fields in most of the newly independent countries will be limited in scope, the training programmes might be developed on a regional basis. An advance survey on an industry-by-industry basis should be undertaken to estimate the needs of engineering and managerial personnel in the next few years.

Another area of fellowship training is the development of government cadres for industrial planning, promotion and administration. Overseas training for this purpose should be restricted as much as possible to persons having received at least secondary education. Fellowship awards might provide, for instance, for a short-term general orientation course on industrialization, organized for groups of English-speaking and French-speaking trainees.

Full-term university education rather than fellowship training is needed to provide the newly independent African countries with engineers, senior plant executives and senior personnel of industrial extension centres and applied research institutes. However, fellowships might usefully be awarded to future middle management personnel of industrial enterprises, providing, for example, for a two-year apprenticeship course including in-plant training. The candidates should preferably be secondary school graduates, at least twenty-five years of age.

[7] Excluding the Republic of South Africa, which is not an aid-receiving country, and the United Arab Republic. The survey made was not concerned with the Congo (Leopoldville), which has an assistance programme of its own.

[8] While the need for vocational training is among those most acutely felt by the newly independent countries of this Continent, the United Nations fellowship programme is not concerned with this particular problem which, as stated earlier, falls within the competence of ILO.

THE ROLE OF FELLOWSHIPS IN TECHNICAL CO-OPERATION PROGRAMMES IN THE INDUSTRIAL FIELD

As has been seen, the fellowship programme of the United Nations and its affiliated organizations is a small part of their total technical co-operation effort. In many cases, fellowship projects are independent of other activities under the technical co-operation programmes. In other cases, the number of which is rapidly increasing, fellowship awards are an integral part of other technical assistance projects. This is so when a fellowship is granted to the national counterpart of a technical assistance expert, to enable him to take over, eventually, part or all of the functions of the expert. Fellowships are also increasingly awarded as a result of recommendations made by experts carrying out assignments under the technical assistance programme of the United Nations and the Special Fund. Thus, recommendations to set up new factories, institutes or centres of various types, or to conduct further surveys and

A Dutch teacher conducting a class of physics in the science faculty of the College of Monrovia, Liberia

research, often result in fellowship awards to train the local personnel needed for the newly-created staff positions.[9]

The need to co-ordinate the fellowship programme with that of expert assistance has been recognized by United Nations organs. In particular, the Committee for Industrial Development has drawn the attention of Governments to this need, and has encouraged them to take it into consideration when formulating their requests for assistance in the field of industrial development.[10]

The Committee has also noted the fact, stressed earlier, that the number of fellowships requested by the developing countries constitutes a very small proportion of the resources available under the technical co-operation programmes. It has urged the United Nations Technical Assistance Committee to take measures to encourage an increase in the share of allocations devoted to the fellowship and training programmes under the expanded programme and other programmes of technical co-operation.

The Committee has attached considerable importance to the co-ordination of training activities, at both the national and the international level. At the national level, such co-ordination would permit better utilization not only of local facilities, but also of those provided under multilateral and bilateral programmes of assistance. At the international level, better co-ordination would be necessary between the activities of the different agencies of the United Nations family.

The Committee has also urged Governments to make an assessment of their needs for training, including a survey of facilities available locally. This would greatly assist not only the recipient countries in formulating their requests for international assistance in training, but also the aid-giving countries in providing such assistance. The Committee has recommended that the United Nations, in co-operation with the specialized agencies concerned, should provide expert help to Governments, at their request, in making an assessment of over-all training needs.

It may be expected that in the decade of the nineteen sixties—the United Nations Development Decade[11]—a major effort will be made in the field of industrial training both by Governments of the developing countries in connexion with their activities for the promotion of industrial development of their countries and by the organizations of the United Nations family in providing the necessary assistance. The rapid survey made in this article shows the desirability of an increased use by the Governments of the resources in technical assistance available under the industrial fellowship programme of the United Nations and of a better co-ordination of the efforts in that field of the organizations of the United Nations family, universities, training centres, industrial enterprises and other organizations.

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[9] United Nations experts frequently take an active part in the selection of candidates for fellowship awards, a practice which is encouraged by the Technical Assistance Board of the United Nations.

[10] *See* the report of the Committee for Industrial Development on its second session, op. cit., paragraph 61 and following.

[11] An article on "Industrial Development in the United Nations Development Decade" appears elsewhere in this issue of the *Bulletin*.

Questionnaire on Industrial Planning and Development

In its report on its first session held in the spring of 1961 (*Official Records of the Economic and Social Council, Thirty-first Session, Supplement No. 2*, paragraph 80), the United Nations Committee for Industrial Development considered that the experience and progress of the various developing countries in the field of industrial development and, in particular, in that of industrial planning and programming, were of general interest. Accordingly, the Committee recommended that a questionnaire be prepared and circulated to Member States of the United Nations to elicit information on the institutional arrangements for, and the methods applied in, industrial planning and programming, as well as on the instruments used in the implementation of such plans and programmes and in the promotion of industrial development in general. It further recommended that replies, as and when received, should be made available to Member States and in due course placed before the Committee.

The questionnaire was prepared by the United Nations Secretariat in consultation with a small group of experts and sent to Governments in February 1962. Additional information intended to facilitate the preparation of the replies was contained in an appendix to the questionnaire. The questionnaire and its appendix are reproduced below. With a view to facilitating the preparation of replies to section I of the questionnaire, the Secretariat also prepared, for each Member State, an annex containing a brief compilation of selected statistical indicators of economic and industrial structure and growth, which was sent to Governments in July 1962. Governments were requested to send in their replies to the questionnaire by the beginning of September 1962.

It is considered that the publication of the questionnaire and its appendix in this issue of the ***Bulletin*** may be of some interest to institutes and research workers concerned with industrial planning and development. These documents provide a classification of problems and data which are to be taken into consideration at various stages of planning and programming. The fields covered by them include assessment of economic structure and formulation of policies and goals of industrial development, determination of the scope and status of the plan, organizational arrangements, procedures and methods applied in planning and programming and in promoting and guiding industrial development, and appraisal of policies, measures, procedures, projects and institutions in the light of actual experience.

Information on the replies to the questionnaire will be published in future issues of the ***Bulletin***.

INTRODUCTION

The decade of the nineteen fifties witnessed remarkable rates of industrial growth in several countries with varied economic systems. The study and evaluation of the dynamic factors in this growth, of the policies and measures adopted by Governments in promoting industrialization, of the institutional arrangements for, and of the methods applied in, industrial planning and programming, and of the instruments employed for the implementation of plans and programmes, may be useful to countries which are in the process of developing their industrial capacities in order to accelerate the rate of growth of their economies. The understanding of these factors and the successful adaptation of such policies and measures have to take into account local institutions, conditions and experience. The objective of the present questionnaire is to elicit information from countries on their experience in the field of industrial development during the past decade, and in particular on those factors which may have contributed in some countries to achieving an exceptional rate of growth during this period.

The industrial sector is, for the purpose of the present questionnaire, understood to include mining. A few questions exceeding the limits of the industrial sector have been included, with the objective of obtaining the necessary information for appraising the problems and developments in industry against the background of the national economy as a whole. The same applies to some specific questions on power and transportation since these activities, although not forming part of industry, are essential to industrial development.

The questionnaire is divided into six sections: I. Present structure and trends; II. Aims; III. The nature of the plan and planning agencies; IV. Procedures and methods applied in industrial planning and programming; V. Instruments for promoting and guiding industrial development, and VI. Past developments and prospects. Each section is prefaced by a short introduction to indicate the nature of the information sought. It is suggested that the replies, wherever appropriate, contain detailed quantitative data. An indication of the degree of reliability of such data (e.g., precise data, reasonable estimates, informed guesses, etc.) when appropriate will be appreciated and, wherever the information or data asked for are not available, it is requested that this be explicitly stated.

In connexion with section I, to facilitate the preparation by Governments of their replies, the United Nations Secretariat expects to be able to prepare a presentation of relevant statistical data for each Member State, on the basis of existing information already supplied by Governments and derived from other sources. These data would be sent to Governments for their approval and modification, if necessary. Subsequently, the data would be circulated, together with the replies to the questionnaire, among the Member States, so as to provide a factual background for these replies.

Individual countries may have had diverse and abundant experience in the planning, programming and implementation of industrial development. There have been notable achievements and at the same time a number of difficulties may have been encountered. An exchange of this experience can be of mutual benefit to all countries. Sections II through V are meant to elicit information on this experience. Section VI is especially directed to providing a round-up and appraisal by each country of its experience in the recent past and prospects for the immediate future. Provision of comprehensive information by Governments in reply to this questionnaire will be of great value in realizing its objectives of disseminating, and mutually sharing in, this experience.

In the drafting of this questionnaire, which is being addressed to countries at various stages of development and with varied economic institutions and systems, the Secretariat had to contend with a certain number of problems. In the first place, issues dealt with in the questionnaire are not relevant in all countries; in some of them they may even be non-existent. In the second place, account had to be taken of the inadequacy of data and differences in classification; and differences in concepts and terminology. While an effort was made to meet these difficulties as far as possible, it was clearly impossible to eliminate them altogether. Under the circumstances, the following observations are submitted for consideration by Governments. Questions which are irrelevant and inapplicable will be ignored. Governments are requested to present the information as much as possible in accordance with the classification suggested in the questionnaire. If this is not possible, the information may be provided in the form in which it exists with an appropriate explanation. Furthermore, it is hoped that differences in terminology will not prove a serious obstacle in replying to the questionnaire and the replies will be framed on the basis of the underlying significance of the concepts in the context of the questionnaire even though the nomenclature used may be different from the one in current usage in a specific country.

Some of the Member States of the United Nations have sent in replies to a questionnaire on economic planning circulated earlier this year by the Netherlands Economic Institute of Rotterdam (NEI). In such cases, it is suggested that a copy of the reply to the NEI questionnaire be attached to the reply to the present document and the corresponding parts of the present questionnaire ignored.

Should the information sought in some of the questions be available either in published or unpublished form or in printed or mimeographed documents, it is requested that these documents be supplied as annexes to the corresponding replies.

It was considered useful to append to the questionnaire a section which provides an elaboration of the items of the questionnaire so as to provide guidance to Governments in the formulation of their replies.

In the preparation of this questionnaire, the United Nations Secretariat has had the benefit of the advice of a group of consultants which met at Headquarters in the second half of October 1961. The group included Professor C. Bobrowski, Vice-Chairman of the Economic Council, Warsaw, Poland, Mr. S. Tarlok Singh, Additional Secretary of the Planning Commission in New Delhi, India, and Professor Jan Tinbergen, Director of the Netherlands Economic Institute of Rotterdam. The contribution of these experts to the formulation of this document is gratefully acknowledged.

I. Present structure and trends

Note

The objective of this section is to ascertain the current situation of, and the trend in, the structure of the economy with special emphasis on the industrial sector. Wherever possible, exhaustive data should be provided, preferably for each year from 1948 through 1960, or at least for the two three-year periods: 1948 to 1950 and 1958 to 1960. For the industrial sector, the Two-digit International Standard Industrial Classification breakdown of industries will be used wherever possible.

As noted in the Introduction, it is expected that the United Nations Secretariat will prepare and circulate to the respective Governments a presentation of the relevant statistical information on each country. This information will include data on the share of the industrial sector, compared with other sectors of the economy, installed capacities and outputs of main industries and the values of total imports of manufactured goods, subdivided into equipment and machinery, intermediary goods for industries and manufactured consumer goods. These data will be prepared from the information already supplied by the Member States and that derived from relevant publications, and sent to the Member States for their approval and modification if necessary.

Questions

I.1. (A) What are the estimates of fixed capital investment in the industrial sector compared with the sectors of agriculture and services?

(B) What are the reasons for discrepancies, if significant, between installed capacities and outputs in the main industries?

(C) What are the values of imports of:

(*a*) Plant and equipment;

(*b*) Spare parts and accessories?

I.2. What is the present position, and what changes, if any, have taken place during the past ten years in respect of:

(*a*) The relative importance of the small-scale industry, including handicraft and household enterprises, in the industrial sector;

(*b*) The relative size—as measured by such indicators as persons employed and/or total value added—of: (i) the publicly-owned industrial enterprises; (ii) privately-owned industrial enterprises; (iii) industrial enterprises jointly owned by the public authorities and private interests, and (iv) industrial enterprises owned by industrial co-operatives;

(*c*) The scale of industrial unemployment, if any? Since the definition of small-scale industry varies from one country to another, please give the definition used in your country. Please include in your answer quantitative data on the value added at factor cost, the number of persons engaged and the estimates of fixed capital investments in (*a*) and (*b*).

I.3. What has been the value of the capital formation in the industrial sector and in the national economy as a whole from 1948 through 1960?

What have been the sources of capital formation in the industrial sector during these years?

II. Aims

Note

This section is aimed at eliciting information on the goals of the policies of the Government as regards industrial development. It is suggested that copies of official resolutions, reports, notes and memoranda, if any, be communicated along with replies.

Questions

II.1. What are the principal aims of the Government's industrial policy?

II.2. What is the Government's policy in respect of:

(*a*) Public and private investment in industry;

(*b*) Participation of private foreign capital;

(*c*) Small-scale industrial enterprises, including the handicraft and household enterprises?

While replying to II.2.(*a*), please state the explicit criteria, if any, by which the Government assigns industries or industrial enterprises to the public sector and the private sector.

III. The nature of the plan and planning agencies[1]

Note

The expression "the economic plan" embraces a wide range of concepts from programmes for all sectors of the economy to be implemented by the Government to a mere forecast of trends for some sectors. The organization of the planning agencies generally corresponds to the concept and structure of the plan. The objective of this section is to elicit information on the nature of the plan or plans and on the organization and functioning of the planning agencies in the various countries.

Questions

III.1. What is the nature and period of the plan or plans?

III.2. What is the legal status of the plan or plans?

III.3. What are the agencies or organizations responsible for:

(*a*) The formulation and

(*b*) The implementation of the plan or plans?

What is the relationship between the planning and implementing agencies?

III.4. What are the arrangements, if any:

(*a*) For supervision of the implementation of the plan and

(*b*) Preparation of progress reports of the plan?

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[1] Some of the information sought in this and the following sections is covered by the NEI questionnaire referred to in the Introduction to this questionnaire. Member States which have replied to the NEI questionnaire may send copies of their replies, with appropriate modification or additions, if any.

IV. Procedures and methods applied in industrial planning and programming[2]

Note

This section seeks to elicit information on procedures and methods employed in regard to different aspects of planning and programming which affect, directly or indirectly, the development of the industrial sector.

Questions

A. *Over-all planning*

IV.1. What procedures and methods are employed to arrive at the aggregate plan and planned targets?

B. *Planning of the industrial sector*

IV.2. What are the methods employed to arrive at:

(*a*) The figures of output, investment, manpower requirements (skilled and unskilled) and foreign exchange expenditure in the industrial sector as a whole, and

(*b*) Corresponding figures for capital goods, intermediary goods and consumer goods industries and for individual industries?

IV.3. Please indicate how the requirements in the following fields are being taken into account in planning:

(*a*) Generation and distribution of electric power;

(*b*) Transport facilities;

(*c*) Industrial housing and related services;

(*d*) Development of sources of raw materials.

Please indicate to what extent insufficient development of these sectors has led to, or still represents, a bottleneck in the development of industry as a whole or of specific industries.

C. *Planning of the public sector in industry*

IV.4. What are the different institutional forms of public industrial enterprises (e.g., factories directly operated by the Government, autonomous public corporations, mixed government and private companies, etc.) and how are their individual plans integrated with the plan for the industrial sector?

Who decides on, and what criteria are applied in determining, the institutional framework of the industrial enterprises in the public sector?

IV.5. In preparing the plan for the public sector, including the selection of individual projects, are the following factors taken into account, and if so, how:

(*a*) Reduction of the input of capital;

(*b*) Creation of maximum employment;

(*c*) Maximization of the growth rate;

(*d*) The gestation period of the investment;

(*e*) Foreign exchange savings;

(*f*) Future technological progress;

(*g*) Industrialization of backward regions, etc?

Are technically feasible alternatives prepared for individual projects? If so, what test of efficiency is applied in selecting one of the alternatives?

IV.6. What arrangements are made for:

(*a*) The implementation of industrial projects, and

(*b*) Provision of finance for the industrial enterprises in the public sector?

D. *Planning affecting the private sector*

IV.7. What arrangements, if any, has the Government made:

(*a*) To secure consultation with, and to obtain co-operation from, the private sector;

(*b*) To induce private industry to adopt, in those cases where alternatives are available, the types of technology and location considered most appropriate by the Government?

E. *Foreign exchange needs*

IV.8. Do you prepare a foreign exchange budget for the industrial sector as part of the general foreign exchange budget? If so, what methods do you adopt and what are the constituent parts of this budget? Does the budget provide for (i) flexibility and (ii) reserves to meet emergencies?

V. Instruments for promoting and guiding industrial development

Note

This section includes questions on the instruments employed for promoting—directly and indirectly—industrial development and for directing it as far as possible into preferred channels.

Questions

A. *Savings and investment*

V.1. What measures do you adopt to attain the planned magnitudes of:

(*a*) Public savings;

(*b*) Business savings;

(*c*) Institutional savings (other than business savings, for example, insurance funds);

(*d*) Personal savings;

(*e*) Savings of co-operatives?

V.2. What measures do you adopt to channel business, institutional and private savings into investment into:

(*a*) The public sector;

(*b*) The private sector?

B. *Fiscal, monetary and financial instruments*

V.3. What fiscal incentives, if any, have been provided by the Government to stimulate industrial development in the private sector? Please indicate the nature and duration of fiscal concessions and incentives with special reference to: (i) income taxes; (ii) corporate taxes; (iii) depreciation allowances; (iv) sales taxes; (v) purchase taxes, and (vi) excise duties.

V.4. What measures of monetary policy have the Government and the Central Bank adopted to encourage industrial development in the private sector?

V.5. What measures, if any, has the Government adopted

[2] Footnote 1 applies also to this section.

to establish, promote or aid financial institutions for industrial development?

V.6. What measures, if any, have been adopted by the Government:

(*a*) To induce private enterprise to undertake industrial projects assigned to the private sector under the plan; and, conversely, to discourage it from undertaking investment not provided under the plan;

(*b*) To ensure that the long-term, medium-term and working capital requirements for projects assigned to the private sector are adequately provided for?

C. *Trade policies*

V.7. In what manner, and to what extent, has the Government's foreign trade policy been designed to facilitate domestic industrial development?

D. *Economic overheads*

V.8. What measures has the Government adopted in the fields of transport, and of supply of power, water and other economic and social overhead to facilitate industrial development in the private sector?

E. ***Regulation and control affecting the private sector***

V.9. What are the physical controls, if any, introduced with a view to directing and controlling the activities of the private sector in the industrial field? Please explain the objectives of the specific controls, and especially refer to the following: (i) control of capital issues; (ii) licensing of imports of capital goods; (iii) regulation of location of industrial enterprises; (iv) licensing of factory establishments; (v) controls affecting raw materials; (vi) controls affecting power and transport.

F. *External resources*

V.10. What measures, if any, has the Government taken to mobilize the inflow of external resources for investment in the industrial sector? And what measures, if any, has the Government taken to ration and allocate these resources?

Or alternatively:

What measures, if any, has the Government taken to ensure or induce an accelerated outflow of resources to under-developed countries?

V.11. What arrangements, if any, have been made to ensure that the foreign exchange requirements of the industrial sector are regularly met by the Ministry in charge of the foreign exchange allocations?

G. *General*

V.12. What provisions, if any, have been made in the industrial sector for education and training of:

(*a*) Managerial personnel;

(*b*) Technicians and engineers;

(*c*) Skilled labour for industrial enterprises in (i) the public sector and (ii) the private sector?

V.13. What provisions, if any, have been made by the Government and other institutions for research in:

(*a*) Industrial processes and techniques;

(*b*) Management of industrial enterprises;

(*c*) Industrial economics?

V.14. What measures, if any, have been taken for:

(*a*) Improving the efficiency and productivity of labour in industrial enterprises;

(*b*) The introduction and extension of standardization;

(*c*) The introduction and expansion of quality control?

V.15. Is there any form of industrial extension service in the country? If so, please state whether it is run by the Government and/or private initiative and indicate the industries and enterprises it assists, and the nature of the the assistance rendered.

V.16. What measures, if any, have been adopted by the Government:

(*a*) To establish, promote, manage or assist industrial estates;

(*b*) To sponsor, promote or assist industrial co-operatives?

VI. Past developments and prospects

Note

As was mentioned in the Introduction, the objective of this section is to sum up and appraise the significant experience of individual countries in industrial development and planning in the past and to indicate the prospects for the immediate future. Full and comprehensive answers to the questions in this section will be of particular value in realizing this objective.

Questions

VI.1. What significant modifications or changes have taken place in policies, procedures, institutions and measures relating to industrial development and planning in the course of the past ten years? Please state the reasons for the modifications or changes.

VI.2. What are the principal obstacles and/or bottlenecks, if any, which you encounter at the present stage of industrial development in your country?

VI.3. To what extent and in what respect is the present structure of the economy, including its institutional framework, more conducive to further industrial development than the one which prevailed ten years ago?

VI.4. What significant changes in the pattern of the industrial structure do you foresee in the course of the next ten years?

Appendix

Indicated in this appendix are a certain number of points which Governments might take into account in their replies to the questionnaire; the enumeration should not be regarded as limitative and Governments are invited to provide any information on each question which they consider relevant and useful. Some of the points may not be relevant in some economies while some others may be applicable to countries which have developed planning. The numbers refer to the questions in the main body of the questionnaire.

I. Present structure and trends

I.1. It was mentioned in the Introduction that the United Nations Secretariat expects to be able to prepare, for review by Governments, statistical background information. This would include data on the share of the industrial sector in the national economy, installed capacities and outputs of main industries and imports of industrial goods. This question is intended to seek such supplementary or corrective information pertaining to these data as the Government may wish to furnish.

I.2. Industrial unemployment in under-developed countries takes the form of (i) totally unemployed workers in large-scale industries, and (ii) under-employed workers in handicraft and cottage industries. They may be distinguished in the reply to I.2 (*c*).

I.3. In the reply to the question on capital formation for the various types of industrial enterprises, it will be desirable to distinguish, wherever possible, between the sources marked "x" in the following scheme:

	Type of enterprise			
	Public	*Private*	*Jointly owned, public and private*	*Co-operative*
(i) Retained profits	x	x	x	x
(ii) Taxation	x		x	
(iii) Domestic borrowing	x	x		
(iv) Domestic equity capital		x	x	x
(v) Loans from members				x
(vi) Government sponsored industrial finance corporations and banks		x	x	x
(vii) Loans from the Government		x	x	x
(viii) Private foreign capital:				
(*a*) Debenture	x	x	x	
(*b*) Equity	x	x		
(ix) Loans from international agencies (with specification)	x	x	x	
(x) Foreign Governments:				
(*a*) Loans	x	x	x	x
(*b*) Grants	x			

II. Aims

II.1. The Government normally pursues several aims in its industrial policy. Some of these are of key importance while others are derivative or secondary. In your reply, you may distinguish between the principal aims and the derivative or secondary aims. Following are some of the examples of the aims pursued.

(A) Maximization of the growth rate with reference to a specified length of time. Thus, the development of heavy industries in the industrial programme could be considered by some Governments as a means of realizing maximum growth rate; other Governments might concentrate on the development of "light" or consumer goods industries. You may indicate the time horizon during which the rate of growth is to be maximized. Heavy industries may find an important place in the plan on account of non-economic factors (e.g., desire for nearly self-sufficient national economy; the creation of an "industrial climate", consideration of defence, etc.). The gestation period involved in the planning and the completion of heavy industries projects is normally very long. Consequently, heavy industries may be developed on the basis of the demand anticipated after the planning period.

(B) Immediate maximization of employment. This aim may lead to a preference for labour-intensive techniques wherever feasible and the development of industries with lower capital-output ratios.

(C) Increase of foreign exchange resources. This aim will result in emphasizing the development of export-promotion and import-substitution industries.

II.2. The Government may give qualitative information in reply to this question.

III. The nature of the plan and the planning agencies

III.1. Following is a brief enumeration of a few of the several possibilities to suggest the nature of the response. Detailed information would be appreciated:

(A) A comprehensive plan for all sectors of the economy, to be implemented by government organs (e.g., centrally planned economies); or

(B) A plan for the public sector to be implemented by the Government, combined with a plan for the private sector, the fulfilment of which is ensured as far as possible by laying down priorities by use of fiscal, monetary and other instruments, and by the Government's financial, technical, and other forms of assistance; or

(C) A plan for the public sector combined with a mere forecast of activities in the private sector; or

(D) A plan for the public sector, to be implemented by the public authorities unaccompanied by any planning for the private sector; or

(E) A mere forecast of trends accompanied by the recommendations on a few guideposts for the Government policy; or

(F) A plan confined to a specified region of the country or to a sector of the economy.

In a few cases, the revenues or income derived from specified sources (e.g., oil revenues or royalties) are assigned for investment in certain types of projects. Since amounts of revenues derived from specified sources fluctuate from year to year, the investment programme in the plans is not spelled out in terms of either total investment or the number and specifications of projects; consequently, only the broad character of projects is initially worked out rather than a programme composed of specified projects.

The plans may be divided into three categories depending on their duration: (i) annual plan, (ii) medium-term plan (two to seven years) and (iii) long-term or perspective plan (eight years and more).

You may wish to indicate whether, in the case of perspective and medium-term plans, the practice of a revolving planning period is being followed, i.e., the planned targets being periodically revised (e.g., every year) in the light of the experience of the preceding period, and the planning period extended accordingly.

III.2. An exhaustive statement would be appreciated on the legal position of the plan and the location of the legal responsibilities for the formulation and approval, as well as the implementation, of the plan or plans. A few of the several possibilities would be:

(i) Incorporated into law by the legislative organs for mandatory implementation; or

(ii) Incorporated into law as a guide to action for the Government's economic policies and practices; or

(iii) A declaration of policy approved by the legislative organs, or

(iv) A declaration of intentions by the Government with or without consideration, but not requiring approval, by the legislative organs.

III.3. For annual, medium-term and perspective plans and corresponding regional and sectoral plans, you may wish to indicate:

(i) The official title of the respective agency;

(ii) Its place in the hierarchy of government machinery;

(iii) The internal structure and composition including:

(*a*) The directing and co-ordinating authority within the agency;

(*b*) The division of work within the agency;

(*c*) The number and qualifications of the staff members (e.g., economists, architects, engineers, statisticians, sociologists, agronomists, lawyers, etc.);

(*d*) The mode of their recruitment;

(iv) The detailed functions of the agency;

(v) The external relations of the agency with:

(*a*) Other planning and/or implementing agencies;

(*b*) Other administrative and legislative bodies;

(*c*) Academic institutions;

(*d*) Private organizations (chambers of industries, trade unions, etc.) and representatives of the public.

It would be appreciated if special attention could be given to a detailed description of (i) the agencies responsible for central planning, and for planning of the industrial sector in particular, with specific emphasis on the co-ordination between the two agencies, and co-ordination between the agency responsible for planning of the industrial sector and the private sector and the handicraft and household sectors and (ii) corresponding implementing agencies and their co-ordination with one another and the planning agencies.

III.4. (*a*) You may wish to name the special agencies, or groups within the planning or implementing agencies, responsible for supervising the timely implementation of individual projects and of the plan as a whole, and explain how the supervision is carried out.

(*b*) You may indicate the agencies entrusted with the task of preparing the progress reports of the plan; whether such reports are prepared regularly or on an *ad hoc* basis; and whether they are published. You may also indicate whether analyses are carried out to identify the causes responsible for discrepancies between the planned targets and actual achievements.

IV. Procedures and methods applied in industrial planning and programming

A. *Over-all planning*

IV.1. (A) You may wish to consider including in your reply to this question:

(1) A statement on how you assess the investment potential (absorptive capacity for investment resources) of the economy; and in doing so, whether and how you take into account the following factors:

(*a*) Utilization of:

(i) Idle or under-employed labour force;

(ii) Unused or under-utilized machinery and equipment in the "organized" modern large-scale sectors of the economy;

(iii) Unused or under-utilized tools and equipment in the "unorganized" handicraft and household sectors of the economy;

(*b*) Expansion of the investment sector by drawing upon unused resources and/or by diverting resources from the consumption sector by means of:

(i) Permitting a rise of the general price level without any regulation or control imposed by the Government;

(ii) Controlling the price—with or without rationing—of essential goods (especially food and clothing) but without any interference in the prices of other goods;

(iii) Fixing the prices of most goods by the Government or specialized agencies unaccompanied by any rationing of consumer goods (some centrally planned economies), and

(iv) Fixing the prices of most goods combined with rationing of essential wage goods (some rationed wage goods may be available at higher prices on the "free" market);

(*c*) Expansion of production of consumer goods in relation to expansion of employment and incomes;

(*d*) Possibility of using imported surplus commodities, e.g., foodgrains;

(2) If you employ an aggregate model to work out the plan, a detailed statement on objectives, endogenous and exogenous factors and parameters of the model, sectors included in the model, and the technique employed in working out the model, including a statement on the procedures and methods employed to:

(i) Achieve a consistency in inter-industry relations (e.g., input-output analysis);

(ii) Co-ordinate financial and physical planning, and

(iii) Elaborate the programme of individual projects consistent with the plan (model);

(3) If you arrive at the aggregate plan as a result of the projection of trends for the individual sectors or industries, a statement on procedures and methods employed for:

(i) Projecting the trends;

(ii) Achieving a consistency in inter-industry relations;

(iii) Ensuring that the resulting aggregate plan is consistent with the over-all availability of financial resources, foreign exchange resources and physical and human resources, such as machinery and equipment, raw materials and manpower, and

(iv) Translating the projected trends into the programmes of individual projects;

(4) If you arrive at the aggregate plan and the planned targets as a result of the summation of individual projects, a statement on the procedures and methods employed for achieving consistency in inter-industry relations[a] and determining that the aggregate plan is consistent with availability of financial, foreign exchange, physical and human resources;

(5) If you simultaneously employ more than one of the three modes of planning outlined under (2), (3) and (4), a statement on procedures and methods employed for each mode of planning and for co-ordinating the various modes of planning;

(6) A description of the measures you adopt to counteract the undesirable consequences of expansion of investment, if any, on:

(*a*) Prices of wage-goods;

(*b*) The cost structure of industries and the general price level;

(*c*) Speculative and hoarding activities in commodity markets;

(*d*) The programme of public and private borrowing;

(*e*) The standards of living of the less flexible income groups among the community.

(B) You may wish to explain the procedures of the co-operation between the policy makers and (technical) planners in the formulation and finalization of the plan.

B. *Planning of the industrial sector*

IV.2. (*a*) If you employ inter-industry analysis, the method of material balance-sheets, or linear programming, you may wish to list the sectors and industries in which the economy and in particular the industrial sector have been subdivided; and also to explain how the method employed takes into account:

[a] This problem will not arise if the material balance-sheet method is used in preparing individual projects.

(i) The demand for consumer goods;
(ii) The demand for investment goods;
(iii) The demand for export goods;
(iv) The demand by the agricultural and services sectors for the goods of the industrial sector;
(v) The demand for intra-industry goods;
(vi) The subdivision of total demand for the goods of each sector between domestic production and imports;
(vii) The specific resource endowment of the country;
(viii) The processing of raw materials hitherto exported in their natural form.

(*b*) You may wish to indicate how the specific nature of the requirements of skills in various fields and at different levels are estimated. If you employ different methods for annual, medium-term and perspective plans, you may wish to indicate it in your reply.

IV.3. In considering the requirements of electric power, transport, etc., it is possible that the time horizon taken into account is longer than the plan period. If so, you may indicate the time horizon taken into account.

C. *Planning of the public sector in industries*

IV.4. You may wish to explain the methods employed for integrating individual plans of the public enterprises and the over-all plan at the stages of both the formulation and implementation of the plans.

IV.5. (A) You may indicate whether the selection of individual projects is based on a priority scheme for the national economy as a whole within the limits of total available resources, or for the industrial sector separately within the limits of the resources pre-allocated to that sector. In the latter case, you may mention whether there is an after-check to compare the marginal projects in the industrial and other sectors.

(B) You may indicate whether the evaluation and priority allocation of projects are based on profitability estimates in accordance with the market prices of production factors, including foreign exchange and yields, or whether deviations from these prices are used to take into account the intrinsic values of the factors and yields from the point of view of the national economy as a whole. In the latter case you may describe the method applied in detail; if accounting or shadow prices are frequently used for this purpose, please indicate for which factors or products, their values, and the method by which they are being determined. Please indicate also whether the same accounting prices are applied in all sectors of the economy and, if not, explain the differences.

IV.6. (*a*) You may describe the arrangements made to ensure the timely progress, and effective completion, of the public industrial projects, including a check upon actual as against scheduled expenditure on their construction.

(*b*) You may wish to indicate whether the financial provisions of the industrial enterprises are subjected to an annual budgetary appropriation. You may also state whether and to what extent the individual enterprises can use the surpluses accumulated by them for further expansion, and what are the provisions for financing of the operating losses which they may have suffered.

D. *Planning affecting the private sector*

IV.7. You may wish to indicate whether the Government has set up a permanent or *ad hoc* machinery for consultation with the private sector, whether the consultation is carried on with the representatives of industry as a whole, groups of industries, individual industries or individual enterprises, and whether representatives of labour and consumers in addition to those of the management participate in these consultations.

E. *Foreign exchange needs*

IV.8. (A) In considering the foreign exchange requirements of industrial projects, you may state whether you work out separately the budget for imports of plant and machinery, and the budget of recurrent foreign exchange requirements (e.g., raw materials, spare parts, technical services, royalties, etc.). If so, please give the account of the breakdown, the relative proportions of the two types of requirements for the industrial sector as a whole, and by industrial branches.

(B) You may indicate the industries which are being developed or expanded with a view to saving or earning foreign exchange either by substituting imports or expanding exports.

(C) You may mention the measures, if any, in industrial planning and programming which have been and are being taken to reduce dependence on imported machinery, raw materials and technical services, and foreign technical know-how.

(D) You may wish to mention whether in planning industrial projects you have provided for (*a*) reducing the pace of the construction of projects—and thereby spreading over a longer period the foreign exchange requirements—and or postponing the construction of certain projects as yet not initiated, in case of an unexpected emergency of shortage of foreign exchange resources, and reversely (*b*) accelerating the pace of construction of projects and or increasing the number of projects to be undertaken, in case of an unexpected improvement in the availability of foreign exchange resources (favourable change in terms of trade, receipt of foreign grants and loans in excess of expectation, etc.).

(E) You may indicate whether any provision of foreign exchange reserves is made, specifically aimed to meet requirements of the industrial sector in the event of an unexpected fall in the foreign exchange earnings or in the receipt of foreign aid, and if such provision is made, what proportion it bears to the total foreign exchange requirement.

(F) You may describe the arrangements made to ensure that foreign exchange requirements of the industrial enterprises in the private sector are accurately assessed, and the available foreign exchange resources are allocated in accordance with over-all priorities.

V. Instruments for promoting and guiding industrial development

A. *Savings and investment*

V.1. (*a*) Public savings consist of excess of tax revenue over current expenditure.

(*b*) Business savings include internal savings of the public enterprises. In cases where no provisions are made to attain specified magnitudes of savings, the Government may indicate the measures, if any, taken to increase savings. In some countries, if categories of savings given in the questionnaire are not applicable, another set of categories may be substituted. In some countries, the measure may include price regulations, subventions and loans by the Government.

V.2. This question deals with the measures undertaken to distribute savings between public and private sectors, since the savings generated in each sector may not correspond to the planned magnitude of investment assigned to them.

B. *Fiscal, monetary, and financial instruments*

V.3. Following are some examples of the fiscal incentives relating to income taxes, profit taxes and depreciation allowances which may apply.

Income taxes:

Exemption from income taxes of personal income derived from specified types of industrial debenture. You may indicate the maturity period of these debentures and the nature of these tax concessions.

Corporate taxes:

(1) A reduction in, or exemption from, taxes on profits for a prescribed length of time granted to any industries or industrial enterprises (tax holidays). It will be helpful if you indicate the nature and duration of these concessions.

(2) Tax exemption of undistributed profits. Please state the nature of conditions, if any, imposed for granting these exemptions (e.g., the re-investment of such profits, etc.).

(3) Lower rate of tax on retained profits than on distributed profits. The statement of the actual rates of profit taxes will be useful.

(4) Treatment for tax purposes of the capitalization of undistributed profits in the form of issuance of shares to shareholders.

Depreciation allowance:

(1) Granting of a total depreciation allowance in excess of actual investment costs. Please indicate the extent of excess.

(2) Granting anticipated depreciation allowances for investment of long maturation period, in specific industries.

You may indicate the usual maturity periods for such investments and the advance allowances as a percentage of fixed costs.

(3) Accelerated depreciation in the case of some industries or enterprises. You may indicate to which industries or enterprises this applies, the approximate life of fixed assets for each of these industries and the total period during which the entire depreciation allowance can be claimed.

You may further indicate whether the Government follows the straight line method of depreciation or the declining balance method, and you may describe in detail the method adopted.

V.4. You may explain the monetary means employed for stimulating industrial development (e.g., lower rates of interest on long term credits, etc.) and the desired effects.

V.5. You may supply the articles and memoranda of the Industrial Banks or Development Corporations and furnish the following information in respect of each such institution:

(i) Name;

(ii) Role of the Government in the organization and management;

(iii) Financial contribution by the Government and of private domestic capital:

Capital-equity;

Loans (please indicate rates of interest and maturation periods);

(iv) Facilities offered through the Central Bank;

(v) Guarantees for payment of dividends and interest on shares and debentures bought by the public;

(vi) Functions: promotion; management; training of personnel; financial assistance:

(*a*) Purchase of shares;

(*b*) Long-term loans;

(*c*) Medium-term loans;

especially designed to assist:

(*a*) Large-scale enterprises;

(*b*) Medium-scale enterprises;

(*c*) Small-scale and cottage industries;

(vii) Participation of foreign capital, including the nature and form of participation:

Private capital;

Foreign government;

International institutions,

Any other source.

V.6. Self-explanatory.

C. *Trade policies*

V.7. (A) You may indicate whether there is any permanent organization (e.g., a Tariff Board) with a view to granting protection to industries. If so, please describe its constitution and the principles on which protection to infant and/or established industries is granted. You may also indicate whether protection to infant industries is normally granted for a pre-determined limited time period.

(B) You may mention the measures taken to ensure the efficient performance by protected industries and to ensure that the protected industries supply goods at fair prices to consumers.

(C) You may indicate whether the Government imposes quantitative restrictions, including complete prohibition on imports of any type of goods, in order to: (*a*) protect domestic industries; (*b*) develop new industries; and/or (*c*) preserve foreign exchange resources for essential imports; and give the lists of goods and the degree of quantitative restrictions imposed on them under each of the three heads.

(D) In cases of an overall shortage of foreign exchange resources, you may wish to state the means adopted by the Government to facilitate imports of machinery and other goods required for domestic industrial development, and explain the system of priorities or rationing in allocation of foreign exchange and issuance of import licences. You may also specify the industries and projects which receive preferential treatment. You may state separately the measures taken (i) in emergencies and (ii) on a permanent basis where the shortage is likely to continue for a long time.

(E) You may describe the goods imported under an open general import licence and the proportion of such imports in the total import bill on an average of the last three years accounted by them.

(F) You may describe schemes designed to promote exports, such as export bonus schemes or other forms of export subsidies, export insurance, quality control of goods exported, etc.

D. *Economic overheads*

V.8. (A) You may state whether the freight policy for internal transport is designed to encourage industrial development, and if so, state concessions on freight rates or subsidies given for the carriage of specific goods (raw materials, machinery, finished products, etc.) and the system of allocation of freight cars (or trucks) in the case of strains and shortages in the transport system.

(B) You may wish to state whether there are any special concessions on prices of power and fuel supplied to industrial establishments. If so, give details.

(C) You may describe the measures, if any, taken by the Government to augment the supply of power for industrial establishments. Please give details of the measures undertaken by the Government.

E. *Regulation and control affecting the private sector*

V.9. (A) You may state the objectives of the control of capital issues, on what basis they are controlled, and which organization is entrusted with the control.

(B) The location of industrial establishments may be regulated with a view to avoid overcrowding of specified urban centres or regions and preserve residential areas, to promote under-developed regions of the country with a view to achieving a balanced regional development, to spread industrialization to rural areas, etc.

(C) Licensing of factories may facilitate the maintenance of statistical records, inspection of sanitary and safety standards, implementation of labour legislation, etc.

(D) You may also state the objectives of price control and rationing of certain goods and also list the goods, prices of which are controlled or subsidized, and the goods which are centrally procured and distributed through a system of rationing.

F. *External resources*

V.10. The first alternative is applicable to countries which are predominantly capital importing and the second alternative to predominantly capital exporting countries.

(A) *Capital importing countries.* You may distinguish between continuing measures and *ad hoc* measures. Distinction may also be made between measures affecting resource inflows from public and private sources.

(i) You may mention measures taken for servicing external public debts.

(ii) You may mention the measures, if aay, adopted by the Government to encourage partnership of domestic and

foreign private capital, so as to ease the shortage of foreign exchange resources.

(iii) You may wish to state the Government policy regarding public ownership in certain sectors of industry. In case of nationalization, what are the provisions regarding compensation of foreign owners?

(iv) You may describe in detail the Government provisions in respect of remittance of income on private foreign investments and repatriation of capital.

(v) You may state whether the participation of private foreign capital in industrial enterprises is screened by the Government and if so, explain the objectives of such policy and the criteria applied.

(vi) You may mention the areas of industrial activities, if any, from which participation of the private foreign capital is excluded.

(vii) You may state the regulations, if any, prohibiting or restricting ownership of controlling interests in industrial enterprises by private foreign capital.

(viii) You may state the steps taken in the form of investment promotion centres to attract private foreign capital.

(ix) You may describe the provisions, if any, regulating or restricting employment of non-nationals in the management and technical staff of the firms owned or controlled by private foreign capital.

(x) You may indicate whether the Government is bound by (i) covenants or treaties with foreign governments, or (ii) provisions in the Constitution, or (iii) resolutions and policy declarations, whereby it is committed to payment of fair compensation for the acquisition of foreign-owned industrial establishments.

Please attach copies of the relevant documents to your reply.

(xi) You may wish to mention explicitly whether the Government accepts the jurisdiction of the International Court of Justice of any other form of legal or arbitration settlement in disputes involving the rights and obligations of private foreign capital.

(xii) You may wish to state the measures and regulations made by the Government affecting import of technical know-how (e.g., royalties).

(B) *Capital exporting countries.* Measures taken by the Government to encourage exports of capital, e.g., special tax treatment of foreign income, public insurance and guarantees, establishment of special financing institutions.

V.11. Self-explanatory.

V.12. You may wish to indicate the arrangements provided for the training of managerial personnel, various categories of engineers and technicians and skilled labour, methods employed for recruiting and training them, including in-plant training; for accelerating and intensifying and improving training; the periods considered necessary for imparting different types of skills; and methods for working out the future demand for different categories of skills. You may also explain the extent to which the costs of training are borne by Government, private enterprise and individual trainees.

G. *General*

V.13. You may indicate whether the technological research (i) aims primarily at adapting techniques that have been already developed elsewhere to domestic circumstances and/or (ii) is related to the processing of specific domestic raw materials, and/or (iii) is directed towards developing new or improved techniques. You may also indicate how the results of research are made available to and applied in industries in each category of research. You may describe the distribution of expenditure on research between the Government and the private sector.

V.14. You may wish to indicate the distribution of expenditure on these measures between the Government and private enterprise.

V.15. Self-explanatory.

V.16. You may wish to state the names of institutions which promote industrial estates and industrial co-operatives, their precise functions and their achievements to this date.

VI. Past developments and prospects

VI.1. You may wish to indicate how the appraisal and scrutiny of policies, procedures, institutions and measures in the light of actual experience led to significant modifications and changes in them. You may pay special attention to modifications and changes in the following fields:

(i) Relative role of the public sector, the private sector and co-operative enterprises;

(ii) Integration of the private sector into the over-all plan;

(iii) Co-ordination of physical and financial planning;

(iv) Promotion of financing institutions;

(v) Preparation, selection and appraisal of projects;

(vi) Reducing of foreign exchange requirements of projects;

(vii) Integration of industries both as regards supplying industries ("backward integration") and consuming industries ("forward integration");

(viii) Balanced development of industry with that of power and transport;

(ix) Promotion of, and assistance to, small scale industries;

(x) Development and promotion of export-oriented industries;

(xi) Development and promotion of import-substituting industries;

(xii) Management of public enterprises;

(xiii) Promotion of higher productivity;

(xiv) Concentration of ownership and operation of enterprises in the private sector;

(xv) Location of industrial enterprises for ensuring balanced regional development.

VI.2. Self-explanatory.

VI.3. You may wish to indicate the extent to which the changes brought about in (*a*) the infrastructure of the economy, (*b*) the manpower distribution among the main sectors of the economy, (*c*) the relative importance of the industrial sector, (*d*) the relative importance of certain industries within the sector, (*e*) the technological level of industry, (*f*) levels of skills of the labour force, (*g*) institutions and their internal organization tend to facilitate the further development of the industrial sector.

VI.4. You may indicate the changes which you envisage in the next ten years in the items enumerated under VI.3.

Preliminary Bibliography for Industrial Development Programming

Part I of the Preliminary Bibliography for Industrial Development Programming—"Industries in General"—was published in the previous (fifth) issue of the ***Bulletin*** (Sales No.: 62.II.B.1). It included 374 entries distributed among the following headings: A. Bibliographies; B. General economics; C. Selected industries; D. Costs and production functions; E. Institutional; F. Data and sources; G. Country industrialization reports; H. Gas, petroleum and energy; I. Transport and industrial location.

Part II, which completes this preliminary bibliography, is devoted to chemical and related industries. The list is presented alphabetically by author, or by title when no author is indicated.

PART II. CHEMICAL AND RELATED INDUSTRIES

TABLE OF CONTENTS

A. Economics

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Forthcoming Publications

INDUSTRIAL ESTATES IN ASIA AND THE FAR EAST

This publication contains the report of the Seminar on Industrial Estates in the region of the Economic Comission for Asia and the Far East (ECAFE), held in Madras, India, from 1 to 11 November 1961, and large excerpts from the discussion and information papers submitted to the Seminor.

The report of the Seminar contains recommendations on objectives and policies in establishing industrial estates, organization, management and financing, integration of industrial estates projects with programmes of urban and regional development, and international and regional co-operation in the development of industrial estates. Since, in most countries of the region, the objectives of industrial estates programmes are to promote the development of small-scale industries and to influence industrial location in accordance with policies of decentralization, the recommendations of the Seminar are mainly focused on these two aspects.

Most of the discussion papers relate to industrial estates as a means of promoting small-scale industries. One of them is a case study describing the role of industrial estates in the industrial development of Ceylon. Other papers are concerned with aspects of labour and management, co-operation between and assistance to small-scale units, physical planning and establishment of industrial estates in a rural setting.

The information papers submitted by countries of the ECAFE region describe plans, progress and problems, review the objectives of the current plans and programmes and, in a number of cases, outline future developments.

The volume also includes information papers submitted by some advanced countries outside the region, and discussion papers on the establishment and operation of an industrial part, problems in establishment of large-scale industrial estates, and some controversial questions concerning industrial estates.

To be published in 1963
United Nations publication, Sales No.: 62.II.B.5
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Price: $US 4.50 (or equivalent in other currencies)

A STUDY OF INDUSTRIAL GROWTH

The objective of this publication is to investigate the pattern of growth of manufacturing industry in different countries at various stages of economic development. The basic tool employed is multiple regression analysis. The study is aimed at determining to what extent industrial development conforms to some pattern, in the sense of a quantitative relationship between the level and composition of manufacturing industry in a given country and a certain number of general economic characteristics of that country, for example, per capita income, population, rate of economic development, government policy, resource endowment, etc.

To be published in 1963
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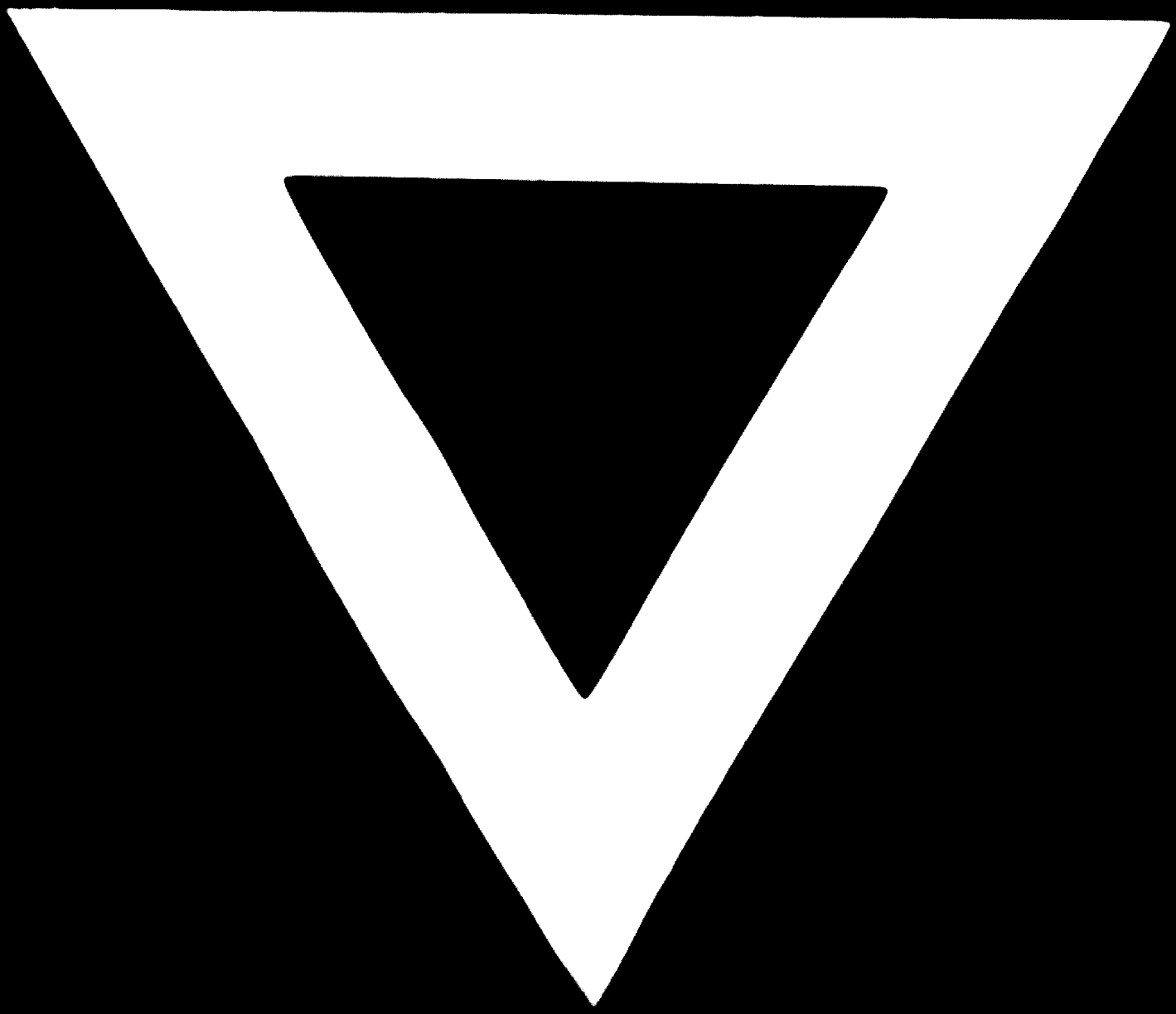

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