OCCASION

This publication has been made available to the public on the occasion of the 50th anniversary of the United Nations Industrial Development Organisation.

DISCLAIMER

FAIR USE POLICY

CONTACT

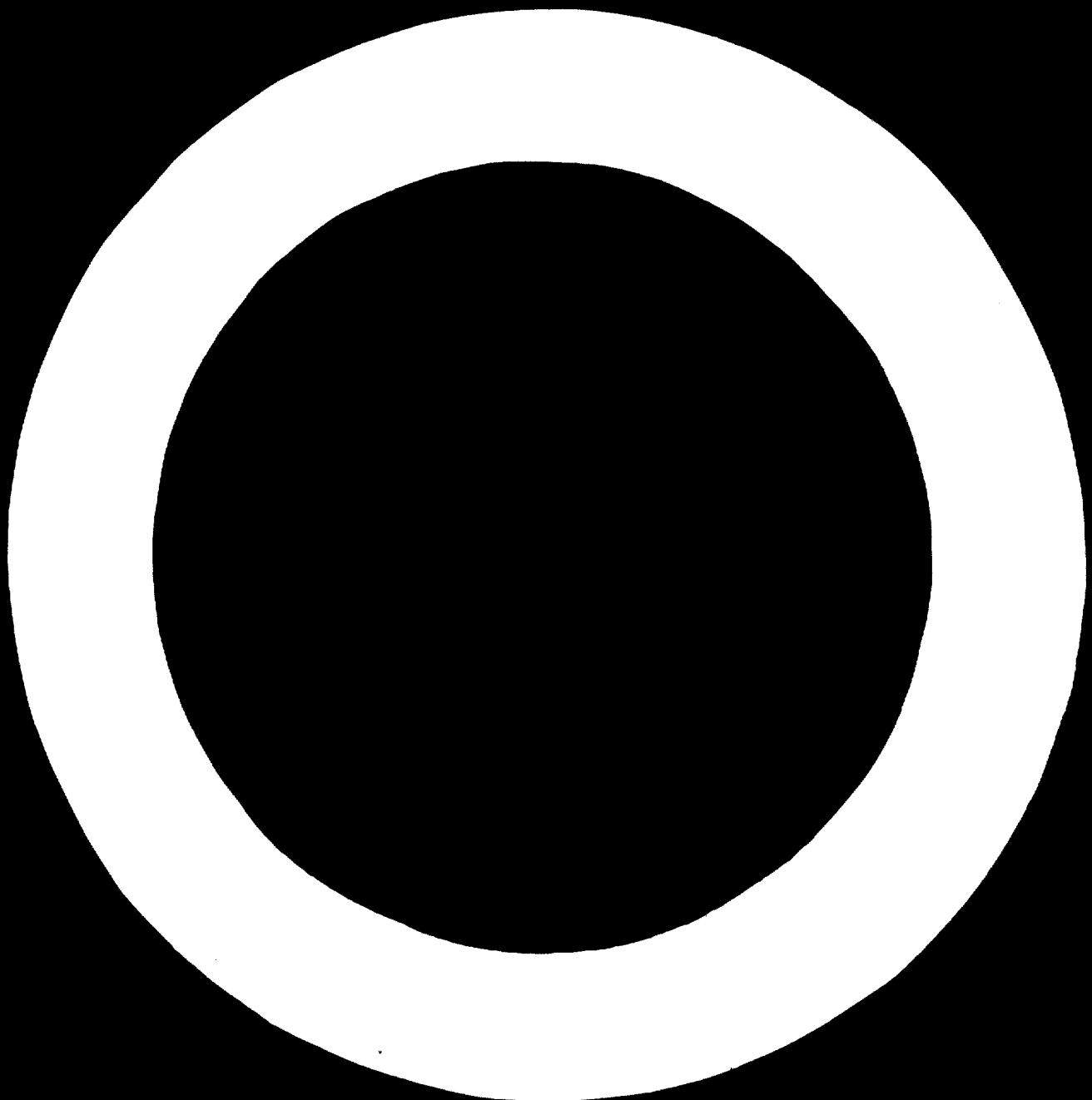
Please contact publications@unido.org for further information concerning UNIDO publications.

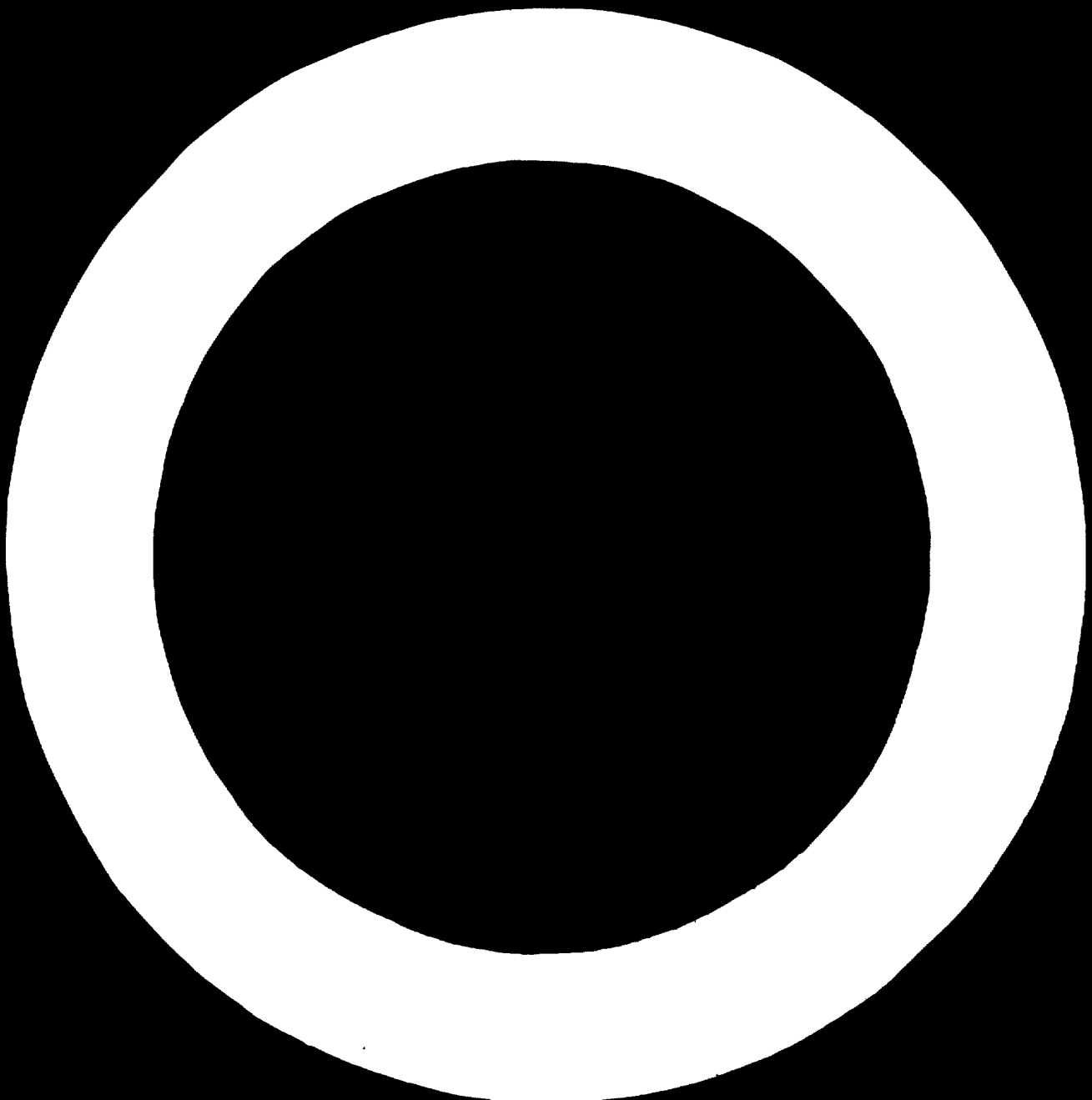
For more information about UNIDO, please visit us at www.unido.org

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

BULLETIN

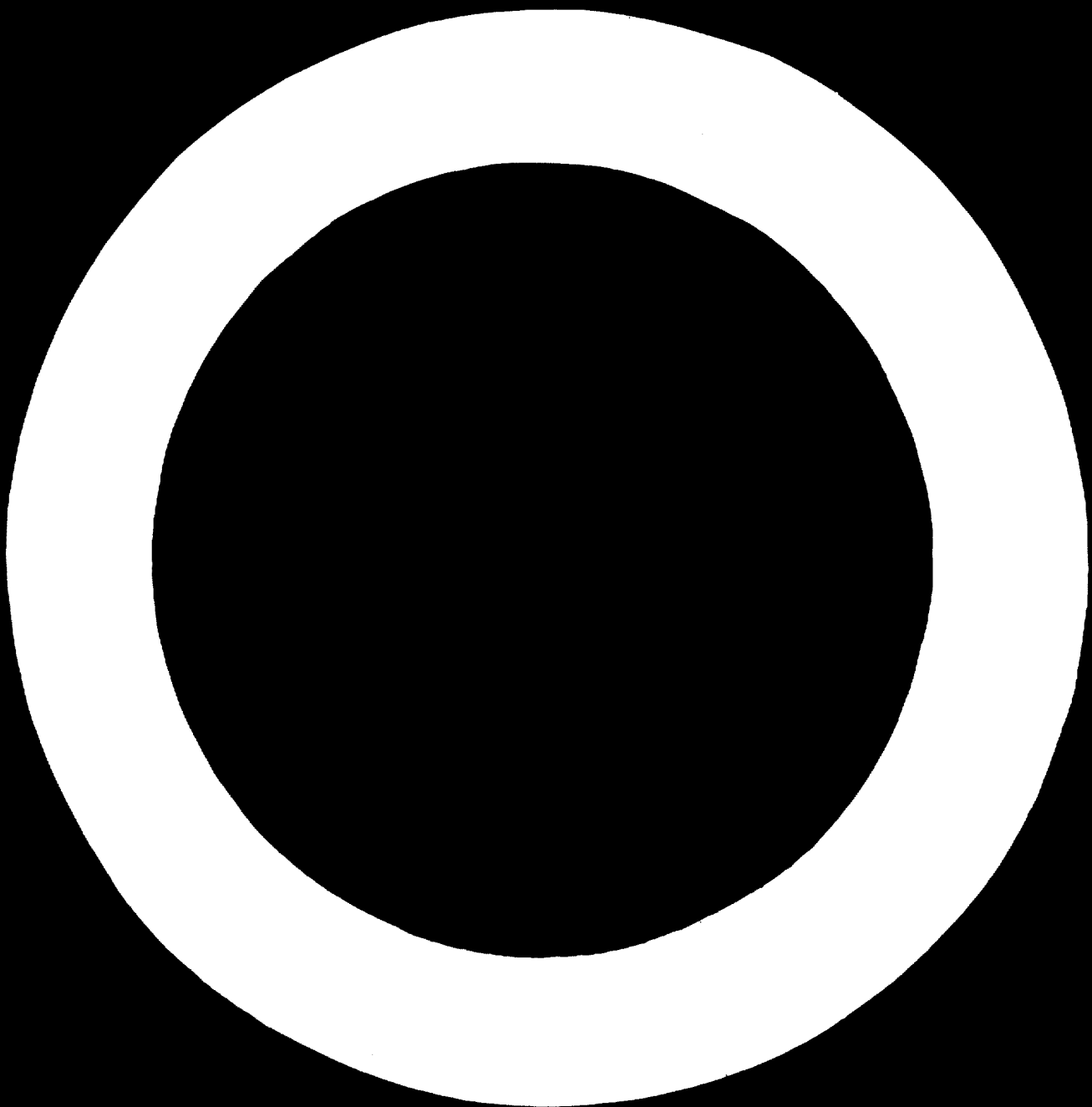
2



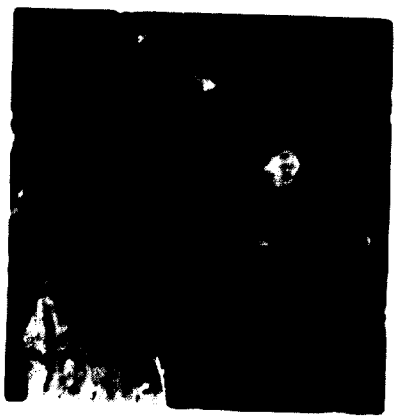


INDUSTRIALIZATION AND PRODUCTIVITY

2



In this issue



Cover illustration: Bolivian Tin Miners. Several articles in this issue relate to problems of industrial management in under-developed countries, one of them to "Labour Aspects of Management"

INDUSTRIALIZATION AND PRODUCTIVITY

BULLETIN 2

UNITED NATIONS

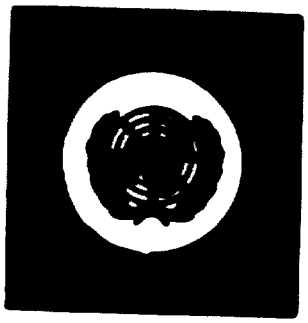
Department of Economic and Social Affairs

New York, March 1959

UNITED NATIONS PUBLICATION

Sales No.: 99.II.B.1
Price: $U.S. 0.70; 5 - stg.; Sw. fr. 1.00
(or equivalent in other currencies)

The designations of countries and territories and the arrangement of material in this publication should not be considered as implying any endorsement or other judgement by the Secretariat of the United Nations regarding the legal status of any country or territory, or of its authorities, or in respect of the delimitation of its boundaries.



Preface

In this issue of the *Bulletin on Industrialization and Productivity*, the Secretariat of the United Nations presents contributions relating to four broad topics in the field of industrialization.

The first is size of industrial plant in under-developed countries. The study on that subject, which analyses changes in costs and in investment outlays in relation to capacity of output in two industries, ammonia fertilizers and glass containers, belongs to the same category of micro-economic studies as the article "Capital Intensity in Heavy Engineering Construction", which was published in the first issue of the *Bulletin*. Here again the objective is to develop a methodology to be applied in studies of similar problems in other industries, the results of which studies would be of use to government agencies, technical assistance experts and others who are called upon to make decisions or provide advice in matters relating to planning, establishing and operating industries in under-developed countries.

The second topic—problems of small-scale industries—is dealt with in the next two articles. The first of these is devoted to a study of subcontracting arrangements between big industrial concerns and affiliated small industrial enterprises, a device which is extensively used in Japan. The other—also based on Japanese experience—presents recommendations by a group of experts on the organization and operation of cottage and small industries.

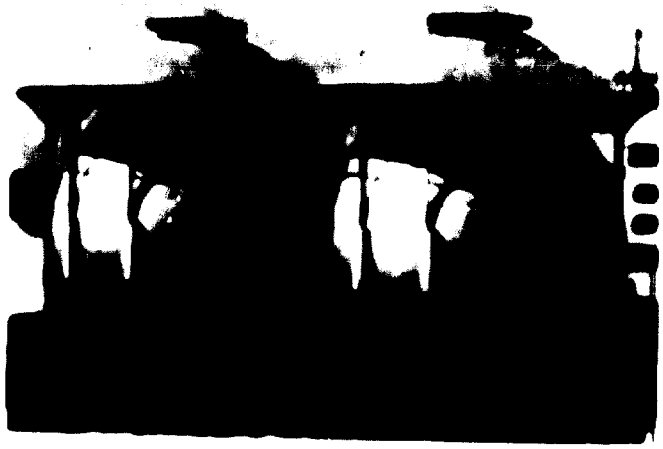
The third topic discussed in this issue relates to management of industrial enterprises in under-developed countries—another area under the programme of work in industrialization of the United Nations Secretariat. A panel of experts in this field was convened at United Nations Headquarters in the autumn of 1957 and, as a result of its discussions, a report on "Management of Industrial Enterprises in Under-developed Countries" was prepared by the Secretariat and published in 1958. Three articles based on some of the papers submitted by participants in the panel and by the Secretariat are published in this issue. They relate to labour aspects of management; to certain environmental factors which influence the formation and structure of management; and to some problems in this field reported by United Nations technical assistance experts. The last mentioned article also contains some of the conclusions and recommendations of the report on management mentioned above.

The fourth topic relates to the problems of establishing and operating technological research institutes. Particular interest attaches to this subject in view of the fact that establishment of technological research institutes is among the fields of assistance envisaged under the terms of reference of the Special Fund, which was recently set up by the General Assembly of the United Nations.

Finally, this issue contains a note on a meeting of a working party on industrialization, which was recently held in Bangkok under the sponsorship of the United Nations Economic Commission for Asia and the Far East, and a note on the meeting of the Advisory Committee on the Work Programme on Industrialization, which was held at United Nations Headquarters in New York, in February 1959.

Packing sulphate of ammonia in a factory in Japan

Problems of Size of Plant in Industry in Under-developed Countries



Prepared by the United Nations Bureau of Economic Affairs

THIS STUDY DEALS with the problem of the size of plant capacity, which is one of the key elements in the decision to set up new industries in under-developed countries, and is essentially related to what is generally referred to as economies of scale. It is well known that the cost of production in industry is, under normal conditions, lower—in many cases much lower—in large-scale plants than in small-scale establishments, the main reason being that the cost of construction and equipment and the amount of labour required for any given process vary less than in proportion to the capacity of the plant. In highly industrialized countries, manufacture of industrial products is generally carried out in plants large enough to ensure economic costs. In under-developed countries seeking to extend the range of their industrial activities, it is frequently not feasible in the initial stages, owing to lack of sufficiently developed domestic markets, to set up plants whose size will permit costs to be kept at a level comparable to that in the older industrialized countries. As long as this is the case, the disparity of costs and the competition of imported products tend to discourage the establishment of new industries in under-developed countries, which, in turn, tends to retard or even arrest their economic development.

The elements to be taken into account in the problem of appropriate size of plant are: (*i*) the cost of production and the investment outlay under the conditions prevailing in the area, and their variation with the capacity of output; (*ii*) the price of competitive imports; (*iii*) the size of the prospective market and its anticipated growth, and (*iv*) the distribution costs of the locally manufactured product, which depend on the geographical configuration of the country and other physical and economic characteristics of the domestic market; these factors in turn involve the problem of location of the industries.

The conclusions based upon an investigation of these elements are, of course, only one of the factors taken into account in deciding to establish—or not to establish—a particular industry. Additional factors, such as the priorities attached to certain industries, and the goals pursued by the country's development policies, as well as extra-economic considerations, also have to be considered.

This study largely concentrates on an analysis of the first three elements enumerated above in respect of two industries—ammonia fertilizers and glass containers—the establishment of which is being considered in a given under-developed region—Central America. It attempts primarily to develop a method of evaluation which could be applied to other industries where similar problems arise.

In view of the fact that the smallness of the domestic market is known to be one of the principal deterrents to the establishment of industrial enterprises in many under-developed countries, it was thought useful to study the case of small countries whose domestic market is limited by small population size as well as by low income levels. The five Central American republics, whose populations range from one to four million inhabitants, are now engaged in a study of a common market and are planning to establish a number of industries which would take advantage of the broader market that will result from this scheme. The two selected for this study, nitrogenous fertilizers and glass containers, are among the "candidate" industries under this integration programme.

From a methodological point of view, a study relating to Central America with particular reference to the "integration industries", has many advantages. As the problem is a concrete one receiving the attention of Governments and businessmen, it is possible to obtain a realistic

picture of the nature of the factors involved, to collect data on actual economic conditions in the countries concerned and to reach certain conclusions as to how this problem should be dealt with in practice and what further studies might usefully be undertaken.

As to the industries covered in this study, their selection was based on the following considerations. Expansion of agricultural production through the adoption of more efficient techniques, in particular the increased use of fertilizers, is generally a major objective of the development programmes of under-developed countries. As chemical fertilizers normally contain only 20 to 30 per cent of active ingredients, freight charges tend to make the cost of imported fertilizers high and sometimes prohibitive. On these grounds, the scheme for economic integration of Central America called for the establishment of a fertilizer industry, to produce, in particular, nitrogenous fertilizers.[1]

Although somewhat less important from the general economic point of view, a glass industry is also considered suitable for inclusion in the integration programme of the five Central American republics. The demand for sheet glass in the area does not seem large enough to justify the establishment of a factory, but the position with regard to glass containers, in particular common glass bottles for beer, non-alcoholic beverages and milk, to be used by the existing food industries, appears to be more favourable.

The two industries have a number of features in common which are of interest for the purposes of this study. For both, the freight charges on competing imported products provide a large measure of natural protection; also in both cases the market provided by the five Central American countries calls for units whose capacity is small by the standards prevailing in more developed countries.[2] At the same time, each of these industries is, to some extent, representative of a wide range of other industries. As will be seen later in some detail, the two differ significantly in respect of the structure of capital investment and costs and minimum economic capacity. While in both cases capital intensive processes are involved, in the case of nitrogenous fertilizers, which exemplifies a chemical process industry, the conditions imposed by technology are somewhat rigid—the process operations are fairly well standardized and cannot readily be subdivided. On the other hand, several operations in the production of glass containers lend themselves to varying levels of mechanization—the handling of raw materials, the preparation of batches for the furnaces, and the packaging and handling of finished goods, for example—and therefore some scope exists for variation in the degree of capital intensity in the industry. Furthermore, in the nitrogenous fertilizer industry, increases in capacity of output proceed by substantial "jumps", each involving a considerable additional investment outlay, while in the glass container industry, capacity variation is more flexible from the capital investment point of view, as augmentations may be achieved, within certain limits, by installing additional standard bottle-moulding units. Finally, the cost structure in relation to capacity is substantially different in the two industries. In the first, capital investment accounts for the major proportion of total production costs, whereas in the second, raw materials represent the major element of cost.

[1] The manufacture of phosphatic fertilizers from imported raw materials such as natural phosphate and sulphur appears not to be advantageous in all cases; the weight of the raw materials is significantly higher than the weight of the finished product and the value added is relatively small in relation to the value of the raw materials.

[2] Although the present consumption of nitrogenous fertilizers and glass containers is not accurately known, data from customs statistics and information supplied by importers and users show that the market provided by the five Central American countries is small.

GENERAL STATEMENT OF THE PROBLEM

The method used in this study may be summarized as follows. On the assumption that the same technology is used in both industrial and non-industrialized countries, the structure of costs of production in relation to capacity is studied for the former and transposed to the latter through appropriate adjustment of relevant data, and the point of minimum economic capacity is determined in relation to the price of competitive imports. Then the minimum economic capacity is compared with the actual size of the domestic market in order to determine whether the establishment of a plant is economically justified. When this proves to be the case, the optimum size of the plant has to be determined; this problem is studied in its dynamic aspect, by assessing the prospective growth of the market during the lifetime of the equipment. In the next step, the initial assumption of identical techniques is relaxed: it is assumed that alternative techniques of production—those involving lower capital intensity, for example—may be introduced, and the results obtained in the first instance are correspondingly reappraised. A related problem is the possibility of extending the lifetime of equipment through more intensive maintenance, thereby reducing indirectly the level of capital intensity of a given manufacturing process. The various steps outlined above are examined in some detail in the following paragraphs.

Cost structure in the industries covered in this study, based on United States practice

The point of departure is the experience of an industrial developed country in manufacturing the product; the country selected for that purpose is the United States.

As far as the cost structure is concerned, production costs are classified in broad groups, selected in such a way that the variation of costs in relation to capacity is sig-

ular within each group. For the sake of simplicity, it is proposed to consider the following three groups of expenditure:[1] (*i*) *raw materials and supplies*, including all current purchases made by the factory and excluding supplies intended for plant maintenance; (*ii*) *labour*, including all wages and related payments, other than the wages of maintenance staff, and (*iii*) *costs relating to capital investment*, including depreciation, labour and materials for maintenance and the normal remuneration of capital and miscellaneous charges, such as short-term interest and insurance charges. It is possible to determine for each of these groups the variation of costs in relation to capacity of output. In general, the amounts of raw material and power consumed are about proportional to capacity, whereas labour and equipment requirements increase less rapidly than capacity.[2]

Transposition of data to under-developed countries

In order to transpose to under-developed areas the economic data based upon the practice of industrial countries, it is necessary to have reasonably accurate information on the costs of the various factors of production in the former. The relevant information for certain Central American countries is given elsewhere in this study. The cost data are then recalculated on the basis of the new factor prices. It will be necessary to make a certain number of adjustments of the data in order to take account of local conditions. Thus, as regards raw materials, those produced locally may be available in an inconvenient form; their quality may not be as high or as uniform as required, or their supply may be irregular. In these cases, additional costs are incurred because the raw materials must be processed before use, or larger inventories must be maintained, or because the yields in finished products may be lower. The raw materials costs will be adjusted accordingly. As regards labour costs, these are determined not only by wage rates but also by the productivity of local industrial labour, and a corresponding adjustment will be necessary.

The import price of competitive products

The cost of production thus arrived at is compared with the price of imports. While, as a first approximation, the import price will be taken in this study as a datum, it might be appropriate, at this stage, to go a step further and to mention briefly a certain number of problems involved in the use of import prices in determining the minimum economic size of plant.

The import price is determined, in the first instance, by production costs in the older industrialized countries. This poses the problem of the level of costs in those countries themselves. In other words, there is generally a minimum level of costs corresponding to operating an industry at optimum capacity of output. The underlying assumption is that the export industries in the under-developed countries are operating at this optimum. The discussion of this particular aspect is, however, beyond the scope of the present study.

Determination of minimum capacity

When the costs at which an article can be produced in the area at different plant capacities, as well as the price at which it is available as an import, are known, these data can be used to determine the *minimum capacity* at which it can be produced domestically on a competitive basis. This capacity will be the one at which local production costs equal the import price; below this point local production ceases to be competitive with imports on a price basis. If market studies show that the local market is too small to sustain that minimum capacity, it is generally cheaper to use imports to meet local needs. If, on the other hand, market studies reveal that local consumption warrants a capacity exceeding the minimum, the establishment of a local industry is economically justified. As a rule, the import price of competitive products is higher than the cost of producing them at a plant of optimum size in an industrial country, principally because of freight charges, which are particularly high for the selected industries, as fertilizers and glass containers are bulky. Thus, the minimum economic capacity of a plant in an under-developed country will, as a rule, be much lower than the average capacity of the corresponding plant in an industrial country.

The problem of determining capacity in the case of an expanding market

In some cases market studies for an industrial product may show that the volume of possible sales will expand in the immediate or near future; it must then be decided how large the producing plant should be. If the size selected is too small, not only will the cost of production be higher than necessary, but it will not be possible after a time to satisfy the entire demand. If, on the other hand, too large a size is selected, the plant will operate over a large part of its lifetime at less than full capacity and at uneconomic cost, largely because full charges for depreciation and maintenance of equipment and interest on capital will continue to be made against costs even though the actual output is below capacity.[3] As will be seen later, this problem is of particular importance in those industries where it is difficult, for technological reasons, to increase plant capacity *progressively* as the market expands; this would be the case in the manufacture of nitrogenous fertilizers. The way this problem is dealt with in the present study is to determine the size of plant for which the average cost of production, taken over the entire lifetime of the equipment, is at a minimum.

[1] The costs obtained as the sum of these three groups of expenditure include production costs only, and exclude such expenditures as those for sales and advertising or distribution.

[2] Curves of this kind can be drawn systematically for a number of selected industries and it may be noted at this point, in anticipation of the conclusions of the study, that the collection of data of this type would be of great practical value for the purpose of planning industrial projects in under-developed countries.

[3] The labour force employed in the plant, as well as the consumption of some raw materials and power, will also probably be too large in relation to output.

Changes in the technological process and extension of the life of the equipment

It has been assumed so far that rigidly defined technological processes used in the industrial countries have been applied without change. In some cases alternative processes are available, at least for certain operations, so that it is possible to select a combination of techniques that will prove to be the most economic under the given conditions. In the circumstances, the cost calculated on the basis of a process currently used in an industrial country is not *a priori* the lowest cost possible. Where wage rates are low, it would be generally advantageous to modify the process, at least for some operations, in order to increase its labour content in relation to capital. Such a possibility may sometimes be difficult to explore, since labour-intensive processes are no longer used in the industrial countries, and consequently no data based on actual experience would be available for the purpose of a comparative study. However, information may be obtained on relevant experience in some under-developed countries where less mechanized processes are in operation. Systematic investigation of the possibilities of substituting labour for capital in various industrial operations would undoubtedly be of great value in planning the industrial development of under-developed countries, particularly as regards information on the availability of less mechanized techniques of comparable efficiency.

A related problem that arises in connexion with the possible variation of the level of capital intensity of the productive equipment, or—to put it in different terms—of the relative inputs of capital and labour, is one of the life expectancy of the installed equipment. Such life expectancy may be regarded as depending on the rate of wear and tear of the equipment and also on the rate at which the equipment becomes obsolete. Wear and tear and obsolescence are relative concepts and it is highly probable that, in the light of conditions in the under-developed countries, the applicable rates of wear and obsolescence might be substantially different from those obtaining in the industrial countries. Thus, it may be considered that the rate of wear of equipment could be reduced by more intensive and extensive maintenance and repair; in countries with scarce capital resources, such a policy would be particularly indicated in industries where capital input is high. As labour accounts for a large proportion of maintenance and repair costs, extending the lifetime of the equipment would be equivalent to substituting labour for capital, and would thus be a capital-saving device of considerable importance. Furthermore, because of lower wage rates in under-developed countries, the expense of a given volume of maintenance and repairs can be further reduced by using more labour and fewer spare parts.

Finally, a few remarks might be made at this point concerning certain aspects of government economic policies affecting industry which may have a significant and sometimes direct bearing upon the problem at hand. The most obvious case is when the government imposes a customs duty or increases the existing one on the imported product or grants tax concessions or straight subsidies which have the effect of lowering the prices of domestically produced goods. Clearly, such measures affect the relative position of import prices and domestic costs and lower correspondingly the point of minimum economic capacity. A similar effect will be provided by a lowering of the country's exchange rate, assuming that the change in the value of the currency is not accompanied by an equivalent change in the domestic price and wage levels.[6] Of a more indirect bearing are general government policies such as, for instance, those aiming at a more sparing use of scarce capital resources by promoting widespread substitution of labour for equipment in industrial operations. The latter case is clearly related to the problem of change in technology discussed above.

[6] This study assumes an unchanged domestic price level. This simplification, which facilitates the presentation of the material, entails no major disadvantages from the point of view of the study itself. It does mean, however, that no account is taken of the possible distortion of the price and cost mechanism of individual industrial enterprises due to inflationary conditions.

OUTLINE OF THE TECHNOLOGY OF THE INDUSTRIES COVERED IN THIS STUDY

Manufacture of nitrogenous fertilizers

THE PROCESS IN current use in the industrial production of nitrogenous fertilizers is based to a large extent on synthesis of ammonia,[7] the principal stages of which are listed below with the technological details omitted.

(*a*) *Production of the mixture of hydrogen and nitrogen.* The production of hydrogen from hydrocarbons[8] is based upon a reaction between light hydrocarbon and water vapour at high temperature and pressure, which results in a mixture of carbonic acid and hydrogen. There are various processes for carrying out the reaction which takes place in the presence of a suitable catalyst. One of the processes currently employed includes the following operations:

(*i*) In a first converter (reformer) about 70 per cent of the hydrocarbon used as raw material is converted into hydrogen and carbon monoxide; the latter is an intermediate product;

(*ii*) In a second converter sufficient air is introduced to complete the conversion of the raw materials into hydrogen and carbon monoxide; the gaseous mixture obtained also contains the amount of nitrogen needed for the synthesis;

[7] Sulphate of ammonia is also a by-product of the manufacture of coke and coal gas.

[8] In Central America, hydrogen could be obtained from oil products, either from heavy fuel oil or from reforming gas, if the ammonia plant were erected in the vicinity of an oil refinery. Reforming gas, which is mainly composed of hydrogen, is a by-product of oil refining. Although there is at present no oil refinery in Central America, it is proposed to build one under the economic integration programme.

(*iii*) In a third apparatus the carbon monoxide is made to react upon water vapour to form more hydrogen, while the carbon monoxide is transformed into carbonic acid.

(*b*) *Purification of the mixture of hydrogen and nitrogen.* In order to ensure a high efficiency in the synthesis, the mixture of hydrogen and nitrogen must be purified. During purification, first the carbon dioxide—which can if necessary be used to produce urea in another section of the plant—is extracted, and then the small quantities of carbon monoxide remaining in the mixture are removed.

(*c*) *Synthesis.* When purified, the gaseous mixture is fed into the apparatus in which ammonia synthesis is carried out. The yield of synthesis reaction is of the order of 20 to 30 per cent; the resulting gas mixture contains ammonia, which is separated by cooling, and the uncombined nitrogen and hydrogen, which are then recycled.

Sulphate of ammonia is obtained by the reaction of sulphuric acid on ammonia; the product is separated and granulated later if required. The manufacture of ammonium nitrate is usually carried out in two separate sections of the plant, in one of which nitric acid is produced by oxidation of ammonia, while in the other the acid is made to react with a further quantity of ammonia to produce ammonium nitrate. For use as a fertilizer, it is generally diluted with inert materials, which results in a product containing 20 to 21 per cent of nitrogen; it is granulated to make it less hygroscopic.

For the manufacture of urea, carbon dioxide is made to react with ammonia under suitable temperature and pressure. The reaction has a relatively low yield and the production of urea by this process is relatively expensive. In an alternative process, which permits simultaneous production of urea and ammonium nitrate, the ammonia not converted into urea after one cycle is used to make ammonium nitrate.

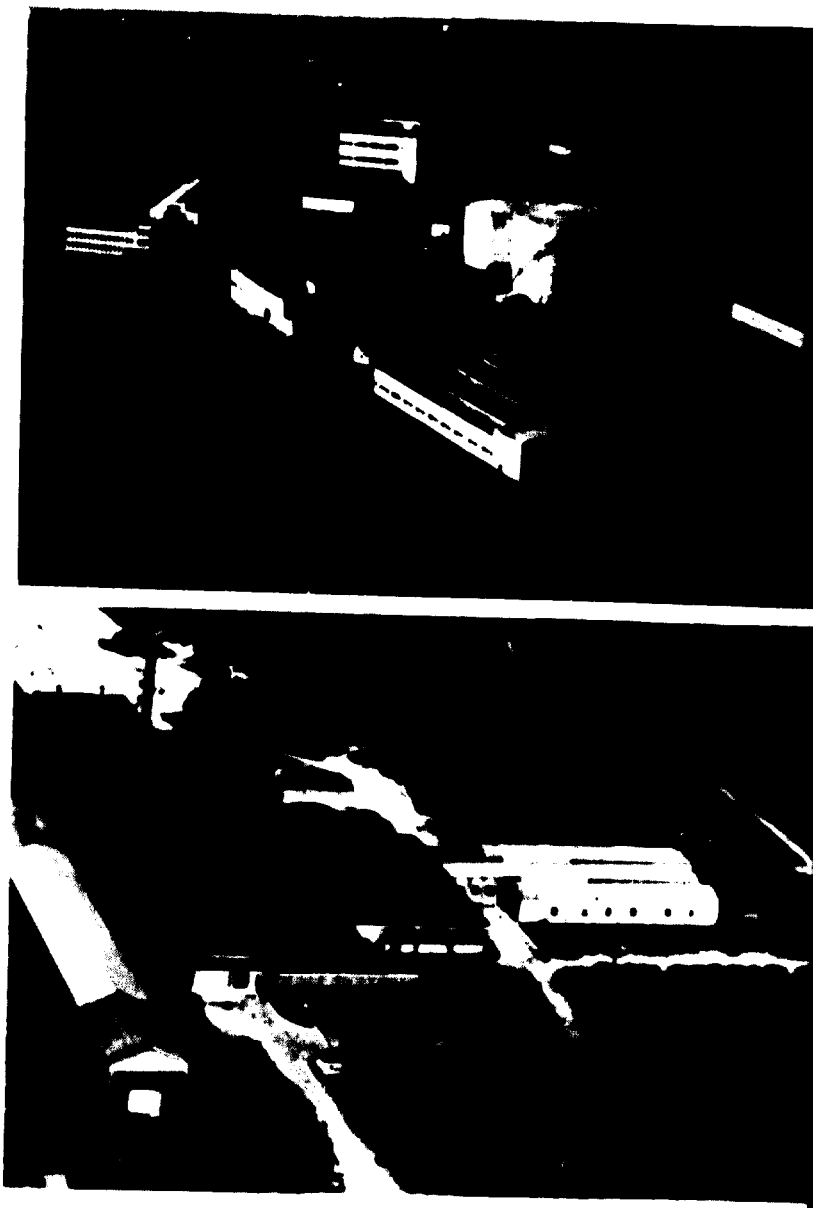
It should be noted that ammonia itself is generally not used directly as a fertilizer. Fairly expensive equipment would be required for transport, storage and spreading. Recently, however, it has been considered that it may be advantageous in some cases, even in under-developed areas, to use ammonia directly instead of transforming it into one of the standard fertilizers.[9]

Manufacture of glass containers

The essential stages in the manufacture of common glass containers are the preparation and mixing of the raw materials, the moulding and cooling of the bottles, and the packing and storage of the finished goods.

The basic raw materials are sand of a high degree of purity, sodium carbonate and lime, which must be mixed in the proper proportions. Small quantities of other mineral salts are usually added, mainly as colouring agents. The mix is placed in furnaces in which high temperatures of the order of 1,500°C are maintained. The

[9] A project recently considered in Mexico provides for the establishment of an ammonia plant with a capacity of one hundred tons a day and the organization of distribution facilities to permit the direct use of the ammonia as a fertilizer.



TOP. *Ammonium nitrate fertilizer plant near Reykjavik, Iceland, with a production capacity of 6,000 tons per year*
BOTTOM. *Glass works in West Virginia, United States, with a production capacity of 25 tons of glass per 24-hour period*

yield of the operation largely depends on the quality of the sand used, the proper mixing of the ingredients and the maintenance of proper temperatures in the furnaces.

The molten glass is transferred to the moulds of the moulding machines where it is automatically pressed and blown to form containers of the desired shape and thickness.[10] Various types of moulding machines exist, and a relatively large number of skilled workers is needed to design and maintain the moulds. The containers are then placed in annealing furnaces where they undergo a controlled cooling process which makes them shock-resistant by reducing internal stresses.

After leaving the annealing furnaces, the containers are inspected and packed. In the United States, users

[10] Semi-automatic moulding and blowing processes are also sometimes, although seldom, used. The older method of blowing by mouth has been practically abandoned in industrial practice.

usually require bottles to be delivered in cardboard containers which are re-used when the bottles are filled. A large labour force is needed for packing even in factories where this operation is partly mechanized. The users also insist that bottles should be carefully inspected before delivery in order to ensure satisfactory machine-filling.

Even if the users are less demanding and are prepared to accept lower quality standards, it appears that, in general, bottles which are to be machine-washed and machine-filled—beer and carbonated beverage bottles, for example—could meet the required standards only if produced by automatic moulding machinery.

COST STRUCTURE IN THE TWO INDUSTRIES IN THE UNITED STATES

Ammonium nitrate

USING INFORMATION PROVIDED by a firm with specialized experience in the construction of ammonia plants, an estimate was made of the cost of production of ammonium nitrate in the United States for a plant of given capacity, assuming full capacity operation. On the basis of these data, costs of production were estimated for different capacities, using certain assumptions. As a reasonable simplification, it is assumed that the components of production costs vary with the size of plant as follows:

(*i*) The consumption of raw materials per ton of fertilizer produced is substantially independent of the size of plant;

(*ii*) As the process is continuous and highly mechanized, it is assumed that part of the labour requirements is independent of size and that the remainder of this component varies in proportion to size. In other words, it is assumed that labour cost per unit, as a function of capacity of output, consists of a variable part which decreases as the size of plant increases, and of a part which remains unchanged. It is further assumed that the fixed and the variable parts of the labour costs are in a 50:50 proportion for a plant of a daily capacity of 150 tons.

(*iii*) Costs relating to capital, which, for the sake of brevity, will be referred to hereafter as capital costs, are clearly proportional to the volume of the required investment. The latter increases with capacity, although relatively slowly. On the basis of engineering practice it is assumed that the investment required, and thus the over-all capital costs, increase proportionally with the 0.6th power of the capacity of the plant. In other words, capital costs per ton of finished product are inversely proportional to the 0.4th power of capacity.[11] The value of this power will be designated hereafter as capital outlay exponent.

The results of the various estimates are given in table 1, from which it will be seen that, for a capacity of the order of 150 tons of ammonia a day, capital costs are the largest component of costs, accounting for 60 per cent of the total, whereas raw materials and labour represent 20 per cent each. For small capacities of the order of fifty tons of ammonia a day, total costs are significantly higher—by approximately 50 per cent—as a result of the substantially higher levels of labour and capital costs per ton produced.

Table 1

UNITED STATES: ESTIMATED COST OF PRODUCTION OF AMMONIUM NITRATE, BY CAPACITY OF PRODUCING PLANT
(Dollars per short ton of ammonia content, at 1957 prices)

ITEM	CAPACITY OF PLANT (*short tons of daily output*)			
	50	*100*	*150*	*300*
Raw materials and supplies [a]	27.0	27.0	27.0	27.0
Labour	46.0	28.8	23.0	17.2
Costs relating to capital [b]	117.4	89.3	75.6	57.3
TOTAL	190.4	145.1	125.6	101.5

Source: Based mainly on information provided by the M. W. Kellogg Company, New York. The following sources were also consulted: Barrett S. Dull, "Economics of Ammonia Manufacture from Several Raw Materials", *Petroleum Processing*, The Fluor Corporation, February 1955; B. J. Mayland, E. M. Conley, J. C. Reynolds, "Ammonia-5: Partial Oxidation with Air", *The Oil and Gas Journal*, 25 October 1954; Will H. Sharon and H. L. Thompson, "Ammonia at 1,000 Atmospheres", *Industrial and Engineering Chemistry*, February 1952; "Synthetic Ammonia from Natural or Refinery Gases", *Petroleum Processing*, September 1956.

[a] Broken down approximately as follows:

		Dollars
Natural gas: 41,000 cubic feet at $0.34 per thousand cubic feet	*(approximately)*	14
Chemicals, electricity and water		7
Miscellaneous supplies (bags, etc.)		6

[b] The investment required for a plant with a capacity of 150 tons a day was estimated at $9 million for the plant itself, plus $4.5 million for the preparation of the site, access roads, general services and others. For an annual output of 50,000 tons, the costs relating to capital per ton produced are:

	Dollars
Depreciation (on the basis of 10 per cent per annum)	27
Maintenance (4 per cent per annum)	11
Insurance, taxes and miscellaneous charges (2 per cent per annum)	6
Normal remuneration of capital (12 per cent per annum)	32

It will be noted that the figure for normal remuneration of capital—taken here at 12 per cent per annum—is substantially higher than the current interest rate. The difference is due to such elements as various charges, profits and taxes.

Glass containers

Factories producing glass containers, especially the larger establishments, normally manufacture a wide range of products varying in shape, capacity, weight, thickness of wall and colour. For the sake of simplicity, the following estimates relate to plants producing standard pattern beer or carbonated beverage bottles with a capacity of twelve fluid ounces and a weight of twelve ounces. As noted

[11] The introduction of these somewhat complicated relationships for the variation of labour and capital costs with the size of plant is necessary because no actual data are available for these cost components for different plant sizes. Clearly, data from actual industry practice—when available—are preferable to those based on mathematical relationships which can only be an inadequate substitute. See table 6, footnote *a*.

earlier, the capacity of factories manufacturing glass containers is determined by the number and type of moulding machines installed. The data which it has been possible to obtain on manufacturing costs for bottles are incomplete and derived from various sources; an attempt has, nevertheless, been made to assess the structure of costs per unit of output—in this case a gross of bottles—for a highly mechanized factory of medium size. The following assumptions were then made as to the variation of the different cost elements with capacity:

(*i*) The consumption of raw materials and other inputs per ton of finished product is considered to be nearly independent of capacity, although the consumption of power tends to be slightly higher in small-scale factories;

(*ii*) Even in highly mechanized factories of the type considered, it seems reasonable to assume a linear—but not proportional—relationship between the required labour force, excluding maintenance staff, and capacity; in other words, that labour costs per ton of finished product decrease slowly with an increase in size. It will be assumed that labour requirements are proportional to the number of moulding machines plus one;

(*iii*) Capital investment outlay increases approximately as the 0.75th power of capacity.[12] Capital costs per ton of finished product would be inversely proportional to the 0.25th power of the capacity.[13]

Although these figures are only approximations, they are probably not seriously in error and have been used as the basis for table 2, which provides an estimate of changes in costs as a function of capacity in factories manufacturing bottles of a given type. They show that in a factory with six moulding machines, raw materials account for about two-fifths of the costs, labour and capital for about three-tenths each. In a small factory with only one moulding machine, costs would be about 40 per cent higher because of the increase in the cost of labour and capital per unit produced.

[12] In the case of nitrogenous fertilizers, a lower coefficient—the 0.6th power of capacity—was assumed. For glass containers, a relatively large proportion of the plant—moulding machines, annealing chambers, handling equipment and part of the buildings—varies directly with capacity, whereas the non-specialized plant—furnaces and water and electricity supply systems—is of relatively little significance. See table 6, footnote *a*.

[13] See footnote 11.

Table 2

UNITED STATES: ESTIMATED COST OF PRODUCTION OF BEER BOTTLES, BY CAPACITY OF PRODUCING PLANT[a]

(Dollars per gross, packed, at 1957 prices)

ITEM	CAPACITY OF PLANT (number of bottle moulding machines)				
	1	*2*	*4*	*6*	*12*
Raw materials[b]	2.40	2.40	2.40	2.40	2.40
Labour	3.09	2.31	1.93	1.80	1.67
Costs relating to capital[c]	3.02	2.54	2.13	1.93	1.62
TOTAL	8.51	7.25	6.46	6.13	5.69

Source: Based mainly on information provided by the Ingalls Manufacturing Company, Hartford-Empire Company Division, Hartford, Connecticut. The following sources were also consulted: Bureau of the Census, *Annual Survey of Manufactures, 1953*; Bureau of Labour Statistics, *Glass Containers*, Report No. 70, October 1954; International Co-operation Administration, *Plant Requirements for Manufacture of Glass Containers*, July 1955.

[a] The figures relate to beer bottles of twelve fluid ounces in content and twelve ounces in weight. As little published information is available on the cost structure in the glass container industry, the figures are approximate and in the nature of orders of magnitude.

[b] Broken down approximately as follows:

	Dollars
Sand, lime, chemicals	0.95
Power	0.45
Cartons	1.00

[c] For a factory with six moulding machines an investment of $5.5 million and an annual output of 970,000 gross, packed, were assumed. Costs relating to capital were then estimated as follows, per gross manufactured:

	Dollars
Depreciation (on the basis of 10 per cent per annum)	0.57
Maintenance (10 per cent per annum)	0.57
Taxes, insurance, interest and miscellaneous charges (2 per cent per annum)	0.11
Normal remuneration of capital (12 per cent per annum) (see last paragraph in footnote *b* to table 1)	0.68

LEFT. ***Transferring ammonium nitrate from storage spheres to a tank car, in a plant in California, United States.*** RIGHT. ***American-made glass container moulding machine***

Comparison of the cost functions for the two industries

Comparison of the cost estimates for the two industries under consideration shows that, in the case of nitrogenous fertilizers, the unit costs tend to fall more steeply as plant capacity increases than is the case in the glass container industry. According to the figures in table 1, a six-fold increase in plant capacity in the former industry—from fifty to 300 tons of daily output—would result in a decline in costs of between 45 to 50 per cent; a comparable increase in capacity in the glass container industry—from two to twelve bottle-moulding machines—would, according to the figures in table 2, result in a fall in costs of only slightly over 20 per cent. This discrepancy is largely due to the fact that, in the glass container industry, the relatively stable cost element of raw materials and supplies accounts for a far greater share of total costs. Moreover, in the same industry, total labour requirements tend to follow more closely the increase in capacity of output than in a chemical process industry such as the production of fertilizers. This causes the labour element of costs per unit of output to be relatively more stable in the former industry than in the latter, where it tends to decrease sharply with the increase in capacity.

COST STRUCTURE IN THE TWO INDUSTRIES IN CENTRAL AMERICA

General remarks

In accordance with the method described in a preceding section, an approximation of the costs which would obtain in countries such as the Central American republics can be made by estimating the differences in costs between the latter countries and the United States with respect to the three main elements of costs—raw materials and supplies, labour and capital.

Most raw materials and supplies will have to be imported. No domestically produced fuel oil or natural gas is available. Neither are most of the chemicals used in the production of ammonium nitrate. In the production of glass containers, glass sand, of which no known deposits of sufficient purity exist in the region, would have to be imported, as well as soda ash and other chemicals—for example, colouring ingredients. Exploration of mineral resources may in due time result in an improvement of the situation, but for the time being the estimates will have to be based on prices of imports, which will be substantially higher than prices of existing resources in the United States. Thus, the price of imported heavy fuel oil in Central America is approximately 2.5 times higher than the price of the calorie equivalent in natural gas in the United States.[14] In the case of other imported materials, the price spread will be considerably smaller, somewhere between 30 and 50 per cent above the United States prices. The cost of domestically produced raw materials is assumed to be the same or perhaps slightly higher.[15]

In the cost calculations for the manufacture of ammonium nitrate in the United States, which is based on the use of natural gas both as a source of energy and as a raw material, the cost of natural gas represents more than 50 per cent of total raw material costs. In Central America, natural gas will have to be replaced by imported fuel oil, and total raw material costs may be estimated to be about twice as high as in the United States. For the glass container industry raw material costs will be some 50 per cent higher.

In regard to the labour cost element, information was obtained on general labour conditions in the Central American region by inquiries made to the management of major factories. While the inquiry covered mostly such plants as cement works and breweries, it was considered that relatively "heavy" industries engaging in the manufacture of nitrogenous fertilizers or glass containers would probably face similar conditions.

According to the information collected, it is possible for large plants, provided wages are adequate, to select and retain a labour force whose skill is comparable to that of labour in the industrial countries. Thus, maintenance of equipment is not an insoluble problem, provided the management follows a consistent policy of upgrading and training workers within the plant.

As to wage rates, these appear to be similar in El Salvador, Costa Rica and Honduras; converted into United States dollars at the official rate of exchange, the hourly rates for the following categories of workers and the monthly rates for engineers are approximately:

Semi-skilled and unskilled workers	25 to 30 cents
Skilled workers	50 to 60 cents
Mechanics	70 cents
Secretaries	One dollar
Engineers	$500 to $600 (per month)

In Guatemala, wages for workers in similar categories appear to be substantially higher, the differences being of the order of 30 to 50 per cent.

If allowance is made for indirect payments and benefits in kind, it would appear that wage rates for manual workers in Central America, except Guatemala, are about one-sixth of those in the United States, and salaries of skilled and clerical workers and of professional staff are some one-half to one-third of corresponding rates. Taking into account the relative proportion of unskilled and clerical workers and professional employees to manual labour, the average level of remuneration in Central America (except Guatemala) can be taken as approxi-

[14] The price of natural gas at the end of 1957 was $0.34 per thousand cubic feet, which is equivalent to a price of $1.65 per 42-pound barrel of heavy fuel oil. At that time heavy fuel oil was available in Central America at about $4.00 per barrel ($3.85 on the Pacific coast of El Salvador, $4.35 in Guatemala City).

[15] This also takes into account the fact mentioned earlier that poor quality and lack of uniformity of the raw materials of domestic origin may be reflected in higher costs of production.

Table 3

INDICES OF COSTS BY MAIN CATEGORIES IN TWO INDUSTRIES IN CENTRAL AMERICA
(United States costs = 100)

COST COMPONENTS	*Fertilizer industry*	*Glass container industry*
Raw materials and supplies	200	150
Labour	40	32
Capital (all elements)	145	135

mately 25 per cent of the United States level in the case of the nitrogenous fertilizer industry and 20 per cent in the case of the manufacture of glass containers.

As was mentioned earlier, labour costs are determined by both wage rates and productivity. Little direct information is available on the latter aspect. On the basis of related evidence the productivity of labour in a Central American country was evaluated at somewhat less than two-thirds of that in the United States.[16]

Taking together the difference in wage rates and in productivity of labour, unit labour costs in Central America are of the order of 40 per cent in the fertilizer industry and 32 per cent in the glass container industry of the corresponding costs in the United States.

As regards capital outlay, the cost of imported equipment delivered at the site will be between 30 and 40 per cent higher than in the United States. On the other hand, according to information collected in the region, the domestic cost of installing equipment and constructing buildings would be approximately the same. The over-all investment outlay in fixed capital is about 25 per cent higher than in the United States.

The individual elements of costs relating to capital have the following characteristics:

The rate of depreciation is taken to be the same in Central America as in the United States, on the assumption that the lifetime of equipment and buildings is identical. Since the value of invested capital is estimated to be 25 per cent higher in Central America than in the United States, the absolute cost of depreciation will also be 25 per cent higher.

In regard to maintenance costs, labour costs in Central America have already been estimated at 32 to 40 per cent and cost of imported equipment at 130 to 140 per cent of United States figures. On the basis of the United States practice of allocating equal amounts for labour and spare parts costs, maintenance costs would appear to be 80 to 90 per cent of the United States figures.

The total of the other two items, miscellaneous charges (taxes, insurance, and so forth) and normal remuneration of capital, is estimated to be 40 per cent higher than in the United States in relation to the value of invested capital, or 75 per cent higher in absolute terms (allowing again for the fact that the value of invested capital is estimated to be 25 per cent higher in Central America than in the United States).

Combining the four cost elements and taking into account their relative share in total costs (see footnotes to tables 1 and 2), total costs in absolute terms will appear as 45 per cent higher in the fertilizer industry and 35 per cent higher in the glass container industry.[17]

Table 3 gives a summary of the indices for the three main components of costs in the Central American industries discussed.

Table 4

CENTRAL AMERICA: ESTIMATED COST OF PRODUCTION OF AMMONIUM NITRATE BY CAPACITY OF PRODUCING PLANT
(United States dollars per short ton of ammonia content, at 1957 prices)

ITEM	CAPACITY OF PLANT (*short tons of daily output*)			
	50	*100*	*150*	*300*
Raw materials and supplies	54.0	54.0	54.0	54.0
Labour	18.4	11.5	9.2	6.9
Costs relating to capital	170.2	129.5	109.6	83.1
TOTAL	242.6	195.0	172.8	144.0

Source: Figures derived from table 1 by applying the indices given in table 3.

Note: The data are approximate and in the nature of orders of magnitude.

Table 5

CENTRAL AMERICA: ESTIMATED COST OF PRODUCTION OF GLASS CONTAINERS BY CAPACITY OF PRODUCING PLANT
(United States dollars per gross, packed, at 1957 prices)

ITEM	CAPACITY OF PLANT (*number of bottle moulding machines*)				
	1	*2*	*4*	*6*	*12*
Raw materials and supplies	3.60	3.60	3.60	3.60	3.60
Labour	0.89	0.74	0.62	0.58	0.54
Costs relating to capital	4.07	3.43	2.88	2.60	2.19
TOTAL	8.66	7.77	7.10	6.78	6.33

Source: Figures derived from table 2 by applying the indices given in table 3.

Note: The data are approximate and in the nature of orders of magnitude.

[16] In Economic Commission for Latin America, *Labour Productivity of Cotton Textile Industries in Five Latin American Countries* (Sales No.: 1951.II.G.2), the productivity of labour in typical plants of the countries concerned was measured in terms of the excess of physical labour input in these plants over input in a "standard" plant used as a norm. This study gives a breakdown of the excess input according to various factors of inefficiency. The data show that the excess labour input in a *modern* textile mill attributable to factors other than size of establishment or type of equipment varied from around 20 per cent in Mexico to 106 per cent in Chile, with an all-country average of 61 per cent of normal labour input. This figure was affected by still another inefficiency factor—newness of equipment—so that it tended to overstate the element of "net" inefficiency of labour. This was in turn offset by the fact that the all-country average was heavily weighted by data originating from such relatively well-industrialized areas as São Paulo and Mexico. In the light of what was said above, the figure of a 60 per cent "excess input of labour"—corresponding to a loss in productivity of about 40 per cent—was considered reasonable for Central America.

[17] The lower figure for the glass container industry is due to the higher proportion of maintenance costs.

Production costs

Production costs for the two industries considered and for different plant sizes are presented in tables 4 and 5 and chart 1 (*A* and *B*). The data were calculated by applying the cost indices summarized in table 3 to the corresponding items in tables 1 and 2.

A comparison of the figures in tables 4 and 5 with those in tables 1 and 2 leads to the following conclusions.

The share of labour costs in total production costs is substantially lower in Central America than in the United States; thus, because of the substantially lower wage rates prevailing in Central American countries, the share of labour in total costs in a fertilizer plant with a daily production of 150 tons would be only about 5 per cent in Central America as compared with close to 20 per cent in the United States. In the glass container industry, for a plant equipped with six moulding machines, these figures would be 8 to 9 per cent as compared with close to 30 per cent.

Total production costs in Central America compare much more favourably with those in the United States in the glass container industry, which is more labour-intensive than the fertilizer industry. The cost of production of glass containers is some 2 per cent higher than in the United States for a plant of the smallest capacity (having one moulding machine) and some 11 per cent higher for a relatively large plant (having twelve moulding machines). In the fertilizer industry the cost differential would be within the range of 27 to 42 per cent, according to size.

The rise in production costs with the reduction in size appears to be generally more attenuated in Central America than in the United States; to put it in other terms, in the former area, the size factor appears to affect production costs to a lesser degree. This is mainly due to the larger share in total costs of unit costs of raw materials and supplies, which have been assumed to be independent of size.

Chart 1A

PRODUCTION COSTS IN THE UNITED STATES AND IN CENTRAL AMERICA FOR DIFFERENT SIZES OF PLANT

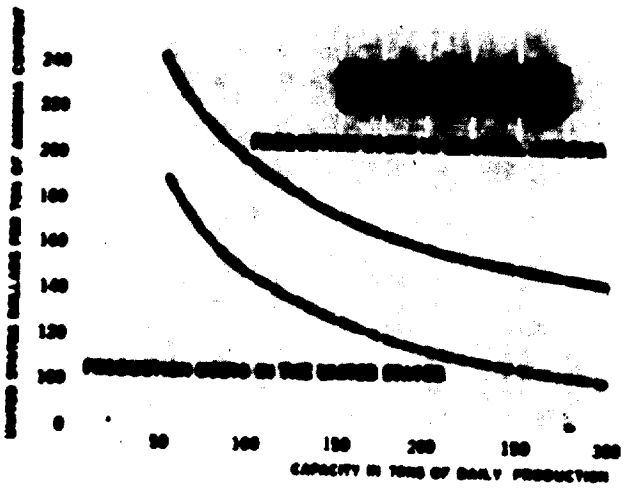
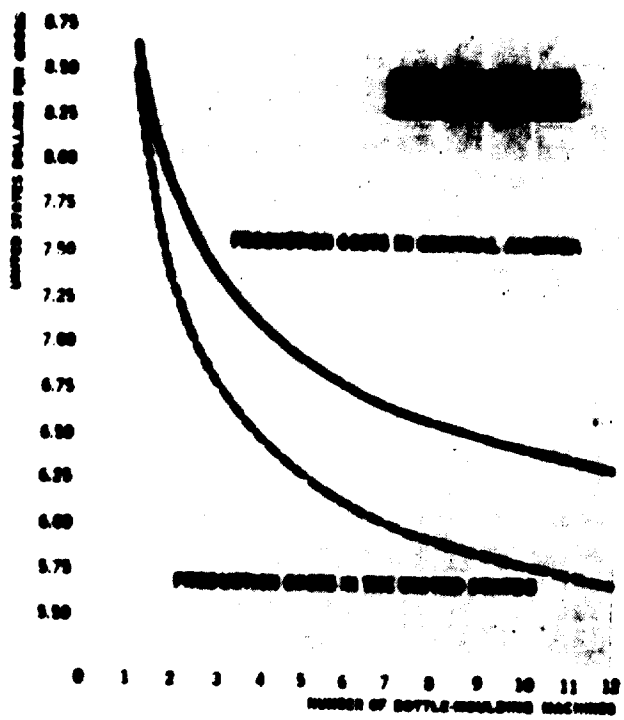


Chart 1B



Source: Tables 1, 2, 4 and 5.

DETERMINATION OF MINIMUM SIZE OF PLANT

General considerations

THE TWO EXAMPLES of cost functions presented above illustrate the fact that production costs would be relatively high in small production units and tend to be considerably lower for larger-sized plants. On the other hand, it may be reasonably assumed that the prices of imports —which are largely determined by prices in the main producer countries and transportation costs—will be substantially independent of their volume.[18] As mentioned earlier, the minimum size of plant for competitive domestic production is taken to be that at which domestic production costs equal import prices. The further question as to whether domestic production is economically justified will depend on the volume and other characteristics of the domestic market.

There may be compelling reasons for a country to embark on domestic production, in cases where the domestic market does not justify the establishment of a plant even of the minimum size, or even where such a minimum size, in the sense defined above, does not exist at all, that is, where the entire cost curve of domestic output lies above the import price. Such reasons may be

[18] A slightly lower price may result from large-scale purchasing contracts and further economies of scale in transportation. This could be taken into account without any major difficulty.

related to a policy of replacing imports with a view to making savings in foreign exchange, providing employment for labour, or other considerations.

Distribution costs will not materially affect the situation when they are substantially the same for both the domestically produced and imported product—for instance, if the contemplated plant is located near the main port of entry of the imported product. However, in many cases, imports may be distributed over several places of entry following the pattern of the main consuming centres, which may give them a competitive advantage over domestic production, particularly if it is concentrated in one plant, regardless of its location, and may raise the economic minimum correspondingly.

Moreover, the price of imports to be taken into account from the point of view of the private entrepreneur is the selling price of the competitive product on the home market, which includes import duties. In the appraisal of the economics of domestic production from the point of view of the national economy as a whole, the latter element will obviously have to be left out of account. Therefore, the "minimum" economic size will be of a different magnitude depending on whether it is considered from the point of view of the private entrepreneur or that of the national economy as a whole.

The following cases might arise in determining the minimum economic size of plant:

(*a*) Assuming that full capacity output is absorbed by the market, the domestic production cost in a plant of the smallest size technologically possible is lower than the competitive import price. In this case, local production will be economically feasible; capacity will depend on the size of the market.

(*b*) The entire cost curve is situated above the competitive import price. In this case, there is no capacity at which domestic production will be economically feasible on a competitive price basis.

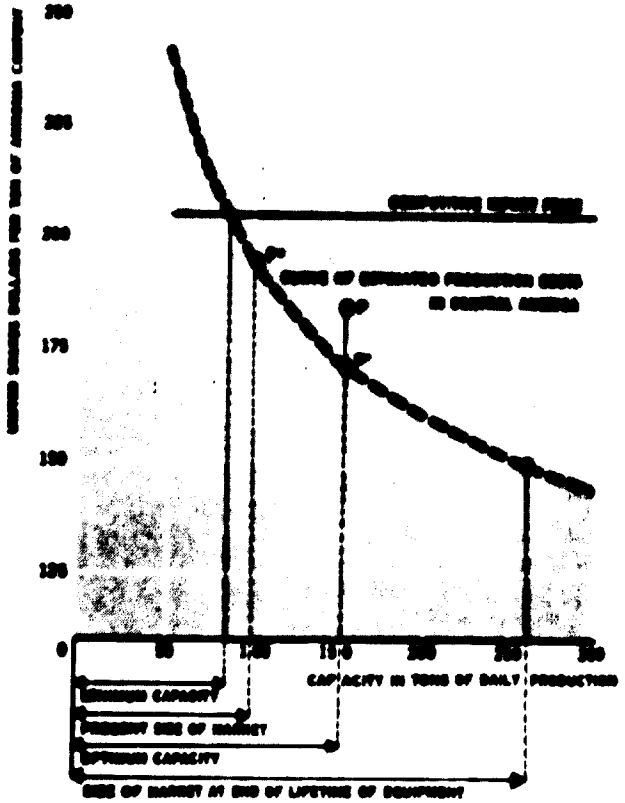
(*c*) The cost curve intersects the import price line. The intersection point will determine the minimum size of economic production.

In evaluating the market the import data of the country or region may be taken as a basis for early estimates. Some adjustments may be required. If imports are diversified in quality and design, a detailed estimate will have to be made of the part of total demand that could be satisfied by the range of the contemplated local production. A possible preference for imported products could be checked through restrictive measures; however, in considering such measures, the extent to which they might be harmful to the interests of special consumers should be ascertained. It would also be unrealistic to assume, without further investigation, that the national or regional market could always be served economically over its entire geographical range by local production, particularly if the establishment of a single productive unit is contemplated. The costs of inland transportation are usually high in under-developed countries. At the same time, in many cases—as, for instance, in the Central American area, because of its geographical configuration—the imported product can be economically delivered at a number of conveniently chosen ports of entry, which, for some local markets, may provide a decisive advantage to imports in regard to transportation costs. When this is the case, part of the market is economically inaccessible to the domestic producer. This means that for a reliable market survey the estimate of total potential demand will have to be supplemented by an investigation of the geographical distribution of the market.

On the other hand, certain factors may affect the prospective size of the market in the opposite direction. In the case of some products with a high demand price elasticity, a larger market could be anticipated if domestic manufactures could be sold at a lower price than imports. The experience of countries with comparable economic structure would furnish a base for elasticity estimates. In other cases, particularly with regard to some basic industries, the development of a source of domestic supply is in itself a powerful factor in promoting local demand. Finally, the possibility of exports might be envisaged. This source of demand should not be overestimated, however, in view of the fact that unless the exported product could benefit from preferential treatment in international trade, it would have to withstand competition in international trade from highly industrialized countries; these would generally be in a better position as regards costs and, possibly, also the quality of the product.

Chart 2

DETERMINATION OF MINIMUM SIZE OF PLANT AND OF RANGE OF OPTIMUM SIZE
(Ammonium Nitrate Industry)



Source: Table 4 and text.

Minimum plant size in the two industries reviewed

The foregoing considerations will now be applied, for purposes of illustration, to the two industries under review. Tables 4 and 5 show, for each of them, the production costs for plants of various sizes in Central America. Competitive import prices in this area will be estimated at US $210.00 per ton of ammonia equivalent for nitrogenous fertilizers and US $9.00 per gross of beer bottles.[19] It will be assumed that these prices will apply to any volume of imports and will remain constant throughout the lifetime of the plant; furthermore, that the distribution costs are the same for the domestically produced and imported products.

In chart 2 the cost curve for alternative plant capacities in the fertilizer industry intersects the import price line at a point which establishes the minimum economic size for that industry at a daily production capacity of eighty-five tons.[20] It will be noted that this point will move to the right either if production costs rise or the import price falls.

It will be assumed that the present fertilizer market in Central America could absorb 100 tons per day, under which circumstances economic production is feasible. The next step is to determine the optimum capacity to be installed, taking into account not only the present market but also its anticipated growth.

[19] These prices are slightly lower than those which prevailed in late 1957.

[20] In the case of beer bottles, the competitive import price (US $9.00 per gross) is higher than the production cost (US $8.66 per ton) in a plant with one moulding unit, the minimum capacity technologically possible. This would fall under category (*a*) above; that is, a plant of the smallest capacity could be operated on an economic cost basis.

SELECTION OF OPTIMUM SIZE OF PLANT UNDER CONDITIONS OF GROWING DEMAND

ONCE THE CONCLUSION has been reached that the establishment of a plant is economically feasible, the problem arises of selecting the optimum capacity of such a plant.

This problem has two aspects, one in space and one in time. The first relates to the evaluation of the existing market to be supplied by the plant; the second relates to the growth of the market in the course of time. The first is essentially a problem in plant location which can be dealt with adequately only if sufficient information is available on such factors as location of raw materials, availabilities of labour and power, geographical distribution of the consumption centres, transportation costs, and the like. It is not intended here to analyse this aspect, which requires a separate study based on information from the field.

Bagging urea for shipment in a California factory

For the present it is intended to deal only with the second aspect—whether and to what extent it might be profitable to select the capacity of the proposed plant at a level above the present requirements, in anticipation of the growth of the market. The problem of selecting optimum plant capacity resides in the fact that while a larger plant would operate below capacity in the initial period, once the market has grown to the size which warrants full capacity operation, the larger size would provide better economies of scale and permit operation at lower cost. If the selected size is not large enough, this would reduce the future benefits to be derived from economies of scale; if it is too large, the plant would operate at full capacity only towards the end of its lifetime, and the economies of scale would not be fully offset by the losses in operating costs due to idle capacity.

As stated above, if the life expectancy of the equipment and the rate of growth of the market are known in advance, it is possible to calculate the optimum capacity, which is such that total costs over the lifetime of the equipment are at a minimum. The optimum capacity will in all cases be intermediate between that corresponding to the market demand at the time when the plant is constructed and that corresponding to the prospective demand at that time when the equipment will have to be replaced. The problem of optimum capacity is of less importance in industries where progressive enlargement of the plant is possible as the market grows—assuming that adequate provision is made for expansion at the time when the factory is built—because of the "flatness" of the corresponding cost-size curve, or, to put it differently, because of constant returns to scale.

Table 6

OPTIMUM PERIOD AND OPTIMUM SIZE IN RELATION TO THE CAPITAL OUTLAY EXPONENT

(Rate of growth of market demand 10 per cent per year; lifetime of equipment ten years)

Value of capital outlay exponent[a]	OPTIMUM PERIOD OF ANTICIPATED MARKET GROWTH IN YEARS	INDEX OF OPTIMUM SIZE (present market demand 100)
0.2	8.4	225.9
0.4	6.8	199.4
0.6	4.5	158.5
0.8	2.2	123.3

[a] It might be useful to illustrate the relationship between various capital outlay exponents and the corresponding values of capital outlay and capital costs per unit of production, as follows:

Value of capital outlay exponent	0.2	0.4	0.6	0.8
Index of required capital outlay for a plant of double size (capital outlay for basic size=100)	115	132	152	174
Index of costs related to capital per unit of production in a plant double size (cost for plant of basic size=100)	58	66	76	87

As to the method of calculation, the optimum capacity will be determined by deriving first the so-called "optimum period"—the number of years of market growth from the beginning of the plant's operation—which corresponds to optimum capacity. Once this time period is known, the capacity itself is determined by using the curve of market growth.

Calculation of the optimum period

It can be assumed that distribution costs are not involved in calculating the optimum period, as these depend upon the geographical configuration of the country and location factors pertaining to the market. As to production costs, it was mentioned earlier that the requirements of raw materials and supplies are assumed to be independent of capacity; labour costs per unit of production tend to decrease with larger plant sizes, but, as their total share in costs is relatively small, their variation will be neglected for the purpose of this calculation. The only cost component that has to be taken into account therefore relates to capital. The optimum capacity has been defined as the one for which costs relating to capital will be at a minimum over the lifetime of the plant. The calculation of the corresponding optimum period is given in the appendix.

Chart 3 gives the curves of variation of the optimum period, in the sense defined above, for different rates of growth of demand as a function of the capital outlay exponent. The latter has been encountered earlier in connexion with the discussion of the variation of costs relating to capital investment as a function of capacity. It was mentioned that capital investment outlay generally varies proportionately to a certain fractional power of capacity. The capital outlay exponent is the numerical value of that power, which is designated in the mathematical calculation by m; it was also seen in the earlier discussion that unit costs relating to capital vary in inverse proportion to the $(1-m)^{th}$ power of capacity.[21]

The chart shows that the optimum period is longer for lower values of the capital outlay exponent, and vice versa.[22] Moreover, it indicates that the optimum period varies only slightly for different rates of growth of the market (the curves shift only slightly upward for higher rates of growth).

The data represented in chart 3 are shown in table 6.

Application to the case of the fertilizer industry

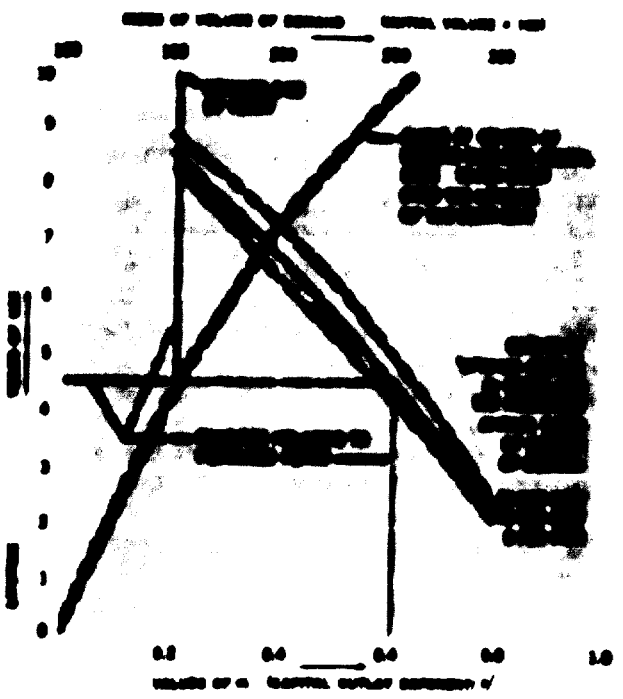
It was assumed earlier that the present market for fertilizers in Central America could absorb one hundred tons of ammonium nitrate per day. It will further be assumed that the market will grow at an annual rate of 10 per cent during the lifetime of the equipment, which is taken to be ten years. This means that at the expiration of the lifetime of the plant the market demand will have increased by some 160 per cent to slightly below

[21] See page 12.

[22] The logic of this result can be seen by considering the extreme cases. A capital outlay exponent close to one would mean that unit costs (at full capacity operation) would be practically independent of capacity; in other terms, there would be hardly any economies of scale. Thus, there would be no sense in building a plant of a larger size than the one warranted by the present market (this would only result in losses due to idle capacity in the initial years). Conversely, a capital outlay exponent close to zero would indicate a very strong effect of size upon unit cost (at full capacity); under the circumstances, the optimum capacity would come very close to the terminal size of the market.

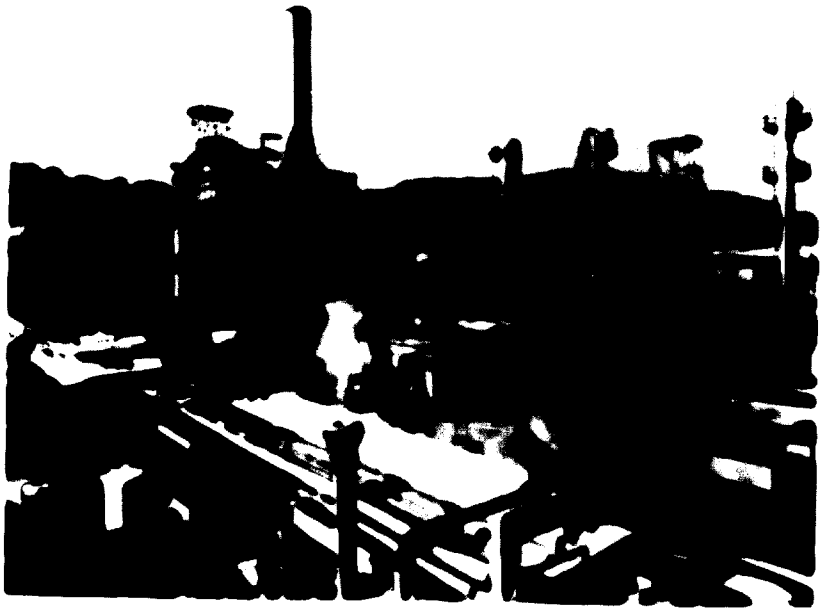
Chart 3

DETERMINATION OF OPTIMUM PLANT SIZE UNDER CONDITIONS OF GROWING DEMAND



[a] Total annual costs relating to capital are proportional to capital outlay and to nth power of capacity.

Note: For method of calculation, see appendix.



View of a large ammonia plant in California

200 tons per day. The capital outlay exponent was taken to be equal to 0.6.

Chart 3 gives for these data an optimum period of 4.5 years. The same chart indicates that, by the end of that period, market demand will have increased by 53.3 per cent to 153.5 tons per day, which represents the corresponding optimum capacity.

In chart 2, the production cost per ton corresponding to that capacity is shown to be US $172.00 per ton of ammonia content (point P' on chart). The latter figure corresponds, however, to full capacity operation, which will not be reached before 4.5 years, so that the average production cost over the entire lifetime will be correspondingly higher at US $194.30 per ton (point P on chart). It will be noted that this cost is still below that which would obtain for a plant of one hundred tons capacity (at full capacity utilization), that is, US $195.00 per ton (point P'' on chart). This illustrates the advantage, in the case of a growing market, of selecting a capacity larger than that corresponding to the initial market demand.

It will be observed that the problem of how the excess of market demand over the installed optimum capacity will be satisfied in the last part of the period has been left open. As one solution, the excess demand could be covered by imports until the expiration of the lifetime of the plant. A plant of a new optimum size could then be established, corresponding to the full market demand at that time, taking into account its further growth. An alternative, particularly in cases where there are strong reasons to avoid imports—which could be of substantial magnitude—would be to build, before the expiration of the lifetime of the first plant, a second one of a capacity corresponding to the "excess" demand only. This would reduce accordingly the market available to the successive plant at the time when the initial plant would have to be renewed; such a solution might result in freezing the cost of domestic production at an unfavourable level and might prevent the country from taking advantage of the considerable economies of scale which a plant of large capacity would provide. This problem is particularly acute in industries with a strong effect of size on costs. Taking into account these factors, it would be advisable, in certain circumstances, to select the capacity of the new plant above the optimum level, in the sense defined earlier.

CHANGE IN TECHNOLOGY AND EXTENSION OF LIFETIME OF EQUIPMENT

Change in technology

The calculations made in the section on cost structure in the two industries in Central America assume that technology in the area is the same as in the United States and, in particular, that the quantitative composition of the main production factors—labour and capital—in the process (the factor mix) remains the same.[23] This assumption of unchanged technology will now be relaxed. In a number of cases alternative technological processes are available which involve different relative amounts of capital and labour. Moreover, in almost any production process there is some flexibility in that respect.

In the economically advanced countries the factor mix in industrial processes is adjusted to the relative costs of capital and labour. It may be surmised that, in underdeveloped countries with a different factor cost ratio, a minimum cost factor mix will require a corresponding advancement of production processes.[24] In terms of the problem under consideration, a change in technology resulting in a relatively larger input of the less costly labour factor and a corresponding reduction of capital requirements will tend to lower the minimum capacity point.

In the United States, the annual costs corresponding to an investment of $100,000 in the two industries considered in this article were estimated as follows:

	Fertilizer industry	*Glass container industry*
	(Dollars)	
Depreciation	10,000	10,000
Maintenance, insurance, etc.	6,000	12,000
Remuneration of capital	12,000	12,000
Total	28,000	34,000

[23] Greater requirements of labour may be due, however, to lower labour productivity in the less-developed areas.

[24] Compare the articles, "Capital Intensity in Industry in Underdeveloped Countries", "Choice of Technology in Industrial Planning", and "Capital Intensity in Heavy Engineering Construction", in *Bulletin on Industrialization and Productivity*, No. 1.

The average annual wage of a worker—corresponding to 50 forty-hour weeks at an hourly rate of $2.50, including social security and other related payments—is $5,000. Thus, the annual cost of employment of one worker is equivalent to an annual cost of investment in equipment between $\frac{5,000}{20,000} \times \$100,000 = \$18,000$ and $\frac{5,000}{34,000} \times \$100,000 = \$15,000$. In other words, whenever it is possible to replace one worker by equipment—the annual cost of which is less than $18,000 (in the fertilizer industry) or $15,000 (in the glass container industry)—there is a net gain in production costs.

If this calculation is applied to Central America, using the cost data in table 5, the corresponding equivalents for the two industries are $\$18,000 \times \frac{0.40}{1.45} = \$5,000$ and $\$15,000 \times \frac{0.98}{4.46} = \$3,300$ respectively.

As an example of substitution of labour for equipment in the case of the glass container industry, various levels of mechanization are possible in a number of ancillary operations such as unloading, conveying and mixing raw materials and handling finished products. According to the fragmentary information obtained, it would appear that, especially in small factories, there are possibilities of saving on equipment by substituting labour at the rate of $10,000 of equipment to one worker. In the United States, such substitution would not be justified, since the employment of an additional worker adds as much to costs as the use of $15,000 worth of equipment. It would, however, be justified in Central America where the same additional employment is equivalent in terms of costs to the use of equipment worth only $3,300.

It might be mentioned in this connexion that the problem of the most economic utilization of capital resources in under-developed countries could be approached in a more basic way through redesign of the processes and equipment so as to adapt them to the endowments in resources of these areas (such as availability of capital and skilled labour).

The trend in the design of standard industrial equipment has been influenced in the advanced countries by the secular increase in capacity in the majority of their industries and in the demand for labour saving processes and equipment. Research in development of equipment which would offer equally high performance for small-capacity operation and for a relatively greater use of labour has been generally neglected. It might be expected, however, that systematic research in that direction through co-operation of research institutes and producers of equipment in both the economically advanced and the under-developed countries would be of substantial benefit to the latter, particularly to those at the earlier stages of industrial development. A related area of research is the development of basic multi-purpose equipment which can be applied in process-based industries; this, again, would require a reorientation of the present trend in design research, which aims at more and more specialized equipment.

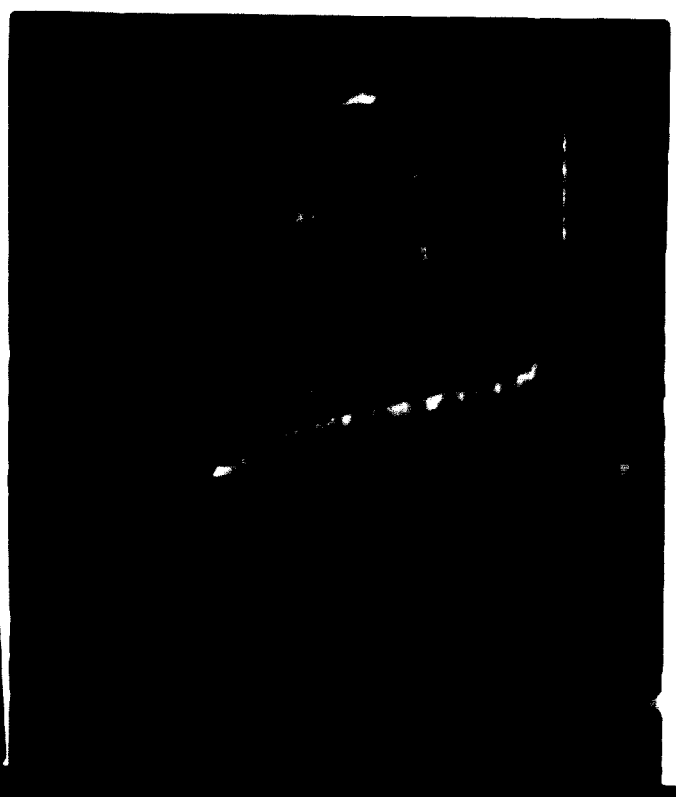
View of an ammonia plant in Canada

More intensive maintenance and repair

The lifetime of a given piece of equipment is not necessarily a fixed magnitude but can be made to vary within certain limits. Extension of the lifetime of equipment would cause annual charges for interest and depreciation to decrease; at the same time, it would be likely to result in progressively higher costs of maintenance and repair as the equipment grew older. Taking into account the variation in opposite directions of these components, there is some optimum value of lifetime which, as a first approximation, corresponds to a minimum *total* cost over the years of use.[23]

The components of interest and depreciation are, other things being equal, proportional to the cost of the equipment, which is normally higher in under-developed countries; moreover, the level of interest rates is generally

[23] A more elaborate calculation would have to take into account also such factors as obsolescence and production losses as a consequence of more frequent break-downs.



Ammonia plant at Porto Empedocle, Sicily

Table 7

COMPARATIVE COST DATA ON DEPRECIATION AND MAINTENANCE FOR A NITROGENOUS FERTILIZER PLANT WITH AN ALTERNATIVE LIFETIME OF TEN OR FIFTEEN YEARS

(Thousands of US dollars per one million dollars of investment in the United States)

ITEM	UNITED STATES		CENTRAL AMERICA			
			Same techniques in maintenance and repairs as in the United States		*Greater relative use of labour in maintenance and repairs*	
	Ten years	*Fifteen years*	*Ten years*	*Fifteen years*	*Ten years*	*Fifteen years*
	(1)	(2)	(3)	(4)	(5)	(6)
Depreciation	100	67	135	90	135	90
Maintenance and repairs:	40[a]	80	35	70	29	58
Labour	20[b]	40	8	16	14.5	29
Spare parts	20[b]	40	27	54	14.5	29
TOTAL	140	147	170	160	164	148

[a] See table 1.

[b] According to the current practice in the United States, the costs of maintenance and repairs are divided about equally between labour and spare parts.

above that prevailing in industrial countries. On the other hand, maintenance and repairs are made up to a very large extent of labour, which is generally available at a lower cost in the former countries. On balance, these factors appear to favour a policy of extending the lifetime of the fixed capital.

Such a policy is justified of course only if the equipment whose life is being extended is not likely to become technically unusable because of obsolescence. It is a common industrial practice—when a new technical process is developed, or when an old process is improved, or when there is a change in taste which calls for a radically different design of the product—to replace the equipment installed even before it is physically worn out. It is true that in the highly industrialized countries, an important factor in obsolescence is the increase in wage rates, which constitutes an incentive to introduce more economic equipment and processes with lower labour content. The pressure of obsolescence due to this factor, however, is less likely to be felt in under-developed countries.[26]

A comprehensive discussion of the problem of practical evaluation of the optimum lifetime of equipment would deserve in itself a special study. At this point only a few remarks will be made concerning the factors involved.

The optimum lifetime is basically determined by (*i*) the required physical volume of maintenance and repairs and its variation with the age of the equipment and (*ii*) the cost of maintenance in relation to the cost of the equipment. The first of these elements generally varies from industry to industry but is materially the same for both developed and under-developed countries. The second element, on the other hand, may differ substantially from country to country, according to the relative prices of labour and capital, and it is this difference that would warrant an extension of the lifetime of industrial equipment in under-developed countries through a greater input of labour-intensive maintenance and repair. Further possibilities to be considered in this connexion are substituting labour for spare parts in maintenance and repairs and the domestic production of spare parts to replace imports, which would further increase the labour content of the capital in use and reduce costs accordingly. Apart from these advantages and related savings in foreign exchange, this would provide under-developed countries with a training ground for the development of mechanical skills in which these countries are generally deficient and might create, in some cases, the nucleus of a domestic machine-building industry.

To give an example, the extension of the lifetime of plant from ten to fifteen years will be considered in the case of the fertilizer industry.[27] It will be assumed that such an extension could be achieved by a larger volume of maintenance and repairs, so that the average yearly costs on that account would be doubled. For an investment of US $1,000,000, the annual costs of depreciation and maintenance in the United States, based on industrial practice in that country, assuming a normal lifetime of ten years, are shown in column (1) of table 7. Extension of the lifetime to fifteen years would result in higher costs, as shown in column (2) of the table. Such an extension would not be economical under the cost conditions prevailing in the United States.

[26] Under certain circumstances, it may be advantageous for under-developed countries to acquire equipment which, although capable of producing goods of satisfactory quality, is in the process of being replaced in the industrial countries by equipment which permits greater economy in the use of manpower, or is being abandoned because of a radical change in the type of product demanded by consumers. Such equipment could generally be obtained on advantageous terms. However, other factors may be involved in industrial obsolescence, so that the problem of use of obsolete equipment by under-developed countries should be approached with careful discrimination.

[27] The period of fifteen years was chosen arbitrarily for purposes of illustration. Whether it actually represents the optimum lifetime would be determined by the procedure indicated earlier.

For the Central American area, the costs of imported equipment (including spare parts) and of labour were estimated earlier at 135 per cent and 40 per cent, respectively, of the corresponding costs in the United States. Conversion of the figures in columns (1) and (2), using these coefficients, is made in columns (3) and (4). The figures show that in Central America extension of the lifetime would result—assuming that the same techniques of maintenance are used—in savings of the order of 6 per cent of the total, and would thus be justified.

It was indicated earlier that it would generally be to the advantage of under-developed countries to carry out maintenance and repairs with a relatively greater input of labour than of spare parts. It is assumed that such a substitution is possible and that labour input may be increased in the same ratio in which the use of spare parts is reduced. The data are recalculated accordingly in columns (5) and (6) of table 7. The figures show that a saving of 17 per cent could be obtained on maintenance and repair costs by the use of more labour-intensive techniques; through extension of the lifetime to fifteen years, the saving in total costs could reach 10 per cent. Under these conditions, extension of the lifetime from ten to fifteen years would be even more advantageous.

A systematic approach to the study of the problems described above would require the collection and analysis of a mass of data—based upon industrial practice—relating to the physical requirements of maintenance and repair as a function of the age of equipment in various industries, including requirements in man-hours of labour and in spare parts, possibilities of changing the ratio between the two, and pertinent cost data. Such a task is admittedly of a vast scope and, in order to be carried out effectively, would require a concerted effort on the part of government or private technical research organizations, academic institutions and industry associations, both in developed and under-developed countries. It is believed, however, that the importance of the problem is of a sufficient magnitude to justify the input of the necessary resources.

CONCLUSIONS

In this study an attempt was made to synthesize the point of view of engineers, whose role is to analyse the technical and cost problems of industry and to design production facilities, and that of economists and administrators, whose functions are to elaborate programmes and evaluate industrial projects from a more general economic standpoint and devise appropriate economic policies and measures.

On the basis of technological data relating to two particular industries in the operational conditions generally obtaining in developed countries, it was sought to bring out some of the economic problems involved in the establishment of these industries in an under-industrialized area and to see to what extent the method employed could be generalized with respect to other industries.

Although the data used are only indicative of orders of magnitude and the conclusions reached only tentative, it would seem that the method of approach suggested in this article could be used to study similar problems arising in other areas. Estimates of investment outlays and costs and comparison with the prices at which the products could be imported and with the scale of the market to be served can offer useful guidance both to industrialists and the public authorities in assessing the possibility and the scale of investment in a given industry.

This suggests that it might be of considerable practical value to undertake systematic case studies of this kind in a certain number of other industries, selected either because they are especially important to the development of the less developed areas or because they correspond to the particular needs of given regions. Such studies would certainly show that some industries—especially those which could make more intensive use of the relatively cheap labour resources—could be established in comparatively favourable conditions and would deserve special attention. Thus, it would appear, on the basis of the present study, that a glass container industry in Central America would be in a good position in this respect.

In this context it would be useful—although the work involved would be considerable—if research centres at universities or technological institutes made an effort to assemble a systematic and coherent documentation on the cost structure in an industrial country, for instance the United States, of a large number of industrial products and on the variation of costs in relation to, for example, the size of the producing plant, taking into account all the factors which influence that relation. It would then be possible to determine, if only approximately, the minimum size of plant in which the manufacture of such products could be envisaged at given levels of costs of raw materials, wages and equipment. The provisional data given in this article would seem to show that in under-developed areas the minimum size may often be less than the average size of plants in the older industrialized countries.

Moreover, it might be of considerable importance for the possibilities of industrial development in under-industrialized areas if producers of the equipment currently demanded in those areas would orientate their research towards designing types of equipment for optimum performance at capacities lower than are normal in the highly developed countries. By thus reducing the minimum size at which industries could be economically established and operated under conditions of generally limited domestic markets, the process of industrialization in its earlier stages would be greatly facilitated.

The same set of data referred to above would also provide a systematic basis for the evaluation of the optimum size of plant to be established, taking into account the given market characteristics as regards size, geo-

graphical distribution and anticipated growth. This article attempted to outline a method which might be used for such evaluation.

The need to maximize employment opportunities and to use the available capital as sparingly as possible is frequently a major preoccupation of the governments engaged in planning or programming economic development. This implies that consideration should be given to adapting the relative use of labour and capital in industry to the endowment in these factors. An attempt was made in this study to show that a lower level of mechanization than is customary in the industrial countries, besides generally corresponding to considerations of national economic policy, would permit a reduction of costs and thus commend itself also to the point of view of the private entrepreneur. The problem of the size of industrial plant is thus related to that of capital intensity inasmuch as it involves consideration of the possible advantages of replacing some equipment by manpower—that is, of substituting technological processes of a lower level of mechanization for more capital-intensive ones. It was noted that some ancillary stages in the production process (for instance, handling of materials) permit such substitution without in any way affecting the efficiency of the process or the quality of the product. Much more important possibilities of substitution may emerge from appropriate studies of the basic production processes themselves. If carried out by producers of equipment, this would require a certain reorientation of their present research in design; in fact, in many cases it would run contrary to the present tendency in design research, which aims largely at economy in the use of labour. It was mentioned that the research might be carried out advantageously by public and private technological research institutes, both in the developed and under-developed countries.

Similarly, it was mentioned that the life expectancy of equipment may be varied within fairly broad limits. Longer life means increased maintenance and repairs, and as these are relatively labour-consuming activities, it was suggested that in under-developed countries it would be economically desirable to prolong the life of equipment beyond the stage considered normal in the industrial countries. An extension of the lifetime of equipment through greater maintenance and repairs could lead to considerable savings in capital and affect accordingly the relative shares of capital and labour inputs in favour of the latter factor. It appears advisable, also in this area, to undertake an investigation of a wide scope covering the real cost of maintenance and repairs in relation to the age of the equipment, including the frequency and duration of break-downs for different industries, and the further possibilities of substituting labour for use of spare parts in repair and maintenance.

APPENDIX

Determination of optimum plant size under conditions of growing demand

As discussed in the preceding pages, the optimum plant size is considered to be the size for which average unit costs relating to capital taken over the lifetime of the equipment are at a minimum. These average unit costs are given by a quotient of which the numerator is equal to total capital costs C and the denominator to total output P over the lifetime of the equipment. The minimum condition is thus:

$$\frac{C}{P} = \text{minimum} \qquad (1)$$

Let: N be the lifetime of the equipment in years, and
n the period corresponding to optimum size which was designated earlier as "optimum" period.

Let further:

$$d_i = d_o f(i) \qquad (i = 1, 2, 3 \ldots.) \qquad (2)$$

be the function which expresses the prospective demand after i years in relation to initial (or present) demand d_o.

The value of C will be proportional to the investment outlay at capacity d_n corresponding to optimum period n, or:

$$C = k\,\{d_o\, f(n)\}^{\alpha} \qquad (3)$$

α being the capital outlay exponent, as defined earlier, and k a constant.

The value of P is the cumulative output over N years, assuming that annual outputs in the first n years will grow with market demand until full (optimum) capacity is reached, after which output remains unchanged at the latter level. Thus:

$$P = d_o\{0.5 + f(1) + f(2) + \text{---} + f(n-1) + (N-n+0.5)f(n)\} = d_o A \qquad (4)^1$$

where A is the value of the expression between the brackets.

Substitution of (3) and (4) in (1) gives:

$$\frac{C}{P} = \frac{k\{d_o f(n)\}^{\alpha}}{d_o A} \qquad (5)$$

The minimum of the quotient $\frac{C}{P}$ can be determined by calculating the minimum of the right-hand part of expression (5) which is a function in n. The value of n corresponding to that minimum is the "optimum period".

K, d_o and α being constants, the minimum of:

$$\frac{k\{d_o f(n)\}^{\alpha}}{d_o A}$$

corresponds to the minimum of:

$$\frac{\{f(n)\}^{\alpha}}{A}$$

The minimum of $\frac{\{f(n)\}^{\alpha}}{A}$ will be determined in the two particular cases below:

1. The growth of demand is at a compound annual rate r. If one takes $R = 1+r$,

$$\{f(n)\}^{\alpha} = R^{n\alpha} \qquad (6)$$

and

$$A = 0.5 + R + R^2 + \text{---} + R^{n-1} + (N-n+0.5)R^n =$$

$$= 0.5\,\frac{R+1}{R-1}\,(R^n - 1) + (N-n)\,R^n \qquad (7)$$

[1] The value of f (i) relates to the end of the i^{th} year which is considered as the midpoint of the period: (i−0.5) to (i+0.5).

THIS ARTICLE AND *the excerpt from a United Nations report which follows it treat two important sets of problems affecting the development of small industries in Japan.*

The article by Mr. Ando deals with the small industry sector in relation to large enterprises in Japan, particularly with a subcontracting relationship—peculiar to Japan—which has evolved between an important segment of the small industry sector and large concerns and which constitutes a form of integration of the operations of the two groups of enterprises.

Mr. Ando mentions that the Japanese experience has aroused some interest in South East Asia and suggests that its study might be of benefit to other under-developed areas. In this connexion, it has been thought useful to reproduce, following Mr. Ando's article, the conclusions and recommendations of a group of experts based on a recent survey of cottage and small-scale industries in Japan. These recommendations, which were prepared for consideration by Governments of countries in Asia and the Far East, relate to the organization and operation of such industries. It will be found that the topics dealt with in Mr. Ando's article and in the experts' report are in many respects complementary.

Interrelations Between Large and Small Industrial Enterprises in Japan

BY TOYOROKU ANDO

MR. ANDO, *President, Onoda Cement Company, Tokyo, is a Japanese industrialist who participated in the meeting of the Panel of Experts in Industrial Management in Under-developed Countries held at United Nations Headquarters in the autumn of 1957. His article is a revised version of a paper which he submitted to the Panel.*

Workers assembling dials in a watch and clock factory in Japan

The minimum of the quotient $\frac{R^{n\alpha}}{A}$ will correspond to the value of n for which:

$$\frac{d}{dn}\frac{R^{n\alpha}}{A}=\frac{d}{dn}\frac{R^{n\alpha}}{0.5\frac{R+1}{R-1}(R^n-1)+(N-n)R^n}=0 \qquad (8)$$

or:

$$\frac{1}{R^n}=\frac{2}{\alpha}\cdot\frac{R-1}{R+1}\left(\frac{1}{\log_e R}-(1-\alpha)(N-n)\right)-\frac{1-\alpha}{\alpha} \qquad (9)$$

It can be proved[2] that for moderate growth rates – for which the value of R will not greatly exceed 1 – the value of

$$\frac{R-1}{R+1}\cdot\frac{1}{\log_e R}$$

is close to $\frac{1}{2}$. Equation (9) thus becomes:

$$\frac{1}{R^n}=1-2\cdot\frac{1-\alpha}{\alpha}\cdot\frac{R-1}{R+1}(N-n) \qquad (10)$$

[2] Indeed: $\frac{R-1}{R+1}\cdot\frac{1}{\log_e R}=\frac{1}{\log_e R^{\frac{R+1}{R-1}}}$

Let: $R=1+\frac{1}{m}$; then: $\log_e R^{\frac{R+1}{R-1}}=\log_e\left(1+\frac{1}{m}\right)^{2m+1}$

For values of R close to 1, m will be large, and therefore:

$$\log_e\left(1+\frac{1}{m}\right)^{2m+1}\leqq\log_e\left(1+\frac{1}{m}\right)^{2m}\leqq\log_e e^2\leqq 2$$

(Actually, $\left(1+\frac{1}{m}\right)^{2m+1}$ converges much faster to e^2 with increasing values of m than $(1+m)^m$ to e. Consequently the value of $\frac{R-1}{R+1}\cdot\frac{1}{\log_e R}$ is 0.4986 for $R=1.2$, 0.4997 for $R=1.1$, and 0.4999 for $R=1.05$).

If this formula is applied in the case of the nitrogenous fertilizer industry, and assuming that $\alpha=0.6$, $N=10$ and $r=0.1$ ($R=1.1$) equation (10) becomes:

$$\frac{1}{1.1^n}=1-0.0635\ (N-n) \qquad (11)$$

This equation can be solved graphically; the value of n corresponds to the intersection point of the curve $\frac{1}{1.1^n}$ with the straight line $1-0.0635\ (N-n)$. The solution gives an optimum period $n=4.5$.

2. The growth of demand is a linear function, the annual increase being λd_o so that:

$$d_i=d_o+\lambda d_o i=d_o(1+\lambda i)$$

in this case:

$$\{f(n)\}^\alpha=(1+\lambda n)^\alpha$$

and $A=0.5+(1+\lambda)+(1+2\lambda)+\text{- - - - -}+\{1+(n-1)\lambda\}+$

$$+(N-n+0.5)(1+\lambda n)=N(1+\lambda n)-\frac{\lambda n^2}{2} \qquad (12)$$

The minimum of the quotient $\frac{(1+\lambda n)^\alpha}{A}$ corresponds to the value of n such that:

$$\frac{d}{dn}\frac{(1+\lambda n)^\alpha}{A}=\frac{d}{dn}\frac{(1+\lambda n)^\alpha}{N(1+\lambda n)-\frac{\lambda n^2}{2}}=0 \qquad (13)$$

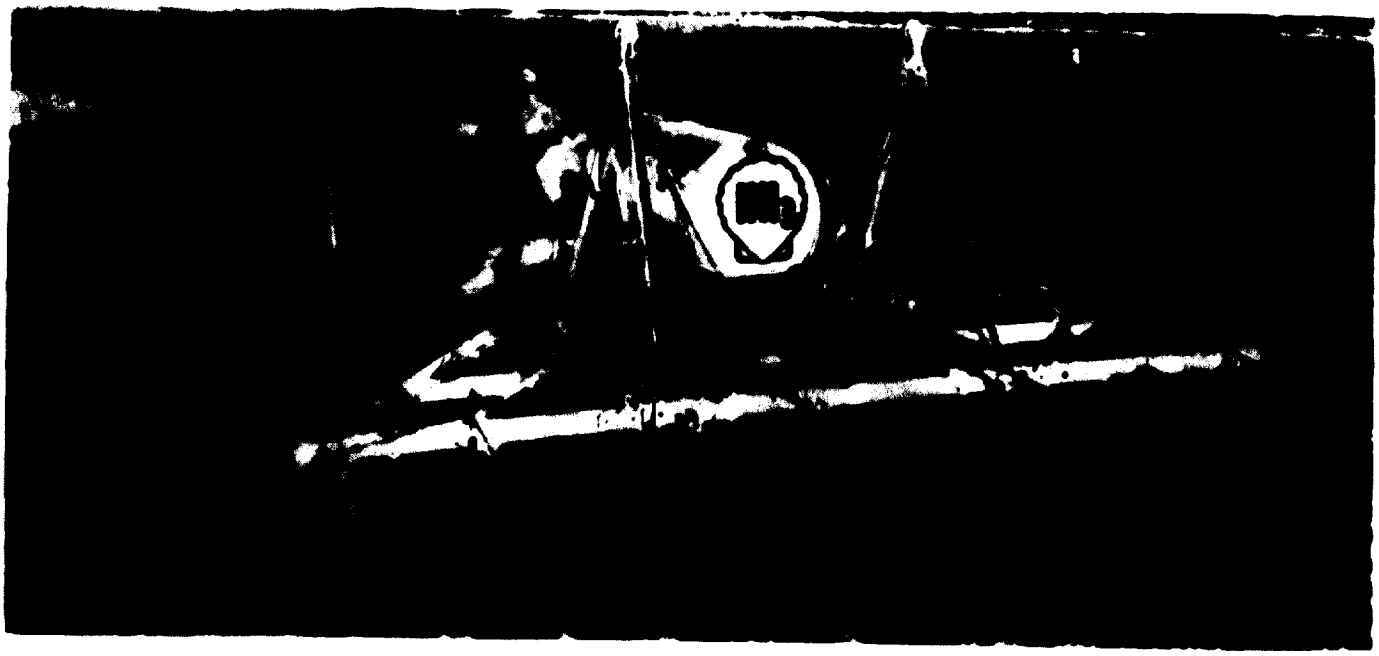
or:

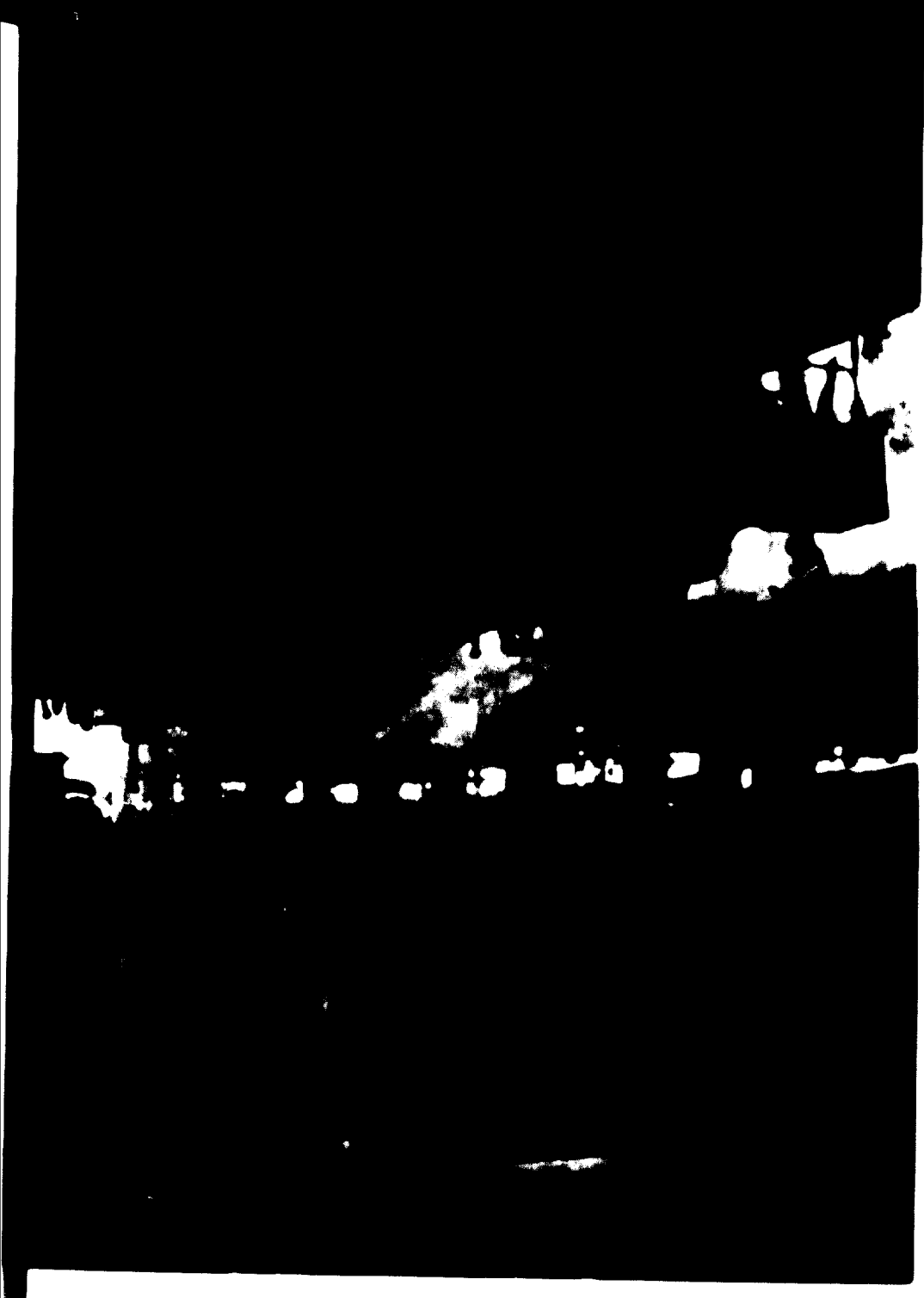
$$(1-0.5\alpha)\lambda n^2+\{1-(1-\alpha)\lambda N\}n-(1-\alpha)N=0 \qquad (14)$$

If this formula is applied in the case of the nitrogenous fertilizer industry, and assuming $\alpha=0.6$, $N=10$ and $\lambda=0.1$, equation (14) becomes:

$$0.07n^2+0.6n-4=0$$

which gives $n=4.4$ years.





Steam locomotive body being lowered onto wheel carriage in a factory in Japan

SINCE THE BEGINNING of the Japanese industrial revolution—almost a hundred years ago—small industries have played a major role in the structure and development of Japan's economy. Under Japanese law, those enterprises are classified as small and medium-sized which employ less than 300 persons (less than 1,000 in mining and less than thirty in commerce) and which have a capital of less than 10 million yen. They amounted, in 1954, to 99.9 per cent of all enterprises in non-agricultural activities (those employing less than thirty persons accounted for 98 per cent, and those employing four persons or less, 80.2 per cent), employed 84 per cent of the workers, and contributed 54 per cent to the net product of that sector and 50 to 60 per cent to the total export trade. In manufacturing alone, small and medium-sized enterprises accounted for 99.7 per cent of the number of establishments (those with less than thirty persons, 94.6 per cent and those with four persons or less, 59 per cent), 73.5 per cent of the number of workers and 52 per cent of the value added in that sector (see table 1).

The exceptional position of small-scale industry in Japan is explained by the widely available external economies, principally in the form of cheap electric power and a good transport network, extending to remote rural areas throughout the country. Many small industries are located in rural areas and dispose of abundant labour working long hours at low wages as well as of part-time manpower. Domestic demand is highly diversified; foreign demand, more than one-half of which originates in less developed countries, is chiefly for low-priced consumer goods. As will be seen later, a system of division of labour between large and small

Table 1

NUMBER OF ENTERPRISES AND WORKERS BY ACTIVITY AND SCALE, 1954

Activity	Percentage of enterprises employing					Total number of enterprises
	4 or less	5-29	30-99	100-299	Over 300	
Manufacturing	59.0	35.6	4.2	0.9	0.3	527,846
Mining	44.4	37.4	10.6	4.1	3.5	8,329
Construction	80.2	16.1	2.9	1.2	0.2	185,790
Transport, communications and other public utilities	73.6	19.7	4.6	1.5	0.6	62,082
Wholesaling and retailing	87.2	12.3	0.4	0.1	—	1,604,504
Banking and insurance	52.1	40.1	7.0	0.6	0.2	57,398
Real estate	89.6	9.5	0.8	0.1	—	16,219
Services and professions	82.7	15.7	1.5	0.1	—	822,442
All non-agricultural activities	80.2	17.8	1.6	0.3	0.1	3,284,610
	Percentage of workers					*Total number of workers*
Manufacturing	11.8	32.1	17.6	12.0	26.5	6,155,722
Mining	1.7	7.6	9.7	12.2	68.4	473,303
Construction	19.7	28.4	22.6	14.2	9.6	1,180,648
Transport, communications and other public utilities	7.7	13.7	14.9	9.7	47.7	1,010,574
Wholesaling and retailing	54.9	35.0	6.0	2.1	1.9	4,920,974
Banking and insurance	9.2	43.6	28.4	8.5	10.3	657,966
Real estate	46.1	31.2	11.9	4.9	5.1	46,274
Services and professions	37.9	39.1	17.2	2.7	2.0	3,173,018
All non-agricultural activities	28.6	32.7	14.7	7.9	16.1	17,618,479

Source: Prime Minister's Office, Bureau of Statistics, *Census of Establishments*, 1954.

enterprises is well established. Under the circumstances, a great many very small, highly specialized concerns find room in the Japanese industrial set-up.

These enterprises offer employment opportunities to a large part of the steadily growing population. The number of persons employed by them, together with the dependents of this group, today approximates 28,000,000 —about one-third of the total population.

Part of Japanese small industry is entirely self-supporting and independent of big business. Certain enterprises in this category have an independent field of activity; others coexist with large industries in the same fields and compete with them. The other part, which is the more important, has interdependent relations with large undertakings. In the prevailing form of this relationship, small enterprises act as subcontractors to large-scale enterprises, for which they manufacture a great variety of parts and components. The relationship is complementary and works to mutual advantage; however, the degree of dependence is clearly much larger, and the extent of advantage much less for the small enterprises than for the large ones. At its limit, the relationship for many small enterprises is one of complete subordination to or affiliation with the large companies.

Government action has been taken over a long period to regulate on the one hand the "horizontal" relationships, that is, those within the small industry sector and the large industry sector, and, on the other hand, the "vertical" relationships between the two sectors. It has so far concentrated on the first type, with the aim of strengthening the small industry sector and, to a lesser extent, of preventing monopolistic action on the part of large undertakings. A few measures have also been taken to regulate the contractual arrangements between the two sectors. The economic and social aspects inherent in both types of relationships have given rise to considerable discussion reflecting the concern with this problem on the part of both government authorities and the general public. A number of recent developments bearing on the situation are reviewed in the following pages.

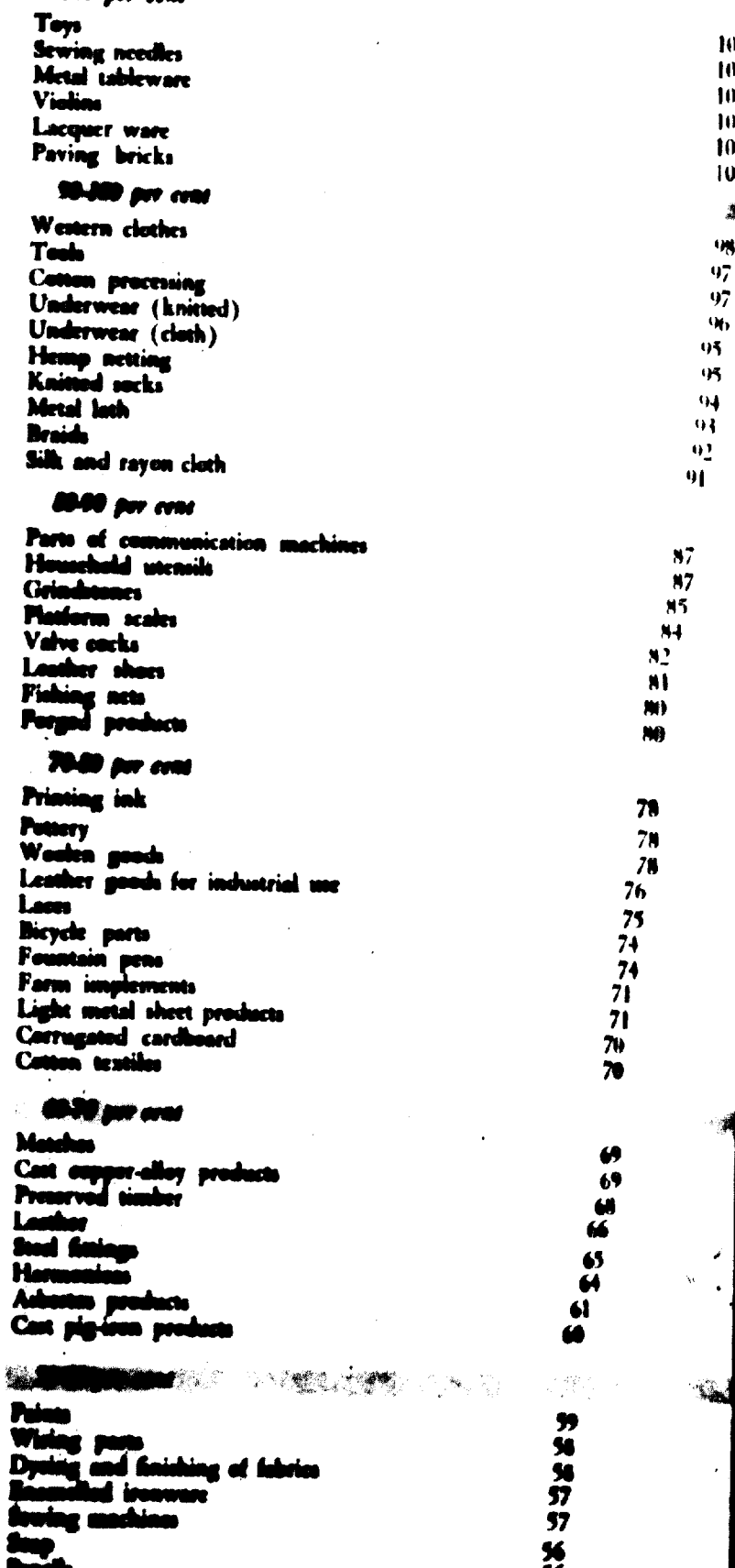
COEXISTENCE AND COMPETITION

Scale of production and spheres of activity

In the advanced countries of Europe and America, small industrial enterprises owe their economic survival to specialization in the manufacturing of goods not suited to mass production. In Japan, the unique process of social and economic transformation which took place in the past century in the form of an exceptionally rapid rate of economic growth and a sharp increase in population has enabled many enterprises, large and small, to mushroom side by side in various branches of industry (see chart 1). Thus, small and large establishments coexist in such industries as weaving, knitting, manufacturing motors and motorcycles, and canning food, which lend themselves to small-scale as well as to mass production methods. Large-scale enterprises predominate in the manufacturing of iron and steel and other metals, automobiles, cement, wood pulp, caustic soda, chemical fibres, cotton yarn, beer and sugar, the demand for which is generally large, stable and uniform; however, parts and components for some of these products are manu-

Chart 1

SHARE OF SMALL ENTERPRISES IN TOTAL PRODUCTION, BY INDUSTRY, 1954 [a] (Percentage)



Source: Ministry of International Trade and Industry, *Vital Statistics of Production*, 1955.

[a] Based on United Nations, *International Standard Industrial Classification of all Economic Activities*, Statistical Papers, Series M, No. 4. Handicraft excluded.

factured by small producers. Small-scale enterprises have practically to themselves the production of such goods as clothing, leather goods, cutlery, toys, wire products, and nuts and bolts. This type of production either caters to particular tastes or fashion or requires a variety of skills and techniques; it involves relatively little mechanization and supplies relatively small markets.

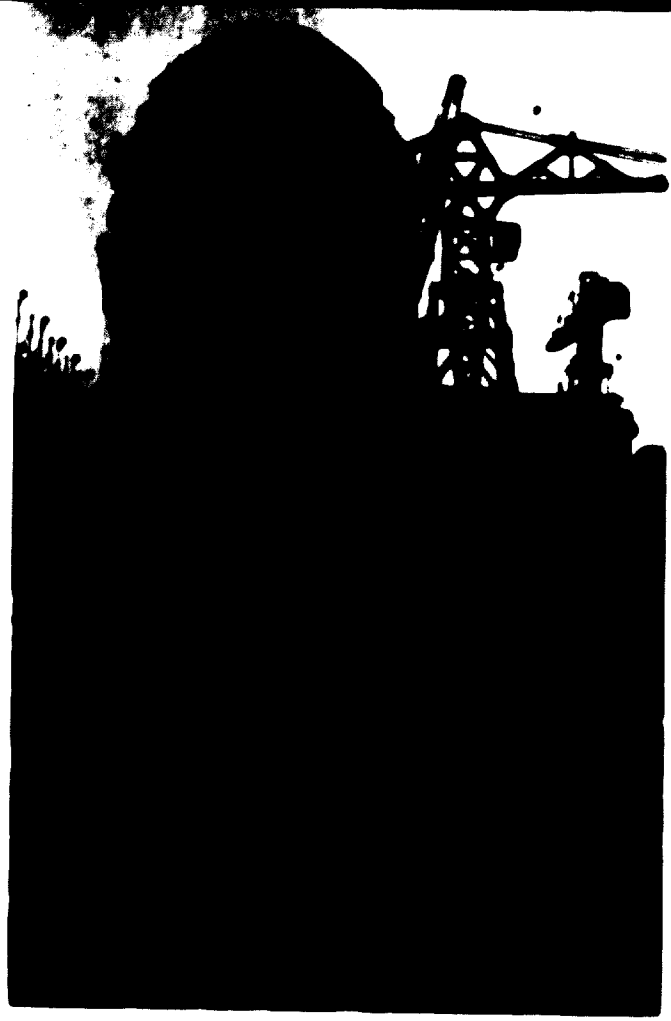
The availability of external economies, the scale of operation and the supply of variously skilled labour, however, are not the only factors making for the survival and development of small enterprises in Japan. Other features of management, production methods, marketing and financing that are peculiar to Japan's economic life have also helped to sustain them. These features are due, to a large extent, to the existence of a system of industrial organization shaped with the help and guidance of the Government.

Organization of the small industry sector

Between 1948 and 1952, the Japanese Government enacted several laws to set up special machinery, procedures and regulations to assist small-scale industries.

The pivotal organization of this machinery is the Smaller Enterprise Agency, established in 1948 as a specialized bureau of the Ministry of International Trade and Industry.

The agency has extensive powers and covers the entire field of assistance to small business. It determines basic policies for fostering and developing smaller enterprises. In particular, it encourages incorporation of small industries in co-operative associations and administers and enforces the Smaller Enterprise Co-operative Law enacted in 1948 to regulate this type of association. Co-operative organization—which has a long history in Japan—is a major element of strength in the small industry sector. Co-operative associations provide their members with common facilities for procurement, production, processing, marketing and shipping. Some also secure loans and procure and equip joint production units. In some of these associations, members retain their identity as entrepreneurs; in others they are absorbed by the association, which itself assumes entrepreneurial functions and responsibilities. Government subsidies are made available to co-operative associations. Some 35,000 of these operate at present under the Smaller Enterprise Co-operative Law. The co-operative structure is further strengthened by federations of co-operative associations.



Ship nearing completion in a shipyard in Japan

The Smaller Enterprise Agency also administers the Smaller Enterprise Stabilization Law of 1952, which provides for the association of manufacturing enterprises in industry sectors suffering from excessive competition. Under this law, enterprises are empowered to form cartels which, under the supervision of the Minister of International Trade and Industry, are given the right to regulate investment, output, deliveries and prices, with a view to improving market conditions. Under certain circumstances, measures taken under this law may apply to firms outside the cartels. Some 300 such associations, in thirty-four industrial branches, now exist.

Among other functions of the agency is the collection, analysis and dissemination of information of interest to small industry. About 650 information bureaux operate throughout the country, 300 of which receive government subsidies to cover part of their expenses. Technical and managerial guidance is provided free of charge on production, accounting, legal, tax and labour questions. The agency organizes lectures, publishes pamphlets, holds exhibitions, and carries on similar activities.

Upon request, it also extends technical assistance. The commerce and industry bureaux established in the five major cities and in the forty-six prefectures provide consultants to conduct surveys, make industrial diagnoses, recommend remedial measures and generally help solve the many problems facing small enterprises. Consultations are free of charge, some of the cost being met by the central Government.

Finally, the Smaller Enterprise Agency is active in the field of financing. It assists small enterprises to secure funds from private banks and public financing institutions set up especially for extending credit to them. In this connexion, it helps to administer the Smaller Enterprise Credit Insurance Law. This law was enacted in 1950 (and amended in 1951 and 1953) with the aim of facilitating grants of loans by commercial banks to small enterprises and co-operatives, a notoriously difficult and vexing matter in view of the generally poor credit standing of such establishments. Under the law, the Government insures up to 80 per cent of the amount of the loans granted to eligible individuals and entities. The agency is also involved in the operations of the credit guaranteeing associations which were established in the five major municipalities and the prefectures to guarantee loans to enterprises unable to offer qualified guarantors or adequate collateral; up to 60 per cent of such loans are insured by the Government. Its activities are also linked with those of a number of special banking institutions, such as the Central Bank for Commercial and Industrial Co-operatives, the National Finance Corporation, credit co-operatives and credit corporations established under the Smaller Enterprise Co-operative Law, mutual banks and mutual loan companies. It supervises operations of the Small Enterprise Financing Bank, which extends loans for the modernization of equipment, some in the form of a hire-purchase plan.[1]

Adjustment of spheres of activity

Large-scale establishments have been subject since 1947 to provisions of the Anti-Monopoly Law enacted to safeguard free competition and fair trade by imposing restrictions on the cartelization and merging of large concerns and by banning cartel agreements among them. The law had some effect in alleviating monopolistic practices of the larger enterprises, but its benefits to small-scale enterprise have been at best indirect and indeterminate. In fact, some of the measures to strengthen the small industry sector mentioned above were taken with the specific purpose of making up for the shortcomings of the Anti-Monopoly Law in that respect.

There is still much pressure for further legislation designed to achieve stronger and tighter organization of small industry and to delimit and adjust the areas of

[1] For more details on the activities of the Smaller Enterprise Agency and the other institutions mentioned, and on economic developments in the small industry sector, see, among others, Economic Commission for Asia and the Far East, Committee on Industry and Trade, "Report of the Study Group of Small-Scale Industry Experts on their Visit to Japan" (E/CN.11/I & T/108, 1 February 1955); "Medium and Small Enterprises in Japan", *Trade and Industry of Japan*, No. 16, 1956 (Tokyo); Asia Kyokai, *The Smaller Industry in Japan* (Tokyo, 1957); Economic Planning Agency, *Economic Survey of Japan, 1956-1957* (Tokyo, 1957); and various issues of the Fuji Bank Bulletin (Tokyo), and the *Survey of Economic Conditions in Japan* published by the Mitsubishi Economic Research Institute (Tokyo). The Smaller Enterprise Agency publishes a monthly *Smaller Enterprise Bulletin*, a semi-monthly *Financing the Smaller Enterprises*, an annual white paper, and a variety of books and pamphlets.

activity of large and small enterprises. In recent years, large enterprises have made strong advances in all branches of industry and trade. For instance, some spinning companies began manufacturing piece goods and clothing, and paper mills engaged in producing finished paper products. The enlarged activity of the bigger enterprises takes place either directly through expansion of their own plants or purchase of other existing factories, or indirectly, through the intermediary of subsidiary companies or job-work subcontractors. In either case, this encroaches upon the small producers and aggravates the acute competition which they already face.

The question of defining and adjusting the respective spheres of activity is, of course, highly controversial and the issue has become largely political. Some Japanese political and economic circles are urging further restrictive measures which would check the inroads of large enterprises into the traditional fields of activity of small business. Others argue, on the contrary, that the government economic policies in favour of small enterprise—which operates at a low level of productivity—hamper the sound development of the economy and are inimical to the interests of consumers.[2]

This controversy came into the open in 1957 at the spring and autumn sessions of the National Diet, when a smaller enterprise organization bill, which combined provisions of the Smaller Enterprise Co-operative Law and the Smaller Enterprise Stabilization Law, was discussed. Some sections of the bill aimed at checking the advance of large enterprises into certain branches of industrial production hitherto in the field of small business. The bill provided, among other things, for expanding the scope of industrial activities in which legal measures for voluntary cartelization of small enterprises are applicable; for legal restrictions on "outsiders" and, in certain circumstances, for their compulsory participation in legal cartel organizations; and for recognition of the right of collective bargaining of small businesses in transactions with large ones. The bill presented by the Government failed to pass at the twenty-sixth session of the Diet, due to strong opposition of certain groups to the last two provisions mentioned. But was finally adopted, on the closing day of the twenty-seventh extraordinary session, without modification.[3]

INTERDEPENDENCE AND SUBORDINATION

Subcontracting

The relations of interdependence between small and large enterprises in Japan take mainly the form of subcontracting.[4]

Subcontracting developed between the mid-twenties and the mid-thirties, when Japanese industry was being put on a war economy footing. Raw materials were channelled to small-scale and cottage industries through large establishments which received the parts and components manufactured by the former and assembled and delivered the finished goods. This integration of production in small and large establishments became a well-established procedure and expanded considerably thereafter. Today, large factories supply iron and steel to small plants and workshops manufacturing parts for such articles as

[2] The following excerpt from "Report of the Study Group of Small-Scale Industry Experts on their Visit to Japan" (*op. cit.*), which outlines the production techniques in use in small-scale industries, is of interest in this connexion:

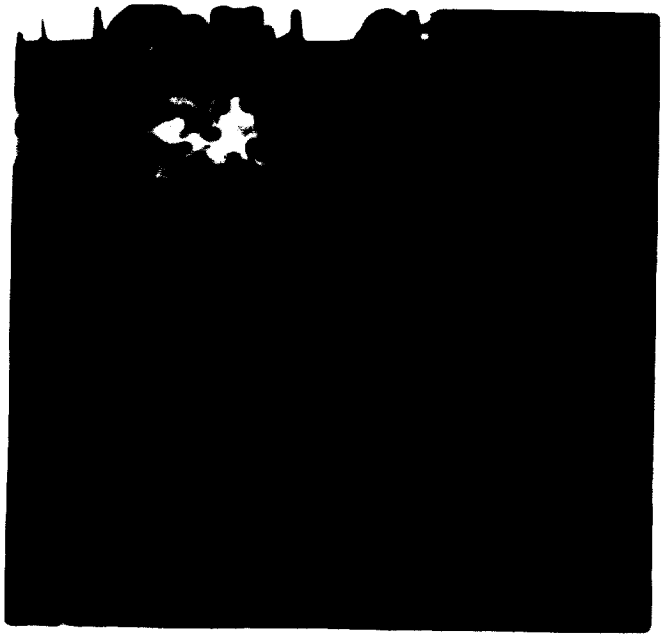
"In those spheres where there is no competition between the small-scale and the larger enterprises, manual-labour manufacturing methods have been adopted unless found unsuitable otherwise. In those spheres where the element of competition prevails between the smaller and larger productive units, all possible labour-saving devices are employed in order to achieve economies in production cost.

"For example, in the paper industry, the manufacture of special or art paper not produced by larger factories is carried out by manual labour with the exception of pulp making. In the production of the less expensive types and of ordinary paper, the small-scale industry has been mechanized to the maximum extent possible. In the textile industry, the production of rugs is done by small hand-operated looms, the weaving and printing of special cloths for 'kimonos' and brocades is mostly done by hand, whereas weaving of silk and rayon for ordinary purposes is done by power looms in the small as well as large-scale establishments. Similarly, special plastic articles, toys, etc., are made on small machines operated by hand or sometimes by power, but other plastic articles of common use like combs, brushes, vinyl sheets are made with the help of special machines."

See also the recommendation in the section on production techniques of the Study Group report, reproduced below.

[3] In the field of commerce, the Government enacted in 1956 the Department Store Law, which provides for various measures designed to restrict business operations of department stores considered as a threat to the activities of retailers. Among these measures are restrictions on projects for new premises or extensions by department stores and a ban on night operations.

[4] Another type of relationship links small producers with wholesale traders or commission agents. In this relationship, which has long existed in different forms in most under-developed countries, a wholesale merchant provides raw materials to peasants working part time or to small workshops, pays them on a piece-work basis, collects or assembles the finished products, and puts them on the market. In Japan, this system is practised on a limited scale for the production of such goods as fabrics, artificial flowers and toys.



Workers assembling toy cars in a Japanese factory

Table 2

SUBCONTRACTORS RECEIVING RAW MATERIALS AND ASSISTANCE FROM PARENT FIRMS, 1955

Form of assistance	*Number*	*Percentage*
Total number of enterprises surveyed [a]	530	100.0
Sale of raw or processed materials	255	48.1
Free supply of raw or processed materials	227	42.8
Technical guidance	144	27.2
Lease of machinery or equipment	140	26.4
Interchange of personnel	9	1.7
Good offices or guarantees for loans	70	13.2
Loans for investment	37	7.0
Loans for working capital	26	4.9

Source: Smaller Industries Agency, 1956.

[a] Most subcontractors in the sample receive several forms of assistance.

sewing machines, bicycles, automobiles, optical and precision instruments, watches and appliances; others supply yarn to small weaving mills, processed clay and glazes to small ceramics factories, and so on. Many subcontractors, in turn, further subcontract part of their production to other small firms.

The main advantages to the small entrepreneur engaged in subcontracting are normally that he receives a regular flow of raw materials, has an assured outlet for his product, and obtains assistance, guidance and sometimes also financial aid from the parent company, as shown in table 2. To safeguard the high quality standards of their production, the parent firms usually impose strict inspection and quality control of the products manufactured by their subcontractors;[5] assistance consists principally of technical advice and loan of equipment. The parent company furnishes financial assistance by extending its good offices or providing its guarantee for securing loans; occasionally also by granting loans directly to the subcontractor for such purposes as investing in production facilities or replenishing working capital.

The help given works to the advantage of the large companies too. These benefit mainly from the low production costs of the subcontractors, who generally pay much lower wages than large concerns;[6] the latter also benefit from being able to reduce correspondingly their own production facilities and skilled labour force and other overhead—which serves to insulate them from the effects of violent fluctuations in demand.

By the same token, however, small industry is exposed, in periods of market fluctuations, to the risk that the parent company, controlling the supply of raw materials, may reduce or withhold orders. This practice is by no means general, as many large companies—which, because of their economic and financial strength, are able to withstand the effect of recessionary tendencies or irregular or fluctuating markets—may consider that their own interest requires maintaining output and employment both in their own factories and among their subcontractors. However, the very system of subcontracting favours large firms by enabling them to spread and thereby minimize risks. It also affords them protection against changes in the nature of demand—small-scale subcontracting factories being generally capable of making change-overs with relatively little difficulty—and to some extent against labour unrest. Moreover, the large enterprises, as suppliers of raw materials and buyers of the output, are apt to enjoy monopolistic advantages vis-à-vis the numerous small producers who are often unnecessarily competing among themselves and are thus caught in the "scissors" of high-cost raw materials against low-price output. The power of big industry to use subcontractors as a safety valve or buffer against business changes, or to impose drastic contractual conditions, especially regarding prices, is particularly great with so-

[5] In some cases, subcontractors are allowed to use the trade marks of the large concerns.

[6] Wage rates in establishments with four to nine workers are about 40 per cent of those of enterprises with 1,000 or more workers.

spect to the subcontractors who are not affiliated to small industry associations. Even the small enterprises which are organized, however, feel it to some extent. As was mentioned above, the Anti Monopoly Law is not fully effective to deal with such situations, so that pressure for further protective legislation has been building up in recent years. A bounced step was taken in July 1956, when the Japanese Government enacted the "Law for the Prevention of Delayed Payments to Subcontractors"; this enactment stipulated that parent industries shall not refuse acceptance of, reduce payments for, or return goods delivered by subcontractors for reasons beyond the responsibility of the latter, and, when accepting the goods delivered, shall make payments without delay.

In spite of its drawbacks, the subcontracting system plays an important and continuously increasing role in the Japanese industrial structure. The very weakness of small enterprises—their inferiority in capital and credit resources and the narrowness of markets at their command—makes them generally willing to accept subcontract assignments and enter into affiliation arrangements with large concerns. According to a survey of subcontract industries conducted in June 1956 by the Smaller Enterprise Agency, some 61 per cent of the total number of subcontractors were receiving aid from the parent enterprises. Other data collected by the Smaller Enterprise Agency and the Fair Trade Commission show the dependence of parent manufacturing industries on subcontractors, as measured by the ratio of value of orders placed with subcontractors to total value of output of parent firms. This ratio was, on the average, 24.6 per cent in 1955 and 27.1 per cent in 1956 (table 3). In the latter year, the average number of subcontractors per parent industry was almost sixty (table 4). Subcontractors with less than 100 employees accounted for 80 per cent of the total and those with less than thirty workers for 32 per cent. Those with a capital under 3 million yen accounted for 80 per cent and those with a capital under one million yen for about 50 per cent. Some 54 per cent of the total number of subcontractors were making use of under subcontractors. Almost all subcontractors were connected with more than two parent industries, and the average number of parent industries per subcontractor stood at nine.

CONCLUDING REMARKS

The organizational and legal measures reviewed above overcame some difficult and urgent problems confronting the small industry sector, but other issues raised by the relationships between large and small industries—particularly by the subcontracting system—and within each group are still to be faced.

There is, for example, a wide gap between managerial efficiency, worker productivity and levels of wages and profits in the two groups of enterprises. The imbalance in wage and profit levels appears to be, for the large companies, one of the main inducements to employ subcontractors; on the other hand, the discrepancy in productivity levels is detrimental to their own operations. The low costs in small-scale industry result not only from low wages, but also from small profit margins. Thus, little capital is available for renewal and modernization of equipment and, to that extent, low cost is a hindrance to the improvement of quality standards. By providing, at nominal cost or free of charge, equipment and technical aid, by introducing quality control and similar measures, large enterprises seek to achieve a high level of efficiency and high quality standards in their subcontractors' output, while benefiting at the same time from the low production costs obtaining in small enterprises; it appears, however, that in the small industry sector as a whole, a very large proportion of the equipment in use is worn out or obsolete and that a considera-

OPPOSITE PAGE

Building the sound-board of a piano in a musical instruments factory

ON THE LEFT

Sewing-machines moving down the assembly line in a Japanese factory

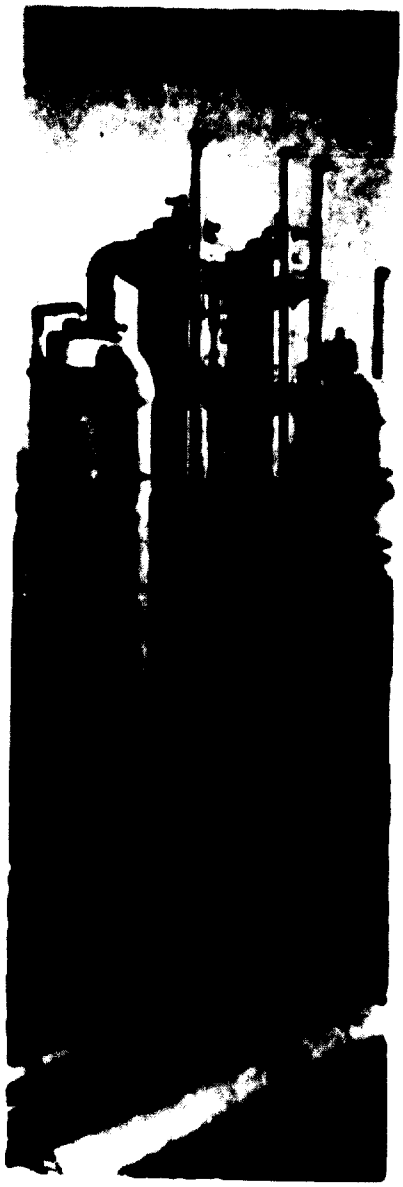


Table 3

DEPENDENCE OF LARGE INDUSTRIES UPON SUBCONTRACTORS, 1956

Industry	*Extent of dependence*[a] *(percentage)*		*Number of parent plants by extent of dependence*					
	Maximum	*Average*	*80-100 per cent*	*60-80 per cent*	*40-60 per cent*	*20-40 per cent*	*Under 20 per cent*	*Unknown*
Shipbuilding	34.4	12.3	—	—	—	1	16	—
Railway rolling-stock	51.0	18.0	—	—	2	1	12	—
Automobiles	45.9	25.3	—	—	3	1	5	—
Auto-tricycles	96.2	38.6	1	2	3	5	3	—
Bicycles	68.0	33.7	—	1	4	—	4	—
Electric machinery	67.0	23.8	—	2	2	6	11	—
Electrical wires, cables	7.0	2.6	—	—	—	—	4	—
Machinery for communications	53.6	28.3	—	—	3	4	4	—
Meters	62.0	30.2	—	1	—	4	1	—
Industrial machinery	63.8	15.1	—	1	—	4	21	—
Mining machinery	22.0	16.4	—	—	—	2	1	—
Mining machinery, repairing	—	—	—	—	—	—	—	6
Machine tools	44.7	22.3	—	—	1	3	3	—
Spinning and weaving machines	55.4	32.0	—	—	5	4	6	—
Motors	56.0	18.3	—	—	1	4	8	—
Sewing machines	97.5	51.4	1	1	3	2	1	1
Arms and ammunition	14.9	7.2	—	—	—	—	3	—
Optical and precision machines	53.8	31.3	—	—	4	7	3	—
Measuring instruments	40.0	21.6	—	—	—	1	2	—
Timepieces	31.1	19.4	—	—	—	4	5	1
Spinning and weaving[b]	100.0	15.4	2	—	1	—	17	—
Spinning and weaving[c]	—	—	—	—	—	—	—	7
Textile products	81.5	44.3	2	2	—	2	3	—
Printing, bookbinding	42.0	17.8	—	—	1	2	4	—
Pharmaceuticals	24.0	8.5	—	—	—	1	9	—
Aluminium products	9.3	6.9	—	—	—	—	5	—
Pottery	36.3	17.1	—	—	—	1	2	—
Synthetic resins	21.0	8.5	—	—	—	1	4	1
Canned foods	8.2	5.7	—	—	—	—	2	—
TOTAL	—	27.1	6	10	33	60	159	16

Source: Fair Trade Commission, 1957.

[a] Value of output of subcontractors as a percentage of value of output of parent plants.

[b] Manufactures.

[c] Trading firms. Source: trading firms directly control and supervise their subcontractors' factories.

able proportion of the machinery purchased is second-hand.[7] The gap in efficiency due to poor equipment has further widened in recent years as a result of an extensive programme of investment and modernization carried out in big industry. This situation appreciably affects also the interests of large companies employing subcontractors. According to a survey conducted by the Smaller Enterprise Agency in 1956, 40 per cent of the subcontractors surveyed experienced rejection of their deliveries to the parent companies; of these subcontractors, 80 per cent admitted their responsibility for defects in the deliveries.[8]

The low profit margins of small entrepreneurs are due not only to pricing conditions imposed by large concerns, but also to the acute competition between small enterprises which often leads to desperate price cutting. This problem cannot be solved simply by an increase in technical aid by parent companies and in financing facilities by the Government. Further governmental measures

[7] See Smaller Enterprise Agency, *Small-scale Industries Machinery Equipment Survey, 1956*, and *Economic Survey of Japan, 1956-1957*, pages 93 to 94.

[8] *Economic Survey of Japan, 1956-1957*, page 100.

Table 4

SUBCONTRACTORS AND PARENT PLANTS, BY INDUSTRY, 1956

Industry	Number of subcontractors per parent plant		Number of parent plants with following numbers of subcontractors					Percentage distribution of subcontractors with capital	
	Maximum	Average	Over 200	100-200	50-100	20-50	Under 20	Under 10 million yen	Over 10 million yen
Shipbuilding	531	137	2	6	5	2	1	83	17
Railway rolling-stock	186	85	—	4	7	3	1	84	16
Automobiles	177	136	—	8	1	—	—	73	27
Auto-tricycles	208	101	1	5	5	3	—	86	14
Bicycles	216	70	1	—	2	2	4	88	12
Electric machinery	183	90	—	8	6	5	2	93	7
Electrical wires, cables	9	6	—	—	—	—	4	100	0
Machinery for communications	206	102	1	4	3	3	—	84	16
Meters	263	129	2	—	3	1	—	93	7
Industrial machinery	118	41	—	2	4	9	11	91	9
Mining machinery	48	25	—	—	—	3	—	95	5
Mining machinery, repairing	19	9	—	—	—	—	6	100	0
Machine tools	90	32	—	—	1	4	2	84	16
Spinning and weaving machines	303	102	2	4	2	5	1	96	4
Motors	150	41	—	1	1	6	5	85	15
Sewing machines	147	81	—	1	5	1	1	97	3
Arms and ammunition	89	48	—	—	1	1	1	91	9
Optical and precision machines	123	57	—	2	5	6	1	96	4
Measuring instruments	32	20	—	—	—	1	2	96	4
Timepieces	71	40	—	—	3	6	—	97	3
Spinning and weaving [a]	155	40	—	1	2	9	8	67	33
Spinning and weaving [b]	188	80	—	2	2	—	3	62	38
Textile products	217	70	1	2	4	1	2	83	17
Printing, bookbinding	299	100	1	1	2	2	1	99	1
Pharmaceuticals	70	25	—	—	1	4	5	87	13
Aluminium products	91	29	—	—	1	1	3	95	5
Pottery	30	20	—	—	—	2	1	90	10
Synthetic resins	66	30	—	—	1	2	3	94	6
Canned foods	10	7	—	—	—	—	2	83	17
TOTAL	—	61	11	50	67	82	70	88	12

Source: Fair Trade Commission, 1957. [a] Manufacturers. [b] Trading Firms.

to control contractual agreements and to regulate markets will be required.

A widening gap has also been developing in the past few years within small industry itself between its organized and unorganized sectors. While this is the inevitable result of the progress made in promoting and strengthening the sector as a whole, the need to narrow down the gap will become more pressing in the future.

The small industry sector in Japan is now becoming a big economic and political force. How to adjust its internal structure and its relationships with large-scale business and what priorities to give to the development of each so as to promote the growth of the national economy as a whole, is a major economic as well as political problem. The present trend of promoting coordination within the small industry sector and a better integration with big industry is likely to continue in the foreseeable future; the solution of these problems may involve various forms of protective regulation.

The Japanese experience in this regard has already aroused much interest, particularly in South East Asia. It may deserve to be brought to the attention of authorities in other parts of the world where the role of small industry in the national economy is now being studied.

Organization and Operation of Cottage and Small Industries

Recommendations of a group of experts based on a survey of cottage and small-scale industries in Japan

THE FOLLOWING EXCERPT *from the "Report of the Study Group of Small-Scale Industry Experts on their Visit to Japan" contains its conclusions and recommendations. The study group's tour, which took place in 1954, was sponsored jointly by the United Nations Technical Assistance Administration and the Economic Commission for Asia and the Far East (ECAFE). The countries participating in the tour were: Burma, Ceylon, China (Taiwan), India, Indonesia, Japan, Republic of Korea, Federation of Malaya, Nepal, Pakistan, the Philippines, Thailand, Republic of Viet-Nam. The body of the report provides an account of the development of Japanese cottage and small-scale industries and of the aid extended to them by the Government, and analyses in detail their production techniques and organizational, financial and marketing methods. The full report is contained in a document of the Economic Commission for Asia and the Far East, E/CN.11/I & T/108, 1 February 1955 (mimeographed).*

ORGANIZATIONAL SET-UP

THE STUDY GROUP'S observations confirmed that the scale on which many Japanese industries operate is, even today, smaller than that which industrially advanced countries of the West regard as economic. Since the other countries of the ECAFE region have adopted many industrial techniques from the western countries, as in the case, for example, of pottery and bicycle manufacturing and plastic goods production, these countries tend to accept western estimates of the optimum size of plants in their industrial planning. *The group therefore recommends that countries participating in the study tour should, in initiating their development programmes for particular industries, make a comparative study of Japanese and western methods of organizing production before deciding upon a suitable set-up.*

It is recognized that the industrial structure of a country is the result of historical circumstances. The success of smaller enterprises in Japan despite competition from large-scale industry has been due to a variety of factors, the most significant being (*a*) the ready availability of abundant electrical power and cheap transportation; (*b*) the lower management costs of the smaller enterprises resulting from lower capital investment on construction, longer working hours and lower wage rates, and (*c*) the prevalence of contracted industries, subcontracting and commission agency systems, which, while assuring continued employment, apportion the impact of market fluctuations among the smaller and large-scale industries, thereby sparing the larger industries the risk of over-equipment.

To reproduce the economic background of Japanese industry in the other countries of the region in order to provide small-scale industry with standards similar to those of Japan is obviously not practicable. However, some of the striking features of Japanese industry, especially the decentralization of certain manufacturing processes and their dispersal to home industries in rural areas, which provide gainful employment and mass participation in industry, could be adopted with advantage by these countries.

TRADE ASSOCIATIONS

Voluntary associations of manufacturers, organized by area and then federated on an industry basis, are highly developed in Japan. Similar associations of wholesalers and exporters of different commodities are also active. Such associations develop mutual assistance between small entrepreneurs, disseminate technical and marketing information, and act on behalf of the trade in negotiations

Handicraft production of Arita ware in Northern Kyushu

with the Government. If given sufficient strength, these associations supply credit and guarantee facilities, and furnish "common facility" services. The group considers that such trade associations, if properly established and operated, would fill a big gap in the industrial structure of most of the countries of the region.

But the group is of the view that, considering the connotations of the word "co-operation" in the different countries, these trade associations should not be called co-operative societies, as the workers in industry do not participate in them. Any facilities which Governments may decide to extend to these associations by way of recognition or tax relief may be made available by separate legislation distinct from the co-operative societies law.

Accordingly, *the group recommends that the countries participating in the study tour take active steps to encourage the formation of trade associations where they do not yet exist, and to develop and strengthen such associations as may already be in the field.*

CO-OPERATIVE SOCIETIES

Most countries of the ECAFE region have plans for expanding co-operative enterprise and particularly for organizing artisans' co-operative societies. The group's itinerary included only a marginal survey of rural co-operative societies organized under the Agricultural Co-operative Law. On the basis of this, it is not possible to say more than that joint production does exist in rural industries, such as fruit canning, in Japan. *The group recommends further detailed examination of the organization of such rural co-operative enterprises and of the steps taken by the Government of Japan to foster them.*

FINANCE AND CREDIT

Small-scale industries everywhere require (*a*) risk capital for establishing the plant; (*b*) long-term credit for extension or re-equipment, and (*c*) short-term credit for operating capital and marketing.

The group is not aware of any State-sponsored organization in Japan, past or present, for the provision of venture capital. It is usually considered that this is for the private investor or entrepreneur to find. But where, as in countries of the ECAFE region, there is a chronic shortage of capital, it may be necessary for Governments to provide at least supplementary or equity capital through corporations for the development of small industries.

The group had no opportunity to examine the actual working of the institutions supplying long-term and short-term credit to small enterprises in Japan or of the government-sponsored credit structure, or to estimate the degree of their success. It was observed that rates of interest, even for State loans, were high as compared to those in many countries of the region. *The group agreed that the principle on which credit policy should be based is to encourage the extension of commercial credit to small manufacturers, supplementing this from public funds by setting up an adequate number of lending institutions, supported by suitable loan-processing and economic advisory organizations, and by appropriating sufficient funds for direct lending or credit guarantee schemes or both. In particular, the group recommends a study by the countries participating in the study tour of the operation of the credit insurance system in Japan.*

TECHNICAL GUIDANCE

Most participating countries have some government organizations corresponding to the Japanese Smaller Enterprise Agency. *Countries which have not are advised to set up such agencies.* Aspects of the activities of the Smaller Enterprise Agency which are not usually found in other countries are the work of "diagnosis", or industrial efficiency surveys, and the introduction of uniform accounting systems. *The group recommends a detailed study of these activities for adoption in participating countries.*

INDIRECT ASSISTANCE

In some countries of the ECAFE region, the following types of assistance to smaller enterprises have been advocated or adopted. They are, however, controversial in nature.

(*a*) Preference given to smaller industries' products for requirements of government stores. From the information at the disposal of the group, it appears that at present there is no such preference in Japanese Government purchases, although an active policy of assisting the development of smaller enterprises by directing military store purchases to them had been in force in the nineteen thirties.

(*b*) Common production programmes through the reservation of certain spheres of production to smaller industries. In Japan, there appears to be no direct reservation of this kind, but for rural industries there is a policy of restricting State financial assistance to registered co-operative associations.

(*c*) Special tax relief or assistance to smaller enterprises only, through import or export policy. The group has not received information concerning the existence of this type of assistance in Japan.

The group does not consider that any conclusion as to the necessity of measures of assistance of this kind in participating countries is warranted as a result of its observations in Japan.

MARKETING AND EXPORT PROMOTION

Organization and technique

Development of marketing channels, domestic and export, is largely left to the initiative of private merchants. The creation and development of dealers' and exporters' associations have already been suggested above. *An organization of the nature of the Japan Export Trade Research Organization (JETRO) is also recommended for each participating country, with such modifications as may be necessary in view of the structure and likely development of the country's export trade. Foreign trade*

representation in each country's embassies and legations abroad should be overhauled and strengthened.

The group also recommends the establishment of market research organizations in different industries, with such assistance from the State as may be necessary.

Both export and domestic market research organizations should establish adequate commercial intelligence services to provide information to the small manufacturer, even in remote areas, in a form easily intelligible to him, which would enable him to adapt his techniques or adjust his output.

The group noted the good work being done by the national and prefectural governments in Japan for trade promotion through exhibitions and permanent display halls. Reference may be made in particular to the All-Japan Smaller Industries' Products permanent display in Tokyo, in which all prefectural governments participate. *The group recommends the establishment of such exhibitions and permanent display halls in other countries of the ECAFE region.* The group wishes in this connexion to draw the attention of participating countries to the report entitled "Domestic and Export Marketing of Handicrafts of Countries in Asia and the Far East".[1]

Design

The group noted examples of both good and bad designing of small-enterprise products in Japan. In some cases, entrepreneurs had been quick to take advantage of the demand for a particular type of goods, such as fishing tackle and bamboo screens, and to adapt their plants to the making of these special products. In other cases—handicraft china, for example—the connexion between producer and consumer was too tenuous and remote, and the design was quite out of date. *The group was impressed, however, by the work of the Industrial Arts Institute in Tokyo, and recommends to participating countries the line of action adopted by this Institute to serve as a model for a central school of design and research in handicraft production.* Among the functions of such a school would be that of keeping in touch with consumer tastes in foreign countries, and co-ordinating its activities with those of the other organizations proposed above.

Quality control

Quality control in Japan of products for the domestic market is entirely voluntary, being carried out through the trade associations. For the export trade there is a system of examination and certification by the Ministry of International Trade and Industry. The group considers that effective quality marking is essential for small industries' products in both domestic and foreign markets. This is not, of course, an easy task. Even the elaborate system of inspection of exports in Japan has not succeeded in eliminating the consequences of earlier exports of cheap, low-quality goods in many lines of merchandise. The group noted the work of the Yokohama Silk Conditioning House, and believes that it could be considered a model for inspection and grading of semi-processed raw material for export.

The group recommends:

(a) *Introduction and gradual extension of quality marking of handicrafts and small industries' products in the countries of the ECAFE region.* In view of the weak organization of the markets in these countries, this work cannot be left entirely to voluntary associations, and the State must play an active part.

(b) *Enforcement of compulsory inspection and quality marking of the products for export.*

In making these recommendations, the group appreciates that their implementation will lead to an extension of State control over the activities of small industrialists, but considers that the advantages will outweigh any difficulties which may initially be experienced.

PRODUCTION TECHNIQUES

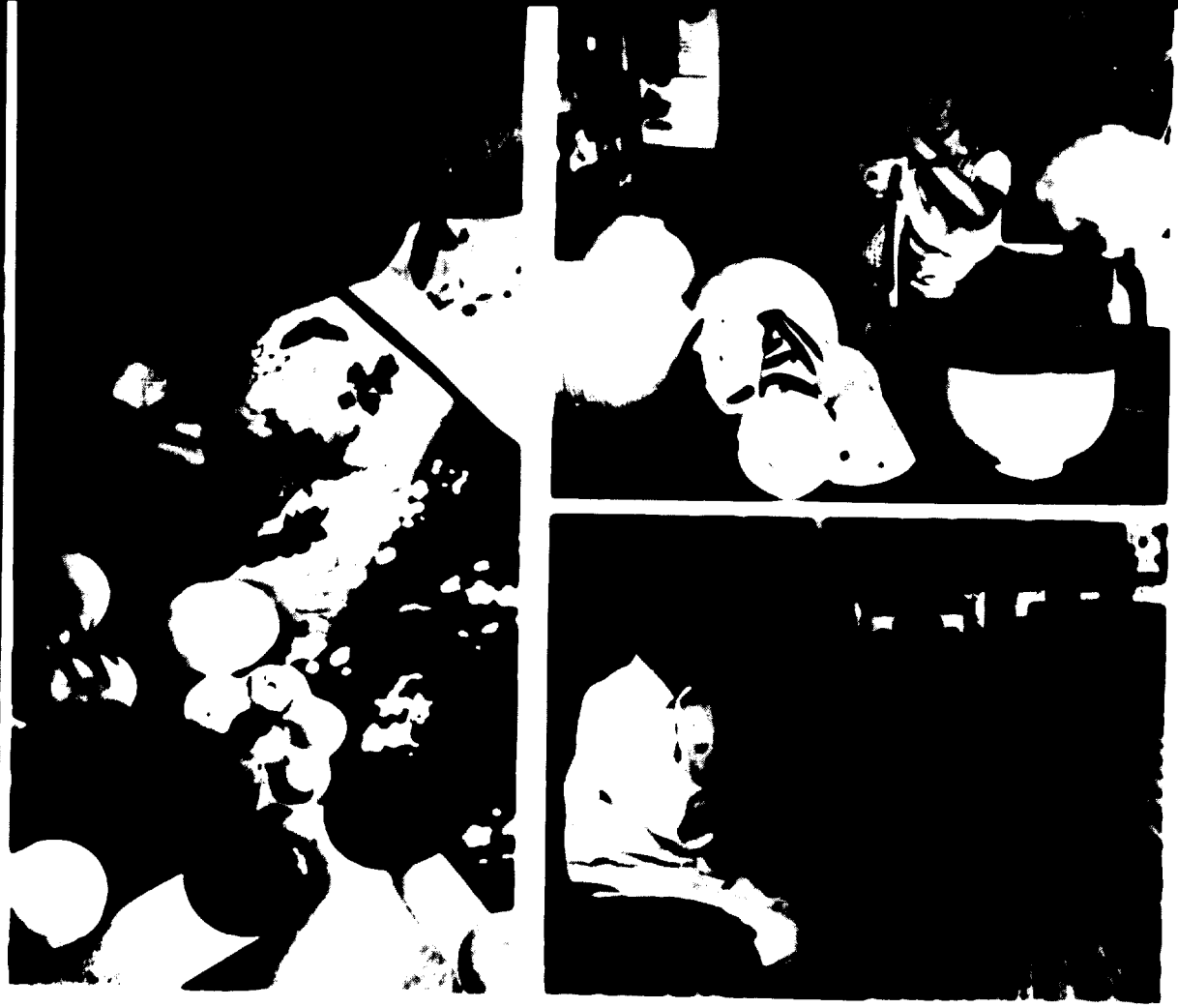
Production techniques adopted in different cottage and small-scale industries in Japan vary according to several factors. Among these are the demand for a particular product and the extent of its production in the large-scale sector, the nature of the product—that is, whether it is a raw material or a part for assembly in large-scale industry, or a consumer article made from raw materials or intermediate manufactures by the large factories—and its price in relation to that of equivalent or similar products manufactured by the large-scale sector and generally in competition with it.

The degree of mechanization, on the other hand, is largely dependent on facilities like those provided by common facility centres and the extent of diversification and the scale of improvement required. The training of workers, availability of raw materials and location of plant are among other important factors having a direct or indirect bearing on the manufacturing techniques adopted.

In cases where there is little or no competition with large-scale industry and where items are either not within the province of this industry or are manufactured in inadequate quantities for domestic or foreign markets, the manufacturing methods adopted are mostly manual, with some exceptions where mechanization has a direct bearing on the quality of the product or on any of its stages of production. Pottery articles, such as decorated artware, are manufactured by hand with simple appliances and tools. For bicycle parts, on the other hand, every labour-saving device is employed, first because this yields better and larger production and helps to keep costs down, and also because the operations involved are such that they have to be mechanized.

The most striking feature of production techniques in Japan is, however, the use of a single-purpose machine for any specific operation. This not only saves the considerable time which would be required in changing tools, dies and fixtures on multiple-purpose machines, but also ensures better and larger production. In the

[1] United Nations document ECAFE/I & T/CIWP.3/7 (mimeographed).



FAR LEFT
Hand-dyeing silk fabrics in a Kyoto workshop

TOP RIGHT
Applying the finishing touches to paper lanterns in a workshop, Gifu Prefecture

BOTTOM RIGHT
Worker applying the wax finish on a paper and bamboo umbrella

other countries of the region, however, the tendency is to use one machine for multiple-purpose operation; it would be to their advantage to follow instead the pattern adopted in Japan. The total capital investment for installing a large number of single-purpose machines need not be more than that for fewer multiple-purpose machines. In fact, it is less expensive to install single-purpose machines for a given job. Moreover, they are easy to handle, repair and maintain locally, and their total consumption of power is considerably lower. These machines are often specially designed and manufactured in the factories themselves.

Another notable feature observed in Japanese industry is the attention paid to the layout of plant and equipment in order to save handling and conveying costs. When it is not possible to use manual labour for conveyance, constantly moving belts and other mechanized conveying systems have been largely adopted.

Most of the factories visited have their own drafting and designing sections, development departments and testing laboratories. The manufacturers of engineering machines and equipment subject their products to rigid tests under normal and extraordinary working conditions, allowing for the requisite safety factors. Only after satisfactory performance of the machines is established under such conditions is mass production undertaken. Similarly, other articles are tested as to their ultimate use. Then the service conditions are duplicated and accelerated tests are carried out.

From the foregoing, it would appear that while the production techniques adopted in Japan have emerged from the peculiar circumstances of the country, they could be adopted with advantage in other countries of the region, with such changes and adjustments as may be required by local conditions. In some cases, it may be necessary further to examine in detail the production techniques adopted in Japan, with special reference to simplification and design of mass-production machines and equipment to suit individual countries.

FACILITIES FOR SMALL-SCALE AND HOME INDUSTRIES

Rural electrification

The almost complete electrification of rural areas in Japan has greatly assisted in the establishment of modern small-scale and home industries. There was no evidence that power was generated locally in any of the factories visited—small-scale or large-scale.

The use of electricity makes for efficient plant operation and saves costly manual labour; it also bears a direct relation to the quality of the finished product. Moreover, electrical appliances and tools are easy to handle. Other sources of power, such as diesel and steam engines, are more costly and, in countries where fuel is imported, they require considerable expenditure of foreign exchange.

It therefore appears desirable to provide electricity to the cottage workers. In countries of the region which intend to implement their industrialization programmes before rural electrification has taken place, it may be pref-

enable to begin with small localized power stations which could later be connected to the national network.

Transport

Another important factor which has aided the development of cottage and small-scale industries in Japan and facilitated their dispersal to well-suited rural districts is the extensive availability of transport. A network of both roads and railways, giving access to all areas, is a rather unique feature of Japan. *Subject to the priority accorded by other countries of the region to the development of their social and industrial activities, transport facilities should be developed in consonance with the industrial development of the country.*

Raw materials

There was no evidence in Japan of any large measure of control over the distribution of raw materials, imported or of local origin. In most countries of the region, raw materials—particularly those in short supply and those imported—are controlled with a view, theoretically, to ensuring a regular supply to cottage industries. In practice, however, it is not always possible for the small manufacturer to procure raw materials in time, at reasonable prices and in such quantities as are normally consumed.

It is recommended that, other circumstances being favourable, the control over essential raw materials should be relaxed to the extent possible.

Research institutes and training

The existence of several research and training institutes run by the national or prefectural governments in Japan has helped small-scale industry to improve the quality and design of its products. These institutes usually act as co-ordinating bodies, and, in addition to watching over the progress of work done, they recommend grants-in-aid and also lay down guiding principles. They afford facilities for post-graduate training, for which no fees are charged, and give free advice to industry, but in cases where a particular unit receives considerable financial income from designs and methods it has adopted which were developed and patented by an institute, some form of royalty is paid to the Government. In short, the institutes are supported by the Government and not by industry. Such facilities do not seem to exist in other countries of the region, and it is learned that, where they do exist, the industry has to shoulder the burden of running them to a great extent.

It is, therefore, recommended that, as these research institutes indirectly help to build the national economy, they should not be made a source of direct revenue.

Apart from institutes for individual industries, it may be desirable to have multiple-purpose institutes such as the Industrial Arts Institute in Tokyo, which has been set up to help the growth and development of several industries.

Another important subject of research by the institutes is packing methods, including use of the best and cheapest packing materials.

Common facility services

Common facility service centres, set up to undertake part or all of an operation involved in processing or manufacturing an article, have eliminated to some extent differences in production costs, and freed cottage factories from the necessity of installing costly and heavy equipment of their own. Such centres have also aided in maintaining uniform quality of the finished product.

It is understood that for such operations as processing and washing clays, compounding bodies and manufacturing saggars—in the case of the pottery industry—these centres charge only the actual cost and a nominal share of the profits realized by the constituent members of the group for which the centres were established.

In view of the nature of cottage and small-scale industries and the desirability of achieving quality production, it is advisable that such common facility centres should be set up in other countries of the region. For example, in countries which have well-established small-scale textile plants, or in those wishing to set up the industry, the creation of common facility centres for sizing, dyeing and mercerizing would be of immense assistance to its growth. In the case of the bicycle parts industry, it may be desirable to have common facility electroplating and case hardening plants. It would be necessary for each country wishing to develop a particular industry to consider what type of common facility centres should be set up, with due regard to the circumstances peculiar to that country.

The manufacture of ceramics, bamboo products and hand-made paper and, to some extent, sericulture lend themselves to rapid development on the scale of cottage or small industries. Several countries like Burma, India and Pakistan have adequate supplies of the raw materials required for these industries, but before any comprehensive planning of cottage and small-scale industries is undertaken it will be necessary to carry out extensive market and raw materials surveys and to adopt only such manufacturing methods as are most suitable, consistent with the quality and extent of the raw materials available and the nature and scope of the total demand.

It may be necessary to set up pilot plants in order to train local labour and to guide existing manufacturers. It appears that a ceramics pilot plant is being set up in Pakistan with these objectives, and establishing a like one is being considered in India. Certain international organizations of a global or regional character, such as the United Nations Technical Assistance Administration, the Colombo Plan, the United States Point Four Program and the Ford Foundation, are already actively assisting in training and importing technicians to aid underdeveloped countries. *It is recommended that experts from Japan also should be delegated for developing specified industries in countries where conditions are similar to those in Japan.*

In September 1958, the United Nations Secretariat issued a report on *Management of Industrial Enterprises in Under-developed Countries* (Sales No.: 58.II.B.5), prepared largely on the basis of the discussions of a panel of experts chosen with a view to bringing together experience gathered in the field of management under the United Nations technical assistance programmes. A number of background papers were prepared for the panel by the Bureau of Economic Affairs of the United Nations Secretariat, officials of the International Labour Organisation and the United Nations Educational, Scientific and Cultural Organization, and other participants in the meeting. Revised versions of some of these papers appear in the following pages in the form of three articles on various aspects of the subject.

Labour Aspects of Management

Some factors affecting the contribution of the worker to the efficiency of industrial operation in under-developed countries

BY C. R. WYNNE-ROBERTS

Mr. Wynne-Roberts, *a staff member of the Economic Division of the International Labour Office, participated in the Panel of Experts in Industrial Management in Under-developed Countries held at United Nations Headquarters in the autumn of 1957. His article is a revised version of a paper which he submitted to the Panel.*

Management problems relating to labour arise both at the level of the enterprise or undertaking and at the higher levels of individual industrial sectors and the economy as a whole. Both sets of problems were discussed at a meeting of experts in industrial and human relations convened by the International Labour Organisation (ILO) at Geneva in July 1956.[1] The present article is of limited scope. It is confined to a discussion of some of the labour problems which arise at the level of the enterprise and which confront management in the less-developed countries. It envisages management of labour mainly from the viewpoint of its effect on the efficient operation of the enterprise; success or failure in tackling labour problems is viewed here as one of the criteria of managerial effectiveness.

In order to operate with full effectiveness, an undertaking must have, in addition to sufficient financial, material, and managerial resources, a labour force physically and mentally suited to the tasks it has to perform and adequately trained and properly motivated to carry out these tasks well.

The extent to which each of these essential conditions is attained depends on a number of factors, the most important of which, in any country, appears to be the attitude of the employers and top management concerned. However well-qualified and willing the workers themselves may be and however co-operative governments and trade unions, the initiative lies squarely with the employer, public or private; if he fails to take it, no one else can do so with the same effectiveness. Conversely, the employer or manager with a sound understanding of the problems of getting the best from his personnel and with the will to try may rapidly achieve a high degree of efficiency, even in the case of initially untrained and inexperienced people.

The problems of effective utilization of the abilities of the worker and of achieving satisfactory human relations between employer and employed are far from having been solved even in the most industrially advanced countries. In these countries there exist, however, formally organized media of communication between employers and employed, and a considerable body of knowledge has been accumulated on factors affecting informal rela-

[1] *See Report of the Meeting of Experts on Industrial and Human Relations*, ILO Governing Body, document G.B. 133/10/6 and associated documents M.I.H.R. 1 and 2 (Geneva, 1956). The meeting was attended by representatives of governments, employers and workers from sixteen countries.

ships between management and labour and on the sound development of workers' abilities and skills.

This is not generally the case in under-developed areas, though in every country may be found a few enterprises outstandingly managed by men of ability and imagination. Nevertheless, it is in the area of personnel management—in its broadest sense, which includes human relations—that some of the greatest problems of industrial operation in under-developed countries occur. Some of these problems relate to the development of labour's capabilities and involve managerial responsibilities for the selection and training of workers; others concern the motivation of employers and employees and involve the responsibility of management for winning the co-operation of its manpower.

SELECTION AND TRAINING OF WORKERS

In very few enterprises in under-developed countries is any attempt made at systematic selection or training of workers. In many instances employees are recruited on the basis of a personal relationship or friendship with a supervisor or someone else already employed in the enterprise. Few firms have adapted selection tests. In a limited number of countries schemes for vocational guidance for young people have been put into operation, but the employment situation is often such that they are forced to take the first available opening. In any case, such schemes as exist are generally restricted to a few centres of industry.

In most under-developed countries, little formal vocational training in industry is so far provided, and formal apprenticeship in industry as opposed to handicraft is rather the exception than the rule. Where it does exist, apprentices are often treated as labourers or shop boys rather than future workers and are left to their own devices to pick up the skills for their future occupations. Teaching is haphazard and depends on the goodwill and teaching ability of the skilled men with whom they are put to work. While this situation is improving, especially in the larger enterprises, progress is slow because of many deep-rooted obstacles.

One of the obstacles is the attitude of employers. In general, they are not interested in giving their workers formal training, even when this might be provided by technical assistance experts working in their plants, and they may even oppose the setting up of institutes for this purpose. This reluctance appears to arise from a fear that if they train a man he will at once demand higher wages or will leave them for a competitor prepared to offer higher pay. It also seems to arise from ignorance of the nature of industrial skills, of the way in which they are acquired, and of their importance in carrying out manufacturing processes; this ignorance in turn stems from the backgrounds and interests of many employers, which often prompt them to concentrate upon the commercial and financial aspects of industrial operation rather than upon those relating to production.[1] The problem is sometimes complicated by widespread illiteracy and the aversion of literate people to manual labour.

In the countries where they have been established, centres for vocational training of young workers and adults are generally sponsored or assisted by the government.[2] As a rule, the schemes are of limited scope, as regards both the number of trades taught (metal trades are often preferred) and the number of workers trained. The primary aim, at best, is to train instructors who will in turn train staff for other centres or pass on their knowledge when they return to industry. Only in large enterprises is it feasible, occasionally, to provide international experts and instructors to set up and operate special departments for the direct training of operating personnel.

The serious lack of skilled personnel in industry indicates the need for plant managers to train workers in their own plants, using foremen and other skilled workers for that purpose. Unfortunately, the latter are not always capable of transmitting their own knowledge effectively. First aid can be provided in this respect by a Training Within Industry Job Instruction programme, a device limited in scope but yielding quick returns. Large-scale training in these programmes has been carried out by ILO experts in India, Yugoslavia, Israel, Burma, Pakistan, and other countries.

The granting of fellowships abroad to enable workers and supervisors to perfect their skills and to bring their knowledge of processes up to date is an important means of raising the level of skill in under-developed countries. A difficulty, however, is that most countries in need of such assistance are far away from the industrially advanced countries where training can be furnished, and the resulting high cost of fellowships restricts their number. Many such fellowships, however, have been provided with the assistance of the International Labour Organisation, particularly to Yugoslavia, and similar projects have been started elsewhere.

Experience shows that while employers are reluctant to take part in promoting schemes for vocational training, they are generally willing—at least, the more enlightened among them—to have their workers trained once such schemes have been set up. The problem remains of educating the majority of employers to appreciate the nature of their own requirements for skilled personnel and to overcome their inertia or their reluctance to take the necessary action.

The training of operatives can be appreciably facilitated and the requirements for skilled labour reduced when programmes of work simplification are adopted by enterprises. By breaking up complex operations, it is possible to concentrate the efforts of skilled workers on those phases which demand particular skills, so that the tasks that do not call for high qualifications and can be quickly taught can be performed by unskilled or semi-skilled workers (for example, handling and transport

[1] See United Nations, *Management of Industrial Enterprises Under-developed Countries* (Sales No.: 59.II.B.9).

[2] A number of schemes receiving technical assistance from the International Labour Organisation and other agencies are mentioned in "International Technical Assistance in Vocational Training", *International Labour Review*, pages 514 to 529 (Geneva, June 1957).

ing). The training time can be reduced by the use of motion studies to simplify the more complex phases of the operations. The training of staff specialists to carry out this work is the special field of activity of productivity missions, productivity centres and similar organizations, many of which have been set up and assisted by the International Labour Organisation.

MOTIVATION

Proper selection and training will enable a worker to develop his capabilities. This, however, is not enough for an enterprise to be productive, its employees should want to use their capabilities to the full. In industrially advanced countries with adequate numbers of skilled workers in many trades, employers have found that, in addition to being available, labour should be co-operative. Perhaps a more important cause of loss of output than strikes—of which every country has a history—is a conscious policy often practised by workers of limiting their output, usually because of fear of rate cutting or of "working themselves out of their jobs". This loss cannot be measured. Sometimes, particularly in the case of piece work, output may be restricted to a level agreed upon among the workers or to a level considered by a worker as sufficient to provide him with a certain income he wants to earn. Considerable loss of output may also be caused by workers who would keep to themselves short cuts or improvements in methods which they have discovered and which, if applied, would raise substantially the productivity of the plant. Over and above the loss due to restrictions, there may often be loss due to excessive scrap or faulty work owing to sheer indifference on the part of the workers to quality requirements.

In industrial countries, conditions may develop in which even enlightened employers fail to enlist the co-operation of their workers; tense relations and industrial strife usually have a long history and are generally concentrated in particular industries or areas. Most of the under-developed countries have no such histories and the bulk of the labour force has no industrial tradition, as it is drawn predominantly from agricultural occupations. Unions are often, though by no means always, weak. Action to develop sound labour-management relations resulting in proper motivation of workers lies squarely on the shoulders of employers and management. The history of industrial relations in the more advanced countries suggests that unless this opportunity is seized and made use of at the start, industry may have to contend with continuing non-co-operative attitudes of labour in an atmosphere of bitterness and suspicion.

The task of overcoming managements in under-developed countries, including managements of public enterprises, of this important truth is not always easy. The predominantly commercial and financial outlook of many industrialists tends to make them consider labour as just another commodity whose services are to be bought as cheaply as possible. Where the industrialist has a land-owning background, he may tend to think of his workers in almost feudal terms, and, although he may give them greater recognition as individuals than employers of other types, he may be prompted to impose his will as a right and to expect unquestioning obedience. Other traditional attitudes stemming from caste or class tend to make relations between managers and workers difficult and distant.

The first impressions which an employee receives of a plant where he is hired may condition his outlook towards his employers for the whole duration of his stay. In most industrially advanced countries, induction procedures have become an accepted technique of personnel management, but in under-developed countries little is done in any but a minority of enlightened enterprises to help the new worker to adjust himself to his surroundings or to explain to him the workings of the enterprise and his role in it. Yet most countries in process of industrializing are faced with the problem of integrating into industry workers who hitherto have had no contact with it and who have lived in remote rural areas. Although there is some awareness of this problem, it does not seem to have greatly impressed the people most

Learning the use of a jig-boring machine in a machine-tool factory at Ambernath, India

concerned with the issue. Indeed, many employers in under-developed countries do not see it at all.

The transition from an agricultural way of life with its varied tasks and self-imposed disciplines to the regimentation of industrial life is usually very abrupt. It is made harder if the worker has to leave his home to live in a city, usually under conditions depriving him of the social satisfactions which would offset the frustration and unhappiness of his working hours. In particular, the move from a small society in which, poor as he may be, he has a recognized status and is accepted as an individual, into one in which he becomes a mere cipher is likely to set up psychological tensions and to be the cause of deep discontent. The well-known phenomena of high labour turnover, prolonged absenteeism and occasional apparently irrational acts of violence—which are to be found in industry in under-developed countries—may well be due to failure on the part of both workers and management to provide for a proper adjustment to the new conditions.

It may be of interest to note that the Yugoslav system of management of enterprises through an elected com-

...ittee drawn from all classes of workers (and in larger ...erprises, subsidiary shop committees) seems to offer ...he newly arrived peasant the type of consultative ...echanism with elective rights not essentially different ...om the social organization to which he is accustomed ...n his own village. While it is appreciated that this ...springs from a basic political philosophy at variance ...with those of many other countries, a study of the system ...s it relates to the integration of peasant labour into ...industry might offer some ideas relevant to the solution ...of this problem elsewhere.

Working conditions affect not only the motivation of the worker but his very capacity to do his work. The conditions in most industrial establishments in the countries under discussion, especially in the smaller plants, are such that the worker simply cannot perform with full effectiveness, even if he would. Anybody who has made visits to factories in tropical countries has been able to see workshops with little or no ventilation, weaving sheds wet with live steam, lack of drinking water and, often, hopelessly inadequate working space. Workers sit in rows outside the buildings, shunning themselves from the work-place in order to keep cool. Good working conditions are a prerequisite to any attempt to improve methods of work or to install incentive schemes.[4]

The report of the ILO meeting of experts on industrial and human relations[5] lists a number of measures which can be taken to influence relations within the enterprise and to raise morale. Some of these—for instance, incentive schemes—require highly trained staff for their effective application, and steps should be taken in underdeveloped countries to ensure that adequate facilities for training such staff are available. Whatever steps are taken, this should be done in consultation with the workers or their representatives. Consultation at all levels is something which can be undertaken without specially trained staff. Workers in under-developed countries have the same basic attitudes as workers anywhere else, and are more likely to co-operate with management if the reasons for management action are explained to them. An example of this is provided in the report of an expert sent by the International Labour Organization to undertake training in work study and industrial engineering in the transport workshops of an Asian country. It was his constant practice, as a first step, to call together management, supervisors and workers' representatives and to explain what he proposed to do and why. Before any technical improvements had been introduced in the shops, a marked rise in output became noticeable. Questioned on this, the union secretary stated: "We were enabled to understand the reasons for many things for the first time; we explained these reasons to the workers and they accepted them where they had formerly been hostile." It is quite possible that in this case the procedure used by the outside expert was more useful because he was trusted by the workers. This points to the fact that it is of little use for management to attempt joint consultation unless it is prepared to do so sincerely and is ready to carry out any promises made. Broken promises to workers would permanently impair relations within the undertaking.

Effective motivation depends largely on a proper attitude of top management towards labour and upon the transmission of this attitude through middle management to supervisors. The frequent failure of the Training Within Industry Job Instruction programme in many undertakings can be directly traced to the fact that the attitudes and behaviour towards subordinates taught to supervisors under this programme were not duplicated in the behaviour of their own superiors towards them. The fact that enlightened attitudes towards employees yield improved efficiency has been demonstrated by advanced firms in all countries. Unfortunately, in too many cases employers fail to realize this fact or lack the energy to act on it. The failure of Robert Owen over a century ago in Great Britain to convince his fellow employers of the necessity of good management labour relations is still repeated everywhere today.

Indian workers rolling latex in a small rubber factory established on the plantation

In conclusion, success or failure in labour management relations rests entirely on the attitudes to one another of the parties concerned. There exist many techniques in the field of personnel management which may be used to better these relations and to improve the effectiveness of the worker in the enterprise. Great care must be taken in all personnel matters not to attempt to transpose directly management attitudes or techniques evolved in the more industrially advanced countries to under developed ones without taking into account differences in tradition and culture. They must be adapted to local requirements and combined with the best to be found in each country. Since employers and top managements generally hold the economic power, their attitudes are crucial. Governmental action through legislation and control is necessary in certain fields, but, to be fully effective, it requires the co-operation of management and workers. Attitudes can be changed only if the problems involved are fully understood by all concerned and the advantages of introducing change clearly seen. Continued education at all levels appears to be necessary to bring about satisfactory solutions to these problems.

[4] In a recent ILO publication, *Introduction to Work Study*, ...ecially written for training purposes in under-developed coun... a special chapter is devoted to this subject.
...see footnote 1 to this article.

Business Leadership in Under-developed Countries

Sociological and institutional aspects

BY CHANDULAL N. VAKIL

The aspect of this article is to draw attention to certain sociological and institutional factors which tend to affect the supply and composition of entrepreneurial and managerial personnel in under-developed countries. This is a broad field of enquiry and many questions arise within its context: Is the prevailing social and institutional atmosphere conducive to providing the community with the required quantity and quality of business leadership? Does business leadership in under-developed countries differ substantially from that in the developed countries, as regards structure and performance? To what extent is performance—both individual and group—dependent on factors beyond the control of management? In other words, to what extent is it constrained by pressures, frictions and rigidities arising on account of institutional and social factors? Is poor performance a reflection or a cause of backwardness? To what extent can the situation be remedied through action by business leaders, the State or public or private agencies? To provide an answer to these questions, much research in hitherto little-explored fields is necessary. This article is confined to a preliminary investigation of some of the factors having an inhibitory effect on business leadership, with special reference to conditions in India.

Mr. Vakil, an Indian economist and sociologist, Director of the UNESCO Research Centre of Calcutta and Director and Professor at the Bombay School of Economics and Sociology of the University of Bombay, participated in the Panel of Experts in Industrial Management in Under-developed Countries held at United Nations Headquarters in the autumn of 1957. This article is a revised version of a paper which he submitted to the Panel.

BUSINESS LEADERSHIP

Managers, entrepreneurs and innovators

In discussions concerning business leadership, the three terms—*manager, entrepreneur* and *innovator*—are sometimes used synonymously. By and large, the same conditions influence the supply of entrepreneurial and managerial personnel and therefore that of innovational talent. However, innovation as such should be clearly distinguished from the performance of managerial and of entrepreneurial functions. Professor Schumpeter conceived of innovations as including the introduction in the economy of new factors, new products, new methods of production, new sources of supply, and the creation of new sources of demand. Essentially, innovation

present the introduction of new production functions by new business leaders or entrepreneurs. Older established firms are as a rule less inclined to innovate; they are accustomed to routine and are reluctant to take the risks involved in large changes. In the Schumpeter system, the process of economic development is characterized by the rise and fall of firms and of business leaders; the entire complex of the phenomena of development and business cycles is linked with innovation, and the innovator is the hero—albeit a tragic one—of the drama of economic dynamics.

Many economists recognize that Schumpeter's picture of development contains certain essential and relevant factors but consider that less emphasis should be given to the role of the innovator. They point out that various types of business leaders and firms participate in the process of development; that established as well as new firms play a role therein; that all developmental changes need not be big and spectacular, nor far-reaching in character and impact. In this different light, the distinction between a successful manager or entrepreneur and an innovator becomes one of degree rather than of kind.

Requisites of efficient management

It is not easy to define efficient business leadership.[1] Some qualities associated with it lend themselves better to empirical than to analytical definition. Among them is the maintenance of a high level of performance. A business leader having this quality—which can be appreciated only by comparison with prevailing standards of performance—is able to keep a footing of equality with competing firms. Another quality is the capacity to adapt the firm's operations continuously and successfully in the face of changing internal and external conditions. This requires a sense of perception and a strong degree of resilience and points to the dynamic character of business leadership requirements. Then there is a capacity to take what might be termed "calculated risks", a quality of pioneering and innovation, involving a willingness and a capability tempered by caution to venture along undertrodden paths. A firm may have to contend with opposition from other firms, with obstacles raised by social interferences of various sorts—in particular, prejudices and biases which might hinder its expansion and block its markets—and sometimes with hostile attitudes from the government itself. The behaviour and mode of action of a pioneer are frequently such that they tend to upset the atmosphere of complacency and stagnation, not merely within his own firm but also within the wider economic environment with which he comes in contact. Not only does he meet obstacles when attempting to translate his ideas into action, but he may expose himself to latent and even open hostile reactions. It is perhaps this quality of pioneering which is particularly scarce among business leaders in under-developed countries.

Effective leadership is not merely a matter of contributing to the economic and financial fortunes of the leader's own firm. The task of business leadership has increasingly to be performed in the context of a socio-political atmosphere permeated with a high degree of social consciousness. Business practices and methods are increasingly subject to scrutiny by the government and the public, not only from a strictly legalistic standpoint but also from the point of view of ethics and social values. The standards of evaluation of business leadership largely rest on the contribution which it makes to the social needs of the community.

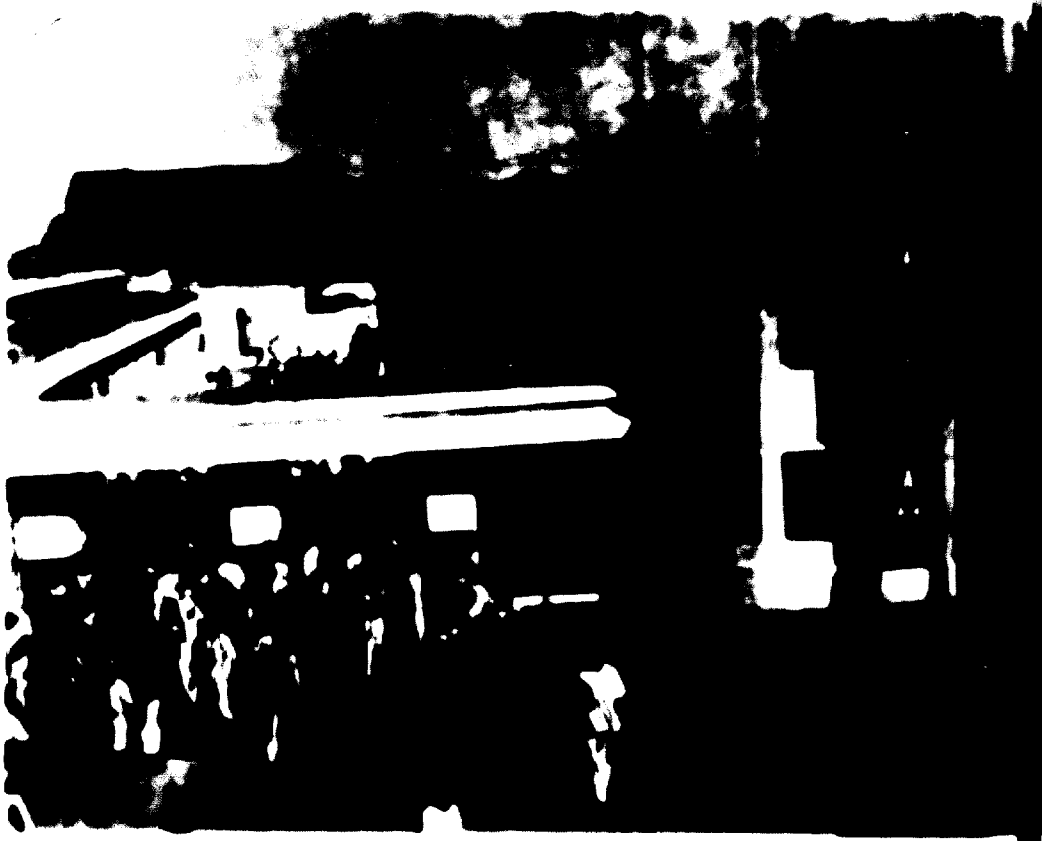
It is a gross oversimplification and a hardly acceptable general proposition to say that under-development is caused by lack of business leadership of an appropriate type, although, within limits, effective business leadership might raise the rate of economic growth and might help overcome certain obstacles to economic development; it is far, however, from being a panacea. Nor is it correct to contend that business leadership in under-developed countries is intrinsically of "inferior" quality; it has often the developed countries a long time to evolve suitable business standards and refined social viewpoints. Also, it is hardly proper to assert that a low level of business performance is due to moral deficiencies in the personalities of the business leaders; such a view tends to confuse symptoms with causes and surface phenomena with deep-rooted motivating factors. While it is not proper to consider deficiency in business leadership as a central limiting factor, neither is it appropriate to ignore or minimize a certain number of institutional and sociological deficiencies inherent in the structure of the under-developed countries. In a concerted programme of economic development designed for a simultaneous attack on various inhibiting factors, a specific remedy must be found for each major deficiency. These ideas must be kept in mind if an answer is to be given to such questions as: What forms of business leadership would be the most appropriate for a given country? What measures might be adopted for improving business leadership? How could knowledge of these techniques be disseminated? What social values should be kept in mind in attempting to improve business leadership?

STRUCTURE AND CONSTITUTION OF MANAGERIAL PERSONNEL IN INDIA

To generalize about the problem of business leadership is hazardous under any circumstances, all the more so in the case of management in under-developed countries. Ideas may be gained by discussing business leadership in a narrower context; in what follows, a few indications will be given concerning the structure and composition of entrepreneurial and managerial personnel in India.

In that country, entrepreneurial as well as managerial personnel are drawn mainly from certain castes. Thus, the dominant groups in Indian industry and business

[1] See P. B. Brahmanand and C. N. Vakil, "Technical Knowledge and Managerial Capacity as Limiting Factors on Industrial Expansion in Under-developed Countries", in *Economic Progress*, edited by Leon H. Dupriez, Institut de Recherches économiques et sociales (Louvain, 1955).



End of the working day at the Tata Iron and Steel Company (TISCO) in Jamshedpur, India

are the Marwaris of Rajasthan, the Gujaratis of Gujarat, the Chettiars of Madras, the Sindhis of the former Hindu community of Sind, which is now part of Pakistan, and the Parsis.

The key positions in business and industry are generally obtained on the basis of family status rather than by recruitment from outside sources or by promotion of personnel who are not members of the families in control. These leading families have wide interlocking interests. Besides caste and family connections, marriage is a means of entry into leadership groups, but it is restricted by widely prevalent traditions and customs which rule out infusion of fresh blood. Leading business and industrial firms in different regions are linked by family relationships, and competition between enterprises is frequently based on rivalry between different families owning or controlling firms or groups of firms.

The most important source of finance for the growth of business is internal accumulation. Not only are credit institutions still few and little developed, but it is next to impossible for outsiders, whether individuals or firms, however enterprising they may be, to obtain from these institutions large credits for long periods. The concentration of financial resources within particular closed groups thus creates additional obstacles to the inflow of newcomers into industry and trade.

In spite of these obstacles, breaches have been made in recent years in the entrenched position of family concerns and their tightly knit management structure. This change is mainly due to the accelerated rate of industrialization, which calls for diversified abilities and, above all, for trained talent. Population growth is another factor, inasmuch as it exerts a pressure for greater inter-occupational and inter-regional mobility. Fewer employment opportunities and lower earnings in traditionally "superior" caste occupations cause the more ambitious members of these castes to shift to new occupations. Limited as they may be, the facilities for credit provided by newly established credit institutions also make possible the establishment of some new ventures by "outsiders".[1]

The characteristic form of organization of the entrepreneurial personnel in India is the joint family management. In large firms, it takes the form of the managing agency system. A managing agency firm consists as a rule of a group of relatives. Its continuity is ensured by succession to partnership of sons or sons-in-law of the original members, who often become partners during the lifetime of the latter. The managing agent combines the functions of promoter, financier, and controller of the joint stock company of which he is in charge. He controls the policy of the company, as he nominates the board of directors—formally elected by the shareholders—and he also conducts the company's day-to-day administration. He controls the shareholders' meetings, where he and his associates hold the voting power. He usually provides the necessary capital investment and working capital. His dominant position is secure.

The following two examples illustrate the types of organization prevailing in Indian managing agency

[1] See C. N. Vakil and P. R. Brahmanand, *Planning for an Shortage Economy* (Bombay, 1952), pages 226 to 274.

firms. In one leading firm, a parent company controls another large concern and a holding company. The former is itself managing agent of a number of other companies. Each of the directors of the concern is in charge of one or several of the controlled companies and is expected to act as an adviser in his special field for other companies as well. Among the companies controlled are iron and steel works, mechanical industries, cotton mills, oil mills and chemical plants. Directors are paid on a salary basis, but some of them are given a fractional share of the commission accruing to the managing agency firm; the managed companies themselves do not bear the cost of this top managerial staff. Each top director is assisted by executives employed by the managing agency, as well as by the managerial personnel who are on the payroll of the controlled company. There is a second-line management structure consisting of executives with well-defined functional responsibilities.

Production is taken care of by a manager, office administration by a secretary and accountant, marketing usually by a superintendent of marketing, and purchasing by another officer; all are directly responsible to the director in-charge. In the case of big companies controlled by the firm, there is usually also a technical adviser. On the whole, there is considerable delegation of responsibility in the firm, and the day-to-day administration and decision-making is carried out at the second executive level without interference from the top. Appointment to all posts is made by special committees with the assistance of executives representing the companies concerned; directors do not sit on such committees. Higher executives are appointed by directors, preference being generally given to promotion of persons from lower echelons. The organization of personnel and the management structure are in this case rigidly defined and there is little room for personal interference.

In another leading industrial group, a private company controls a managing agency firm; these exercise jointly the financial control of a great number of other industrial concerns. There is considerable diversification of investment in this group, which controls such industries as jute, rayon, paper, soda ash, calcium carbide, and air-conditioning equipment. The group is family controlled, and the directorate includes hardly any outsiders. The overall control of each managed firm is entrusted to one or more members of the large family: several brothers, and sons and sons-in-law of each. The top executives of each firm or group of firms managed by them are appointed by the directors. While operational duties are in the hands of managers, secretaries and similar officials, responsibility in this group is largely concentrated in the hands of the directors and top executives. The personnel organization is fluid and the personal element is present to a high degree in staff management.

Most large Indian firms under the managing agency system present features similar to those described above. A few local groups, however, have somewhat different set-ups. For instance, one family-controlled managing agency, which today has a large stake in Indian cotton mills as well as in the manufacturing of starch, dyestuffs and pharmaceuticals, started out by obtaining a substantial proportion of its capital in the form of "deposits" from shroffs (indigenous bankers). The cotton

Car bodies receiving the final coating of paint at the Hindustan Motors, Limited, Calcutta

mills were primarily financed with these resources and their paid-up share capital remained very small. Some of the depositors eventually received shares in the managing agency concern, which thus includes a number of sleeping partners not belonging to the family.

With few exceptions, one of which was described above, decision-making is highly centralized in managing agency firms, and the senior partners usually maintain a close watch over day-to-day affairs. This method, which is sometimes called the *pedhi* (small firm) way of controlling business, is generally possible only when the agents restrict the scope of their business to a few lines. Delegation of responsibility is usually associated with higher diversification.

A different managerial set-up exists also in certain industries subject to government controls, for instance, in the cement industry, where prices are government-controlled and trading is a State monopoly, or in steamship companies, which have to depend to a large extent on government loans and subsidies. A recent trend in these industries has been to employ former Indian Civil Service officers as top executives, in order to take advantage of their experience in government administration.

The system of family management, though not unique to under-developed countries, has a special significance when it is a dominant feature of a stagnant or slowly growing economic system which allows little scope to enterprises of a corporate type. As a rule, the family management system does not provide a sufficient number of suitable positions for all members of the family; on the other hand, the remaining members are discouraged from seeking employment outside the family firms. This tends to increase the ratio of dependents to earners in the family. Even where employment is given to members of the family, often it is either unproductive, or could be filled by better outside candidates. Excessive dependency reduces the saving capacity of the family as a group, while overstaffing and incompetence lead to inefficiency. The parental authority basis of the system makes it difficult for the younger men to develop qualities of leadership; the atmosphere of security breeds complacency and unwillingness to exercise initiative. A feeling tends to develop that any problem can be solved through assistance provided by the family.

While the managing agency system has done its part in establishing modern industry in India under British rule, its weaknesses have long been apparent. In recent years, some steps—for instance, the Company Law Amendment Act and the Company Administration Law—were taken by the Government to regulate and curb the activities of the managing agent. Many of the managers concerned fear that the future will bring further and greater restrictions on their freedom of action to the point where the system is bound to disappear.

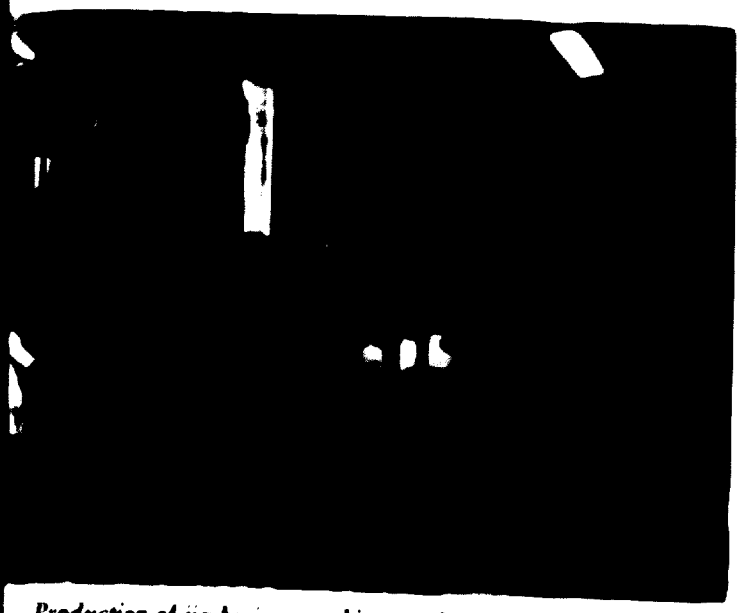
In the early days, when firms were relatively small and the relationships between them were few and simple, the system could perpetuate itself without exerting a too debilitating effect on management efficiency. This is, to some extent, still true today for many small-scale enterprises. However, for large-scale firms which have to steer their way through the increasingly complex network of industrial relationships involving their sources of supply of raw materials, factors of production, credit, and outlets for their products, and have to maintain their position in wider and increasingly competitive markets, the situation is quite different. It is the increasing complexity of the managerial functions required today, and the spur of competition, perhaps more than the measures of restriction taken by the Government, that doom the system of joint family management, at least as regards large establishments.

As a result, aside from government action, some correctives have been taken by the firms themselves. Several business families are discouraging the dependence upon family for recruitment of the management staff. Various types of training on the basis of caste or even sub-caste have been devised, and business leaders are gradually realizing the importance of education as well as of intensified training within the firm. But, by and large, there is still room for adequately recognizing the need to infuse fresh blood and talent into business. One difficulty is that, as mentioned earlier, in India, even today, the methods of granting credit as well as the terms under which it is offered are not conducive to the development of an enterpreneurial class which would be independent of family or caste. The main obstacle, however, arises from the fact that caste and religion are still major factors which make for strong cohesive forces within the family and prevent entry of "outsiders".

The hold of caste, religion and custom

There is no doubt that caste and religion still play a major role in shaping the occupational structure in India. Although urbanization, spread of education, growing contact with the institutions and ideas of the West, and new developments in the legal, political, and constitutional fields are slowly undermining these barriers, considerable time will pass before the influence of the caste and religious system is reduced.

It is well known that the caste system creates a powerful obstacle to moving from one occupation to another and, to some extent, from one region to another. Under this system, birth rather than education or talent determines eligibility for particular occupations. This results in large and lasting inequalities in income, which tend to grow in the course of time. Along with the caste system there developed certain social attitudes influenced by religious beliefs which gave rise to occupational taboos. Some professions came to be thought of as "superior", some less "high", and some "inferior". Business occupations were not considered to belong to the "superior" category. It was adjudged below the dignity of the highest castes—whose role was essentially to spread knowledge—to enter industry or trade. Thus, a chasm developed between educational competence and occupational skill. This was not a serious drawback as long as effective performance in trade and industry did not demand an extensive background of general and tech-



Production of jig-boring machines at the Hindustan Machine-Tool Factory, Bangalore, India

Class of trainees in a workshop of a machine tool factory at Ambernath, India

nical knowledge; with the more complex requirements of the industry of today, the acute shortage of trained talent has become a problem of national importance.

Another obstacle of a social nature is raised by the inheritance system, the most prevalent form of which, in India, leads to fragmentation of ancestral property. This dampens the initiative and enterprise of members of the family and is unfavourable to their financial capacity. In the case of agriculture, the economic effects of the inheritance system are nearly catastrophic.

Among other inhibiting factors might be mentioned the social and religious prejudices against interest, which retard the growth of capital accumulation. Religious restrictions on sea travel, or attachment to particular locations or areas, tend to impede mobility and reduce the opportunity for enterprise. Finally, the subordinate social status assigned to women is a serious limiting factor upon the supply of latent talent.

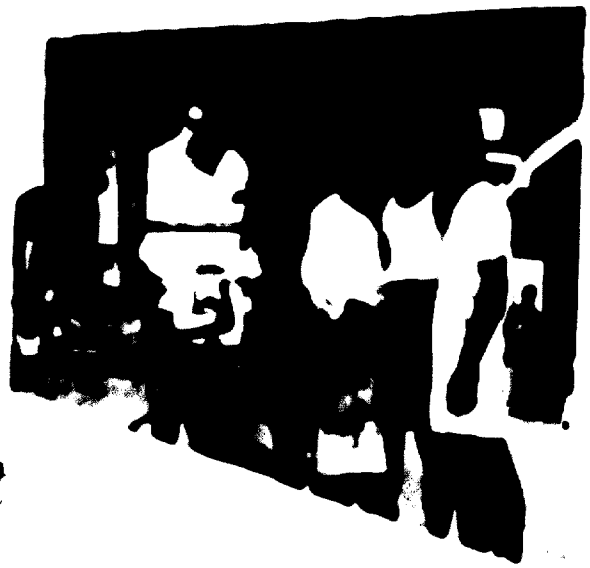
•

To summarize the foregoing, while there is need in India, as in other countries, for making available the best talent to carry out entrepreneurial and managerial functions in a way conducive to economic growth, there are considerable difficulties in achieving this because of certain structural characteristics of the society. Prior to India's independence, these difficulties were compounded by an institutional set-up imposed by the ruling country, which concentrated the major economic functions in the hands of its own nationals; at that time, the best talent available in India devoted itself largely to the struggle for independence rather than to economic endeavours. Despite considerable handicaps, indigenous enterprise still succeeded in developing various industries even in that period. In the decade which has elapsed since India became an independent country, great strides towards expanding and diversifying industry have taken place; these point to the changes to be achieved in the future.

It will take a long time to break up basic attitudes, traditions and conventions. In the short run, the problem is one of providing those in family enterprises who possess the financial means with the other resources which they usually lack, namely, education, training and experience. The younger men in industry—and also in banking and finance—should get sufficient general education and some specialized technical knowledge in their fields of activity. Education should be supplemented with experience gained by training periods in various occupations within the firm. This should be carried out in such a way that no preferential treatment is given to trainees with family connections; any such practice would vitiate the object of the training. On the other hand, taking young men away from the sheltered atmosphere of the family firm and training them outside the narrow managerial circle would ease the break with traditional practices. These preliminary steps will facilitate the next task of recruiting managerial talent from outside the family.

In the long run, action should be directed at removing the rigidities which contribute to maintain managerial and entrepreneurial performance at a low level. It is not enough, in order to improve performance to the degree and on the scale required, that educational and training facilities be increased and that a few large enterprises provide executive employment to competent "outsiders". Adjustments are called for on the part of the various caste groups participating, in managerial, technical or financial functions, in the productive process. Such adjustments as allowing intermarriage between members of different castes and providing employment opportunities in executive positions regardless of caste would constitute a major breach in the caste system. Above all, these adjustments call for profound changes in attitudes. While economic progress will in due course build up pressure for such changes, further legislative measures of the type already introduced by the Government would accelerate the transition.

United Nations expert explaining to Korean workmen how to operate and maintain a diesel generator



Some Problems of Industrial Management Reported by Technical Assistance Experts

A considerable amount of information on problems facing management of industrial enterprises in under-developed countries is contained in the reports of experts sent under the United Nations technical assistance programmes to advise Governments on industry. This information is included not only in reports by specialized management advisers, but also in those of experts in the general field of industry—production engineers, industrial economists and marketing research specialists—who, in the course of their work, dealt with one or another aspect of management.

The material presented in this article was gathered by the United Nations Secretariat in the course of preparing one of the background studies it submitted to the Panel of Experts on Industrial Management which met at United Nations Headquarters in October 1957. While the findings of the background study have been taken into account in preparing the Secretariat's report, based on the discussions of this panel, *Management of Industrial Enterprises in Under-developed Countries*,[1] some of the factual material thought to be of sufficient general interest to deserve separate publication. The selected material presented below relates to the following important management problems: structure of management, managerial policies and practices, maintenance and repair of equipment, and marketing.

The reader will bear in mind that management of industry in under-developed countries has to operate within a largely unfavourable environment, particularly as regards availability of economic and social overhead facilities which provide for the so-called external economies, of an adequate credit and fiscal structure and of responsive public services. While these elements of the management problem—which, taken together, constitute the "climate" of industrial operations in under-developed countries—are beyond the scope of action of individual enterprises, they are obviously prerequisites for good management; in fact, for the process of industrialization itself. It is in this context that the management performance described in the following pages should be viewed and appraised.

It should be borne in mind that where experts have failed to take fully into account these peripheral elements, they may have tended to be overly critical in their evaluations, also that the nature of the material covered in this article lends a certain bias to the picture of the over-all performance of management in the industry of under-developed countries; clearly, the advice of technical assistance experts was sought only in those cases where particular problems had arisen.

STRUCTURE OF MANAGEMENT

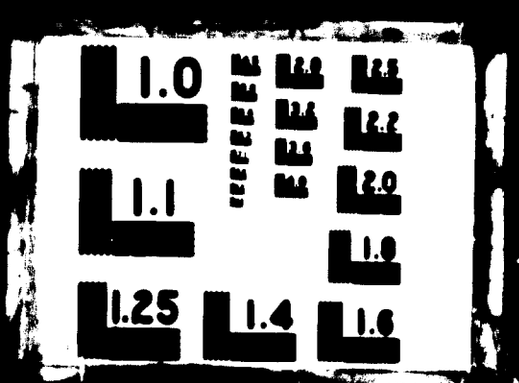
In the larger establishments visited by technical assistance experts there seemed to be, on the whole, no striking departure from organizational patterns found in comparable establishments in the developed countries. However, in many cases it was noted that the definition of functions and the allocation of responsibilities among different departments were not clearly established, and thus tended to bring about an accumulation of unrelated duties and overlapping. Thus, in a group of enterprises in one country, the sales field offices were entrusted with a multiplicity of duties ranging from legal representation to procurement, which placed excessive work loads on the sales personnel to the detriment of their sales responsibilities. In another enterprise, the experts noted an accumulation of production and administrative responsibilities in the maintenance department. One

[1] United Nations publication, Sales No.: 58.II.B.5.

74.10.10

2 OF 2

05419



versely, engineering responsibilities were often found scattered among a number of departments, even in plants where the size of the enterprise and the magnitude of the task justified a concentration of such functions under a chief engineer.

Experts also found in many cases a lack of delegation of authority by top management which resulted in excessive "spans of control." In a large iron and steel works, a variety of minor problems of production and development were referred for decision to the general manager and his deputy, absorbing a large proportion of their time. The expert recommended decentralization in the form of the appointment of a chief of production and a chief engineer to take over the respective areas of management.

Excessive span of control was observed in a fertilizer plant in one country, where nineteen executives were reporting directly to the general manager. The technical assistance adviser recommended a reorganization which included the appointment of a deputy to the general manager, the grouping of departments according to major functions, and the reduction of executive posts to eight.[2] A unit in charge of co-ordination and planning was to be set up, under the direct authority of the general manager or his deputy, to handle inter-departmental issues and assume the functions of performance control.

A number of reports dealt with the organizational problems of publicly-owned enterprises. In one country, a corporation owned and controlled by the Government, engaged in the production of chemicals, was run completely as a government department in spite of its formal autonomy; the secretary of the government department concerned was chairman of the board of the corporation. The relationship between the board and the general manager had not been properly defined, nor had their respective responsibilities and functions been clearly established. Day-to-day operating problems were referred to the ministry with consequent lengthy delays in decisions.[3] Similar situations were found to exist in other countries where publicly-owned undertakings were directly subordinated to government departments. In one case, the efficiency of the enterprise was adversely affected by interference from a number of government offices. In all such cases, the expert recommended that the management should be reorganized, with appropriate boundaries between its functions and responsibilities with respect to public ownership and those with respect to the enterprise itself.

[2] The nineteen executives were in charge of the following departments: production, maintenance, tooling, power plant, chemical, gypsum development, technological, performance control, stores, purchase, rail traffic, automobile transport, accounts, training, personnel, medical, technical services, public relations and administration. The reorganization reduced the number of executives to eight, in charge, respectively, of production, engineering, traffic, research and development, finance and accounts, personnel, administration and public relations.

[3] As an example of excessive centralization of authority, it was found that, in one government enterprise, the accounting department was responsible directly to the ministry concerned. In another enterprise, the chief accounting executive had veto powers on operating matters, and was empowered to reverse decisions of the general manager.

MANAGEMENT POLICIES AND ORGANIZATION OF INDUSTRY

One of the characteristics frequently noted by technical assistance experts was the propensity of management to operate industrial enterprises in accordance with practices developed in non-industrial activities. This tendency gave rise to a number of major weaknesses. In one case involving a plastics manufacturing concern, the factories were run by men who were primarily interested in the commercial side and who had only a limited understanding of production problems. Little attention was given to such matters as design and quality of equipment and products, organization of production and production planning; testing and inspection of the products were practically non-existent.

In other cases cited by experts, the organization and operation of the plants reflected a lack of long-range approach. In one country, textile manufacturing had been established shortly before 1940 and had grown rapidly during the war and in the immediate post-war period, but in a haphazard way. The equipment of the plants had come to include a large proportion of heterogeneous and obsolete *matériel*, and no effort had been made to develop a skilled labour force or technical personnel. In spite of the high quality of the raw material and the low wage rates, production costs were twice as high as in similar plants in the industrial countries. The expert noted that management had failed to take any of the long-range policy measures which would normally be expected in the circumstances, such as providing sufficient reserves for replacement of worn-out and obsolete equipment, upgrading skilled workers, and developing a trained force of foremen, technicians, engineers, accountants and marketing specialists.

In a textile centre in another country, high wartime demand resulted in setting up small spinning mills—of about 5,000 spindles each—to supply yarn to the weaving industry, which consisted entirely of handloom establishments. Recently, the demand for handloom products has declined, and the demand for yarn has diminished accordingly. Furthermore, the small spinning mills found themselves faced with competition from newer and larger integrated spinning and weaving mills erected elsewhere in the country. However, as in the case cited above, no provision for modernization had been made by management and no reserves set aside during the period of prosperity in the industry, which would have made it possible at least for some firms to develop into integrated mills of an economic size, capable of sustaining effective competition. Rehabilitation of the mills could not be achieved in this case through improvements in organization and management alone. In the expert's opinion, only a few plants could be salvaged at the cost of extensive financial assistance; most of the plants were obsolete and inefficient and could be expected to be eliminated in the course of time.

Another characteristic feature of management behaviour noted by experts is the lack of communication be-

tween entrepreneurs. Many experts have commented on the reluctance of owners and managers—of large as well as small plants—to exchange information and experience with a view to pooling their resources, or to undertake concerted action to deal with common industry problems beyond the control of individual enterprises. As the authorities could not be expected to assume responsibility in all cases for dealing with such problems, the experts stressed the necessity of stimulating the interest of manufacturers in a collective approach to their problems, for instance, in the form of industry associations. To cite an example, in one country, lack of technical knowledge, primitive production facilities and poor organization in many small food-processing factories resulted in poor quality and low volume of output. Several uncoordinated plans were proposed for their expansion and modernization, involving public or private investment in the industry. As an alternative to a costly programme of investment in new factories, the expert suggested that a series of corrective measures should be taken jointly by public development agencies and existing plants. These included strengthening professional industry associations and establishing a joint committee of representatives of government and private enterprise to deal with the common problems of the industry.

Another problem in industry organization noted by the experts was extensive diversification of types of goods produced and lack of specialization. In the first case, many varieties of the same goods are produced by the plant on a job lot or custom basis; in the second case, a multiplicity of different articles are produced by the same plant. Both cases reveal overcrowding in the industry, a low level of operating efficiency, wasteful use of labour and equipment, and higher costs. These conditions were appraised by the experts as reflecting more deep-seated maladjustments, such as low levels of demand and primitive distribution and marketing organization. The recommendations of the experts in this field were directed at overcoming the problem at the source and aimed at bringing about more orderly conditions in the industry, in some instances by means of joint action of the kind mentioned above.

MANAGEMENT OF PHYSICAL FACILITIES: MAINTENANCE AND REPAIR

Considerable attention has been given by both management specialists and engineering experts to management of production facilities in industrial enterprises. Numerous examples could be cited of problems encountered by experts in such fields as organization, control and coordination of industrial and commercial operations, selection of equipment, plant design, supply of raw materials and quality control. These problems are essentially similar to those arising in industrial enterprises in any country, developed or under-developed, and involve principles and practices of conventional industrial management.

It may be useful to discuss briefly under this heading one particular problem in management of physical facilities—maintenance and repair of equipment—which appears to be often neglected in industry of under-developed countries.[4] As stated in the report by the United Nations Secretariat referred to above,[5] "because of inadequate maintenance, industry in many under-developed countries suffers from an unduly high rate of depletion of capital assets and a chronic waste of productive capacity which even economically stronger countries could hardly afford". A few examples will serve to illustrate this problem.

Many experts have stressed neglect of maintenance as an important cause of chronic under-utilization of equipment and low quality of output. Many instances have been cited of equipment being allowed to deteriorate beyond repair and having to be replaced. In a typical case, a technical assistance expert who was advising the management of a recently established large-scale chemical enterprise, noted that defective maintenance had been the main cause of declining output. Among several corrective measures, he suggested that the maintenance department should participate in staff conferences on production and costs, so that maintenance could be carried out with the full understanding and co-operation of all concerned. He recommended that management should give considerable attention to the provision and proper scheduling of spare parts and supplies. Finally, he noted that, whereas the production staff had been trained abroad, this had not been the case with maintenance personnel, and he recommended on-the-job training for them.

Many experts showed considerable interest in establishing joint maintenance facilities to serve the needs of several co-operating plants. While some of these schemes were proposed with a view principally to meeting the requirements of small plants, there were projects of wider scope. Thus, in one country, a few multiple-plant enterprises set up central mechanical shops to service their affiliated factories. In another country, a central repair shop was established to service several textile plants located in the same area, and to replace small, individual maintenance shops. A survey indicated that such a central shop offered the advantages of greater capacity, higher work standards, and better quality and lower costs as a result of improved techniques and methods of organization and control.

A number of experts dealing with the closely connected problem of spare parts noted instances of new factories, furnished with imported equipment, being set up without a single spare part in stock. There were long delays in deliveries of parts, particularly since importers were often reluctant to maintain large inventories; on the other hand, very limited stocks of parts were kept by the plants themselves. In one such case, the expert recommended that the public development institution should not extend credit to new enterprises unless they met minimum standards in regard to spare parts inventories. In many countries, the spare parts situation

[4] See, in this connexion, United Nations, "Capital Intensity in Heavy Engineering Construction", *Bulletin on Industrialization and Productivity*, No. 1 (Sales No. 58.II.B.2).

[5] *Management of Industrial Enterprises in Under-developed Countries*, paragraph 84.

was adversely affected by shortages of foreign exchange and by lengthy delays arising from inefficient and cumbersome administration of import controls; applications for imports of parts often involved unduly long and complex administrative procedures. An extreme case was noted by an expert who reported that, in the country he advised, it was easier to obtain an import licence for a new machine than for a supply of spare parts involving a fraction of the cost. Many experts advocated greater flexibility in the administration of import controls on spare parts and other essential supplies for industry.

MARKETING AND DISTRIBUTION

Generally speaking, less attention has been given by United Nations experts to problems of sales and marketing than to those of management of production facilities, the main reason being that relatively few requests have been made by Governments for technical assistance in this area. Moreover, advice, when sought, has been in relation to marketing of primary products rather than manufactures, in spite of the fact that deficient management of sales and marketing of industrial goods is a great obstacle to the development of industry.

The importance of proper co-ordination of production and marketing was stressed by many experts. One who advised on the establishment of a new fertilizer factory observed, among other things, that because farmers lacked information and experience in using fertilizers, consumption of that product was low. He recommended an educational campaign by means of demonstration plots and experimental stations supplied with imported fertilizers. He also recommended that the industry proceed at once to select and train a sales force. For the purpose of assessing potential demand, he recommended the development of appropriate market research on such data as population, area under crops, characteristics of soil and climate, and crop response to fertilizers.

It has been pointed out by many experts that the problem of evaluating market demand for manufactured goods in under-developed countries is particularly complex because of the dynamic nature of demand in developing economies, influenced as it is by shifts in income and changes in patterns of consumption. In one country where there was a steep fall in demand for one of the basic types of domestically produced fabrics, the contributing factors were found to be a change in style of dress[6] and the appearance on the market of a new and cheaper machine-made cloth. Development of domestic production, particularly of basic industrial goods, could, in itself, have an important effect on demand. Thus, in one country where the entire supply of cement was imported and sold at high prices, the per capita consumption of Portland cement was extremely low. Contractors followed designs and methods of construction which minimized the use of cement, to the detriment of quality. The recommendation of the expert that a cement plant should be constructed was based on the assumption that the availability of a cheaper domestic product would increase consumption enough to justify the proposed volume of output.

As regards distribution, many experts noted that low efficiency and high costs in that sector hindered the growth of markets and the expansion of output. They observed little or no specialization among commercial houses, the usual pattern followed being that of a cumulation in one enterprise of different marketing functions and heterogeneous product lines. In the small-industry sector, many experts noted that the position of the entrepreneurs was frequently weakened by their tendency to rely on their wholesalers to provide raw materials, working capital, and sometimes even long-term investment capital; their manufacturing operations were little more than an appendage to the commercial activities of the wholesalers.

Measures to remedy marketing and distribution problems usually meet with such obstacles at the individual plant level that experts try instead to elicit joint action at the industrial sector level. They advocate establishing producers' organizations, collectively sponsored channels of supply of essential domestic and imported raw materials, joint domestic and export sales organizations and other co-operative schemes as the most efficient means of encouraging, guiding and assisting individual producers. Such organizations can also help to conduct market surveys, maintain quality standards, promote advertising, packaging and related techniques, foster the use of trade names, and disseminate other commercial practices. Co-operation by the government, at least in the initial stages of such projects, is usually recommended.

*

The material contained in this article, which deals with limited aspects of the problem of industrial management in under-developed countries, would perhaps be given better perspective if set against the background provided by the suggestions for early action in selected areas formulated in the report prepared by the Secretariat.[7] These suggestions were considered to lend themselves to immediate practical action by individual entrepreneurs, industrial associations and government authorities, with the assistance, when necessary, of the appropriate international agencies.

> "One aspect of the development of effective management is the transition from personal to functional management. Since the structure of the latter is affected by varying local circumstances, it is suggested that comparative studies be undertaken of typical organizational patterns of industrial enterprises, in both developed and under-developed countries, including the relevant aspects of corporate legislation. In addition, in view of the fact that public participation plays a major role in the development of the industrial

[6] The substitution of skirt and blouse for the traditional feminine costume of that country and the resulting shift to mass-produced factory textiles were due, in part, to a change in mode of transportation—the new attire was more suitable for bicycle riding, which was becoming popular.

[7] *Management of Industrial Enterprises in Under-developed Countries*, paragraphs 127 to 137.

sector in many under-developed countries, there is great need for studies of the structure and functions of management in public enterprises.

"Because of the shortage of managerial talent in newly developing economies, it is suggested that some areas outside the technical professions—for example, civil service, liberal professions, military personnel—might be explored for suitable candidates for managerial positions in industry. It is also suggested that, in designing training schemes for upper-echelon managerial personnel, the needs of such candidates, some of whom may lack technical training, should be taken into account. In this connexion, too, attention should be given to an important source of managerial personnel represented by retired executive and supervisory personnel from developed countries, and, to this end, appropriate registers of available individuals in this category should be established and kept up to date by the international agencies concerned.

"It is further suggested that facilities which exist in many countries for training in technical subjects be expanded to provide, as well, facilities for short-term training of managerial and supervisory personnel in industry, including foremen. Advantage might also be taken of existing bilateral and international fellowship programmes to train management personnel abroad. The related problem of placing managerial personnel in foreign firms for in-company training should be thoroughly explored, including the use of existing international machinery for technical assistance. The needs of smaller enterprises for training in management should be taken into account by Governments in their fellowship programmes.

"In order to assist management in meeting their needs for skilled labour, it is suggested that a manual be prepared for the use of industry, which would describe the nature and principles involved in vocational on-the-job training for unskilled workers.

"To enable smaller firms to make use of the economies of scale in some stages of their production process which could be more efficiently performed by using large and costly special equipment beyond the means of individual enterprises, it is suggested that consideration be given to establishing appropriate common production facilities to service several affiliated plants. The latter arrangement might be combined with the device of industrial estates. The need of smaller enterprises for adequate repair and maintenance facilities might also be met by providing common repair facilities within the same organizational framework.

"In many under-developed countries the low quality standards of industrial output are due to insufficient attention to the technical problems of production, in particular to adequate quality control procedures throughout the various stages of production, from raw materials to finished goods. To meet this deficiency, it is suggested that technological institutes be established to provide advice, guidance and assistance in production problems, including quality control, particularly as regards raw materials. It is suggested that these institutes might be used to conduct systematic research on the utilization of domestic raw materials, assist in drafting, and advise on the use of, standard specifications for raw materials and manufactured goods, and assist in training industry personnel in the use of quality control techniques. The services of the institutes would be particularly useful for smaller enterprises.

"It is recognized that inadequate maintenance practices lead to an unduly high rate of depletion and waste of scarce capital assets in the industry of under-developed countries. The attention of governments and industry is drawn to the urgent need for adopting proper maintenance methods and practices, and to establishing proper facilities for training of maintenance personnel.

"Because of the importance of market research as a tool in guiding the development of industrial production, as regards both existing industries and new industries to be established, and the weakness of existing statistical information for this purpose, it is suggested that governments, in developing their statistical programmes, consider the needs of industry in this field. To facilitate wider adoption of techniques of market research in under-developed countries, it is also suggested that a prototype manual on market research techniques be prepared for general use, which could be adapted by individual countries to fit their particular needs.

"In view of the fact that prevailing inefficiencies and resulting high costs in distribution are a serious obstacle in the development of domestic markets for industrial products, and are thus an important factor in limiting industrial output, it is suggested that governments consider making studies of existing channels and practices in distribution, with a view to analyzing the factors involved and suggesting means for improvement; the distribution problems of smaller firms should, in particular, be taken into account in such studies.

"It is recognized that in many under-developed countries industrial development would greatly benefit by better co-ordination between private entrepreneurial motivation and the public interest, as expressed in government economic policies. This problem is particularly important in cases involving the achievement of specific targets under economic programmes or plans. The co-ordination problem might be approached, in addition to the conventional economic controls, by appropriate measures to guide private production and investment into desired channels. It is suggested that studies be undertaken to explore appropriate measures in this field.

"In order to meet particular needs of small-scale enterprises in various management areas, it is suggested that management service institutes be established on a country or regional basis, the function of which would be to provide services, including training facilities, in such areas as marketing, accounting and other controls, and personnel."

Establishment of Technological Research Institutes in Under-developed Countries

Prepared by the United Nations Bureau of Economic Affairs

GROWING INTEREST IS being evidenced in establishing institutions for technological research to service industries in under-developed countries. Some have been founded under the technical assistance programmes of the United Nations and certain of its specialized agencies, such as the International Bank for Reconstruction and Development. More are likely to be set up when aid under the Special Fund becomes available, as one of the Fund's main functions is to assist in the creation of such aids to development.[1]

The present article outlines some general problems connected with the establishment of technological research institutes and puts forward some suggestions which might facilitate consideration of specific projects. The following discussion takes into account the experience gained in setting up and operating two centres which have been founded with the assistance of the United Nations and certain of its specialized agencies—the Ceylon Institute of Scientific and Industrial Research (CISIR), and the Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI) (Central American Technological Research Institute for Industry). The first is a national institution, the second a joint undertaking of the five Governments in the region.[2]

Since this article is designed to provide general guidance, it does not concern itself with local conditions, even though these may be quite important: the statute and work programme of an institute would evidently be largely shaped to respond to local resources and needs, availability of funds, staff and equipment, requirements of local industry, and national legal and administrative procedures. For the same reason, no attempt is made to compare or evaluate the activities of the above-mentioned centres. However, it has been considered useful to pro-

[1] The Special Fund was established by the General Assembly of the United Nations in October 1958 to provide systematic and sustained assistance in fields essential to the integrated technical, economic and social development of the less-developed countries (resolution 1240 (XIII)).

[2] This article also makes use of an unpublished report on the establishment of industrial research facilities in a far eastern country, prepared by Dr. Francis Godwin, Director of the Ceylon Institute, in his personal capacity.

vide at the end of the general discussion an outline of their history, organization and main activities.

PURPOSES, FUNCTIONS AND STATUS

The general purpose of a technological research institute is to undertake—mainly at the request of public or private bodies, but also upon its own initiative—investigation, research, analysis and testing, and to provide other technical assistance to industry. Its activities are directed towards improving or developing technical processes and methods which may promote the expansion or raise the efficiency of existing industries or permit the development of new ones. This endeavour involves many different types of activities. Thus, a technological research institute may carry on laboratory tests, pilot plant experiments and other types of research in industrial technology; study the use of natural resources; provide industry with technical and economic advice; survey factories to improve production methods, reduce costs, promote quality and other controls, and supply technical supervision of production processes; develop equipment, processes and products for local manufacture and test equipment, materials and products. Also, it may advise banks and investors on the technological and economic merits of manufacturing projects and propose the establishment of new industries; assist Governments in development matters; promote and encourage technical training, and prepare and disseminate technical information.[3]

In view of the resources prospectively available to technological institutes in under-developed countries and, more essentially, because of the needs they are expected to meet, the research they would carry out would be "applied" rather than "basic" and much of it would consist in adapting already known techniques to local resources and needs. However, some basic research invariably becomes involved in such work, particularly when dealing with new local raw materials, including waste materials, whose properties are not yet known and for the processing of which techniques have not yet been developed.

It has sometimes been argued that there might be practical and economic advantages in entrusting the functions outlined above to existing government institutions in charge of scientific or technical research, or to appropriate departments of technical schools or universities. The main reasons given were that this procedure would avoid duplication in facilities and equipment, make use of personnel already trained and experienced, and result in appreciable savings. This argument may be submitted to critical examination.

In the first place, the functions and scope of service of government scientific institutions are, as a rule, much more specialized than those of technological research institutes, so that the facilities, equipment and personnel of the former may not be suitable for the latter.

In the second place, it may be difficult to integrate the applied research functions of technological institutes with those of schools or universities, inasmuch as the latter generally concentrate on academic training—which involves different experience, skills and even interests—and as their personnel could probably devote only part of their time to these new activities.

It is true that contact with practical industrial problems might be beneficial to the academic personnel. On the other hand, the set-up under discussion might not enjoy the full confidence of manufacturers, who might hesitate to risk large investments on the advice of any but those considered by them conversant with industrial practice. Also, such a set-up might impair the effectiveness of research and advisory activities which—if competent and prompt service is to be provided to clients—should be carried out by a staff of fully experienced technicians giving undivided attention to their work. The employment of students on the operating staff would be particularly inadvisable. After an institute has become well established, some training in specific techniques might be occasionally furnished to a few students, towards the end, or upon completion, of their academic studies, to acquaint them with practical industry problems. Consultation between the staffs of the institute and of universities, which may be required for special problems, would be of mutual benefit.

Another question concerning the status of a technological research institute is whether it should be a government agency. It is the considered opinion of those who have participated in the establishment of such institutes that, even though they may be sponsored by Governments, they should be autonomous. An institute should have wide discretion and authority in the conduct of its day-to-day business. It should have its own staff regulations and policies, especially since its requirements in respect of recruitment, promotion and termination would not necessarily be met by civil service rules. It should have its own procurement and accounting methods and procedures. It should be able to provide consultations to its clients and to conclude contracts with them privately and confidentially. It should not have to depend upon, or be subordinated to, government departments, or be exposed to possible political pressures. For all these reasons, an institute should have an autonomous corporate structure and administration.[4] Its autonomy should be guaranteed in its charter. In the case of a regional institute established under the sponsorship

[3] It will be noted that while promotion and encouragement of technical training is mentioned in this outline, the direct provision of training to personnel other than research workers is not a basic function of the research institutes discussed here. Such a function may be fulfilled by *ad hoc* training centres or may be combined with other functions in technological institutes of other types. Some of the latter are discussed in United Nations, *First Expert Working Group on Technological Centres, Copenhagen, 10 May to 4 June 1954* (Sales No.: 1955.II.H.2).

[4] This is also the conclusion arrived at in the report by the First Expert Working Group on Technological Centres, *op. cit.*, paragraph 102. The freedom of operation of a technological research institute allows, under certain circumstances, its entering into co-operative arrangements with other institutions, for instance for sharing certain working facilities. Such arrangements are practised in varying degrees by the Ceylon Institute of Scientific and Industrial Research and the Central American Technological Research Institute for Industry.

of several Governments, this autonomy should be acknowledged in the basic agreement between them. Incorporation of the institute should be made, preferably, by legislative act.

BASIC OPERATING POLICIES

The suggestion that a technological research institute should have an autonomous corporate structure does not imply that it should be operated on the same basis as a private firm of industrial consultants. The activity of the institute would be oriented towards serving the public interest and, for that reason, government sponsorship and financial help—supplemented in some cases by financial and technical assistance from international organizations—would be involved. Furthermore, subsidies would normally be required during the formative period, and some continuing public financial support might be needed even later.

It does not follow from the public nature of the institute that it should devote all of its activities to servicing public industrial projects. It is quite likely that much of its activity, particularly during the early years of its establishment, would be given over to projects on government account; this would constitute the nucleus of its initial operations and provide for a minimum turnover which is needed for sustaining it. However, this would not necessarily be its main activity, particularly in the long run. It is essential that an institute should, from the very beginning, endeavour to build up a broad clientele and gain its confidence. In point of fact, to operate effectively, an institute must have a certain size which, even at the minimum, would involve considerable financial outlays for both establishment and operation; this would generally be justified only if a wide basis of operations is secured.

While initial and in some cases continuing public support is indispensable, an institute should strive to become financially self-supporting as soon and to as great an extent as possible and, to that end, should supply its services to both its public and private clientele on a contractual paying basis, except for simple consultation and certain minor services which could be provided free. The advantage of such a policy would be threefold. First, businesslike and efficient operation would be encouraged if the institute had to "meet its payroll", if not in full, at least to the largest extent possible. Second, in many cases services to private industry would be more valued—and advice would more likely be followed—if provided on a paying basis. And, third, in the particular case of projects on government account, only by setting them up on a contractual basis—rather than as a free service rendered at the government's discretion—would it be possible to ensure orderly working schedules and a sound financial management.

Government financial support of the institute generally would be required on both current and capital account. It might include, with respect to current account, such payments as fees for projects contractually agreed upon between the government and the institute; subsidies for projects undertaken on the initiative of the institute; also, in some cases, subsidies for projects carried out for private industry. As already indicated, it is important that the institute should be assured of a sufficient number of government contracts during its first years of operation. As regards capital account, government support would generally be in the form of donations to meet installation costs in plant and equipment. These might be gradually reduced over several years and totally eliminated when the institute is well established. The government commitment to support the institute should be made for a sufficiently long period so that it would not be at the mercy of political shifts and budgetary controversies; it is desirable, for that purpose, that such a commitment should be incorporated in the basic statute of the institute and in the legislative acts which establish it.

The government and public institutions should not receive more favoured treatment than private clients. Rates for services should be identical for all. In the case of one institute, a "free quota" system of services to the sponsoring public authorities had to be discontinued. In point of fact, such a system is tantamount to reducing correspondingly the public contribution to the institute. Any allotment of the governmental contribution for the purposes indicated in the preceding paragraph should be clearly defined.

Since the research institutes under discussion do not operate for profit, charges for research and technical services should be set on a cost basis, that is, (*a*) the actual *pro rata* compensation paid to the research personnel working directly on the particular project, (*b*) a further percentage of this amount as a fair share of the cost of the auxiliary research service personnel, and of gas, electricity, maintenance of laboratories, depreciation, and similar overhead and operational costs, and (*c*) the actual cost of any necessary materials and supplies, of construction or acquisition of special apparatus, of travel or other incidentals required by the project; the institute would retain possession of the equipment acquired under (*c*). Simple consultations and "question-and-answer" service requiring no research would generally be given as a public service, free of charge, the cost being either subsidized by the government or—if small enough—absorbed into overhead expense.

The institute should be exempt from payment of income or profit tax, stamp duties, excise or other taxes and import duties on any goods purchased by it for its own use. The loss in revenue may be expected to be more than offset over time through the increase in taxable income resulting from the development of industry assisted by the institute. Private donations to the institute would be encouraged by allowing equivalent deductions from income for tax purposes.

To operate effectively, an institute will need to maintain a sufficient volume of consulting and research activities. It is very difficult to determine in advance the volume of demand for such services in the short run and even more so in the long run, especially in areas where industrialists are not accustomed to them. A marketing survey of potential demand is likely to be inconclusive;

only small weight could be attached to its results. Acceptance of the services provided by the institute will depend essentially on its performance, once established; to some extent it may depend on the attitude of local manufacturers, independently of performance.[5] In any case, an element of uncertainty will have to be faced during the formative period of the institute. Local interest would have to be stimulated by various means, such as publicity, education and even financial incentives. Among the latter, an effective measure would be to allow private clients to claim the fees paid for services as a deduction from income for tax purposes, as necessary costs of operation.

The problem of providing services to small undertakings is particularly hard to solve. Small-scale industry is especially in need of advisory and technological services, and it is often with this in mind that proposals to establish technological institutes are being made.[6] One difficulty is that management of small industries is generally least aware of the need for these services and, when aware of it, frequently cannot formulate its problems. A patient effort of education and the demonstration value of the institute's performance may be of help in this respect. Another difficulty is that management may think it cannot afford technological help or may not indeed be able to appropriate funds therefor. To counteract this, a subsidy system might be envisaged under which the institute would be reimbursed for services rendered to financially weak enterprises. In order to keep the subsidy outlay within reasonable limits, however, the system should be highly selective. Another means, which, in some countries, might be more difficult to implement, would be to prevail upon development financing institutions or similar agencies, concerned—principally or incidentally—with assistance to small industry, to include in productivity loans allowances for fees demanded by the institute. In any event, preferential treatment is likely to be given to loans requested by private industrialists when based on recommendations made by a sound institute (for example, for purchase and installation of machinery), a consideration being that capacity to repay such loans would be more than assured through savings obtained from the resulting increase in productivity. This aspect is closely related to the problem of supervised credit, which need not be discussed here.

It is possible that free technical assistance from various sources made available to a country or region where an institute is to be established may duplicate the services to be extended by the institute and lead to wasteful competition. This may occur where the various organizations which provide technical assistance do so in an uncoordinated fashion. Thus, the United Nations provide aid only upon government requests channelled through the technical assistance agencies of Ministries for Foreign Affairs; other organizations frequently deal with technical departments of the relevant ministries or directly with private enterprises and individuals. A minimum degree of co-ordination, which would facilitate the operation of a technological institute, would be secured by having the government departments concerned keep the institute informed of the requests for technical assistance in its fields of interest which they intend to submit to the assisting organizations.[7]

The respective functions and responsibilities of Governments and international organizations, on the one hand, and of the governing board and director of the institute, on the other, should be clearly defined and effectively co-ordinated. The co-operation and even, in some cases, the direct participation of numerous institutions and organizations, national and international, may be required to launch and—at least in the formative period—operate the institute. The various participating organizations may have different policies, regulations and procedures which may adversely affect this operation. Jurisdictional and procedural difficulties would be avoided by clear-cut definitions of functions and lines of authority and responsibility, as well as by appropriate arrangements for consultation. Needless to say, these should not infringe upon the prerogatives and basic functions of the institute's governing board and director.

STRUCTURAL ORGANIZATION

It has sometimes been suggested that, in order to provide advice and guidance for technical and scientific work and to ensure co-ordination of scientific and applied research, the institute should be supervised and controlled by a body composed of local scientists and government officials. Such a set-up would as a rule be more appropriate for centres carrying out fundamental scientific research. Most of the work of the institute would be concerned with applied research undertaken in response to requests by industrial enterprises or the government; the work undertaken on the institute's initiative would also be based primarily upon local needs. A body of the type mentioned above would thus not be required either to select projects or to provide guidance in their implementation. The well-known inhibitive effects of over-centralization of control, even in the case of pure research, might be recalled in this connexion.

The principle of autonomy and the need for efficient administration suggest that a corporate type of structure would be the most appropriate. This would involve a governing board as a policy-making organ, and a director as an executive officer, with both administrative and substantive duties.

The board would determine and control the financial needs and the operations of the institute, appoint the director, authorize contracts and transactions and deal

[5] The experience of existing institutes shows that acceptance of their services required different periods of time, and there is evidence that differences in local attitude partly accounted for that situation.

[6] See report of the First Expert Working Group on Technological Centres, *op. cit.*

[7] Wider co-ordination would be achieved by appointing a co-ordinator, or—if the magnitude of assistance to a country or region justifies it—by establishing a co-ordinating body. However, the problem in its wider aspect is beyond the scope of this article.

with other major policy problems. One general recommendation that can be made on the composition of the board is that, aside from members representing the government, a number of local businessmen and industrialists should be included. Members in the latter group should be selected for the contribution which they are willing and able to make to the work of the institute; they should not be chosen as representatives of various industrial interests.

The director would be a member of the board, participating in all deliberations. He should have full authority in personnel matters and in the general conduct of day-to-day business. Sufficient power should be delegated to him to that effect by the board.

Staffing a technological institute raises some particularly difficult problems. In any organization, a proper choice of staff, especially in the initial period, is of fundamental importance, as lasting success depends to a large extent upon it. Managing and operating an institute is in fact a profession in itself, requiring special talent, knowledge and experience; these requisites are scarce not only in under-developed countries, but even in industrial ones. The director should be not only a technician with wide industrial experience, but also an administrator proficient in management and public relations. Staff requirements, with respect to type and number, will vary from case to case. A basic staff would typically cover such branches as mechanical engineering, chemical analysis, industrial chemistry and chemical engineering, metallurgy and metallography, electronics, industrial economics and productivity. Professional staff members should be conversant with fields of knowledge related to their own, and able to co-operate with each other in a spirit of pioneering and teamwork. A minimum staff would be needed for workshop maintenance and repairs and for administrative services.

A nucleus of foreign specialists may be required in the early stage, but in the long run they will gradually be replaced by nationals. Although training nationals is not a primary activity of the institute, it would carry out on-the-job training as an accessory operation with a view to upgrading the abilities of its own research and administrative staff. One of the tasks of the foreign experts working in the institute would be to assist in selecting national counterparts with requisite aptitudes and to train them.[8] The more general question of training local technicians is beyond the scope of this article.

As to physical plant, a technical research institute should be equipped with its own laboratories and other appropriate research installations, including some facilities for pilot-size production. There may be advantage in beginning operations in temporary quarters, as the experience gained will facilitate devising the layout and design of the permanent installations. Sufficient flexibility should be kept, bearing in mind the necessity of adapting the physical plant to the future needs of the institute.

The site of the institute should be chosen with great care, taking into consideration not only the availability of water, power, transportation, communications, and other requisites, but also the possibility of future expansion.

The selection of appropriate equipment is a major problem which must be paid considerable attention. To quote from a recent report of the Ceylon Institute:[9]

> "Equipping an industrial research laboratory located far from the normal sources of scientific supplies presents unusual problems. Research, by its very nature, cannot know in advance everything it is going to need, but must call for various unexpected things as the exploratory work unfolds. There can never be such a thing as equipping a laboratory for 'anything that might come up' and to attempt it would mean an astronomical waste of costly apparatus seldom if ever used. The development programme of CISIR seeks to build up its facilities for ready service on the types of problems most frequently encountered under local conditions, and to provide a flexible pattern of basic equipment so as to meet the unforeseen problem with a minimum of delay. The chemical engineering equipment, for example, is planned on the unit-process basis throughout, permitting the use of the same apparatus in a wide variety of combinations for carrying out innumerable pilot plant processes."[10]

A technical reference library is an indispensable part of the physical plant. It would be used both for answering technical inquiries—an important activity of the institute—and for its research work. Technical assistance for setting up the library and training national library personnel would be indicated.

Only actual experience will determine the type of work the institute will be mainly requested to do and the extent to which it will devote its resources to research and to technical service to industry; also, whether it will concentrate on a few large projects or on many small ones.

According to the experience of the existing institutes, it appears desirable that, in the early period, efforts should be made to expand contacts with local industries and collect information on local industrial conditions and needs. This experience also shows that a question-and-answer service is likely to be among the first to develop. Such services are fairly easy to furnish, do not involve large costs, contribute to making the institute more widely known, and thereby pave the way for further contacts and consultations.

It may be suggested that an institute should, at the beginning, accept only those projects which it can tackle with its existing equipment, unless the additional equipment required is likely to be of more general use (for example, standard laboratory or testing apparatus). As the work of the institute expands, projects requiring

[8] Short courses of specific practical instruction and demonstrations could occasionally be provided to outside groups.

[9] CISIR, "A Service to Industry", excerpt from the *Second Annual Report* (Colombo, 1957), page 6.

[10] It may be added that the staff of the institute should be able to use its facilities without having to request official permits, or to submit to licensing regulations, inspections and other restraints.

more specialized equipment will become possible. Availability of personnel may be another factor limiting not only the undertaking of major projects but also the carrying out of consultations and question-and-answer service. If necessary, however, specialists may be hired for particular assignments to supplement the permanent staff.

Concerning costs of operation, the uncertainties mentioned earlier regarding the scope and nature of activities in the course of the formative period make it difficult to prepare in advance a detailed budget covering a longer period of time, a fact that should be recognized by the authorities responsible for the financing of the institute. A rough estimate of operating expenses, including those for equipment, incurred in connexion with current projects, could be made for the first few years on the basis of comparable experience elsewhere. To give an order of magnitude, the experience of the two institutes discussed in the following summary, which operate in small and hardly industrialized areas, indicates that such a figure would be, on the average, for similar areas, around $500,000 a year. It might be difficult to derive from this experience an estimate of the initial installation costs.

Summary Information on Two Technological Research Institutes

A national institute

The Ceylon Institute of Scientific and Industrial Research (CISIR), located in Colombo, was established by the Government of Ceylon with the co-operation of the United Nations Technical Assistance Administration (UNTAA) and the International Bank for Reconstruction and Development (IBRD). It was founded in April 1955, by Act of Parliament, on the basis of studies and recommendations of the Ministry of Industries, Housing and Social Services, the Ministry of Finance, the IBRD and UNTAA. Establishment of an institute had been recommended in 1951 by an IBRD survey mission to Ceylon. Following a preparatory mission in the summer of 1954, the Ceylonese Government formally requested, in December of that year, assistance from UNTAA and IBRD for the establishment of the Institute, and a five-year initial assistance agreement between the two organizations and the Government was signed at the end of that month. The Institute began to operate immediately after it was established in April 1955, at three widely separated temporary locations—two in Colombo and one in Kalutara. The Institute moved into its own buildings—recently completed—in September 1958, having had partial use of some of the buildings for about a year.

CISIR in an autonomous corporate institution. Its Governing Board is composed of seven members, three of whom—currently two businessmen and one banker—are elected by the Board (at the beginning, these members were appointed by the Minister of Industries); one member—a civil engineer—is appointed by the Prime Minister; one member—an officer of the Treasury—is appointed by the Minister of Finance; and two officials—the Permanent Secretary to the Ministry of Industries and the Director of CISIR—are *ex officio* members, with vote. The Director is by statute Vice-Chairman of the Board. Currently, the services of the Director are jointly provided by UNTAA and IBRD.

The main divisions of the Institute are: (1) Research and Development Division, which carries out laboratory work in the basic fields of chemical technology, soils, rubber technology and process engineering; (2) Management Engineering Division, which carries out projects in technical appraisal, management counselling, production planning, plant layout, and design testing; (3) Auxiliary Services Division, which operates the workshops, stores, electronics department and the library, and provides administrative liaison; and (4) Business Office, in charge of accounting, internal auditing, and maintenance of buildings and grounds.

The Institute began with a staff of twenty-three, including the Director; at the end of 1957, reflecting the increased demand for its services, its staff had risen to a total of sixty-two, including an operating staff of fifty, of whom six were trainees. In the formative period, UNTAA and IBRD provided, besides the services of the Director, those of the Chief Engineer of the Institute.

CISIR receives from the Government an annual donation of one million rupees ($210,000) to support it; this donation is granted by statute during the first five years. Other income is derived from CISIR's private clientele. During 1955/56 and 1956/57, a portion of the government contribution was earmarked for continuing and completing government research projects taken over by the Institute at its establishment; another was reserved for new research on government account, and still another was set aside for the new laboratory building. The balance was allocated to research begun by the Institute, operation of the library, purchase of scientific equipment and supplies for training staff, and to administration and contingencies. In 1956/57, a separate fund was received from the Government to finance the establishment of a palm-sugar research, demonstration and training centre.

Measured by expenditure, before accruals, and excluding the cost of free public services, building construction, basic capital equipment, training and general institutional development, the volume of specific research and technical services performed by CISIR amounted to 268,000 rupees ($56,280) during the first year, 457,000 rupees ($95,970) during the second year, and 446,000 rupees ($93,660) in the third year. Free public services now amount to 175,000 rupees ($36,750) per year. Paying clientele at the end of the third year numbered 145, of which 115 were private industries and banks.

The headquarters buildings just completed provide 3,753 square metres of floor space, including a laboratory wing with 813 square metres, a pilot plant area of 418 square metres, and a workshop affording 1,161 square metres of high clearance floor space. In addition, a new research laboratory of 697 square metres was being built

at the time of writing by CISIR for regional service to the Gal Oya project.

In addition to the equipment provided by the Government and purchased by the Institute, apparatus and machinery were donated by the United Kingdom and the United States. Technical assistance was also provided by Canada and the Asia Foundation.

According to its annual reports and other documents, in its first year, 1955 56, CISIR took over from the Department of Industries seven uncompleted research projects relating to: new vegetable oil sources; improved desiccation of coconut; manufacturing of hardboard from coir waste; higher yields from citronella oil distillation; better processing of cinnamon oil; rubber compounding and testing services; and production of commercial factice from rubber-seed oil. During the same year, sixteen new major projects were undertaken; seven for government account, three on the Institute's initiative, and six contracted for and wholly financed by local private firms and the Gal Oya Development Board. These projects were concerned with: cottage industry products from palmyra palm; cheap shoes and rugs from banana stalk fibre; algae-resistant paints; mechanized chemical blending; commercial extraction of the alkaloids of *rauwolfia serpentina*; development of a special rubber compound; preservation of palm toddy; bottling of mineral waters; manufacturing of local vegetable tanning agents; graphite foundry facings; rain guards for rubber tree tapping panels; treated coir fibre cushions, and sago starch manufacturing. The services of the Institute have also been contracted for the reorganization and technical management of a number of plants, manufacturing or processing rubber products, sugar, tire retreads, and brick and tiles. Five of these projects were completed in the first year.

In 1956 57, in addition to the eighteen projects carried over from the previous year, CISIR announced the undertaking of fourteen new major projects, of which five were for government account, three were initiated by the Institute, and six were for private companies and industrial investment organizations. These projects dealt with: liquid and vapour phase cracking of caoutchoucin from rubber waste; manufacturing of wax polish emulsions; economics of acetic acid production; sugar extraction from indigenous palms; establishment of a palm-sugar centre; technical problems of small brass foundries; concentration and preservation of coconut milk; development of new flooring materials; manufacturing of bottle caps; culture and processing of tobacco; protection of food products in shipment; improved manufacture of plywood; and technical advisory services to the Development Finance Corporation and the Bank of Ceylon.

By the end of 1957 58, CISIR had undertaken a total of 337 contracted technical investigations, of which 47 were major research projects; of the latter, 25 projects were undertaken for private industries and 22 for the public sector.

In addition to engaging in these research projects, CISIR provides a wide variety of advisory services, testing, design and other technical services, and undertakes short-term research projects. The Institute's library supplies free information. Since 1956 57, the Institute has experienced growing demand for its specialized services in examining the technical and economic merits of proposed new private industrial ventures, or of plans for the expansion and modernization of existing ones.

A regional institute

The Instituto Centroamericano de Investigación y Tecnología Industrial (ICAITI) (Central American Technological Research Institute for Industry), located in Guatemala City, is a regional establishment covering the five Central American republics: Costa Rica, Guatemala, Honduras, Nicaragua, and El Salvador. The Institute was established by the Governments of the five republics in co-operation with the United Nations Technical Assistance Administration (UNTAA) and the Economic Commission for Latin America (ECLA). It was founded in July 1955, began informal operations shortly thereafter, was formally opened in January 1956, and moved into its own buildings—to be completed in 1959—in March 1957.

The establishment of the Institute was preceded by a phase of preparation and planning going back to 1952. In August of that year, the Committee of Ministers of Economy on Economic Co-operation in Central America—a permanent ECLA body under its Central American Economic Integration Programme—met in Tegucigalpa, Honduras, and passed a resolution recommending that UNTAA, together with the Executive Secretary of ECLA, should propose a basis for an institute of industrial technology and the means of establishing such an institute in co-operation with the Central American republics. A report on this proposal was discussed by ECLA at its fifth session held in Rio de Janeiro in April 1953. At the request of the five Governments, a mission of three experts was appointed by UNTAA; it visited the area in November-December 1953 and submitted a report on 15 September 1954,[11] recommending the creation of an institute. The report was approved by the Committee of Ministers of Economy on Economic Co-operation in Central America at its meeting in San Salvador in May 1955. In July 1955, the Charter Agreement of ICAITI was adopted by the five Governments at a meeting in Guatemala City. In November 1955, arrangements were made under an agreement between the United Nations and each of the five Governments with respect to the co-operation of the United Nations in the work of ICAITI, which supplemented earlier technical assistance agreements between the United Nations and these Governments.

ICAITI is an autonomous inter-governmental institution. Its Governing Board is composed of the five Ministers of Economy of the Central American republics and of the Director of the Institute, whose services are provided by UNTAA.

[11] Reissued as United Nations document TAA/LAT/11, dated 30 January 1957.

The main divisions of the Institute are: (1) Industrial Economics Division, which carries out economic surveys and studies of markets and of the economic feasibility of projects; (2) Technological Investigations and Research Division, which carries out analytical and research laboratory work in various industrial fields, testing of materials, and development of manufacturing processes and standards; (3) Geological Surveys and Mining Division; (4) Industrial Planning and Services Division, which carries out studies in planning of manufacturing operations, establishment and location of new industries and utilization of indigenous raw materials; (5) General Technical and Engineering Services Division, which carries out projects in design and layout of plant and equipment and operates the workshops as well as a pilot plant for developing and testing manufacturing processes; and (6) Industrial Engineering and Rationalization Division, which deals with industrial administration and management problems.

The Institute also has a library and documentation and translation services.

As of December 1958, the Institute had, besides the Director, a total of fifty-one employees, including non-professional personnel and manual workers. Eight staff members, including the Director, were provided and remunerated by UNTAA. In the early period, two experts were provided by the International Labour Organisation (ILO) and one by the United Nations Educational, Scientific and Cultural Organization (UNESCO).

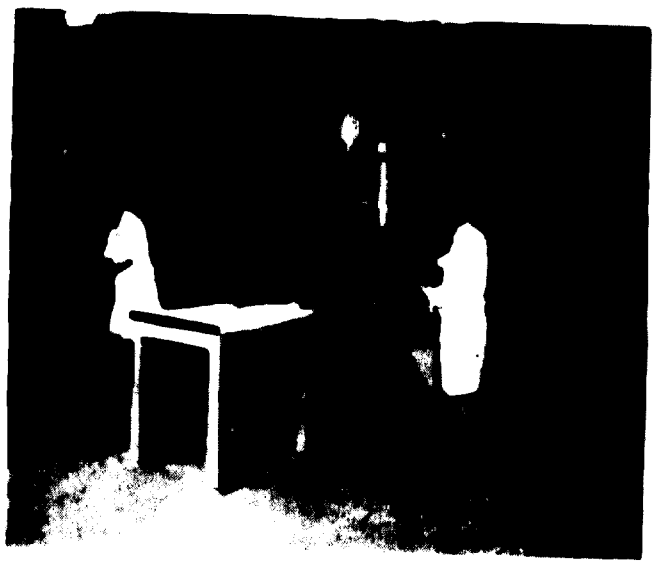
The operating budget of ICAITI amounted, in 1956, to $312,000; in 1957, to $322,200, and in 1958, to $367,000. The five Central American Governments provide a contribution scheduled to increase progressively during the first five years; it amounted, for each Government, to $32,000, $40,000 and $47,000, respectively, for the years mentioned. The contribution of the United Nations covers the remuneration of expert personnel seconded to the Institute; it amounted to about $84,000, $98,000 and $91,000 in 1956, 1957 and 1958. The United Nations also provided equipment to the Institute in 1956 and 1958. Earnings from the Institute's private clientele amounted, in 1956, to $1,800; in 1957, to $21,730, and in 1958, to $33,168.

The host country—Guatemala—in addition to its contribution, provided land, buildings and some equipment. The total area of the buildings is 3,359 square metres, including laboratories with 470 square metres, a pilot plant area of 668 square metres, and workshops with 737 square metres. Buildings are designed to support a second floor, if required in the future.

Since its inception, ICAITI has carried out various technical and techno-economic projects of national and regional scope.

According to its annual reports and other documents, projects of national interest have dealt with, among others: conservation of foodstuffs under tropical conditions; construction of a slaughter-house; storage and processing of meat and utilization of by-products; construction of a pilot plant for processing maize flour; processing milk; utilization of molasses; and processing rosin and turpentine, essential oils and medicinal plants.

Laboratories and pilot plant, ICAITI, in Guatemala City



Technicians at work in an ICAITI laboratory

Projects of regional scope, carried out within the framework of the Central American Economic Integration Programme, dealt with: glass and carton containers for foodstuffs; salt; yeast; coffee; oils and fats; insecticides; rayon; processing hard fibres; utilization of henequen wastes; building materials; recovery of sulphur from volcanic mud; and assistance in the establishment of a regional geological centre. Certain of these projects have been undertaken on the initiative of the Institute.

Other projects included marketing and cost surveys and studies in such fields as wheat flour, food canning, meat, absorbent cotton, plywood, fertilizers, electrolytic chlorine and caustic soda, insecticides and textiles.

In addition to conducting research projects, the Institute provides a variety of consultations, advisory services, investigations and tests for factories in the region. A question-and-answer service is in operation, with assistance, when required, from the Office of Technical Services of the United States Department of Commerce, from the Organisation for European Economic Co-operation, and from the European Productivity Agency.

CONFERENCE ON INDUSTRIALIZATION IN RELATION TO ECONOMIC DEVELOPMENT

PROBLEMS OF INDUSTRIALIZATION in relation to economic development and planning were discussed by the Working Party on Economic Development Planning in Asia and the Far East, at its fourth session held at the headquarters of the Economic Commission for Asia and the Far East (ECAFE) in Bangkok, Thailand, from 2 to 13 September 1958.[1]

The working party centred its discussion on three sets of economic problems of major import in planning the development of industry in the countries of the region; these problems were considered within the broader context of over-all economic development planning. They related, respectively, to government policy and action for promoting industrialization, in particular within the framework of national economic development plans in countries where such plans exist, and for dealing with factors limiting industrial expansion; to selection criteria in establishing new or expanding existing industries, having regard to requirements of economic balance and international division of labour; and to choice of techniques and scale of industrial production.

Promotion of industrialization and limiting factors

Having agreed, from the outset, that the growth of manufacturing industry had to proceed hand in hand with the development of agriculture, mining and basic facilities, the working party noted that the emphasis required might vary considerably not only from one country to another, but in the same country at different stages of its development. The discussion showed that the policies and measures to promote industrialization and the emphasis on the development of industry as compared to that of other economic sectors varied widely between countries of the region. It was agreed, however, that expansion of economic overhead, such as power, transport, communications and research establishments, might have an appreciable effect on the growth of industrial output, even in the short run. Social overhead, such as schools and health services, might take somewhat longer to yield returns in the form of higher productivity. In both cases large capital investments would be involved.

The working party reviewed ways of providing a favourable environment for the expansion of industry which would not require large capital investment. These would include reforming the institutional framework, maintaining law and order, spreading information on better techniques, and improving the marketing system and banking and credit facilities. As regards economic controls, the working party agreed that, whether or not they aimed primarily at influencing the direction which industrial development should take, their administration inevitably involved a certain degree of discrimination between different industries. In this connexion, it raised the questions as to what criteria would be appropriate, how to carry out the measures, and how to co-ordinate industrial development in the private and public sectors. Regarding this last aspect, it was agreed that a short-term goal should be to restrain both sectors from placing excessive claims on available resources; a long-term objective should be to have them support, rather than conflict with, each other, so as to achieve maximum growth.

The working party reviewed the questions of direct government participation in industrial production, tariff protection, allocation of foreign exchange and scarce materials, and financial assistance through loans, subsidies and tax concessions; it noted that there was, within the region, little experience in using tax concessions to industrial enterprises on a selective basis.

The working party then considered the factors limiting industrial expansion, such as lack or inadequate supply of industrial raw materials, shortage of entrepreneurial and managerial talent

[1] The working party was attended by forty-eight representatives from eighteen member countries of the Commission, who participated in their personal capacity, and by observers from five non-member countries, three specialized agencies and five non-governmental organizations. The full report of the working party is published in United Nations, *Economic Bulletin for Asia and the Far East*, vol. IX, No. 3, 1958 (Bangkok).

and of skilled labour, lack of effective demand and, above all, shortage of capital. It pointed out again that while a balanced programme of industrialization would have to deal with all limiting factors taken together, the emphasis would vary from case to case according to the factors considered to be of key importance in individual countries.

As regards the shortage of capital, the working party recognized that, to raise the rate of savings, it was necessary to raise the levels of income and productivity, and that this could not be done to any significant extent without large capital investments. Nevertheless, efforts to increase industrial productivity without much capital investment might also be useful, within limits. Regarding the use of taxation to promote capital formation, it was stated that a deliberate policy directed at substantially increasing inequalities of income would not be acceptable to countries in the region, even though it might have the effect of raising the rate of saving. The rate of saving could be raised by increasing budget surpluses, which could be done not only by raising tax revenues, but also by reducing non-development expenditure, or at least its rate of expansion. Tax revenues could best be increased, under the conditions prevailing in the region, by improving the collection of existing taxes and widening their base rather than by raising the rates of taxation.

The working party drew attention to the possibilities of capital formation through the profits of government monopolies and surpluses of compulsory social insurance schemes and noted the growing importance of private contractual saving through provident funds, pension schemes and life insurance. On the other hand, it failed to reach agreement on the appropriateness of deficit financing, which, if carried to the point of inducing inflationary price rises, amounted to forced saving. Some members considered this to be a dangerous expedient, but others thought it worth while to take a calculated risk by allowing a limited degree of inflationary price rises.

Several members emphasized the importance of enlarging investment opportunities, especially in rural areas. It was suggested in this connexion that, when land reform is carried out, landlords might be compensated by payments in the form of industrial shares, which would be equivalent to compulsory participation in industrial enterprises.

Concerning foreign capital, several members stated that their countries sought to attract investments from abroad by offering liberal conditions as to remittances of profits, tax exemptions and guarantees in respect to nationalization policies. The inflow of foreign capital was considered to be particularly valuable when provided together with technical knowledge.

Import substitution was considered as one method of helping industrial development without increasing balance of payments difficulties. The industries to be chosen should be those yielding the highest *net* saving of imports.[2] However, the working party recognized that in a developing economy with

rising internal demand, a policy of import substitution might not lead to any absolute fall in imports or to a concomitant increase in exports. There was agreement that careful budgeting of foreign exchange resources was necessary: phasing of plans for industrial development was recommended to that effect.

In reviewing measures to deal with other limiting factors, the working party recommended carrying out geological surveys and other methods of exploring natural resources, setting up training facilities for managerial and technical staff, and adopting measures to enlarge the market for local industries. Among the latter are measures to limit the competition of imports, such as tariff protection, import control and import substitution, referred to above in another context. As regards tariff protection, the working party failed to reach agreement on its merits as a means of achieving industrial efficiency, but recognized that principles governing protection should be flexible. It discussed other measures to enlarge the market and facilitate its operation, such as closer liaison between government purchasing departments and small enterprises, development of transport, banking and other facilities contributing to efficiency in marketing operations, and stimulation of exports, particularly by promoting trade within the region. In the latter connexion it was considered worth while to explore the opportunities that existed for a group of countries in sharing their internal markets and in agreeing on some measure of national specialization.

Criteria for the selection of industries

The working party recognized that the choice of industries depended, for each country, on its endowment in natural resources, its stage of development and the size of its market. However, it thought it useful to examine the various selection criteria involved; it considered that while these were largely complementary, short-run considerations might require that some of them should be given greater emphasis.

Thus, it agreed that it was desirable in principle for each country to produce the kinds of goods for which it was best suited—that is, those permitting achievement of maximum efficiency and minimum cost—but that the principle of international specialization should not be followed unreservedly. Certain countries depending on exports of a few primary products with sharply fluctuating prices regarded diversification of the economy as an important criterion for the allocation of the investment resources in industry, inasmuch as it tended to reduce this dependence. Countries whose labour force could not be fully absorbed in the agricultural sector attached much weight to expanding employment opportunities in industries permitting use of labour-intensive techniques. The increased use of domestic natural resources was important to countries having to save foreign exchange or create employment. Building the industrial base through the development of heavy industry was a criterion for some countries. Elsewhere, the criterion was to raise the standard of living by promoting production of consumer goods. Other criteria in the selection of industries were import substitution and export promotion.

The working party emphasized the need for balanced growth not only among the various sectors of the economy, but also within the manufacturing sector itself. This involved—should there be conflict between some of the objectives—a choice as to the relative emphasis to be laid on each. For example, in order to obtain a given

[2] That is, the value of imports displaced, less the direct and indirect import costs of equipping, operating and maintaining the industry. The selection of industries might be facilitated by the use of input-output calculation techniques.

rate of development of heavy industry, a certain rate of increase in the production of consumer goods also had to be achieved.

The working party agreed that there should be greater exchange of information to enable each country to take into account the industrialization plans of other countries within the region. Finally, it noted the need for further study of the so-called accounting or shadow prices of factors of production—as against market prices—as an analytical tool for evaluating industrial investment projects.[3]

Choice of techniques and scale of production

The working party recognized that the choice between labour-intensive and capital-intensive techniques depended upon whether the country's development goals aimed at the best utilization of scarce capital and abundant manpower in the short run, or alternatively, at the achievement of a higher rate of capital accumulation, larger output and larger employment, in the longer period.[4] However, it pointed out that further study was required of the implications of the use of labour-intensive and capital-intensive techniques in terms of capital formation and employment.

It was felt that the time element was a vital factor bearing on this problem. There was a general belief that, over a longer period, capital-intensive techniques would bring about increases both in productivity and in employment. Over the short period, however, the unregulated and unplanned introduction of capital-intensive techniques, particularly in existing industries, might result in displacement of labour and worsening of unemployment. A gradual and planned transition to higher levels of techniques would thus seem to be a prudent course.

The working party felt that cottage industries and small industries, using mostly labour-intensive techniques, should be assisted on a selective basis. Promotion of subcontracting arrangements between large manufacturing firms and small producers was considered as a fruitful method of bringing about co-ordination between capital-intensive and labour-intensive techniques. Such arrangements should be voluntary and take into account questions of quality control, standardization, and costs and prices relating to the production of subcontractors. It was pointed out, in this connexion, that there were limits to the expansion of small-scale industry and that some undesirable social aspects might be involved. Small industries constituted a low-wage sector of the economy and did not have to pay minimum wages and comply with certain legal provisions, as large industries did. Competitive coexistence of the two types of industries was based on somewhat lower standards of pay in the small industry sector. Also, excessive support of that sector might tend to perpetuate antiquated methods of production.

The working party pointed out that the extent to which labour-intensive and capital-intensive techniques might be introduced or combined varied from one industry to the other. In assessing the comparative costs of the different techniques, it was not enough to calculate the economic costs; the social costs—for instance of providing employment or giving relief to the persons laid off as a result of mechanization—should also be considered. Further study of the problem, particularly of different techniques and possibilities of combining them, was recommended.

[3] See, in this connexion, United Nations, "Choice of Technology in Industrial Planning" by J. Tinbergen, *Bulletin on Industrialization and Productivity*, No. 1 (Sales No.: 58.II.B.2).

[4] See also the discussion of this problem in "Capital Intensity in Industry in Under-developed countries", *op. cit.*

REPORT OF A GROUP OF EXPERTS ON THE UNITED NATIONS SECRETARIAT'S WORK PROGRAMME ON INDUSTRIALIZATION

AN ARTICLE IN the first issue of the *Bulletin*[1] contained an account of current activities in the field of industrialization and productivity undertaken by organizations of the United Nations family, in particular by the United Nations Secretariat. Work by the Secretariat on industrialization has been carried out, since 1956, under a programme approved by the Economic and Social Council. Most of the studies in connexion with this programme are being published in the *Bulletin*.

At its twenty-fifth session, held in the spring of 1958, the Economic and Social Council invited the Secretary-General to establish a committee of experts, to be appointed in consultation with Governments, for the purpose of reviewing the programme of work of the Secretariat in the field of industrialization and productivity, and making recommendations to the Secretary-General on the further development and implementation of this programme.

Ten experts of the highest standing, each with particular experience in problems of economic and industrial development, were appointed by the Secretary-General to the Advisory Committee on the Work Programme on Industrialization which met at United Nations Headquarters in New York from 4 to 14 February 1959.[2]

The Secretariat submitted to the Committee a number of documents to facilitate the discussion, and the debates led to a report, containing the Committee's recommendations to the Secretary-General, which is being submitted to the Economic and Social Council at its twenty-seventh session in April 1959. Some of the salient points of this report are given below.

The Committee expressed the view that the research which had so far been carried out had been of interest for the less-developed countries both in content and orientation. It made several recommendations concerning the general orientation of the proposed programme, among them that studies on industrialization should provide Governments of under-developed countries with a basis for practical action to promote general economic development; that an even closer relationship should be established between projects under the programme and United Nations technical assistance and Special Fund activities; and that the research work of the Secretariat, which had so far largely concentrated on the micro-economic aspects of industry, should give more emphasis to studies of a macro-economic nature; that systematic work relating to general development policies and techniques of programming economic development would greatly enhance the over-all effectiveness of the research activities in the field of industrialization.

As regards work in connexion with technical assistance operations, the Committee recommended that, in addition to substantive servicing, the Secretariat should collect and analyse information on the experience gained from technical assistance programmes relating to industry, carried out by various governmental and non-governmental agencies.

Concerning research activities, the Committee recommended undertaking projects in certain broad areas of work. In the field of over-all planning and programming of industrial development, it recommended studies of government incentives to the private sector for "steering" investment decisions of that sector into line with government policy objectives; and studies on co-ordination, in the case of mixed economies, between macro-economic targets and their fulfilment in the form of individual projects. The Committee considered that forecasts of demand for selected industrial products, using macro-economic approaches as well as market research methods, would be valuable for development planning. It also recommended studies of more specific incentives and of national and international measures of assistance to industry, such as the establishment of industrial zones, or estates, for attracting and developing industry in given areas, and the supply of equipment and related requisites for new industries.

In the field of small-scale industries, the Committee recommended projects on measures to facilitate the solution of the financial, technological and organizational problems specific to those industries, and to improve relationships between large and small industries, particularly by means of subcontracting arrangements.

The Committee also considered that specific industry studies involving micro-economic analysis, such as have been undertaken by the Secretariat on problems of capital intensity and size of plant, should be continued with a view to developing a methodology to be used in studying various problems in the economics of industry.

The report also includes recommendations for studies of institutions to promote industrial development, and of certain industrialization problems in individual countries. It concludes with recommendations concerning the implementation of the programme, with special reference to methods of work.

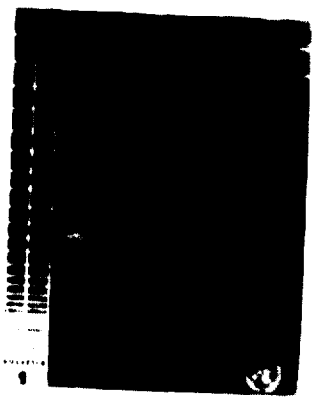
The report of the Committee will be discussed by the Economic and Social Council at its session in April 1959. Further information on the development of the United Nations Secretariat's programme of work in the field of industrialization will be published from time to time in the *Bulletin*.

---

[1] *Bulletin on Industrialization and Productivity*, No. 1 (Sales No.: 58.II.B.2), pages 65 to 70.

[2] The Committee consisted of: Mr. B. N. Adarkar (India), Minister, Embassy of India, Washington, D. C.; Mr. Koichi Aki (Japan), President, The Association for International Technical Co-operation; Professor Czeslaw Bobrowski (Poland), Vice-Chairman, Economic Council; Mr. Charles Sylvester Booth (Australia), Chairman of the Board of Directors, The Australian Paper Manufacturers, Limited; Mr. Voiin Guzina (Yugoslavia), Director, Institute of Planning; Mr. Stacy May (USA), Board Member, International Basic Economy Corporation; Professor Alessandro Molinari (Italy), Director-General, Associazione per lo Sviluppo dell'Industria nel Mezzogiorno (SVIMEZ); Ingeniero Gonzalo Robles (Mexico), Economic Adviser, Banco de Mexico; Professor Jan Tinbergen (Netherlands), Director, Netherlands Economic Institute, and Professor Evgeny Pavlovich Unksov (USSR), Director, Central Scientific Research Institute of Technology and Machine-building.

The photographs on pages 6, 26, 27, 30 to 36 and 40 *(top and bottom right)* are by courtesy of the Japanese Foreign Ministry; those on pages 7, 13 *(left)*, 18, 20 and 25, by courtesy of the Shell Chemical Corporation; the photograph on page 11 *(bottom)*, by courtesy of the Brockway Glass Company, Brockway, Pennsylvania; the photograph on page 13 *(right)*, by courtesy of the Emhart Manufacturing Company, Hartford-Empire Company Division, Hartford, Connecticut; the photograph on page 21 (right-hand column), by courtesy of the Shell Oil Company; those on pages 37 and 40 *(far left)*, by courtesy of the Japan Tourist Association; those on pages 42, 44, 45, 48, 49 and 51, by courtesy of the Information Service of India; those on page 65, by courtesy of the Instituto Centroamericano de Investigación y Tecnología Industrial.

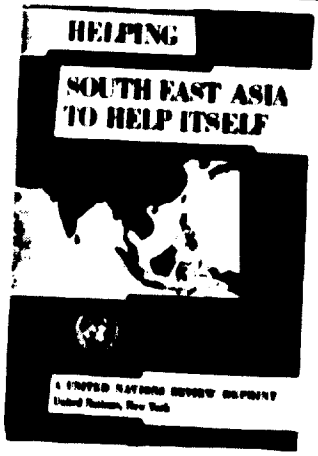


BULLETIN ON INDUSTRIALIZATION AND PRODUCTIVITY No. 1

Among the articles in the first issue: capital intensity in industry in under-developed countries; choice of technology in industrial planning; capital intensity in heavy engineering construction; hire-purchase loans for the mechanization of small industry; use of accounting as an aid to management in industrial enterprises in under-developed countries; round-table discussion on industrial management in under-developed areas.

U.N. Publ. 58.II.B.2 77 pages
$0.70; 5/-stg.; 3 Sw. frs., or equivalent

Available in English, French and Spanish editions



HELPING SOUTH EAST ASIA TO HELP ITSELF

An illustrated account of the unique way in which the United Nations program of technical assistance is helping South East Asia to help itself. An Indian River is Harnessed, Social Welfare in Pakistan, and Snows and Snowmen in Nepal are among the interesting stories of specific projects in the area. (*A United Nations Review reprint*). 60 pp.

U.N. Publ. No. 1957.I.30

$0.25; 1/9 stg.; 1 Sw. fr.

HELPING ECONOMIC DEVELOPMENT IN ASIA AND THE FAR EAST

An interpretation of the work of the United Nations Economic Commission for Asia and the Far East whose activities encompass all aspects of Asian economic life. Among the subjects discussed: industrial development, trade and finance, transport, flood control, agriculture, technical training and assistance. 3rd ed. 32 pp.

U.N. Publ. No. 1957.I.27
$0.15; 1/- stg.; 0.50 Sw. fr.

Obtainable in other currencies from sales agents for United Nations publications.

SALES AGENTS FOR UNITED NATIONS PUBLICATIONS

ARGENTINA
Editorial Sudamericana, S.A., Alsina 500, Buenos Aires.

AUSTRALIA
H. A. Goddard, A.M.P. Bldg., 50 Miller St., North Sydney; and 90 Queen St., Melbourne.
Melbourne University Press, 369/71 Lonsdale Street, Melbourne C.1.

AUSTRIA
Gerold & Co., Graben 31, Wien, 1.
B. Wüllerstorff, Markus Sittikusstrasse 10, Salzburg.

BELGIUM
Agence et Messageries de la Presse, S.A., 14-22, rue du Persil, Bruxelles.
W. H. Smith & Son, 71-75, boulevard Adolphe-Max, Bruxelles.

BOLIVIA
Librería Selecciones, Casilla 972, La Paz.

BRAZIL
Livraria Agir, Rua Mexico 98-B, Caixa Postal 3291, Rio de Janeiro.

BURMA
Curator, Govt. Book Depot, Rangoon.

CANADA
Ryerson Press, 299 Queen St. West, Toronto.

CEYLON
Lake House Bookshop, Assoc. Newspapers of Ceylon, P.O. Box 244, Colombo.

CHILE
Editorial del Pacífico, Ahumada 57, Santiago.
Librería Ivens, Casilla 205, Santiago.

CHINA
The World Book Co., Ltd., 99 Chung King Road, 1st Section, Taipeh, Taiwan.
The Commercial Press, Ltd., 211 Honan Rd., Shanghai.

COLOMBIA
Librería Buchholz, Bogotá.
Librería America, Medellín.
Librería Nacional, Ltda., Barranquilla.

COSTA RICA
Imprenta y Librería Trejos, Apartado 1313, San José.

CUBA
La Casa Belga, O'Reilly 455, La Habana.

CZECHOSLOVAKIA
Československý Spisovatel, Národní Třída 9, Praha 1.

DENMARK
Einar Munksgaard, Ltd., Nørregade 6, København, K.

DOMINICAN REPUBLIC
Librería Dominicana, Mercedes 49, Ciudad Trujillo.

ECUADOR
Librería Científica, Guayaquil and Quito.

EL SALVADOR
Manuel Navas y Cía., 1a. Avenida sur 37, San Salvador.

ETHIOPIA
International Press Agency, P.O. Box 120, Addis Ababa.

FINLAND
Akateeminen Kirjakauppa, 2 Keskuskatu, Helsinki.

FRANCE
Editions A. Pedone, 13, rue Soufflot, Paris (Ve).

GERMANY
R. Eisenschmidt, Schwanthaler Strasse 59, Frankfurt/Main.
Elwert & Meurer, Hauptstrasse 101, Berlin-Schöneberg.
Alexander Horn, Spiegelgasse 9, Wiesbaden.
W. E. Saarbach, Gertrudenstrasse 30, Köln (1).

GHANA
University College Bookshop, P.O. Box 4, Achimota, Accra.

GREECE
Kauffmann Bookshop, 28 Stadion Street, Athènes.

GUATEMALA
Sociedad Económica Financiera, 6a Av. 14-33, Guatemala City.

HAITI
Librairie "A la Caravelle", Port-au-Prince.

HONDURAS
Librería Panamericana, Tegucigalpa.

HONG KONG
The Swindon Book Co., 25 Nathan Road, Kowloon.

ICELAND
Bokaverzlun Sigfusar Eymundssonar H. F., Austurstraeti 18, Reykjavik.

INDIA
Orient Longmans, Calcutta, Bombay, Madras, New Delhi and Hyderabad.
Oxford Book & Stationery Co., New Delhi and Calcutta.
P. Varadachary & Co., Madras.

INDONESIA
Pembangunan, Ltd., Gunung Sahari 84, Djakarta.

IRAN
"Guity", 482 Ferdowsi Avenue, Teheran.

IRAQ
Mackenzie's Bookshop, Baghdad.

IRELAND
Stationery Office, Dublin.

ISRAEL
Blumstein's Bookstores, Ltd., 35 Allenby Road, Tel Aviv

ITALY
Librería Commissionaria Sansoni, Via Gino Cappani 26, Firenze, and Lungotevere Arnaldo da Brescia 15, Roma.

JAPAN
Maruzen Company, Ltd., 6 Tori-Nichome, Nihonbashi, Tokyo.

JORDAN
Joseph I. Bahous & Co., Dar-ul-Kutub, Box 66, Amman.

KOREA
Eul-Yoo Publishing Co., Ltd., 5, 2-KA, Chongno, Seoul.

LEBANON
Librairie Universelle, Beyrouth.

LIBERIA
J. Momolu Kamara, Monrovia.

LUXEMBOURG
Librairie J. Schummer, Luxembourg.

MEXICO
Editorial Hermes, S.A., Ignacio Mariscal 41, México, D.F.

NETHERLANDS
N.V. Martinus Nijhoff, Lange Voorhout 9, 's-Gravenhage.

NEW ZEALAND
United Nations Association of New Zealand, C.P.O. 1011, Wellington.

NORWAY
Johan Grundt Tanum Forlag, Kr. Augustsgt. 7A, Oslo.

PAKISTAN
The Pakistan Co-operative Book Society, Dacca, East Pakistan.
Publishers United, Ltd., Lahore.
Thomas & Thomas, Karachi, 3.

PANAMA
José Menéndez, Plaza de Arango, Panamá.

PARAGUAY
Agencia de Librerías de Salvador Nizza, Calle Pte. Franco No. 39-43, Asunción.

PERU
Librería Internacional del Perú, S.A., Lima.

PHILIPPINES
Alemar's Book Store, 749 Rizal Avenue, Manila.

PORTUGAL
Livraria Rodrigues, 186 Rua Aurea, Lisboa.

SINGAPORE
The City Book Store, Ltd., Collyer Quay.

SPAIN
Librería Mundi-Prensa, Castelló 37, Madrid.
Librería Bosch, 11 Ronda Universidad, Barcelona.

SWEDEN
C. E. Fritze's Kungl. Hovbokhandel A-B, Fredsgatan 2, Stockholm.

SWITZERLAND
Librairie Payot, S.A., Lausanne, Genève.
Hans Raunhardt, Kirchgasse 17, Zürich 1.

THAILAND
Pramuan Mit, Ltd., 55 Chakrawat Road, Wat Tuk, Bangkok.

TURKEY
Librairie Hachette, 469 Istiklal Caddesi, Beyoglu, Istanbul.

UNION OF SOUTH AFRICA
Van Schaik's Bookstore (Pty.), Ltd., Box 724, Pretoria.

UNION OF SOVIET SOCIALIST REPUBLICS
Mezhdunarodnaya Knyiga, Smolenskaya Ploshchad, Moskva.

UNITED ARAB REPUBLIC
Librairie "La Renaissance d'Egypte", 9 Sh. Adly Posha, Cairo.
Librairie Universelle, Damas.

UNITED KINGDOM
H. M. Stationery Office, P.O. Box 569, London, S.E.1.

UNITED STATES OF AMERICA
International Documents Service, Columbia University Press, 2960 Broadway, New York 27, N. Y.

URUGUAY
Representación de Editoriales, Prof. H. D'Elía, Plaza Cagancha 1342, 1° piso, Montevideo.

VENEZUELA
Librería del Este, Av. Miranda, No. 52, Edf. Galipán, Caracas.

VIET-NAM
Librairie-Papeterie Xuân Thu, 185, rue Tu-Do, B.P. 283, Saigon.

YUGOSLAVIA
Cankarjeva Zalozba, Ljubljana, Slovenia.
Drzavno Preduzece, Jugoslovenska Knjiga, Terazije 27/11, Beograd.
Prosvjeta, 5, Trg. Bratstva i Jedinstva, Zagreb.

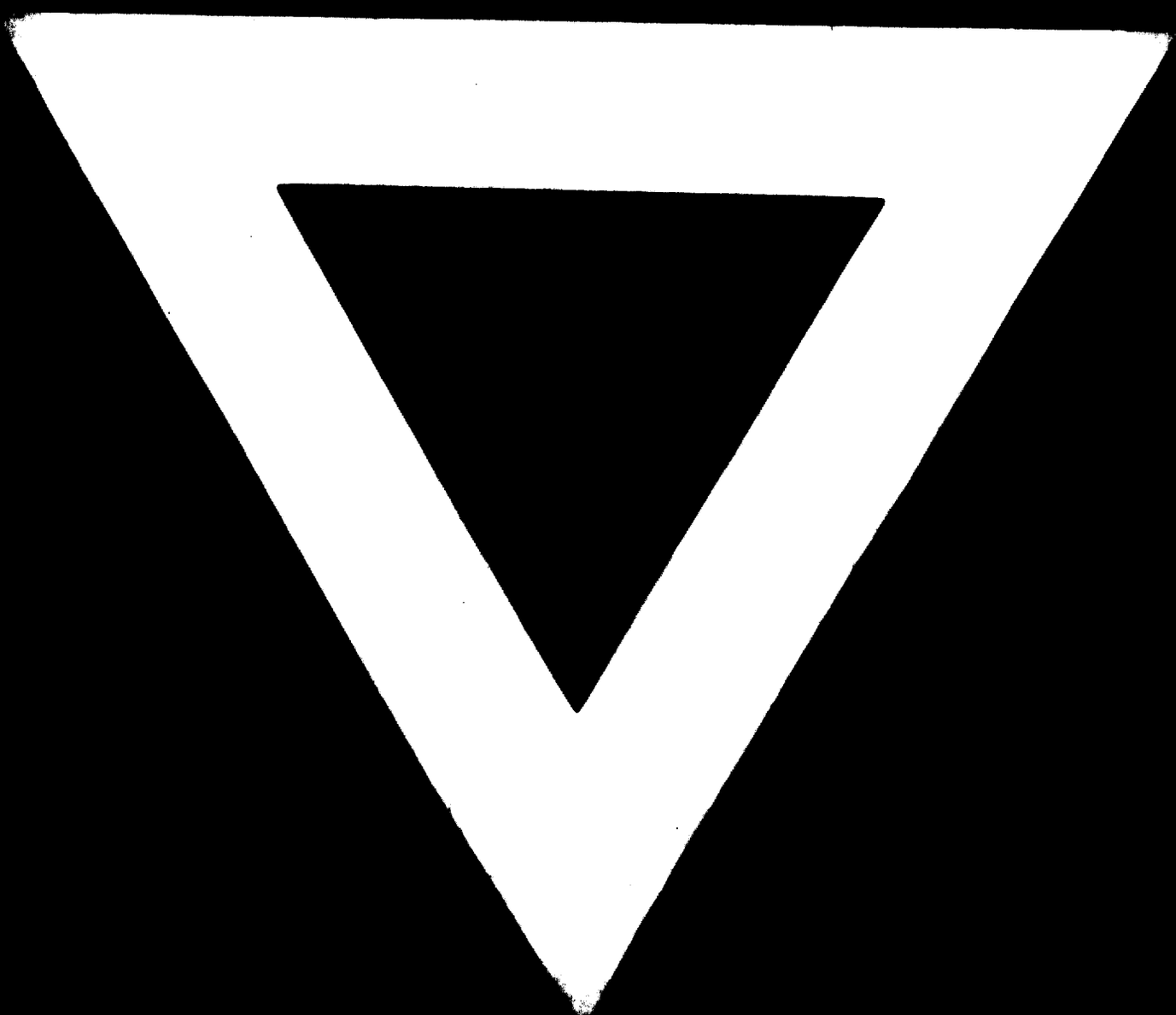
[59E1]

Orders and inquiries from countries where sales agents have not yet been appointed may be sent to: Sales and Circulation Section, United Nations, New York U.S.A.; or Sales Section, United Nations, Palais des Nations, Geneva, Switzerland.

Printed in the U.S.A.
08370—March 1959—4,050

Price: $U.S. 0.70; 5/- stg.; Sw. fr. 3.00
(or equivalent in other currencies)

United Nations Publications
Sales No.: 59.II.B.1



74.10.10