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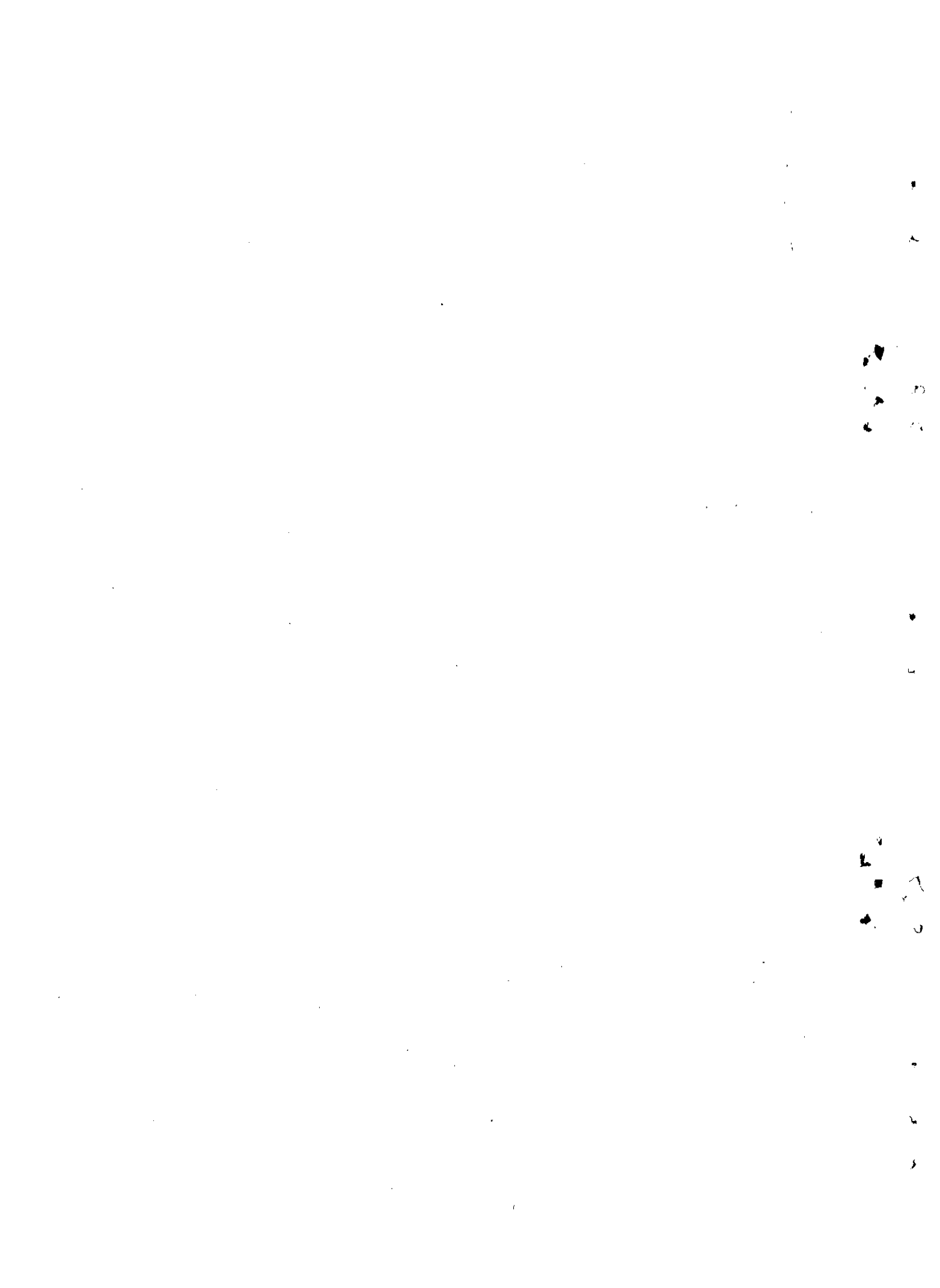
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ECONOMIC COMMISSION FOR LATIN AMERICA  
Sixth Session  
Bogota, Colombia  
29 August 1955

IRON AND STEEL TRANSFORMING INDUSTRIES  
IN SELECTED LATIN AMERICAN COUNTRIES

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NOTE: This is a provisional translation, subject to detailed  
revision at a later date.



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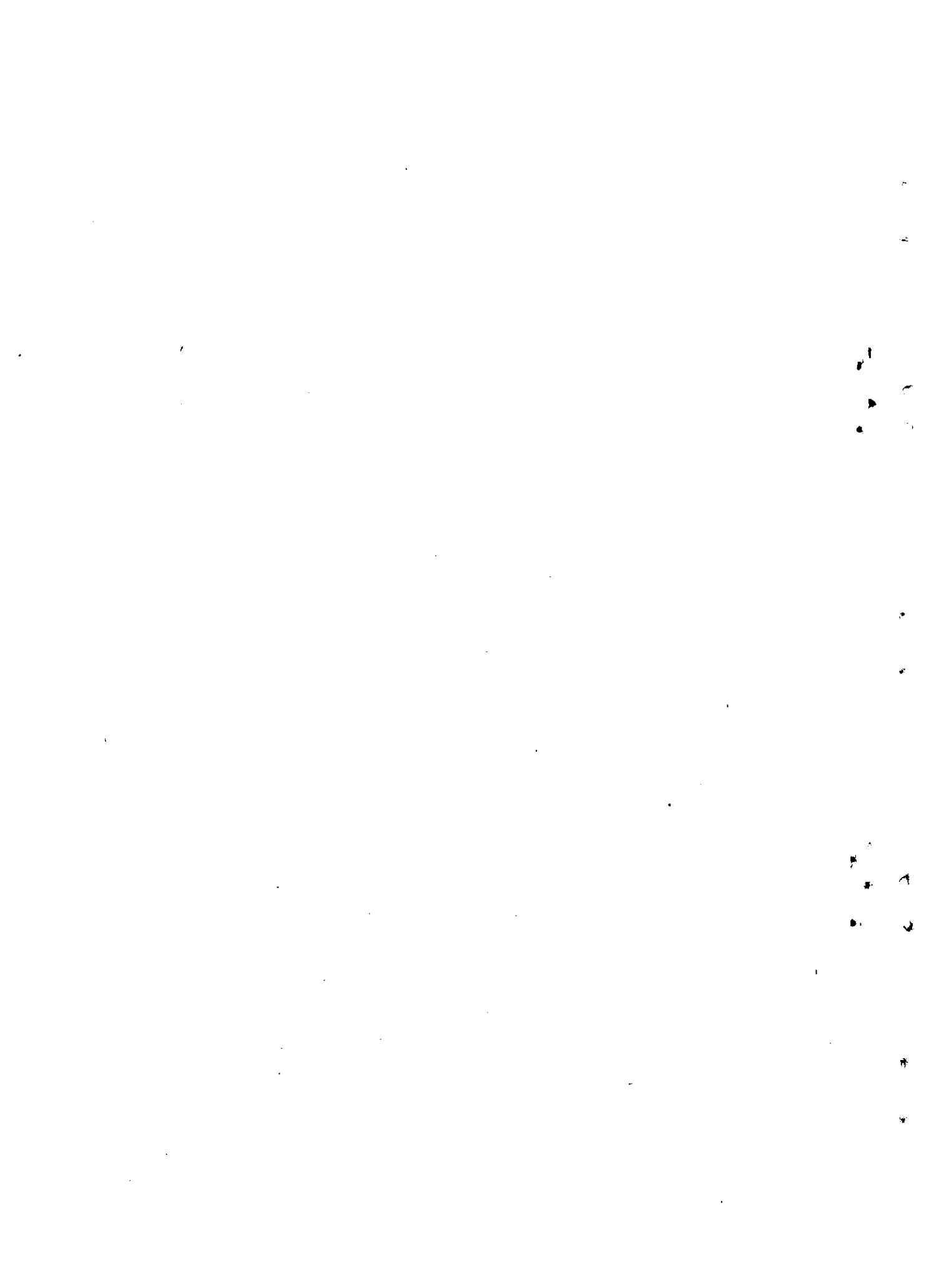
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#### APPENDIX



## Chapter I

## INTRODUCTION

Earlier ECLA studies<sup>1/</sup> relating to certain sectors of industry have always dealt with the manufacture of a limited number of products. It was thus relatively easy to determine the respective markets and the manufacturing processes to be recommended in each case. This study of the iron and steel transforming industry refers to an innumerable variety of products, ranging as it does from the manufacture of such items as nails to more complicated mechanisms such as typewriters, calculating machines and other office equipment.

Because of these features, it was essential to undertake a small-scale study first, in order to establish the methods to be followed. Consequently a pilot study was undertaken in Chile from July 1953 to January 1954.<sup>2/</sup> Once this had been completed, a study was begun in February 1954 of the mechanical and metallurgical industries of Brazil, particularly those in the State of São Paulo. Effective co-operation was received from the Confederacao Nacional da Industria of Rio de Janeiro, and from the Federacao das Industrias of the State of São Paulo.<sup>3/</sup> Almost simultaneously a similar study was begun on the transforming industries of Colombia. Co-operation was received from the Government and from the steelworks Acerias Paz de Rio S.A. Once the background material had been collected, and while the respective reports were being prepared, the study of Chilean industries was recommenced to obtain a

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1/ Labour Productivity of the Cotton Textile Industry in Five Latin American Countries (document E/CN.12/219), United Nations publication, Sales No.: 1951.II.G.2; A Study of the Iron and Steel Industry in Latin America (document E/CN.12/293/Rev.1), United Nations publication, Sales No.: 1954.II.G.3; Pulp and Paper Prospects in Latin America (document E/CN.12/370).

2/ Preliminary study of the iron and steel transforming industries in Chile, completed in January 1954 and prepared provisionally for restricted distribution.

3/ In these two cases the organizations mentioned have provided information of various kinds, as well as funds for the local expenses of specialized staff, etc.

/broader perspective

broader perspective of the subject and to complete the study along the lines followed for the other two countries; full collaboration was given for this purpose by the Government of Chile and the Asociación de Industriales Metalúrgicos.

Studies have to date been completed of the iron and steel transforming industries in Brazil and Colombia, while that of Chile is well advanced. These studies will be submitted for analysis and discussion at a meeting of experts on the metallurgical and mechanical industries to be held at São Paulo, Brazil, in mid-1956. This document is a summary of these studies; it anticipates the principal conclusions for the two countries, and compares the individual situations.

There are obviously fundamental differences in the degree of development of the mechanical and metallurgical industries in the two Latin American areas studied in greater detail, the State of São Paulo in Brazil and almost the entire industry in Colombia. São Paulo has become a manufacturing centre of primary importance, and the close-knit industrial concentration is reflected in high steel consumption. In Colombia, notwithstanding the high degree of progress in some sectors, such as the manufacture of metal furniture, these activities are still in the initial stage.

One conclusion to be drawn is that, because there are so many specific factors within each country which influence the initiation and expansion of these activities, no general statement can be made which would cover those countries not yet studied. This will only be possible when detailed information is available for other countries such as Argentina, Mexico, Peru or Venezuela, as well as for one or two of the smaller Republics in the hemisphere. Only then can a complete and rational picture be formed of the conditions under which Latin America's mechanical and metallurgical industries are developing.

An earlier study on Latin America's iron and steel industries showed that only seven countries - Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela - were at present suitable for the development of a domestic iron and steel industry. They were so placed either because they possessed the necessary raw materials or because the domestic market was sufficiently large to warrant integrated mills of a reasonable size.

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In the case of iron and steel transforming industries the situation is entirely different. For many of the numerous manufacturing branches of these industries, the effect of the size of the installation on the cost of the finished product is relatively small as compared with the influence of other factors. Consequently, there is no Latin American country where the installation of some of these manufacturing industries cannot be justified economically.

This is why a study of the present position and future prospects of the mechanical and metallurgical industries is, to a greater or lesser degree, of interest to the whole of the region.

This document is fundamentally dedicated to an analysis of the iron and steel transforming industries. They use ferrous raw materials produced by steelmaking industries: pig-iron, steel ingot and rolled steel products such as bars, sections, black or galvanized sheet, tinplate and special steels. On a smaller scale they also use various non-ferrous metals such as copper and copper alloys, aluminium, lead, zinc, etc.

Manufactured products may be classified as mechanical if they are appliances containing parts with relative movement, and as metallurgical if they are articles, either simple or complex, consisting of one or more pieces which do not move. The simpler metallurgical products - here termed primary metallurgical products - consist of one single part and are often intermediate products used by the more complex mechanical or metallurgical industries. Among them are wire, piping and tubes, tacks, nails, screws, bolts and certain kinds of containers.

Interest in the study of mechanical and metallurgical industries lies in the fact that a major share of their products are equipment for agriculture, industry, mining, transport and the generation of energy, all of which are essential to raise both production and productivity, with a subsequent acceleration of economic development. Immediate consumer goods, such as tinplate containers, are but a small fraction of the output of the mechanical and metallurgical industries, a much larger part consisting of durable consumer goods such as metallic furniture, electric household appliances, etc., the demand for which rises at the same rate as the standard of living.

Other ECLA studies have made it clear that many Latin American countries are hampered in purchasing capital goods abroad because of limitations in the capacity to import. Therefore, it is advisable in this analysis to focus attention on the possibilities of replacing or partially supplementing such imports by domestic output.

Although some metallurgical and mechanical products are manufactured on the basis of non-ferrous metals and their alloys, the study here will be confined as far as possible to those activities producing capital and durable consumer goods made from ferrous metals, omitting those using other industrial metals. This restriction will permit a deeper study of the selected sectors. It is, moreover, justifiable in view of the fact that the activities eliminated usually represent no more than 20 per cent of mechanical and metallurgical industries, but their inclusion would introduce into the analysis complications out of proportion to their importance. Nevertheless, their elimination is not complete, particularly as regards the aggregate analysis based on census data or other statistics.

Because of this desire to gain in depth what is lost in scope, the steelmaking industry is not studied in detail. Only a brief and aggregate description of this basic activity is given for the two countries, because it provides the raw materials for the transforming industries analysed here.<sup>4/</sup>

Among steelmaking activities, particular attention was paid to the problem of the production and demand for special steels, both from a quantitative and qualitative aspect, since they constitute an important raw material for mechanical and metallurgical industries. Moreover, the problem of special steels is of added interest because their use constitutes one of the best available indices for assessing the level

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<sup>4/</sup> A Study of the iron and steel industry in Latin America, E/CN.12/293/Rev. I, analyses the limitations in the steelmaking industry's development using a different method based on comparative cost estimates for hypothetical installations. It concludes by giving the development prospects for this industry in seven countries: Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela.

of technical progress achieved in the activities analysed. For this purpose, the collaboration of a European specialist in the subject was obtained; he spent several months studying the problem in the field and at ECLA headquarters.

Appendix I gives a complete list of the sectors of activity considered here and of those which were excluded for the reasons already given. This classification was drawn up purely for the purposes of this study and differs from the international classification<sup>5/</sup> although it is not difficult to establish a fairly close correlation between the two. Because of the great variety of activities included in this analysis, there was found to be insufficient homogeneity between the classes of activities enumerated in most Latin American censuses and in industrial or foreign trade statistics. Hence it was necessary to prepare new groupings of sectors of activity, corresponding mainly to two criteria: (i) the final aim within the economy of the goods manufactured (capital goods, durable consumer goods, etc.); and (ii) the relative proportion of the use of some productive sectors (skilled labour, capital, etc.) On the basis of these criteria, the various activities were separated into five large branches: (i) steelmaking, including wire-drawing and the manufacture of special steels; (ii) primary metallurgy, that is the manufacture of articles consisting of a single part, usually mass-produced on a large scale; (iii) secondary metallurgy, that is the manufacture of articles composed of several parts, but not intended to have movement, such as metallic constructions, metallic furniture, etc.; these activities require a higher proportion of skilled labour than the preceding ones, but the machinery used needs very little special attention, no skilled setting etc. being needed; (iv) heavy mechanics, mainly comprising the manufacture of machinery for industry, with greater requirements of skilled labour whose work is carried out within very narrow limits of tolerance; and (v) light mechanics, with exactly the same characteristics as the preceding group, but covering the manufacture of durable consumer goods.<sup>6/</sup>

5/ International Standard Industrial Classification of all Economic Activities, Statistical Office of the United Nations, Statistical Papers ... Series M, No. 4, Lake Success, N.Y., 31 October 1949.

6/ Appendix II provides definitions for the technical terms most frequently used in this study.

This study is basically concerned with an analysis of the 1953 situation in the industry<sup>7/</sup> and the prospects for future development. For this purpose, a panorama is given of what is being made, how it is being made and the more probable or more desirable course to be followed in its future development. This objective could not be attained unless a separate examination were first made of the situation in each sector of activity, of the manner in which available resources are used and the problems posed by expansion. This analysis is followed by an examination of the needs of certain scarce productive factors, such as skilled labour, technical skill, organization, etc.

The study of the present utilization of resources poses the problem of the working efficiency in the factories, since an understanding of how to increase productivity without new investment is of great interest from the standpoint of economic development. In many cases the additional output necessary to replace imports can be obtained in the course of production by combining existing factors to obtain a higher level of productivity.

To obtain an approximate idea of the real level of existing productivity, it was considered necessary to compare it with the situation in other countries. The United States was selected for this objective and, for purposes of comparison, prevailing conditions in the mechanical and metallurgical industry in that country during 1947 were adopted.<sup>8/</sup> Between 1947 and 1953 productivity in that country rose substantially, although the increase was not the same for all the various branches of manufacturing output. But the high level in 1947 is sufficient authority for adopting the figures for that year as a comparison with Latin America's industrial activities.

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<sup>7/</sup> Nevertheless, in some cases of particular interest, more recent information is used and at times a mention is made of projects which appear to have a reasonable chance of being accomplished.

<sup>8/</sup> The source of information used is the 1947 Census of Manufactures, United States Department of Commerce, Bureau of the Census, Vols. I - IV.

Broadly speaking, the absence of suitable data - working hours required to produce one unit in each branch - prevents productivity from being estimated in physical terms; it can only be assessed in monetary terms, that is, as a coefficient of the value added per man-year.

Moreover, the analysis in physical terms - except in very few cases - would be exceedingly difficult because of the very different degrees of vertical integration existing in the North American and Latin American industries. In the former there is a considerable division of labour between various establishments, so that raw materials and semi-finished products usually pass through several factories before the final product has been completed. A comparison of the quantum produced per man-year for the same industry in the United States and in a Latin American country would lead, in many cases, to erroneous results, unduly exaggerating the difference between the real existing levels of productivity.

The value added per man, used as a means of assessing productivity in monetary terms, also introduces some discrepancy in the comparisons, which arise from both the exchange rates used for converting monetary values to a standard basis expressed in dollars and the different price levels when they represent unreal competitive conditions. Nevertheless, the results obtained are clear in themselves and in relation to the other elements of analysis. Moreover, it is not intended that these monetary comparisons should go beyond suggesting the probable size of operations. In view of the total absence of informative elements in this field, the productivity estimates given here may be of value, even when expressed in monetary terms.

The dollar rates, which follow, were used as conversion factors for the national currencies in 1953: 31.5 cruzeiros for Brazil and 2.70 pesos for Colombia.<sup>9/</sup>

The fact that the conversion rates do not fully correspond to reality would only alter the differences, in absolute terms, between the productivity levels of the corresponding North American and Latin American industries. It would not affect the comparisons between productivity in the different

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<sup>9/</sup> These conversion factors are taken from the results of other ECLA studies.

mechanical and metallurgical sectors within the same country. Furthermore, comparisons of productivity in monetary terms may be contrasted with comparisons of physical productivity carried out in some sectors when there appears to be a similar degree of vertical integration in the United States and in that of the Latin American countries.

Estimates and other data on import substitution in each of the branches of industry, on domestic industry's share in supplying the country, etc., were obtained from official statistical data with the important addition of the visits made by ECLA teams of specialists to industrial enterprises in the same field. In these visits, and in the interviews with directors and executives, a very broad knowledge was obtained of technical and economic problems in each sector. This data will mainly be used in the preparation of the complete studies to be presented at the meeting of experts to be held in São Paulo during 1956. It suffices here to place on record the very favourable reception given, in most cases, to the ECLA teams on their visits to the factories. Very seldom were data or information refused, even those of a strictly confidential nature.

In brief, the following sources of information in the three countries were utilized:

#### BRAZIL

Economic and Financial Statistics Service of the Ministry of Finance.

Estatística do Comercio Exterior, Rio de Janeiro.

National Statistics Council. Sinopse preliminar do Censo Industrial (1950), Rio de Janeiro.

Detailed and unpublished data from the Industrial Census of 1950 and from the Industrial Survey of 1950, obtained directly from the I.B.G.E. and the D.E.E.S.P.

Study of the financial balances for the years 1951 to 1953 of 104 limited companies in the metallurgical field, made for ECLA by the Department of Economic Research of the São Paulo Stock Exchange.

Report on the visits of ECLA teams to 105 firms in the State of São Paulo, 15 in the State of Rio de Janeiro (and the Federal District) and 12 in the States of Rio Grande do Sul and Santa Catarina.

/COLOMBIA

## COLOMBIA

Series of Foreign Trade Yearbooks.

Preliminary data from the 1953 Census of Industries, as yet unpublished, supplied by the Dirección General de Estadística, Bogota.

Study of the effects of the 1948 tariff on imports of mechanical and metallurgical products in 1953, undertaken by the Dirección General de Aduanas, especially for ECLA.

Reports of the visits made by ECLA teams to 104 mechanical and metallurgical enterprises.

## Chapter II

## THE IRON AND STEEL TRANSFORMING INDUSTRIES IN BRAZIL.

In 1921, the small integrated steel mill of Barbára, in the State of Minas Gerais, began operations. This gave rise to considerable controversy. For some it represented the beginning of a new era in Brazil's economy, others were not in agreement and pointed out that it was undesirable to go against the sacred principle of the international division of work, according to which Brazil's role was that of an exporter of raw materials and an importer of finished products. At that time, imports of rolled steel in its various forms amounted to about 300 thousand tons a year.

Thirty years later, in 1951, imports of these products were still about 309 thousand tons. Although they had fallen to 176 thousand tons in 1953, this was due to the severe restrictions imposed by foreign exchange difficulties, and not to any contraction in demand. In 1950 and 1953, domestic production of steel ingot amounted respectively to 850 thousand and 1,009 thousand tons. Although the growth of Brazil's iron and steel industry has been great, output is still small in per capita terms. In 1953, for instance, per capita consumption of unfinished steel in Brazil was up to 20 kilogrammes, which, not to mention the industrialized countries in other regions, compares unfavourably with the 1952 level of 26 kilogrammes in Cuba, 34 in Mexico, 42 in Chile and 52 in Argentina. Per capita consumption in the United States during that year was 384 kilogrammes.

The effort involved in raising supplies to the figures achieved in recent years is well known; but in view of the development of Brazilian industry, it is worth asking what these figures will be in the next 10, 20 or 30 years, and what efforts must be made to prevent a perpetuation of the present situation in which, according to most of the industrialists interviewed, the main factor limiting the development of the transforming industries is the serious shortage of ferrous raw materials, particularly for rolled steels and the various types of special steels.

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1/ The term "rolled products" includes the following sub-products: strip, thin sheet and finished rolled products, such as wire, bars, sections, black plate, thin and galvanized sheet and tinplate. In this study,



Adding imports of iron and steel products to finished steel consumption, the per capita figure would rise to some 30 kilogrammes, that is by some 50 per cent. In other words, then, there is a considerable market potential for the Brazilian iron and steel industry; this potential must obviously increase as a result of the growth in population and in income. The rate at which this increase takes place will depend largely upon the development of mechanical and metallurgical activities, to the study of which this document is fundamentally dedicated.

One of the main hindrances to the development of the iron and steel transforming industries lies in the small consumer market. The size of the factories has therefore to be limited to dimensions which are often below those considered economically justifiable and only a small number of products can be mass produced cheaply.

Nevertheless, in this respect Brazil at present occupies a favourable position in Latin America, for despite the low per capita figure, total consumption of steel and of products made from it is sufficiently large to justify, with few exceptions, the installation of optimum size industries.

Moreover, it should be remembered that the average figure for Brazil's steel consumption is not very representative, because of the unequal distribution of economic activities over its vast territory. An attempt has been made to break down steel consumption into that for some clearly defined areas, as is shown in table 1 for 1950. It reveals that the country's principal industrial region, which had a population of nearly 22 millions, had a per capita consumption of unfinished rolled steel some 117 per cent higher than the country's general average. Assuming that this proportion was carried through to 1953, then in that year per capita consumption in the industrial region would have been some 43 kilogrammes per capita.

There is a considerable contrast between per capita consumption figures for the region comprising Sao Paulo, Rio de Janeiro and Minas Gerais and those for other regions given over mainly to farming, particularly in the North and North-east. These regions receive only a very small proportion of the mechanical and metallurgical output of the country's industrial states. Thus, for example, a well-known company making durable consumer goods which was visited in Sao Paulo stated that 70 per cent of its output is sold within that same state, 25 per /cent in

cent in other southern states, and only 5 per cent in the vast remaining regions. There are indications that these proportions are equally applicable to most of the other iron and steel transforming industries.

Therefore the future evolution of the mechanical and metallurgical industries will not only be a function of the increase in real productivity in the currently more advanced areas, but also of the economic development in that part of Brazil's territory which is at present more backward.

Table 1

BRAZIL: GEOGRAPHIC DISTRIBUTION OF PER CAPITA CONSUMPTION  
OF UNFINISHED STEEL, 1950

Geographic grouping	Population (thousands)	Steel consumption (kgs)
<u>Industrial zone</u>		
San Paulo, Rio de Janeiro, Federal District and Minas Gerais	21,526	33.2
<u>Farming region in the South</u>		
Rio Grande do Sul, Santa Catarina and Paraná	7,860	12.9
<u>Farming region in the North and North-east</u>		
Goiás, Mato Grosso, Espirito Santo, Baía, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará Maranhao, Pará, Amazonas, Territorio do Acre and Territorio do Amapá	33,497	4.3
Total and average	51,783	17.6

Source: ECLA estimates based on official Brazilian statistics.

1. Analysis of supply and demand

An analysis of Brazil's supply of iron and steel products may be undertaken from two angles: in the first place, the extent to which the steelmaking industries supply the country with ferrous raw materials; and /secondly, the

secondly, the stage of development reached by the transforming industries in supplying the country with finished iron and steel products. This examination may be further complemented by an analysis of the part played by the São Paulo transforming industry in the supply of Brazil as a whole, taking each of the main types of products into consideration.

The figures in table 2 summarize apparent consumption for certain years, and suggest two kinds of observation. First of all, they point to the large and growing share of the transforming industries - which can be assessed by the consumption of raw materials, that is, rolled products - in supplying the country with finished products. In this connexion it should be mentioned that in 1952 (and in 1951), when the percentage consumption of rolled products as against total consumption showed a sharp drop, there was considerable freedom to import, based on the desire to facilitate stockpiling and to renew equipment in view of the threat of a new world conflict. This policy of encouraging imports far exceeded the country's capacity to import and was soon replaced by the traditional limitation of imports in accordance with the scanty resources available. Consequently, 1949 and 1953 were normal years as regards imports of finished products.

Table 2

BRAZIL: CONSUMPTION AND DEMAND FOR IRON AND STEEL AND  
THEIR PRODUCTS, IN 1949, 1952 AND 1953  
(Thousands of tons)

Year	Output of rolled products	Imports of rolled products	Imports of finished products	Total consumption
1949	506	235	305	1,046
1952	719	296	655	1,670
1953	841	218	289	1,348

Source: ECLA estimates, based on official Brazilian statistics.

The figures in table 2 clearly show that the Brazilian iron and steel transforming industry has become ever more dependent on domestic production of rolled products as regards its raw material supply, since in normal years

2/ From 70 per cent in 1949 to 61 per cent in 1952.

/imports of

imports of unfinished steel have remained at an annual level barely exceeding 200 thousand tons; these imports have thus not followed the upward trend shown by total consumption of iron and steel products. Even the figure for 1952, which was a year of exceptional import facilities, does not show too great an increase in the import tonnages of rolled products.

As no quantitative data are available relating to the use of steel in building, the estimate of the part played by the transforming industry in meeting the country's demand for iron and steel products is approximate. Only by knowing the volume of unfinished steel used in the building industry could the existing ratio between the country's total consumption of finished iron and steel products and the domestic output of such products be estimated.

Even with these reservations, table 2 provides some indication of the extent to which products made in the country meet Brazilian demand. It may also be seen that the iron and steel transforming industries supplying the domestic market have developed, insofar as concerns the rolled products used as raw material, much more on the basis of increased domestic output than on increased imports. Imports, on the other hand, show a tendency to remain stationary or even to decline. These facts, apart from the known limitation in the capacity to import, confirm that, in Brazil, the recent expansion of the mechanical industries and of those processing secondary metallurgical products would have been impossible had it depended on raw material supplies based on imports of unfinished iron and steel products. Domestic manufacture of iron and steel in relation to raw material supplies for the mechanical industry is thus an important factor limiting the development of this industry, although, as will become evident later on, this does not mean that an increase in steelmaking output is the only possible solution for a better supply of finished products.

To obtain a general picture outlining the part played by Brazil's iron and steel transforming industry in supplying the domestic market with finished products, an analysis should be made of the extent to which the mechanical and metallurgical industry supplies that market with the products of each of those branches of the industry into which it has been subdivided for the purposes of this study.

/Table 3

Table 3  
BRAZIL: SHARE OF THE TRANSFORMING INDUSTRY IN THE SUPPLY  
OF IRON AND STEEL PRODUCTS, 1949

Types of products	Production	Imports	Production plus imports	Percent of production plus imports)
	(Thousands of dollars)			
B 4 Cables and wire netting	5,984	957	6,941	86.21
B 5 Sundry applicanes	34,053	8,665	42,718	79.72
D 6 Machine parts	1,157	8,172	9,329	12.40
D 7 Mining and industrial machinery	33,680	106,932	140,612	23.95
D 8 Farm machinery	8,390	17,368	25,758	32.57
D 9 Boilers, internal combustion engines and turbines	1,658	21,405	23,063	7.19
D 10 Electrical material, including motors and generators	11,637	17,624	29,261	39.77
D 11 Railway material, excluding rails	4,976	17,768	22,744	21.88
D 12 Motor vehicles and cycles	62,705	126,486	189,191	33.14
D 13 Vessels and other means of transport	551	7,436	7,987	6.90
C and D 14 Building materials	17,566	4,740	22,306	78.75
C and Articles for industry and E 15 commerce	8,352	27,486	35,838	23.30
C and D 16 Articles for general use	10,791	2,954	13,745	78.51
C and E 17 Articles for house hold use	34,082	26,016	60,098	56.71
C 18 Articles for personal use	597	957	1,554	38.42
Total	236,179	394,966	631,145	37.50

Source: Sinopse Preliminar do Censo Industrial.

Note: At the following exchange rates: 24.90 cruzeiros per dollar, for domestic production and 18.70 cruzeiros for imports.

/Table 3 shows

Table 3 shows the extent of import substitution for each category of product. For this purpose the value added by domestic industry in each branch has been compared with the country's total consumption in 1949 (output plus imports).<sup>3/</sup>

As a general rule, imports substitution occurs last in the case of products of the mechanical industry. This is because of greater technical difficulties in their manufacture. Even so, in Brazil at present, substitution in this sector is relatively well advanced, as for instance in the case of the manufacture of certain types of machinery and equipment for farming, industry and mining or even of parts for automobile vehicles. Power generators, other than electric, and automobile vehicles are more complex products because they require more skilled labour and better quality of raw materials; they usually belong to the last phase of import substitution.

It should be observed then, that in Brazil domestic industry tends to concentrate on both primary and secondary metallurgical activities, the first being included in groups B 4 and B 5 and the second, almost exclusively in groups C 14 to 18 (see table 3). The reasons for this are given elsewhere in this document; among the more important of them is the greater facility in these sectors for obtaining customs protection, or indirect but nonetheless efficient protection, through the exchange system or through quantitative restrictions on imports, since many of the respective products are considered as luxuries. Another less important factor is that, as mentioned earlier, these activities require less skilled labour. Thus, domestic manufacture of electric household appliances considered as luxuries was possible because these goods enjoyed considerable tariff and exchange protection. Once these light mechanical industries had been successfully established, the next stage could be reached of manufacturing similar utensils, such as sewing machines, which cannot be considered as luxuries and imports of which have always been among those most favoured.

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<sup>3/</sup> To avoid possible duplication because products of some countries represent raw materials for others, such items have been excluded from semi-products.

/Nevertheless, table 3

/Nevertheless, table 3

Nevertheless, table 3 indicates that the contribution of the heavy mechanical industry towards import substitution of means of production and transport is by no means insignificant in Brazil.

Some mention should now be made of the strong tendency towards concentration of Brazil's mechanical and metallurgical industries (excepting the basic steel industry) in the State of São Paulo. Table 4, which is quite explicit on this point, shows the number of workers employed in Brazil as a whole in each of the main categories of mechanical industry considered in this study, and gives a percentage distribution for the country's principal industrial states.

/Table 4

BRAZIL: LABOUR DISTRIBUTION OF THE MECHANICAL AND METALLURGICAL  
ACTIVITIES, BY STATES, IN 1949

Activity	Brazil (workers)	a/ (P e r c e n t a g e s)						Other States
		Sao Paulo	Rio de Janeiro	de Minas Gerais	Rio Gran- de do Sul	Santa Cata- rina		
A 1	Primary products	17,317	29.7	23.3	46.2	-	-	0.8
B 4	Cables and wire netting	2,193	58.0	26.7	1.5	11.5	1.5	0.8
B 5	Sundry appliances	13,823	58.1	19.2	6.1	8.3	0.9	7.4
D 6	Machine parts	592	67.8	5.9	-	19.4	0.7	6.2
D 7	Mining and industrial machinery	19,391	57.2	20.1	4.1	6.5	5.5	6.6
D 8	Farm machinery	4,568	64.6	6.6	8.9	12.2	2.1	5.6
D 9	Boilers, internal combustion engines and turbines	1,591	27.8	51.1	2.8	17.4	-	0.9
D 10	Electrical material, including generators	3,240	89.5	27.6	2.0	0.9	-	-
D 11	Railway material excluding rails	3,296	67.6	18.6	10.6	-	3.2	-
D 12	Motor vehicles and cycles	6,512	74.4	15.4	1.0	5.2	0.2	3.8
D 13	Vessels and other means of transport	4,970	6.0	68.7	2.3	6.1	4.2	12.7
C and D 14	Building materials	8,595	61.2	22.7	2.8	5.6	0.4	7.3
C and D 15	Articles for industry and commerce	4,253	59.2	29.1	1.5	6.0	1.5	2.7
C 16	Articles for general use	5,842	53.4	29.6	3.1	8.0	1.7	4.2
C and B 17	Articles for household use	18,292	60.8	17.3	3.1	15.5	0.4	2.9
C 18	Articles for personal use	333	76.0	24.0	-	-	-	-
	Grand total	114,808	53.4	23.0	10.2	7.2	1.7	4.5
	Total excluding the steelmaking industry	97,492	57.7	22.9	3.8	8.5	2.0	5.1

Source: Sinopse Preliminar do Censo Industrial, 1950.

a/ Includes the Federal District.

/In nearly



In nearly all branches of the mechanical and metallurgical industry the importance, gauged by the proportion of man-power in relation to the total industry, is decidedly greater in the State of Sao Paulo than in any other one State or even in all the other states taken as a whole. The manufacture of non-electrical power generators, ship-building and the manufacture of vehicles are exceptions, these industries being mainly concentrated in the State of Rio de Janeiro (including the Federal District) due to the special nature of their manufacturing activities. In the first of these industries boiler manufacture predominates; the sugar-cane industry is a large consumer of boilers, and it is a traditional activity in the State of Rio de Janeiro. Ship-building and the manufacture of vehicles are also traditionally rooted in this State and no great initiative has been shown in this respect in the State of Sao Paulo.

The predominance of the State of Sao Paulo in the value added by the various branches of activity is even more evident than may be deduced from the percentage distribution of labour by states as shown in table 4. This is because output per man-hour in nearly all the sectors mentioned is higher in Sao Paulo than in the other states.<sup>4/</sup>

This rapid analysis of the geographic distribution of the iron and steel transforming industries explains why the study of Brazil's mechanical and metallurgical industry was concentrated on the States of Sao Paulo, Rio de Janeiro (including the Federal District), Minas Gerais, Rio Grande do Sul and Santa Catarina, but particularly in the first-named. Information relating to mechanical and metallurgical enterprises in Sao Paulo and the characteristics of their respective activities, including as a gauge the labour employed, covers nearly 58 per cent of all these industries in Brazil. This proportion rises to nearly 70 per cent in five sectors of activity.

2. The steelmaking industry and the production of primary by-products<sup>5/</sup>

These industries were the main object of the research undertaken prior to the Meeting of Experts held in Bogota in 1952. Those subjects which remain

<sup>4/</sup> It should be noted that the greater output per man employed in Sao Paulo, measured by greater value added, is obtained despite the heavy restrictions in electric energy supplies, which have forced industries to extreme economy measures through the adoption of special shift systems or the installation of equipment which takes best advantage of this factor.

<sup>5/</sup> For the purposes of this study, the "steelmaking industry" will be taken to include those activities related to the production of pig-iron, the manufacture and rolling of steel ingot, made either from pig-iron or scrap, as well as the manufacture of special steels.

pending will be presented at the new meeting which it is hoped to hold in Sao Paulo in 1956. Therefore this document will not focus attention on them. Nevertheless, the relationship between the steelmaking and steel transforming industries, both because the former are raw material producers and because in Brazil some of them also carry out transforming activities,<sup>6/</sup> justifies a brief examination of the steelmaking situation.

With the exception of certain products and for limited periods only, Brazil's iron and steel production has been and continues to be insufficient and the resulting shortage is at present one of the most serious factors limiting the development of the transforming industries. Furthermore, with the exception of a few mills, productivity on the whole is low and therefore costs and prices are high. Quality defects, which also exist, are another, though less important, factor; they occur in given factories or products and only affect particular sectors of the transforming industries.

The scarcity and high cost of the product has led certain transforming industries to assure their raw material supply by undertaking small-scale steelmaking activities. On the other hand, there is a tendency among the steelmaking industries themselves, to undertake certain primary transforming activities in order to offset, in part, the handicaps of low productivity in their basic output.

Obviously these trends towards vertical integration, coming from two different directions, affect the independent transformer in various fields of activity in two different ways: competition for the markets and a reduction in raw material supplies.

a) The steelmaking industry as a producer of ordinary rolled steels  
(A-2)

Table 5 gives output figures for almost all the steel mills in 1953 and the distribution of products by individual types.

It should be recalled that in 1953 some 260 thousand tons of rolled

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<sup>6/</sup> Excepting the Companhia Siderurgica Nacional, some 64 per cent of the tonnage produced by the other firms corresponds to simply rolled steel and the remainder to products undergoing some stage of transformation. If the output of the integrated mill at Volta Redonda is included, this percentage would rise to 79 per cent.

Table 5

BRAZIL: PRODUCTION OF THE STEELMAKING INDUSTRY BY ESTABLISHMENTS  
IN 1953<sup>a/</sup>  
(tons)

Enterprise and mill	Production					Total b/
	Ordinary rolled products	Wire	Tubes	Special steels	Sundries	
<u>Cia. Siderúrgica Belgo Mineira</u>						
Monlevade mill	52,000	60,000	24,000	9,000		145,000
Sabará mill	40,000					40,000
<u>Cia. Siderúrgica Nacional</u>						
Volta Redonda mill	346,000				17,000 <sup>c/</sup>	363,000
<u>Cia. Aços Especiais</u>						
Itabira	36,400			5,600	1,000 <sup>d/</sup>	43,000
<u>Cia. de Mineração Geral do Brasil</u>						
Santa Olimpia mill	31,520			8,000	480 <sup>e/</sup>	40,000
Mogi das Cruzes mill	40,000		20,000 <sup>f/</sup>			60,000
Rafael M. de Martino mill	900		3,600			4,500
Sao Francisco mill	25,000					25,000
Sao José mill	26,400			3,600 <sup>g/</sup>		30,000
Sao Caetano mill	25,000					25,000
Siderúrgica J. Aliperti	33,000			5,200		38,200
<u>Industria Metalúrgica</u>						
N.S. Aparecida	2,000			5,000	6,500 <sup>d/</sup>	13,500
Aços Villares mill				4,200	2,500 <sup>e/</sup>	6,600
<u>Siderúrgica Mueller, Curitiba</u>						
Eletro Aços Altona, RGS	1,600				200 <sup>e/</sup> 600 <sup>e/</sup>	2,200
Eletro Aços Plangg SC					1,080	
	659,820	60,000	47,600	40,600	29,360	836,000

Source: Information gathered during visits to the industry by ECLA staff.

- a/ Excluding, among others, the following mills: Siderurgica Rio-grandense S.A., Usina Santa Eugenia S.A., Usina Queiroz Junior, Usina Luporini, Usina HIME, to which a combined annual output of 40 to 50 thousand tons of rolled products may be attributed.
- b/ The official figure according to the Anuario Estatístico do Brasil (I.B.G.E.) is 841 thousand tons as a whole. Adding production omitted as given in note a/, there would be a surplus of 45 thousand tons, that is 5 per cent. This is probably due to the upward rounding out of figures by some informants.
- c/ Metallic structures.
- d/ Forged tools.
- e/ Cast iron pieces.
- f/ Production began towards the end of 1953 and cannot have reached this figure in the 1953 calendar year.
- g/ Ferro-alloys. /products were

products were imported. Even so, the raw material shortage was one of the more important factors limiting the output of the transforming industries. That is why raw materials will be studied first, followed by other resources available for expanding the steelmaking industry.

In the first place, the strong influence of the size of the operation upon costs must be remembered. In the report submitted to the Meeting of Experts at Bogota<sup>7/</sup> a study was made of the variation in the cost per ton of rolled steel at prices prevailing in 1948, between a 250-thousand tons a year steel mill - frequently found in Latin America - and others with different production capacities, to be installed on the Atlantic coast of the United States. The following figures were reached:<sup>8/</sup>

<u>Annual output of rolled steel (thousand tons)</u>	<u>Cost per ton of rolled steel (1948 dollars)</u>	<u>Difference from a mill producing 250 thousand tons (percentage)</u>
1,000	72.4	- 28.5
716	76.3	- 24.6
500	84.0	- 16.9
250	100.9	-
105	133.8	32.9
50	155.0	54.1

Consequently it may be said that, unless raw materials are extremely cheap and the haulage distance is very short, only Argentina, Brazil, Mexico and Venezuela have a sufficiently large consumption to offset high costs for coke or iron ore; that is, their final cost would be low owing to the size of plant justified by the existing market.

Much capital is required to create an integrated steel mill (from 400 to 500 dollars per annual ton of output).<sup>9/</sup> It would thus be very difficult for private enterprise in Latin America to obtain sufficient capital to build such mills.

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<sup>7/</sup> E/CN.12/293/Rev.1, chart 1, page 56 of the Spanish edition.

<sup>8/</sup> If the industry were in Latin America, in some country where wage rates were considerably lower than in the United States, the influence of the scale of production on cost would be somewhat less. In any event, the data in the table indicate the very great influence of this fact, since the lower wage rates in these countries are often partly offset by lower productivity.

<sup>9/</sup> Dollars at 1948 prices.

/Brazil has

estimated

Brazil has excellent and abundant iron ore resources, at 21 per cent of the world's known reserves which can be exploited. On the other hand, fuel presents serious problems. The State of Minas Gerais - bounding the States of Sao Paulo and Rio de Janeiro where demand is concentrated - has the country's largest and most accessible iron ore deposits; however, it has no fuel other than charcoal, from either natural or plantation forests. As charcoal blast furnaces cannot be built on the scale currently used for coke blast furnaces,<sup>10/</sup> the use of charcoal precludes the advantages to be derived from the size of operations. Hence the steel produced in Minas Gerais is relatively expensive and can only with difficulty compete with output in the coastal states, in large-scale installations, using coke. This is so despite the fact that at present the ore has to be brought 500 to 800 kilometres from Minas Gerais to the coast by railway.

The steel industry in the State of Minas Gerais therefore tends to supply the local market in that State with ordinary steels. The more expensive items are reserved for sale in the coastal states, because they are better able to meet the high transport costs.

The main deposits of Brazil's coking coal are found in the south, near the coast, in the State of Santa Catarina. Although the quality, once washed, is ideal for making coke, the geology of the coalfields and the impurities found cause serious working problems. The coke produced in Santa Catarina, like the charcoal of Minas Gerais, is a fuel of low productivity.

Apart from Volta Redonda, which has for the first time organized coal mining in Brazil, so as to standardize the qualities produced and to ensure an adequate supply, the Companhia de Mineracao Geral do Brasil is using small amounts of coke on a trial basis in its charcoal furnaces at Mogi das Cruzes. For the moment this fuel substitution, in addition to its experimental value, has produced no other advantage than that of supplementing the supply of charcoal, which is becoming scarce in the vicinity of Sao Paulo and is subject to sharp seasonal fluctuations.

As regards expansion plans, those of the firms appearing in table 6 are known. Should these be realized, production capacity would be raised from 836 thousand tons in 1953 to 1,712 thousand tons in 1957-60. According to these plans, output of special steels, tubes and other primary steel products made by some steel mills, should rise from 176 thousand tons in

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<sup>10/</sup> The maximums in Brazil are 180 and 1,300 tons per day, respectively.

Table 6

## BRAZIL: EXPANSION PLANS FOR THE STEELMAKING INDUSTRY, IN 1953

Enterprise and mill	Production		Rolled products available for sale	
	1953	1957-60	1953	1957-60
Barbará	40,000	40,000	40,000	40,000
Monlevade	145,000	250,000	52,000	150,000
Volta Redonda	363,000	750,000	346,000	733,000
Acesita	43,000	60,000	36,400	-
Mogi das Cruzes <sup>a/</sup>	60,000	300,000	40,000	200,000
Sta. Olimpia <sup>a/</sup>	40,000	40,000	31,520	15,000
Rafael M. De Martino S.A. <sup>a/</sup>	4,500	4,500	900	-
Sao Francisco <sup>a/</sup>	25,000	25,000	25,000	25,000
Sao José <sup>a/</sup>	30,000	30,000	26,400	-
Sao Caetano <sup>a/</sup>	25,000	25,000	25,000	25,000
Aliperti	38,200	38,200	33,000	33,000
N. Senhora Aparecida	13,500	13,500	2,000	-
Aços Vilares	6,600	24,000	-	-
Siderúrgica Mannesmann	-	110,000	-	-
Mueller, Paraná	-	-	-	-
Electro Aços Altona	2,200	2,200	1,600	1,600
Electro Aços Plangg	-	-	-	-
<b>Total</b>	<b>836,000</b>	<b>1,712,000</b>	<b>659,820</b>	<b>1,221,000</b>

Sources: Information relating to the last three mills was supplied to ECLA economists by the enterprises concerned; data for the rest of the industry were obtained during visits to the mills by an expert in special steels contracted in Europe for the purposes of this study.

<sup>a/</sup> Due to the flexibility and inter-relation of the mills' manufacturing programmes, which, although corresponding to the group as a whole, may be different when considered individually.

/in 1953

in 1953 to 491 thousand tons in 1957-60. Table 6 also shows that the total rolled products available for sale will rise from 660 thousand tons in 1953 to 1,221 thousand tons in 1960.

It is particularly noteworthy that the steel mills sell a considerable percentage of steel products with some work added to ordinary rolling, as is the case with wire, tubes, metallic constructions and even farm implements or even special steels.

It may be said that, except for Volta Redonda and a few scrap rolling mills, the rest of Brazil's steel output comes either from mills originally planned for transforming iron and steel which, later, by a process of vertical integration, advanced towards producing their own ferrous raw materials, or else from industries originally planned as primary steel mills which have subsequently taken on some transforming activities.

Production of raw materials by the transforming industries has mainly arisen through supply shortages. This was particularly the case during and after the Second World War. To this must be added the possibility of using scrap which began to accumulate as the transforming industry developed.

The tendency of the steel mills to engage in transforming activities is, in turn, due to various causes. Among them is the need to improve the cost situation since, as already explained, most of the steel mills are high-cost producers.

Finally, in relation to the expansion plans given in table 6, it is difficult to say whether or not their opportune fulfilment will lessen the shortage of rolled products which confronted the transforming industry in 1953, or whether the interim growth of demand will continue to cause an inadequate supply for the domestic market. A study of this problem is complicated by the fact that many rolled products, particularly bars and sections, are consumed directly by the building industry; no reliable information is available as to this industry's demand, which varies according to a number of factors.

b) Demand and production of special steels in Brazil <sup>11/</sup>(A-3)

Together with those elements composing simple or ordinary steels,

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<sup>11/</sup> For the purposes of this study the term "special steels" is taken as meaning all those which differ from ordinary steels having a maximum of 0.25 per cent carbon, and produced on a large scale by the steel mills. In other words, the term refers to steels with greater than usual proportions of a) carbon or manganese, to increase resistance or hardness; b) sulphur, to facilitate the work of cutting tools; c) silicon to reduce magnetic properties or to increase elasticity; d) metals for imparting special properties of resistance to corrosion, tension, temperature, penetration etc.

special steels contain another or other elements, metallic or non-metallic, which give to the steel special properties such as greater resilience, greater resistance to certain stresses, or specific properties, such as resistance to corrosion (stainless or chrome-nickel steels) etc.

In the research undertaken on the Brazilian iron and steel transforming industries, requirements for 1953 of special steels of various kinds were estimated at some 90.7 thousand tons. In that same year, the domestic steel industry produced 38.6 thousand tons; but imports did not cover the difference <sup>12/</sup> and hence during visits to the industries it could be seen how at times the manufacturers, because of insufficient supply and of relatively high prices, resorted to the use of ordinary steels in cases where special steels were more appropriate. In many cases this substitution had to be accompanied by changes in design.

In order to compare demand with output in 1953, table 7 has been prepared. This also gives the expansion plans mentioned by manufacturers of special steels as more immediate possibilities, together with a forecast of consumption for 1960. The figures for this forecast are obviously low and could well be considered as a first stage in evolution towards greater use of special steels.

The figures in table 7 show that in 1953 domestic output covered only 42.5 per cent of the country's total requirements for these steels. Analysed by types, it is evident that that share was some 30 per cent for tool steels, 34 per cent for steels used in making machinery and some 51 per cent for spring steels and other special steels, while there was no domestic output of stainless steels. Even assuming that the forecasts for 1960 are fulfilled as regards expansion of demand and of domestic production, imports will still have to cover nearly 60 per cent of consumption requirements.

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<sup>12/</sup> Foreign trade yearbooks do not give import statistics for special steels; imports are included within the 164 thousand tons of steel products shown annually.

/Comparing the



Comparing the estimated figures for special steel and those for their production within the country with the total output of steel ingot - 1,140 thousand tons in 1953 - the percentages are 8.0 and 3.3 per cent respectively. These are low in comparison with those for more industrialized countries, where all the special steels used are usually equivalent to 15 per cent of steel ingot of all kinds.<sup>13/</sup> Assuming that all the expansion plans for the industry as a whole are fulfilled, as well as those relating to the consumption and production of special steels, then the proportion of domestic supply would be slightly more favourable in 1960 than in 1953. (4.1 per cent of steel ingot output). This would still be far from real requirements, however, and further still from meeting the potential demand which will arise as a function of the greater advances in skill.

Since their utilization depends on greater technical progress, the consumption of special steels is one indication of the degree of progress in mechanical and metallurgical industries. It is therefore logical to assume that once a country has reached a certain stage of development, special steel consumption should grow faster than that for ordinary steels.

Demand for special steels in Brazil will be even heavier, if the mass production of road vehicles is begun, since such steels represent almost 17 per cent of their weight. To this should be added, as an accelerating factor, the acceptance and spreading of standards for ferrous raw materials to be used in the various applications. The absence of such standards is recognized at the present time as helping to retard the development of Brazil's mechanical industries. There is no doubt that some producers of quality steels conform quite strictly to United States SAE<sup>14/</sup> specifications

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<sup>13/</sup> The ratio between consumption of special steels and of all steels naturally depends on the structure of the country's transforming industries. There are activities, such as the manufacture of many durable consumer goods in the secondary metallurgical industry where special steel consumption is practically nil; by contrast, it is high in the mechanical industries making production goods. In Brazil, therefore, where the mechanical industries are as yet little developed, it is justifiable that there should be a lower special steel consumption per total steel tonnage than in more industrialized countries.

<sup>14/</sup> Society of Automotive Engineers.

BRAZIL: DEMAND AND PRODUCTION OF SPECIAL STEELS  
(tons)

Type of steel	Situation in 1953			Expansion plans	Hypothetical situation in 1960	
	Estimated demand	Production	Deficit partly met by imports		Estimated demand	Production
<u>Tool steels</u>						
with a high carbon content	1,000)				1,750)	
ordinary alloy steels	1,200)	800	1,900	1,200	2,100)	2,000
special alloy steels	500)				850)	
<u>Steels for machinery</u>						
with a high carbon content	20,000	15,600	4,400	3,000	35,000	18,600
alloy steels	20,000	1,200	18,800	-	35,000	1,200
<u>Stainless steels</u>						
bars	2,000	-	2,000	-	3,500	-
sheet	3,000	-	3,000	-	5,000	-
<u>Sundry steels</u>						
silicon steel sheet for motors and transformers	6,000	-	6,000	2,000	10,000	2,000
spring steels	25,000	21,000	4,000	16,000	45,000	37,000
sundry steels	12,000	-	12,000	3,000	20,000	3,000
Totals	90,700	38,600	52,100	25,200	158,200	63,800

Source: Direct research undertaken by a European expert contracted specially by ECLA for the study of the problem. This research included visits to the producers of special steels, to the main consuming industries and to salesmen and importers of these products.

/for their

for their output of certain specialties, such as spring steel and certain types of steel for making machinery. But if the use of such specifications should become widespread among transforming industrialists, the figure for probable demand in 1960 will fall even farther below reality.

Brazil's natural resources for producing special steels in greater quantity and variety are truly extraordinary. High-grade iron ores are plentiful, as well as charcoal for reducing purposes, which permit the production of pig-iron free from those impurities normally derived from coke ash. Possibly the only drawback as regards resources lies in the electric power shortage which has obliged some producers to manufacture quality steels in Siemens-Martin furnaces. The quality of the steel is thus impaired through the absorption of part of the sulphur contained in the petroleum. But this is a defect that can be overcome, and therefore it may be said that Brazil is in a privileged position to produce special steels, as compared with other countries. It may be said to occupy a position similar to that of Sweden, which is a traditional producer in this field.

It is very probable that if the special steel industry develops in Brazil, on the firm basis of the domestic market, it would also be in a position to export many types of special steels to other Latin American countries under competitive conditions vis-a-vis the more industrialized countries.

c) Production of tubes and pipes in the steelmaking industry (B-3)

In order to analyse the situation in this sector a distinction must be made between i) cast-iron tubing, usually produced by centrifuging near the blast furnaces; ii) seamless steel tubes also nearly always made by the steel mills themselves, and iii) welded steel piping, which is usually produced in separate establishments but which in Brazil constitute an important item in some steel mills and iv) accessories of malleable iron.

Tube imports into Brazil have stood at 47 thousand, 50 thousand and 53 thousand tons respectively during the years 1951-53. The average price has been close to 290 dollars in 1951 and 1953, and to 380 dollars in 1952. This last figure, however, should be considered as abnormal, and was due to the world shortage of iron and steel products as a result of the exceptional demand during the period following the Korean conflict.

/i) Cast-iron tubing

i) Cast-iron tubing (B-3-a) Thick tubes should be included here, with diameters between 50 and 500 mm. or more, usually intended for underground installations. Thin tubes should also be included, used principally for plumbing in houses and buildings. Both are produced in Brazil, and practically all the demand is met. Thick tubes have been made since the 'twenties in installations attached to two small blast furnaces located in the States of Minas Gerais and Rio de Janeiro. Thin tubes are produced in several secondary casting foundries, some of them being quite small.

ii) Seamless steel tubing (B-3-c) It is probable that, except for special piping with very few uses, almost all pipe and tube imports until 1953 inclusive were of this type. It has been more difficult to substitute for these imports since such tubes are made by special rolling processes requiring expensive equipment which is not built for small outputs.

Towards the end of 1953 a factory started operations in the State of Sao Paulo, with an initial capacity of 50 to 60 thousand tons of piping of all kinds between 3/1 and 3-inches diameter; a second was installed in Minas Gerais in the middle of 1954, with an annual capacity of 60 thousand tons of piping up to 7-inches diameter inclusive. As a result, it is probable that many imports have been replaced, except for tubes with larger diameters which are mainly used in the petroleum industry. But, as this activity is still on a small scale in Brazil, it is unlikely that there will be any justification for many years for the installation of equipment for making seamless tubes of larger diameters.

Comparing the import quantum in recent years with the joint capacity of these new establishments, it may be concluded that this capacity is at present excessive for Brazil. It will therefore be interesting to watch developments during the next few years and to see whether the greater supply will act as an incentive for higher demand. It is quite possible, however, that increased output will not materialize immediately, since both the factories are at present encountering difficulties in their raw material supply. The plant at Minas Gerais, which is supplied with semi-finished products from Volta Redonda, plans to build an integrated steel /mill, based

mill, based on an electric reduction furnace, supplied with power from a hydro-electric project at present under construction. The Sao Paulo factory is part of an integrated steel mill, but because of limited output and the size of the blooming mill which supplies the semi-finished raw materials, it also must depend on some raw materials from Volta Redonda to produce the larger-diameter tubes. This steel mill, as may be seen in table 6, has expansion projects under way which will enable it to overcome these obstacles shortly.

Both these seamless tube mills have the necessary space and part of the necessary equipment to double their output and extend their range of products.

iii) Welded steel piping (B-3-c) This type of piping is mainly used for household gas and water installations and may be galvanized, black or painted. Hence there is little use for the larger diameters, except for conducting low-pressure gas. Towards the end of the 'forties, Brazil's import substitution was almost complete, except for very special types. Two integrated steel mills are important among producers (see table 6). These are the Companhia Siderurgica Belgo Mineira, with a 1953 output of 24.6 thousand tons of tubing, most of it galvanized, and Mineraçao Geral do Brasil at Sao Paulo, with an output that same year of 3,600 tons, sold without galvanizing.

The same manufacturing process is followed with thin steel tubing used in the manufacture of bicycles and chrome furniture. Most of the factories producing these articles have cold rolling mills to make thin smooth strip and equipment for welding the tubes.

iv) Accessories of malleable iron (B-3-a) Elements for joining pieces of piping are usually made of the same material at the same factory, using similar methods. Nevertheless, some malleable iron accessories are also used, and these are made in specialized shops very similar to ordinary foundries, except that they have re-heating furnaces for the parts. In Brazil, mainly in the State of Sao Paulo, there are several of these shops, the combined output of which fully meet domestic requirements.

3. Analysis of the situation in the various sectors of the transforming industry

This section examines in detail the outstanding characteristics and principal problems for each of the sectors into which the mechanical and metallurgical industry has been divided. Within each sector, one or more groups of products have been chosen for a detailed analysis of their manufacturing status. When selecting these products, consideration was given to their importance within the particular sector under study; where the sector is large and not very uniform, more than one group of products was selected, in order to obtain a more representative sample. Nevertheless, gaps in the available information have led, in many cases, to the study of the manufacture of some product which is not the most important in, nor the best example of, the sector concerned. With a few exceptions, the figures are averages for very broad sectors, ranging from installations which are large and modern in equipment, staff and organization to establishments with a low efficiency.

Some of the gaps in the information were filled with estimates based on the personal experience of the research workers, or on analogies with other activities for which complete information was available. Where the establishments were unique in their field, or too prominent, the data have been used without emphasizing information of a private nature. As a whole, however, the figures for Brazilian output are on the conservative side; this is because the censuses of industry are incomplete, owing to indifference or unwillingness on the part of the industrialists when completing the respective questionnaires.

It is obvious that the conclusions drawn from the analysis of each group cannot be applied either to a given establishment or to all the activities within a given sector. Nevertheless, the data presented can be used - with the necessary reservations - to evaluate all the various branches of these industries. This is but a first exploratory effort in this complex field of the manufacturing industry and neither the method used nor the scope of its results can be considered as final

/until the

until the meeting of experts to be held in 1956 at Sao Paulo has given its opinion.

The study of each sector begins with a description of the variety of products being made, the way they are made, the extent to which import substitution has already been achieved, cost relationships within the industry and the major problems to be faced.

For some large sectors of industry, where there is no Brazilian output or where it is in an initial stage, some remarks have been added as to the reasons why there is no such manufacture and the prospects for its introduction in the near future.

a) Primary metallurgical industry (B). This includes the manufacture of nails, bolts, nuts, screws, rivets and similar items, steel cables, wire netting and mesh, tanks and containers.

All these activities, - except those producing wire products - can be highly mechanized, and usually do not require highly skilled labour. The raw materials are currently made in Brazil, and the fact that, as already indicated, high tonnages are still imported is mainly due to insufficient supply of the said raw materials. Tinsplate and its products constitute a typical example of this situation. Despite Volta Redonda's considerable output (40.4 thousand tons in 1953), imports have continued to grow each year, reaching some 64 thousand tons of tinsplate alone.

As for wire products, imports of cables and netting correspond to high-tension cables, screens for ores and other hard materials, etc., made from special steels. It should be noted that flexible elevator cables are made in the country and that the Monlevade plant is making high carbon steel wire which covers part of the demand for cables and netting.

i) Nails, bolts, nuts, screws, rivets and similar items (B-5-c) Products manufactured. This sector of the primary metallurgical industry includes many products manufactured from steel bars. In Brazil, there is a relatively high degree of mechanization in their manufacture. The cold manufacture of bolts in automatic feed machines is fairly common, although hot manufacture in continuous furnaces is

/only just

only just beginning. Some special types are not mass produced, because there is little demand for them, but it will become economic to manufacture them as the market grows.

Market. Brazilian output, in 1953, may be estimated at 30 thousand tons. This is based on an approximate estimate for production in the State of Sao Paulo, which amounted to 17.3 thousand tons. Imports in that same year were 1,129 tons.

Conversion rates used for aggregate imports and total domestic output are respectively 18.7 cruzeiros and 31.5 cruzeiros to the dollar. This gives a total of 9.89 million dollars for production in Sao Paulo (574 dollars per ton), 17.2 million for Brazilian output and 400 thousand dollars for imports (average price, 370 dollars per ton).<sup>15/</sup> Within this group, domestic industry supplies approximately 90 per cent of the total tonnage consumed on the Brazilian market.

The level of imports in 1953 was only 1,129 tons, which must have consisted of material with very few uses; it may therefore be concluded that no import substitution is required in this sector. The picture changes, however, when figures are considered for 1952, a year when liberal imports permits were granted and imports in this sector reached 6.9 thousand tons. The figures given below are based on the assumption that domestic production should be increased by 5 thousand tons.

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<sup>15/</sup> Obviously this unequal conversion rate of 18.7 cruzeiros to the dollar for imports and 31.5 cruzeiros for domestic output to a certain extent, represents a subsidy for imports; since it means an external cost, expressed in cruzeiros, below the cost level of domestic output. But as quantitative restrictions on imports existed until October 1953, the effect cannot be too great.



<u>Some characteristics of the industry</u>	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	56	63
Labour expenditure as a percentage of value added	39	53
Value added per man/year in dollars <sup>a/</sup>	3,425	5,820
Average annual wage, in dollars	740	2,030
Production per man/year in tons	6.75	..

a/ The dollar figures for Brazil relate to 1953, and for the United States to 1947. They are not therefore strictly comparable year by year, since they do not take into account either the increase in productivity or the difference in prices between those years in the United States.

The industry's problems. In the manufacture of such items as screws, the size of the establishment is not of primary importance, and has not effect on productivity. At Sao Paulo, for instance, a shop was visited which employed 9 workers altogether; physical productivity per man/hour was 38 per cent of that achieved in 1947 by the same industry in the United States, whereas the average physical productivity index for all the firms visited in this industry stood at 41 per cent of the United States index. It is clear that, under Brazilian conditions of organization for this industry, the size of the enterprise has very little bearing on efficiency.

Since this industry is satisfactorily equipped in Brazil, the additional output required to meet the small annual deficit should be possible simply with a slight increase in the average productivity of the factors employed. No new manufacturing units will have to be equipped. Perhaps it might be desirable to install some new units of equipment for making some special products. Moreover, better organization of existing means of production (except for equipment required to eliminate eventual disequilibrium in some shops), might result in a production capacity in excess of present market requirements. Taking the problem as a whole, however, it may be concluded that in view of the probable simultaneous growth of productivity in other sectors and consequently of demand, there will hardly be any chronic over-production of screws and similar items.

There are two main reasons for the average low level of

/productivity, according

productivity, according to observations made. These, in relative order of importance, are: poor raw material, in short supply, and the industry's defective organization.

This industry mainly uses ordinary round and hexagonal steel bars. When the building industry in Brazil is very active, this product becomes scarce, prices rise and manufacturers tend to neglect quality specifications. Factors of this kind considerably affect productivity in the industry making screws and similar items, either because a quota system is introduced which removes much of the manufacturer's incentive to improve manufacturing conditions or because the poor quality raw material has direct effects on the output of machines and labour.

Raw material quality is usually deficient for this industry because dimensions are not exact; this is serious in the case of high-output machinery, unless the transforming industry itself proceeds to rectify the dimensions of the bars, which is not current practise. The chemical composition is not uniform and the steel's carbon content varies; this happens because the steel mills give preference to round steels having quality standards sufficient for armoured concrete usage.

I In view of the volume of demand, it should be possible to manufacture some 20 to 30 thousand tons a year of steel bars with exact dimensions which will conform strictly to standard specifications as regards content of sulphur and other elements.

To cover the remaining demand of the Brazilian market, it will quite probably become essential to make steel with a higher carbon content. These are necessary for making high-strength screws and nuts such as are used in the car industry.<sup>16/</sup>

Shops in the industry run relatively large series, and given the type of product, it should not be difficult to have an efficient productive organization. Nevertheless, the level of productivity per unit of labour is too low, because machinery is poorly arranged in the available space. This hampers a continual flow of production.

16/ It is interesting to note that screw and similar factories in Sao Paulo have already received experimental orders from the automobile industry.

/Moreover, there

Moreover, there is little use of suitable internal means of transport, which has an important bearing on output in a shop of this type. The uneven growth (often not foreseen by the proprietors themselves) of such enterprises in Brazil has occasioned serious problems of space shortage. Another contributory factor that has not been properly respected is the periodic inspection of machinery and cutting tools, for preventive purposes, to avoid forced stoppages during work periods.

A further factor limiting productivity in this sector is the electric power shortage, which affects the whole of Brazil.

b) Secondary metallurgical industry (C). Products manufactured by industries considered as secondary usually represent several parts, but without being complete mechanisms. The manufacturing series are generally less extensive than those in primary metallurgical industries, because of the greater diversity of sizes and models. In contrast, the secondary industry requires more skilled labour, although not with the same capacity as that needed by mechanical industries.

Import substitution of secondary metallurgical products might progress very substantially in Brazil; nevertheless, imports of some volume are still made, principally technical articles for complicated production purposes which have not yet been reached in the country, or certain products for which the domestic market does not justify their production at present.

The figures shown below provide an indication of imports in the secondary metallurgical industry.

/Imports in

## Imports in 1953

S e c t o r s	Tons	Value (Thousands of dollars)	Average price (Dollars)
C - 9 Generators	3,870	5,582	1,440
C - 14 Building materials	15,869	6,711	420
C - 15 Articles for industry and trade	2,261	5,077	2,150
C - 16 Articles for general use	195	674	3,530
C - 17 Articles for domestic use	18	53	2,950
C - 18 Articles for personal use	3	66	22,000
T o t a l	22,216	18,163	815

i) Steam generators and similar apparatus (C-9-a) Products made.

This group includes all boilermaking work, including the manufacture of autoclaves, retorts and steam boilers. Imports of primary elements required for boilermaking have been almost entirely replaced by domestic manufacture, but fairly large imports are still made as will be seen later on.

Steam boilers can be divided into three main types: a) ordinary boilers for low pressures and temperatures, for use in buildings and in small industries; b) industrial boilers for medium pressures and temperatures, the steam from which is used to generate energy or even to meet the requirements of a manufacturing process. In some cases the steam is used successfully for both purposes, first generating the energy in a turbine and then drawing off the steam, at fairly high pressures, for use in the thermic processes. Boilers of this type are used in the beer, sugar and textile industries, as well as in several chemical industries, etc; c) large boilers for high pressures and temperatures, used in thermo-electric power stations. The combination of high temperatures and pressure imposes serious quality requirements on the materials used and very strict specifications have to be followed. Although these requirements are usually observed in some of the larger shops, it is possible that purchasers do not yet have complete confidence in the /domestic product.

domestic product.<sup>17/</sup> It may be noted, however, that imports of this type of equipment are proportionately higher in the economically less developed Brazilian states. However, it should also be remembered that this type of equipment is often acquired through international loans. These appear to be the main reasons for the small manufacture of boilers for Brazil's thermo-electric power stations.

Ordinary boilers for heating purposes are at the opposite end of the scale; the manufacture of this type of boiler is very widespread in medium-size and even very small works. Using sheet from Volta Redonda, these shops also make autoclaves, boilers, retorts, etc. As for industrial boilers for medium pressures, these are made in shops whose size and degree of technical progress vary.

Market. Output in this field, for Brazil and Sao Paulo respectively in 1953, is estimated at 18,300 and 3,650 tons. It is difficult to make even an approximate calculation of the value of Brazil's total output;<sup>18/</sup> the value of Sao Paulo's output was some 2.3 million dollars, the average price being 631 dollars per ton.

Purchases abroad amounted to some 3.9 thousand tons, with a value of 5.6 million dollars, at an average price of 1.5 thousand dollars per ton.

Imports consigned to the States of Rio de Janeiro and Sao Paulo corresponded to boilers with a high unit price. This is particularly true of Rio de Janeiro, where there is a large sugar industry. By contrast, those purchased by other less industrialized States are very varied, both in type and size. In the State of Sao Paulo, local output has almost entirely replaced imports, even for boilers of special types. It is estimated that half the current imports could be replaced over a short period; the other half corresponds to special cases where for technical or economic reasons manufacture within the country is not desirable. The target for import substitution in this field would be some 2 thousand tons, having a value of over 2 million dollars.<sup>19/</sup>

<sup>17/</sup> Boiler works of this kind, in Brazil, usually produce other types of machinery at the same time, and they are classified under these headings in official statistics.

<sup>18/</sup> The value of Brazil's aggregate output, based on the more accurate data available for the State of Sao Paulo, would undoubtedly range between 10.6 and 18.0 million dollars.

<sup>19/</sup> It is estimated that the average price of the additional output required for import substitution will exceed the average for present domestic production, which is some 1.1 thousand dollars per ton.

Some characteristics of the industry.<sup>20/</sup>

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	40	62.5
Labour expenditure as a percentage of value added	48	55
Value added per man/year (dollars)	1,910	5,190
Average annual wage (dollars)	910	3,080
Volume of production per man/year (tons)	1.11	-

The industry's problems. The average size of the shops is small; as a general rule it seldom exceeds the economically feasible minimum. Productivity is low, but could be increased by improving organization and by modernizing the available equipment. The supply deficit mentioned above might possibly be eliminated in this way. Nevertheless, as one of this brand's limitations is the need to produce in accordance with strict specifications and with a high level of quality, much of the additional output required would probably have to be concentrated in a small number of establishments. These would then be obliged to undertake large expansions and heavy investments.

ii) Building materials (C-14) Products made. The sector of ferrous building materials includes three distinct groups: metallic structures (C-14-a); iron and steel sanitary appliances (C-14-b); and heating equipment (C-14-c). Only the first is important, because substantial imports are made.

<sup>20/</sup> Although many shops are simultaneously engaged in manufacturing equipment with some mutual similarity, such as stoves, autoclaves and retorts, the technical coefficients used in this study are based on the characteristics of those shops making little else but boilers. Nevertheless, the global figures for tonnage produced and value of production in Brazil and in Sao Paulo include shops of both types operating in 1953.

/Imports in

S e c t o r s	I m p o r t s   i n   1 9 5 3		
	Tons	Value (Thousands of dollars)	Average price (dollars)
C-14-a Metallic structures	15,573	5,994	385
C-14-b Iron and steel sanitary appliances	18	30	1,670
C-14-c Heating equipment	278	687	2,470
T o t a l	15,869	6,711	420

iii) Metallic structures (C-14-a) Products made. The metallic structures group includes the manufacture of all kinds of structures, such as doors, windows and other building components. In the case of structures, fairly strict specifications are usually followed both in calculating and manufacturing them.

Market. Brazil's entire output of metallic structures in 1953 stood at 48 thousand tons, with a value of 21.7 million dollars, while production in Sao Paulo was 29.5 thousand tons, having a value of 13.3 million dollars. The average price per ton was thus 450 dollars. Consequently, output in the State of Sao Paule represented over 60 per cent of that for the whole of Brazil. Imports recorded for that same year amounted to 15.6 thousand tons with a value of 6 million dollars, at an average price of 385 dollars per ton. These imports usually consisted of building components similar to those manufactured in Brazil. They represented mainly petrol and petroleum tanks, power pylons and, to some extent, structures for buildings. There were two reasons for these imports: a) the constructions for which they were intended are located far from industrial centres, as in the case of the Northern or North-eastern territories; b) imports are financed by public international loans or else form part of installations brought into the country in the form of oreign capital.

The above figures show that Brazilian industry supplies 75 per cent of domestic demand. There is therefore a not inconsiderable margin that could be covered by domestic production instead of by imports.

/Imported structures

Imported structures correspond, without exception, to types and models for the calculation and manufacture of which the Brazilian industry is perfectly equipped. Hence it has been assumed that an increase in domestic output would result in the total elimination of the supply deficit recorded in 1953.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	48	52
Labour expenditure as a percentage of value added	53	58
Value added per man/year (dollars)	1,695	5,380
Average annual wage (dollars)	898	3,120
Volume of production per man/year (tons)	7.0	-

The industry's problems. The size of the undertaking does not appear to exert any influence on the operations of this type of manufacturing enterprise. This is particularly true in the case of structures, which are not mass produced but are made individually for each order.

The present size of the market suggests that imports could be entirely replaced by domestic output from already existing shops. There would be no need to create new enterprises or, in other words, to resort to new investments involving large imports of equipment.

A production increase could be obtained through a better organization of existing shops. This means that the market deficit could be covered with existing means of production, provided a programme for improving productivity were put in hand. From this point of view the standardization of metal doors and windows made by the various factories would represent a considerable progress. Efforts made in this direction during recent years were unsuccessful because architects usually continued to design doors and windows with slight variations for each building. This results in a waste of time for architects and means that the industry cannot be organized on mass production lines, with intermediate stocks of the component factors.

One of the difficulties encountered by this industry is that local steel mills do not make sections of special design. This means that

/these sections



these sectors have to be produced in the structural factory itself, by cutting and welding certain sections. As a result, both labour and raw material are wasted.

iv) Articles for industry and commerce (C-15). This sector includes the following groups: Hand tools for various trades (C-15-a); metal furniture (C-15-b) and farm implements (C-15-c). The second and third groups are studied below, the first being omitted as it is a very heterogeneous group of products (saws, knives, spanners, automobile tools, etc.).

v) Metal furniture (C-15-b) Products made. The manufacture of metal furniture in Brazil resulted in an industry covering two different fields: the industrial one, with mass production in relatively large manufacturing establishments where productivity is high; and the craftsman's shops, consisting of numerous small shops which work almost exclusively to order, without catalogue models and with much more rudimentary mechanical equipment. The figures given here refer to industrial establishments. The manufacture of safes is included, although they have little significance to the total.

Market. In 1953, Brazil's production of metal furniture must have amounted to some 14,7 thousand tons with an approximate value of 24 million dollars. This estimate is based on the figures for São Paulo which were 7,050 tons and 14.4 million dollars, respectively, the average price being 2,038 dollars per ton. Imports for that same year were insignificant, amounting to 55 tons and a value of 116,600 dollars, the average price of 2,120 dollars being slightly higher than that of domestic production.

In view of the high transport costs involved and the fact that the manufacturing process is relatively simple, it is easy to understand why import substitution has reached such a high level in this branch of industry.

/Some characteristics

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	74	53.5
Labour expenditure as a percentage of value added	38	59
Value added per man/year (dollars)	2,280	5,320
Average annual wage (dollars)	856	3,120
Volume of production per man/year (tons)	2.0	-

The industry's problems. While the manufacture of these products - discounting craftsmen's shops - is carried out in relatively large units, (the five largest establishments in Sao Paulo have 100 to 300 workers each), there are indications that indirect labour and administrative expenditure represent a considerable share of the cost of the final product. Furthermore, while keeping total labour at almost the same level, it should be possible to effect a substantial increase over the 1953 output. This statement is related to observations made in the craftsmen's sector of metal furniture manufacture, where small shops with 10 or 20 workers obtain a much higher profit per piece and per unit of capital. This would appear to confirm that the larger industrial enterprises are below the optimum size which would have given them a net advantage over the small manufacturers. Nevertheless, there are various obstacles in the way of increasing the current scale of operations. These obstacles include: the mass production of the different pieces would mean tying up heavy intermediate stocks and would imply a large increase in circulating capital and in the space used; this difficulty is enhanced by the large variety of models, the instability of the market and the relative ease with which it could become saturated, discourages the manufacturers from making any drastic cut in the numerous types of articles made.

These conclusions seem to warrant the opinion that shops in this branch will very slowly approach the optimum production size, which is

/greater than

greater than the average actual size of the establishments.

The high cost of transport, which hinders Sao Paulo's output from reaching the other States of Brazil, is an obstacle to this industry's expansion into economically more productive units. Consequently, small local shops are developing in these States, supported by the high costs of transport and heavy marketing expenses.

In spite of market limitations, the average level of productivity in metal furniture manufacture in Brazil is relatively high, particularly in view of the high degree of vertical integration in most of the establishments. Productivity could be quite considerably increased by the systematic manufacture of intermediate stocks, as this would facilitate large-scale mass production. Some firms have adopted this procedure on a limited scale, but obstacles to it are shortage of capital and, at times of space.

Surface defects in Brazilian steel plate mean that too much labour has to be used for finishing operations. In other respects the quality of the raw material is satisfactory, but the irregularity of supplies leads to difficulties.

The electric energy shortage, arising either from insufficient rationing quotas or because of daily interruptions in the supply was a basic difficulty for the metal furniture industry in 1953, as it was for other sectors.

vi) Farm implements (C-15-c) Products made. This group includes a series of simple forged steel implements used in agriculture, such as spades, hoes, picks and sickles.

Market. On the basis of production in the State of Sao Paulo, which was 7,380 tons in 1953, Brazil's total output for that year may be estimated at some 14 thousand tons. The output of Sao Paulo represented a value of 4.5 million dollars, while the country's can be set at some 8.5 million dollars, thus giving an average price per ton of 600 dollars. Imports were some 780 tons, with a value of 634 thousand dollars, that is, an average price of 815 dollars per ton; they consisted mainly of machetes. Domestic production therefore accounted for approximately 95 per cent of the country's total demand, which means that there is only a very small margin for import substitution.

Some characteristics of the industry.

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	66	64
Labour expenditure as a percentage of value added	29	59
Value added per man/year (dollars)	3,070	4,910
Average annual wage (dollars)	930	2,810
Volume of production per man/year (tons)	7.7	

The industry's problems. Production in Brazilian factories range from 1,000 - 5,000 tons. The most efficient of those investigated produces some 2,600 tons a year.

Shortage of suitable raw material is the principal difficulty for this sector. It is so acute that one factory in Sao Paulo has been obliged to use old rails, with a considerable loss of efficiency.

Electric power rationing and the daily interruptions in supply constitute a second important difficulty.

As the market is practically saturated, any eventual advantages to be derived from increasing the scale of production per enterprise might well result in the closing down of some marginal firms.

vii) Articles for general use (C-16). This sector includes the manufacture of padlocks and locks (B-16-a), lamps and lanterns (B-16-b), chains (B-16-c) and hardware articles for building, furniture, etc. (B-16-d). Imports in this sector were very low in 1953, amounting altogether to 191 tons. This is the

/proof that

proof that almost the entire demand is covered by domestic industry. As on the other hand the enterprises offer no special characteristics differing fundamentally from those of the groups studied, nor any problems other than those relating to raw materials and electric power shortages, these groups are not studied in detail here.

viii) Articles for household use (C-17). The following manufactures are included in this sector: cutlery and knives (B-17-a), steel enamelware (B-17-b) and cookers, stoves and heaters (B-17-d). Imports in 1953 stood at 18 tons and 198 tons in 1952. Here again, import substitution is practically complete.

Only the first group - cutlery and knives - has any specific raw material problems, since it requires special steels (either those with a high carbon content or stainless steels) which, for the time being are not produced in Brazil. The other two groups depend on Volta Redonda's output of thin sheet, which in 1953 was insufficient to meet total demand. Cookers and similar items are made in shops similar to those making metal furniture, and the same problems are encountered, except, perhaps, that standardization is more advanced than in the case of metal furniture, so that mass production on a larger scale is possible. This is not the case with enamelware production, however, where products must be standardized before output can be increased and improved.

ix) Articles for personal use (C-18) The sector includes: scissors, penknives, razor blades, needles, pins and similar items. Steel nibs and the numerous small items for office use, generally made from wire, have been added because the type of manufacture is similar.

Imports in this sector are very small, 3 tons in 1953 and 126 in 1952, a year when ample stocks must have remained for use in the following year.

Some of these products made in the country, such as razor blades, use imported special steel strip. The wire goods, except needles, are also made locally. As for the rest, special techniques are often required, and as the total amounts are so small and the assortment of products is so broad, very few are produced in the country.

c) Heavy mechanical industry (D). This group covers all those activities making machines and mechanisms used for production. Appliances such as polished refrigerators, scales, typewriters etc. are not included, as these are really

/durable consumer

	<u>Percentages</u>
Machine parts	12
Sundry machines for the transforming industry	55
Machinery for building and for lifting weights	7
Machines for processing agricultural products	25

This study does not take into account the production of machinery for mining and for petroleum exploitation, since these activities are limited in Brazil.

The listing of the uses for machinery covered by the group provides an idea of the broad assortment comprised therein. Only in a very few items does domestic industry entirely or almost cover market requirements. And in these cases, the products made correspond to the most modern designs and requirements, as for instance in the branch of lifts and elevators. More commonly, domestic industry is engaged in reproducing simple models, at times of quite old-fashioned design, made from ordinary materials (using a large proportion of cast iron). The resulting product, with some exceptions, has a low price per kilogramme because it is very heavy and its output in the activity using it is often limited. The average technical level achieved in this branch of industry is probably farthest from what might be termed optimum requirements for the sector. This lack of technique is more evident in the small and medium establishments, particularly as regards choice of materials and use of quality steels; lack of adequate or modern equipment often leads to the selection of poor manufacturing processes, while there is little organization of the work with a view to increasing productivity and ensuring the quality of the products.

One of the handicaps encountered by industries of this type in Brazil is the small market, which for many items prevents production in economic series.

Market. Brazil's entire production of machinery and equipment in this group in 1953 may be estimated at some 86 thousand tons with a value of 74 million dollars, as against some 50 thousand tons with a value of 44 million dollars in Sao Paulo. The average price per ton thus works out at 860 dollars.

Imports amounted to 78 thousand tons with a value of 126 million dollars, the average price per ton being 1,615 dollars. This means that Brazil's estimated output represents, in value, 37 per cent of the country's total consumption.

/The difference

The difference between average prices for domestic production and for imports stresses the more specialized nature of the latter. In view of this difference in quality and in specialization of imported machinery, domestic output is expected, over a reasonable period to replace some 35 thousand tons of these imports, with a value of some 54 million dollars. In other words, the average price will be practically double that of present output, because more complicated machines are involved.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of the value of production	56	60
Labour expenditure as a percentage of value added	40	62
Value added per man/year (dollars)	2,225	4,920
Average annual wage (dollars)	900	3,095
Volume of production per man/year (tons)	4.65	-

The industry's problems. These sectors of the mechanical industry consist of large modern establishments alongside small craftsmen's shops. As a rule, there is little complementation between factories; when an article is produced successively in several establishments, each of which undertakes one stage of manufacture, specialization is possible and this reduces costs while at the same time considerably increasing productivity. More important than the size of the factory is the length of the series; considerable progress could be achieved here by adequate standardization of products, as it is believed that the number of types could be substantially reduced.

Domestic raw materials are an obstacle to total efficiency in the factories as they are not always of satisfactory quality; moreover, supplies are insufficient and distribution is effected on the quota system. The thickness of the plates often varies and sometimes as much as 15 per cent of an order has to be rejected and returned to the suppliers.

Shortage of suitably trained labour results in poor utilization and in low yields. There are also cases, however, where low productivity arises not to lack of skilled labour but to inadequate use of it, either because of the quality of existing equipment or because of the defects of poor organization. Lack of system in planning production operations and in controlling industrial

/costs may

costs may often be observed in the factories concerned. And where such planning and control do exist - often in a rudimentary fashion - they are not used to control labour output and proper use of machinery.

ii) Manufacture of machines for the mechanical industry (D-7-f). Products made. Machine tools or machines for the mechanical industry considered here are, above all, mechanical lathes, presses, planning and milling machines. Some 70 per cent of the domestic output of these machines consists of mechanical lathes of different sizes and types: 10 to 12 models of parallel lathes, the most modern of which has an automatic chuck for four tools and various additional devices, and over 20 models of simple turret lathes; the manufacture of larger sizes of parallel and turret lathes as well as automatic lathes is planned for the near future. The presses made are eccentric, normally up to 80 tons, and to order, up to 200 tons. Friction presses of up to 300 tons are made, and hydraulic presses for metal working up to 1,000 tons. The planers made in the country are shaping machines with a maximum carriage of 450 mm, and table types of up to 800 centimetres. Drills of various sizes are made, of the pillar type, and the manufacture of radial drills is planned.

The quality of mechanical lathes made in the country is almost entirely satisfactory, in view of the relatively simple and limited uses to which they are put, particularly the more recent models. The eccentric presses, at least those of some manufacturers, are good and almost identical to certain wellknown foreign marks. The friction presses are also of good quality. Some antiquated models are still found in the manufacture of hydraulic presses. The shaping machines and the table type planers are of satisfactory quality, within their rather simple characteristics. Pillar drills, with few exceptions, correspond to antiquated models and are of little use except for ordinary work requiring no great precision.

Market. Production of machine tools in 1953 for Brazil and Sao Paulo respectively was 17 thousand tons with a value of 15 million dollars, and 9.8 thousand tons, with a value of 8.8 million dollars. The average price per ton was 900 dollars.

Imports during this same year amounted to 16,969 tons with a value of 25,295 million dollars, at an average price of 1,515 dollars per ton. Brazilian output represented 50 per cent of the physical volume and 37 per cent of the value of total consumption of the group's products during 1953. The average price.  
/of imports,



of imports, much higher than that of domestic output, reflects the difference in quality and characteristics of the equipment imported.

Brazil's degree of sufficiency in meeting its own requirements cannot be properly appreciated in a separate analysis for each of the main types of machine tools. As regards mechanical lathes, particularly the various models of parallel lathes, domestic production covers approximately 60 to 65 per cent of Brazilian industrial requirements; the remaining 35 or 40 per cent has to be imported. As domestic output is quantitatively insufficient to meet market requirements, imports consist of models similar to those made in the country, as well as of more complicated ones which are not. Domestic output of the other types (turret lathes etc.) falls still further below the country's requirements. The supply of the other types of machine tools mentioned above is slightly more favourable. Somewhat more than 1,000 eccentric presses are made each year, which is sufficient to meet demand. There are indications that the manufacturers are planning to expand production to meet an increase in demand. Friction presses are also produced in sufficient quantities, and so are hydraulic presses, except that all units exceeding 200 tons pressure are imported. Of the larger types, exceeding 500 tons, the country annually absorbs from 6 to 10 units. Of the smaller types, up to 200 tons, nearly 150 units are produced each year, which is sufficient to supply the market. All the special presses, such as those for coachwork and other types, must be imported.

Brazilian production of shaping machines is some 300 to 360 units, and covers 70 per cent of the demand. Production of table planning machines is more restricted, being slightly above 30 units per year, but this is sufficient for local requirements in the various sizes. The larger capacity types with more modern characteristics have to be imported. As for drills, other than bench drills, Brazil's annual output must be some 300 units, which is also sufficient to meet local requirements for simple models. Imports of more complicated models are estimated at 80 or 90 units per year. Annual requirements of radial drills are some 25 to 30 units, all imported. All other special perforating machines are imported.

Perhaps the simple mention of import figures actually recorded in 1953, or the average for recent years, does not give a sufficiently realistic idea of the potential market for the country's additional output. Import difficulties have been more marked in recent years, and this, together with some uncertainty in

/various sectors

various sectors as to the future had led industrialists to reduce their machinery purchases and to await a more favourable opportunity.

Imported machine tools fall into three categories: a) special models which for technical reasons cannot be produced in the country over the short term; b) ordinary models, but in rather unusual sizes; there is no technical obstacle to their production but this would not be economic for the moment; c) machine tools of ordinary models and sizes, imports of which are intended to complement local production which is insufficient both as regards quantity and quality.

It is estimated that within total machine tool imports effected in 1953, some 5 thousand tons falling into the last two categories, with a value of 5 million dollars, could technically and economically be made in the country.

It is quite likely that in the near future the real deficit will exceed the figures deduced from imports in recent years, because many machine tools have been in use for more than twenty years; these have not been replaced because of uncertainties as to exchange and foreign trade policies. Should the mechanical industry start production of automobile vehicles, a development foreseen for the near future, a substantial revision of the apparent deficit might be required. The relatively modest figure given earlier for machine tool import substitution is based on the most specific data currently available.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of the value of production	62	69.4
Labour expenditure as a percentage of value added	37	64
Value added per man/year (dollars)	2,360	5,180
Average annual wage (dollars)	860	3,340
Volume of production per man/year (tons)	4,200	3,340

The industry's problems. As a rule with some fortunate exceptions, the enterprises in this group are mostly craftsmen's shops and have not made such technical progress over the last 20 years. Their equipment is quite adequate for repair work but not for manufacturing. The machinery in these shops has neither the capacity, nor the cutting speed, nor the precision essential for the manufacture of machines with the characteristics required by the modern consuming industry.

/Generally speaking,

Generally speaking, the shops are small, and in many cases they barely exceed artisan size and organization. Hence the small series made and the predominance, in many cases, of manufacture to order. Machine tools are at times made as a complementary, to some extent secondary, activity, in machine repair shops with no suitable equipment for precision work or for large-scale production. The average size of the establishment in this group must be increased and re-organization along modern industrial lines must take place, if any expansion of output is to be obtained.

The gradual transformation of the craftsmen's shops into larger units is being hampered by the instability of government policy as regards imports of machinery and equipment. In recent years, imports have fallen off, either because of quantitative restrictions or because of the effects of exchange difficulties. Nevertheless, there is a widespread belief among industrialists in this group that a more liberal policy for machinery imports will be re-introduced, similar to that which prevailed in the early post-war years and in 1951-52. Because industrialists are unable to compete with foreign products, particularly at prevailing exchange rates, they are postponing their expansion plans.

Another severe handicap is the great shortage of technicians and skilled workers, who are of vital importance in this field. The very scope of the enterprises, directed mainly towards repair activities which above all requires all-round training of the worker, makes the training of specialized skilled workers more difficult, yet these are essential for mass production at a high technical level.

iii) Manufacture of farming machinery (D-8). This sector includes the manufacture of different equipment which may be grouped as follows: a) tractors (D-8-a); b) machinery for soil preparation (D-8-b); c) produce harvesting machinery (D-8-c); d) machinery for processing products such as coffee, cotton, sugar, etc. (D-8-d); e) smaller equipment such as pulverizers equipment poultry-keeping, bee-keeping etc. (D-8-e). Manufacture of farming machinery in Brazil suffers from the fact that there is no tariff protection for any equipment except machinery for processing products. Furthermore, imports are granted exceptional facilities such as preferential exchange rates etc., to encourage farm mechanization. Nevertheless, scattered throughout the country there are numerous small craftsmen's shops engaged in the manufacture of some simple equipment for soil preparation, such as ploughs etc.; it is this group which is studied here. Tractor manufacture /resembles that

resembles that of cars and lorries, as regards the characteristics of the industry producing them, and a part of this study deals with that subject. The manufacture of equipment for processing agricultural products, although very common throughout the country, is not studied here because its characteristics largely resemble those of the mechanical industry. The remaining activities in this industrial grouping, such as harvesting machinery or other machines for extensive cultivation, are not analysed separately, since no such machines are made in the country. Neither is smaller equipment studied here, because non-ferrous raw materials predominate over ferrous ones in its manufacture.

In order to provide some idea of the potential market for factories making all these various types of equipment, the respective import figures are given below:

Groups	1 9 5 2			1 9 5 3		
	Value thousands of dollars	Tons	Average price per ton	Value thousands of dollars	Tons	Average price per ton
D-8-a Tractors	32,483	25,588	1,269	26,051	18,566	1,405
D-8-b Machinery for soil preparation	8,386	12,361	678	2,025	2,630	780
D-8-c Produce harvest- ing machines and those for extens- ive cultivation	2,843	2,320	1,225	415	366	1,130
D-8-d Machinery for processing products	3,837	2,537	1,512	4,173	2,209	1,890
D-8-e Smaller equipment	1,584	464	3,410	1,169	465	2,420

The preceding data evidently cannot reflect the full size of the potential market for farming machinery, as Brazilian farming will undoubtedly advance both as regards area and productivity, and a first requisite for such progress is more intensive mechanization.

iv) Machinery for soil preparation (D-8-b) Products made. The group analysed forms a small part of the farming machinery industry, and includes ploughs, cultivators, sowers and other items.

Market. Brazil's total output of this equipment in 1953 amounted to 22.3 thousand tons, with a value of 19 million dollars, and production in Sao Paulo to 16.5 thousand tons with a value of 10 million dollars, that is, an average price of 685 dollars per ton.<sup>23/</sup>

Imports in 1953 totalled 2,025 tons, with a value of 2.63 million dollars and an average price of 780 dollars per ton.

Domestic production supplies a large proportion of the country's requirements for products in this group. Output is scattered over small artisan shops throughout the farming regions. The average price per ton is low, because most of the articles made are very simple.

Some characteristics of the industry.

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of the value of production	57	47
Labour expenditure as a percentage of value added	37	63
Value added per man/year (dollars)	1,320	4,470
Average annual wage (dollars)	550	3,160
Volume of production per man/year (tons)	3.38	-

The industry's problems. Most of the shops are very small. The larger ones have as many as 20 workers and only in very exceptional cases, 50. Nevertheless, the problem here is not to increase the average size of the establishment but rather to convert the industry from the artisan stage to that of an organized industry. This does not mean that the artisan shops should be eliminated, for it should be remembered that these constitute nuclei for training workers with some understanding of mechanics and that, in many isolated areas they engage simultaneously in repair work which by its very nature is beyond the scope of the individual farmer. There are

<sup>23/</sup> The quantum indicated refer only to the content of ferrous material.

/modern factories

modern factories with an output per man/year of 8 tons of the various products in the group. Nevertheless, the country-wide average falls to 3.4 tons because of the influence of the smaller shops.

v) Motors and turbines (D-9). Taken as a whole, this activity is one showing the least progress as regards import substitution by the domestic product. The existing industry is concentrated on one or two types of product, while for the remaining majority, hardly any activity is recorded.

Imports for this sector in 1953 were as follows:

	Tons	Value (thousands of dollars)	Average price per ton
a) Steam and internal combustion engines	12,267	30,070	2,440
b) Hydraulic and steam turbines	1,573	3,367	2,140

The group of hydraulic turbines is the one selected for analysis. However, a few lines must be devoted to the conditions affecting internal combustion engines, since this is a group ranging from large Diesel units for generating energy in thermo-electric power stations down to small combustion motors for pumps and household electrical equipment. Neither of these types is made in Brazil, although there are plans on foot to begin this line of manufacture in more than one enterprise currently engaged in other activities. In order to produce this equipment, a good malleable iron foundry is required, as well as certain types of special steels and personnel trained for precision work.

The volume of products to be replaced may be estimated <sup>24/</sup> at approximately 6 thousand tons a year, with an average value of almost 1,500 dollars per ton.

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<sup>24/</sup> This estimate is based not on an exact study, but on a probable magnitude at a first stage, according to opinions received from Brazilian industrialists in this field.

vi) Hydraulic and steam turbines (D-9-c) Products made. This group includes Pelton wheels, hydraulic turbines and steam turbines. Import substitution is practically complete as regards the first. As for the second, the industry almost supplies demand for the small sizes, but larger units are imported. By contrast, there is no domestic production of steam turbines, nor would it be justifiable to start this within a short period, as a considerable amount of scanty resources would thus be tied up (capital, technique and skilled workers); moreover, at first sight Brazil is not in a favourable position to compete with the traditional European suppliers.

Market. Brazilian output of hydraulic turbines (in 1953) was 1 thousand tons with a value of 1 million dollars, while Sao Paulo accounted for 390 tons with a value of 0.4 million dollars, the average price per ton being approximately 1 thousand dollars.

Imports amounted to 1,573 tons, at a value of 3,367 million dollars, the resultant average price per ton being 2,140 dollars. In other words, Brazil's output in 1953 represented 25 per cent of the consumption value of these products and 39 per cent of their weight.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of the production	63	50
Labour expenditure as a percentage of value added	48	89
Value added per man/year (dollars)	1,403	3,750
Annual average wage (dollars)	620	3,330
Volume of production per man/year (tons)	1.96	-

The industry's problems. The existing industry is essentially of a craft nature. It consists of small foundries scattered throughout the country, engaged in repair work, but occasionally making small cast iron turbines. Just as in the case of the manufacture of farm implements, with which there is a close resemblance as regards geographic distribution and organization, large-scale import substitution can only be achieved if many of these small workshops are replaced by modern average and large-size units.

vii) Electrical

vii) Electrical material (D-10). This sector comprises the manufacture of electric motors, generators and transformers, as well as other electrical apparatus made principally from ferrous materials. In view of the large variety of products included in this second group, it is not considered in this analysis, although its volume of production is relatively large and it employed nearly 40 per cent of the labour in the whole sector of electrical material in Sao Paulo in 1953.

The manufacture of motors, generators and transformers lends itself more readily to analysis, as in spite of the variety of models and sizes of each of these articles, there is basic uniformity in the respective manufacturing process. Production in Sao Paulo in 1953 reached the following figures:

	Tons	Value (thousands of dollars)	Average price per ton
Electric motors	7,046	9,150	1,300
Generators	610	1,305	2,140
Transformers	<u>400</u>	<u>982</u>	<u>2,455</u>
Total	8,056	11,437	1,420

This shows that the manufacture of electric motors occupies an outstanding position among activities in this branch, and that the average price per ton is considerably lower than in the case of the other two. This may be attributed to the greater size of the enterprises and of the production series, which reduces production costs.

Imports into Brazil in that same year, for these three types of products were:

	Tons	Value (thousands of dollars)	Average price <sup>1)</sup> per ton
Electric motors	2,418	5,250	2,178
Generators	356	620	1,741
Transformers	<u>1,978</u>	<u>3,700</u>	<u>1,875</u>
Total	4,752	9,570	2,011

/A comparison



A comparison of average prices for domestic output and for imports is quite explicit. In the case of electric motors, import prices are much higher, because on the one hand these consist of special models and capacities, while on the other the Brazilian electric motor industry has progressed to a really surprising extent in recent years. This is not the case with generators and transformers, and hence the high per ton prices of domestic output, which are respectively 20 and 13 per cent higher than the average price of the imported product. That is another reason why imports represent over 40 per cent of the consumption figure.

The higher productivity in the output of electric motors as against that of generators and transformers is corroborated by the following figures:

	Quantum (physical volume) of production in tons per man/year	Value added in dollars per man/year
Electric motors, generators and transformers	3.6	2,160
Electric motors	4.4	2,320

Based on data for Sao Paulo in 1953, Brazil's total output may be estimated at some 9.6 thousand tons, including electric motors, generators and transformers, with a value of 14 million dollars. This means that Sao Paulo contributes 84 per cent of the national total.

The analysis of this sector covers only electric motors which, with the reservations already made, may be taken as being the representative group.

viii) Electric motors, generators and transformers (D-10)

Products made. Brazil is producing for current use electric motors of up to 100 HP in factories of widely differing sizes. In special cases motors of any type and size can be made, but the manufacture is usually restricted to those types which are assured of the broadest market. This means that relatively continuous production series can be made, while all remaining types and sizes are usually left to imports. Some Brazilian factories have

/introduced the

introduced the rule of not accepting orders for special models except for minimum series of 200 units.

Market. Electric motor production is concentrated, to a greater extent than most mechanical and metallurgical production, in the State of Sao Paulo. The volume of production in 1953 represented 7,046 tons for a value of 9.15 million dollars, or an average price of 1,300 dollars per ton. Although the volume of domestic output is not known exactly, it may be estimated that it supplies approximately 80 per cent of current market requirements. If generators and transformers are also included, then the industry's share would fall by almost 60 per cent.

In this, as in other sectors, it is admitted that it is undesirable to produce in Brazil any models for which demand is insufficient to justify manufacture in fairly large series. There will thus be a long period during which it will still be desirable to import such items as vertical motors, those with a reduction gear, enclosed motors, etc. It is unlikely that additional production of motors can be organized for total import substitution in series exceeding the minimum needed for economic manufacture. This possibility may arise later on after there has been a considerable expansion of the domestic market. For the immediate future, imports that cannot economically be replaced will probably amount to 20 per cent of present imports.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	43	56
Labour expenditure as a percentage of value added	74	63
Value added per man/year (dollars)	2,320	4,687
Average annual wage (dollars)	1,690	2,950
Volume of production per man/year (tons)	4.37	-

/The industry's

The industry's problems. These activities are relatively new in Brazil, and were planned from the beginning for a given purpose and using modern methods. As to the size of the factories, while the number of persons employed is higher than the general averages for Brazilian industries, they are still relatively small compared with factories in more industrialized countries.

The size of the Brazilian domestic market varies according to the types and dimensions of the motors, but it is already sufficiently important so that models for ordinary uses can be produced in reasonably large series. The fact that quite a large number of factories contribute to Brazilian production suggests the future possibility of a trend towards specialization. In order to cover the market deficit at present met by imports it is probable that instead of an increase in the number of factories making electric motors, there will be a tendency to expand and perfect each of the existing factories.

In some electric motor factories in Sao Paulo where series exceeding 10 thousand units are made, the productivity level is good. The main internal obstacle for improving this level is undoubtedly the large variety of sizes and types made, combined with space difficulties arising out of an unforeseen rapidity of growth. This has led to a defective flow of raw materials and finished products.

Domestic ferrous material used in this branch is confined to cast iron pieces. Silicious sheet, copper and bearings are all imported, which means that surplus stocks have to be maintained because of the irregularity of imports. Most of the electric motor factories do not have their own foundries, and the capacity of foundries in Sao Paulo working to order is insufficient to cover the demands of local industry; this results in delays and at times in imperfections.

Although the larger factories in the group are well organized with good manufacturing technique, poor use of available capacity can sometimes be observed, owing to lack of skilled workers.

Electric power rationing and interruptions in the supply, restricted operations and reduced the use of machinery, on an average, to 50 per cent of available capacity. This, in varying degrees, has affected all other Brazilian industries and in particular those in Sao Paulo.

/ ix) Railway

railway rolling stock alternate between idleness and periods of activity.

xi) Automotive equipment, bicycles and similar items (D-2-6) This sector includes cars, lorries, omnibuses and similar items, bicycles, motorcycles and tricycles. Tractors have also been included, both farm tractors and those used in civil engineering, because their manufacture is similar in many respects to that of motor vehicles. Nevertheless, some remarks of a technical nature made later on refer to a certain type of vehicle, and particularly to small and medium-capacity lorries.

The items in this sector form the most significant whole within Brazil's total imports of iron and steel and their products. They amounted to approximately 300 million dollars in 1952 and to some 100 million dollars in 1953. Of these, motorcycles, bicycles and similar items represented less than 3 per cent in each of the two years mentioned.

The fall of imports in 1953 was not due to any contraction in demand but simply to limitations in the capacity to import. So serious were the repercussions of this restriction, that the import licensing system has led to the sale of vehicles at a substantial price over and above import costs at the official rate.

A report made during the middle of 1954 by the Subcomissao de jeeps, tractores, caminhoes e automovers,<sup>25/</sup> points out that during the period 1949-53, motor vehicle transport has increased - within inter-state transport - from 25 to 48 per cent, while coastal shipping has fallen from 47 to 36 per cent and railway traffic from 28 to 16 per cent.

The Sub-Commission holds the view that, for the moment, the most important group that should be produced in the country is that of lorries, beginning with lighter models.

Statistics relating to the number of lorries in different years reveal that during the period 1925-29 there was an annual increase of 7.5 per cent, rising to 11.8 per cent during the period 1946-1952. But as this last period may have been affected by the heavy imports which took place at the end of the war, the Sub-Commission took into consideration both theoretical rates of annual growth, which would mean that by 1962 between 71 and 142 thousand light lorries would have

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<sup>25/</sup> Established in July 1951 and responsible to the Comissao do Desenvolvimento Industrial.

to be replaced. To this should be added the spare parts, estimated according to United States coefficients, at an average of 50 dollars per vehicle per year.

Analysing the problem from the technical point of view, the Sub-Commission reached the conclusion that, while some spare parts are at present being produced,<sup>26/</sup> the complete manufacture of lorries would require heavy investment to expand existing factories and create new ones, plus a series of other technical resources which Brazil does not possess. It was therefore thought preferable to proceed by stages. The first goals were to be the production of part of the 20 to 30 thousand lorries per annum of the 4-ton or less type, which the country required immediately. This would begin with domestic production accounting for only about 12 per cent of the weight, but ending in 1962 with the production of 70 per cent of the weight of the 71 to 142 thousand lorries needed each year, in addition to their spare parts. At a later stage consideration would be given to eliminating imports of the engine block assemblies and the back axle systems as well as to the manufacture, in the country, of the other types of vehicle. To carry out this plan, it would be essential to grant import licences only for vehicles fully stripped, refusing them for those parts to be made in the country at each successive stage, while at the same time ensuring imports of the parts, raw materials and means of production essential for making and assembling the other vehicles. Although several foreign vehicle manufacturers have indicated their acceptance in principle of the plan, and have submitted specific tenders, no definite decision has been taken to date.<sup>27/</sup>

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<sup>26/</sup> These establishments in Brazil are currently producing spare parts for which the demand is high - pistons, rings, casings, chassis springs, simple dies for body accessories, etc.; other parts - motor blocks, bearings, differentials, etc. - are not manufactured, since their large-scale production is only justified by the domestic production of vehicles.

<sup>27/</sup> The Government's indecision to approve a plan for making lorries as a first stage in the creation of an automobile industry appears to be rooted in fear of the impact of the heavy investments required not only on the balance of payments but on domestic monetary equilibrium. But, in the meantime, many partial steps have already been taken outside this plan - and in anticipation of it - in the field of spare parts, pieces of coachwork, etc.

The Sub-Commission's plan to the effect that it should be obligatory to use a certain percentage of domestically made pieces when vehicles are assembled in the country - a percentage which would gradually increase until substitution was complete - might constitute a first step towards overcoming this obstacle as, quite naturally, some makes with low sales in Brazil would decide against installing assembly shops, with the resulting utilization of domestically manufactured spare parts.

Another observation which possibly touches on a more serious problem raises doubts as to the desirability of the mass use of the types of road transport vehicles currently made and sold, that is, types with low lines and great power. In view of the rather poor road networks in Brazil and in the other Latin American countries, it might be advisable to use a more solid and simple vehicle. This could be of a special design, taking into account the numerous economic and technical problems which arise in most of the less developed countries.

The research of the ECLA group on industries in the State of Sao Paulo revealed that there were many enterprises connected with the automobile sector whose productivity was close to the level achieved in the United States during 1947. Their annual production was such that it is no longer a hindrance to the increase of productivity. Aggregate labour employed in these factories is on an average about 200 persons. This last fact is important, since it shows that these enterprises have expanded sufficiently to be able to employ the necessary administrative personnel in activities such as these, where they currently handle large stocks of materials.

Enterprises of this nature are essential for the reasonable production of automotive vehicles. Thus it may be concluded that, if the required large investments are made in a gradual manner, as is projected, and the specialized technical labour is built up at the same time, it will be perfectly simple to establish this industry in Brazil with a satisfactory economic yield, provided that the cost to the public is not abnormal.

/ d) Light Mechanic

d) Light mechanical industry (E). The light mechanical industry includes the production of articles for industry and commerce (E-15) and of articles for household use, as well as their parts and spares (E-17). The manufacture of typewriters and of other office machines, as well as scales, balances and weighing machines, falls into the first group. The second group covers the manufacture of sewing machines and electrical household appliances, such as refrigerators, mixers, washing machines, polishers, vacuum cleaners and ventilator fans. On the other hand, the manufacture of electrical household appliances such as mixers, polishers, etc. will be studied here, and on the other, that of sewing machines, because these two groups are considered to be most representative within the complex aggregate of activities comprising the sector of light mechanical industry.

Some characteristics of each of these types of products, which have a bearing on market demand for them, require special emphasis. Of the household appliances, there are types which meet a real need and which may, or may not, be considered as luxury goods, depending on the average income level of the consumer. Examples of these are household refrigerators and fans. With these products, the trend is to integrate them into ordinary consumer habits as per capita income rises. Other types of household appliances such as mixers, are really luxury items, although in this case also modifications in consumer habits may well make such appliances necessities. In this sense, publicity in Brazil and, above all, in the State of Sao Paulo, has been eminently successful. Finally, there is a group of appliances used for increasing the productivity of domestic services, such as polishers and washing machines. Such appliances were originally a luxury, but are becoming more of a necessity because of the complexity of urban life, which makes labour for domestic service more expensive. The demand for scales is also associated with the degree of urban concentration reached.

The manufacture of household appliances such as mixers, polishers, etc. often shows a high degree of vertical integration, since each establishment has its own foundry and makes its own electric motors. Imports play a relatively small part in supplying Brazilian demand in

/this field.

this field. In the case of household refrigerators, the sealed units are imported but all other parts are made in the country.<sup>30/</sup> In the case of sewing machines, imported elements represent an insignificant proportion of the final cost. Scales are entirely made in the country, with the exception of precision scales which are all imported.

i) Electrical household appliances (E-17-c) Products made. The products included here - mixers, polishers, liquifiers, fans and similar items - constitute the largest group with light mechanical industry.<sup>31/</sup> Within this group, the volume of annual production for mixers and polishers is particularly high. The remarks below refer, however, to all products in the group.<sup>32/</sup>

Market. Output of these articles in Brazil and in Sao Paulo respectively in 1953, is estimated at 4.9 thousand tons with a value of 49 million dollars, and 2.9 thousand tons with a value of 29 million dollars. The average price is therefore 10 thousand dollars per ton. Imports were negligible, as they did not exceed 14 tons, with a value of 111 thousand dollars, or 7.9 thousand dollars per ton.<sup>33/</sup>

Domestic output thus supplies almost the whole of the market, and succeeds, from year to year, in extending the boundaries of demand far beyond the limits previously reached by imports.

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<sup>30/</sup> There is only one establishment in Sao Paulo which manufactures the entire refrigerators. The others only produce the metal container. There are no technical problems for the manufacture of the units in Brazil. The difficulty is an economic one and lies in the length of the manufacturing series; if it is small, as at present, no profit can be made.

<sup>31/</sup> From the aspect of manufacturing technique, electrical appliances for household use constituted the most accurately representative group of the light mechanical industry.

<sup>32/</sup> It should be noted that within the whole group of enterprises selected to obtain certain technical coefficients, some of those with the highest productivity were omitted.

<sup>33/</sup> The difference between the average price per ton of domestic production and of the imported product is due to the fact that the former is based purely on the metal part of these articles, without considering the part made of plastic, glass or wood; on the other hand, for the imported product the total weight was included.



Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of production value	63	51
Labour expenditure as a percentage of value added	34	54
Value added per man-year (dollars)	3,370	5,345
Average annual wage (dollars)	1,125	2,850
Volume of production per man-year (tons)	0.46	-

The industry's problems

Brazilian enterprises within this group are of very varied sizes. As these factories nearly always developed from artisan origins, establishments which still work on a small scale exist alongside enterprises which have evolved with time and are now of appreciable size. There is therefore a very marked trend towards increasing the average size of the establishment, with a parallel improvement in organization.

These industries have few problems that could in any way constitute a serious obstacle to their efficient operation. A relatively high level of productivity has been achieved, which is not really surprising in view of the competitive market conditions.

ii) Sewing machines (E-17-9) Products made. This includes production of sewing machines exclusively for household use, which are made with a few imported parts, consisting at present of little more than the bearings and shuttles.

Market. Brazilian output of sewing machines is concentrated in the Sao Paulo area. Production amounted in 1953 to 1.15 thousand tons with a value of 2.7 million dollars, that is an average price of 2.4 thousand dollars per ton. Imports stood at 1 thousand tons for a value of 2.85 million dollars, or 2.8 thousand dollars a ton. Domestic output thus represented 53 per cent of Brazilian consumption in 1953. Imports include a regular supply of industrial-type sewing machines, which are not yet manufactured in the country. In the near future,

/domestic industry

domestic industry will possibly be able to replace approximately 70 to 80 per cent of imports, particularly for the household types. The remaining 20 to 30 per cent, consisting of specialized types, will still be imported.

Some characteristics of the industry

	<u>Brazil</u>	<u>United States</u>
Value added as a percentage of the production value	40	71
Labour expenditure as a percentage of value added	40	71
Value added per man-year (dollars) <sup>34/</sup>	968	4,502
Average annual wage (dollars)	554	3,165
Volume of production per man-year (tons)	2.0	-

The industry's problems. Brazilian factories producing sewing machines are larger than the economic minimum. Moreover, the average size should increase as a result of the broad expansion noticeable in this field. It is interesting to discover that the factory with the highest productivity - almost three times the national average and equivalent to over 60 per cent of the corresponding industry's level in the United States - is one of the smallest as regards the volume of output. This demonstrates that production of large series of sewing machines is not essential for efficient operating conditions.

If, as a result of improved organization, the level of productivity in the other factories should equal that in the particular plant mentioned, it may be expected that a large percentage of import substitution could be effected by the existing enterprises, without recourse to heavy investment.

Furthermore, new factories are being established or are in the blueprint stage. Allowing for the heavy demand for sewing machines in under developed countries, both in urban centres and in rural

<sup>34/</sup> In 1954 productivity in Brazil was considerably higher. The low figure for 1953 is due to the fact that one of the large factories began operations in April and the remaining nine months of the year were occupied with its organization and incipient industrial output.

/areas, there

areas, there will probably be a future imbalance between domestic supply and demand. It will become even more pronounced through greater productivity as a result of competition. When that time comes, the domestic industry should look to the export market for the sale of its surplus production, while it could also undertake the manufacture of more specialized types of machines.

The availability of suitably trained staff is a decisive factor for efficient operation. In this connection, it is significant to note the difference in the distribution of personnel found in the factories as a whole and in that with the best organization:

Distribution of staff	In all sewing machine factories	In the best-organized factory a/
Administrative and inspection staff	10.0	15.5
Engineers, technicians and foremen	5.0	5.0
Skilled workers	12.0	23.0
Semi-skilled workers	50.0	40.5
Unskilled workers	26.0	16.0

a/ Incidentally, the average wage in this firm is almost 60 per cent higher than for all the factories in the group.

As for raw material supplies, there are no serious problems, because almost 75 per cent of the weight of sewing machines consists of cast iron. Quality is not always uniform, however, and this reduces working efficiency.

/ 4. The Productivity

Because of these defects the method of comparing productivity based on the value added per man-year must be considered as a first approximation to give a rough idea of the way in which these two countries used the labour force in the given years. It also allows efficiency in the use of labour in the various sectors of the industry to be compared. From this aspect the rate of conversion in dollars has no influence on the comparison.

With reference to the different sectors in Brazil, table 9 gives productivity in monetary terms and as a percentage of the corresponding sector in the United States. For each sector the average salary in dollars in Brazil has also been included, as well as the percentage corresponding to the United States.

It will be seen that average productivity for the whole of the mechanical and metallurgical activities considered was, for Brazil (State of Sao Paulo) in 1953, 47 per cent of the level reached in the United States in 1947. It is true that this proportion can only be accepted with the reservations already mentioned elsewhere in this study. Even so, this result appears to provide a sufficiently approximate indication of the size of the relationship between average productivity levels for the iron and steel transforming industries in the two countries.

Nevertheless, a comparison by sectors shows very great variations in the average percentage. Thus, primary metallurgical activities in Brazil only reached 59 per cent of productivity in the United States; in secondary metallurgical activities it varied from 32 per cent (metallic furniture) to 63 per cent (agricultural instruments), a sector in which the average size of the individual enterprise exceeded a labour force of 1,000 persons. In the heavy mechanical industries, excluding passenger cars and other similar items, the Brazilian level of productivity varied between 30 per cent (manufacture of machinery for soil preparation, a sector of artisan work) to 51 per cent (manufacture of goods trucks, despite the very low use of available capacity). Finally for light mechanical industries, which are among the best organized in the country, the ratio runs from 22 per cent (sewing-machines) to 63 per cent (electrical household appliances). As noted earlier, statistics for sewing-machines are affected in 1953 by the beginning of this industry in Sao Paulo, but in the following year productivity in that State for sewing-machines had reached 81 per cent of that of the United States in 1947.

/It was

It was also possible to compare the productivity in physical values of a limited number of products or groups of products manufactured by undertakings with a degree of vertical integration similar in both countries. Table 10 presents the ratio of the coefficients of productivity both in monetary terms and those of physical value for seven industrial sectors. Because this latter system is considered as more accurate, table 10 enables an evaluation to be made of the margin of error in each sector when considered in terms of the value added per man-year.

Table 10

BRAZIL AND THE UNITED STATES: COMPARISON OF PRODUCTIVITY IN  
PHYSICAL AND MONETARY TERMS  
(Percentages)

Activity	A Ratio between productivity in monetary terms a/	B Ratio between productivity in physical terms b/	C Comparison between A and B
Screws	58.0	22.8	39.4
Bolts	57.0	15.0	26.3
Nails	61.2	36.0	58.8
Metallic furniture	46.0	18.2	39.5
Safes	37.4	17.6	47.0
Springs for cars	44.0	13.4	30.5
Sewing-machines	81.0	46.0	56.7
Arithmetic average	54.4	24.1	42.6

Source: ECLA, based on the sources given in footnote 36/

a/ Ratio between value added in Brazil in 1953, converted to dollars and the value added per man-year in the United States in 1947.

b/ Ratio between the tonnage produced per man-year in Brazil (1953) and the United States (1947).

/It may

In none of the four sectors studied does the highest level of productivity coincide with the largest enterprise. Thus, for example, in the manufacture of metallic furniture, one enterprise with personnel equivalent to 72 per cent of the average of the sector has a productivity superior to twice that of another factory where the labour force is more than double that of the first. In the sector devoted to enamel baths, one firm whose labour force only reached 28 per cent of the average, has a productivity only 24 per cent less than another which has five times the number of workers. In the manufacture of springs for motor-cars, the comparison between the second enterprise given in table 11, with 42 per cent of the average labour force and the larger enterprise of the group, is even more significant, since this latter offers a productivity 6 per cent less than the former. Lastly, in the manufacture of screws there is an even greater disparity, since a very small factory, employing only 9 workers, shows a productivity nearly double that of the larger establishment, which has 27 times the number of workers.

There are many factors which cause these peculiarities. Thus, for example, in the case of the screw factory, the small establishment concentrates on a very limited number of models and sizes, and possesses good internal management, while the larger enterprise tries to supply the market with nearly every type and size of screw. Therefore, it is not surprising that, at least to some extent, the size of the establishment imposes its influence upon the other factors. This does not occur, however, except in special cases where the nature of production demands expensive specialized equipment, which can only be installed in large factories. Apart from these examples, it appears reasonable to conclude that the influence of the size of the establishment is less - in determining the level of productivity - than that of the other factors.

b) Machinery and equipment. Brazil's industry, particularly the larger and medium establishments, in general took advantage of the ample import possibilities during 1951-52 to replace and to increase their machinery and equipment. A large share of the existing equipment is new, but it is not all yet in use, through a lack of sufficient supplies of raw materials or energy. In a few cases, machinery was not bought for

/immediate use,

immediate use, but as a reserve against future enlargements. The general trend is to acquire equipment of a more specialized nature and with a high capacity. For example, simple lathes are being replaced by revolving or automatic lathes. But some such complicated machinery is not being used to its maximum capacity. During visits made by ECLA personnel, it was noted that revolving lathes were sometimes used for work which could be done by simple lathes. The heavy machinery imports of 1951-52 did not, however, mean a mass modernization of Brazil's industry. Rapid expansion and uncertainty as to market possibilities have caused old and out-of-date equipment, which should have been replaced, to remain in use for work requiring little precision and with a very low yield.

The situation of the smaller establishments is more favourable. Broadly speaking, equipment is deficient, because high capacity machines can only be justified by a large amount of work. This does not occur in the smaller establishments, where - between repairs - small series of manufactures are produced.

Thus, it may be said that, if the trend towards acquiring specialized equipment continues - and this does appear to be so, although in many cases without detailed plans - an increase in the average level of productivity may be forecast for the next few years.

c) The labour force and its training. Of all the Latin American countries, Brazil, without doubt, has made the greatest efforts to train skilled labour. Indeed, the Federal Government, as well as many State governments, support technical schools for the training of workers. In the mechanical branch, the training is not specialized, although it is of a highly technical nature implying a general knowledge of the use of lathes, cutting, drills, etc., as well as essential theoretical knowledge. Workers with this training are especially useful in repair shops, in the maintenance of machinery in industrial plants and in the tool shops of mechanical industries.

Plans for training in official Brazilian establishments are being revised with the aid of the Servicio Cooperativo Interamericano. (Inter-American Co-operative Service). The methods of training instructors, by a more complete education than that given to workers, was abandoned after the discovery that in order to carry out such functions, the capacity to obtain the co-operation of the subordinates was more important than

/theoretical knowledge

theoretical knowledge acquired by the candidate during the training period. The lack of practical experience upon leaving the school, impossible to rectify except through empirical methods, places the candidates in a poor position to assert the necessary authority over subordinates. Instructors are now partly prepared by means of a rapid training in the plants themselves, which is known in the United States as T.W.I. (Training within Industry).

The SENAI,<sup>37/</sup> together with the schools directed by the Confederacao Nacional da Industria do Brasil, concentrates on training "mono-technicians", that is, specialists in one particular branch, to meet the substantial need for mechanics capable of handling modern machinery with precision and efficiency. By law, industrialists must send to the SENAI a certain number of apprentices each year, according to the size of their labour force. These pupil-apprentices alternate the classes given by the SENAI with their factory work every six months and during the period of apprenticeship, receive a fraction of the full wage.

There is no doubt that the expansion of the mechanical and metallurgical industry in Brazil has been greatly assisted by the annual training of many thousands of mechanics in these schools.

Since the total number of SENAI schools is as yet inadequate for the requirements of the country, to date only a small proportion of industrialists have enjoyed this privilege, although all of them contribute towards expenses in accordance with the law. The visits made by ECLA personnel to enterprises in Brazil resulted in a variety of opinions as to the services provided by the SENAI. In general, the response was favourable from well-organized companies and unfavourable in respect of the others. It is probable that in the latter group the results achieved with workers trained by the SENAI have been to some extent unfavourable; the cause must be sought in the enterprises themselves, which have been unable to supplement the training given by the SENAI.

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<sup>37/</sup> Servicio Nacional de Aprendizagem Industrial, established by law in 1952.



d) Influence of the organization of the enterprise. The research carried out by ECLA shows that, among all the factors bearing on productivity in the mechanical and metallurgical industries of Brazil, and perhaps also in other Latin American countries, the most important is the failure of adequate organization by industrialists themselves. The effects may be felt in two principal ways - firstly, through the combination of productive resources and their utilization within the establishment and, secondly, through the selection of the market and adaptation of the product to demand.

To analyse the first factor, the methods used by industry in Latin America should be borne in mind. Two types of enterprise may be used as a hypothesis, although they cover many other combinations. One is that of individuals with available capital and who study the market in order to determine the needs, or who simply imitate an existing industry with the sole aim of a profit. The second is that of an artisan activity which expands until it becomes an industry. The latter case frequently occurs in Latin America, when the artisan possesses the essential technical knowledge and some initiative. With the growth of the factory, the supervision of workers, the needs of the public, purchases of raw materials and accountancy acquire ever-greater momentum; thus the time arrives when the artisan, who at the beginning undertook all these functions, must decentralize some of them if he wishes to be successful. Observations made during the programme of visits to establishments indicate that the first functions performed by the artisan in a growing enterprise are those connected with bookkeeping, secretarial work and correspondence. At a second stage, he proceeds to contract an engineer, technician or draughtsman. At a later period, he resigns part of this direct authority over the shop-operators, dividing it in sections and handing over the direction of some or all of them to foremen trained by himself, that is to say, selected amongst the workers. When this third stage has been reached, the system works smoothly without any further control of materials and tools other than simple on-the-spot inspection, without either cost-accounting and even less by prior planning of work for employees and equipment. There are many establishments - including those employing a thousand or more workers - which operate with this type of organization in Latin America. They are in direct contrast to a number of small artisan shops which make use of common business and accountancy services.

Better organization requires the employment of engineers and technicians responsible for organizing the work. They should study the suitable productive processes, should choose the tools and other elements for a better use of productive resources and should ensure that raw materials are at the right place at the right time. In addition, they should make sure that each worker is fully informed of his duties and responsibilities, they should establish adequate incentives for the labour force to work at a high rate of productivity and, in particular, they should be available to face unforeseen situations which arise during the manufacturing process. It is clear that such an organization is very simple if one product alone is being manufactured and that it is extremely complicated when each article is being made only once. Moreover, the necessary documentation to handle a system of this type requires both employees and expenditure. For this reason it is necessary to establish as accurately as possible the type of organization which will best correspond to each activity and to each size of establishment.

There is no school to train engineers and technicians of this type, either in Brazil or in other Latin American countries where the mechanical and metallurgical industries have been analysed to date. As a result, the entrepreneur of the first type, that is to say, the organizer of a large-scale industry, will lack suitable executive personnel. These remarks do not imply that this professional class does not exist in Brazil, any more than that other important factors which hinder an immediate increase of productivity are not available. As regards the effects of the quality of industrial executive guidance upon factors related with the market, the following observations are pertinent. Firstly, it is evident that much depends upon the choice of the product, its adaptation to the tastes and needs of the consumer and upon the available raw materials. It is a fact that when raw material supplies are irregular, industry must face additional expenditure and effort to discover substitutes, which will lead to changes in machinery and other auxiliary elements. A second step in the same direction consists of standardizing products. When Latin American industry tries to replace imports, it is confronted by the problem of manufacturing articles of different types or sizes to meet the greater capacity of its potential market, which will complicate the establishment of intermediate stocks of semi-products and the planning of work in the factories.

Some large establishments which exercise a certain influence upon the market can limit their production to a few models, suppressing those which do not sell well and gradually eliminating different branches of the work; to some extent this is true of metallic furniture. But smaller industries can only achieve such results through previous agreements with other producers, or through the action of a regulating body.

To accomplish these aims, the preparation of suitable models for the market, for the raw materials and for standardization - engineers and technicians are required who, although they are rare in Brazil, may be found in greater numbers than those for organizing production. Such technicians should additionally be responsible for the systematic control of production, as regards its quality, beginning with the selection and inspection of the raw materials, the control of the quality of the work (size, resistance, etc.), throughout the whole production process. In Brazil, only a few of the better organized industries maintain such controls, because it is more usual to limit this task to a brief glance at the raw materials - when it is done - and to a final test of the finished product.

While the importance of a selection of the models lies in easier sales, standardization permits mass production, which facilitates the organization of the factory, and a control of the quality to the benefit of the public. In view of the difficulties of these problems and the shortage of a professional class to carry them out, many large and even medium undertakings have made agreements for technical co-operation with firms in the same line abroad. In general, the foreign firms provide designs and specifications for the materials, to which are added at least: i) information dealing with modifications and improvements introduced by the foreign company in its own factories; ii) instructions and detailed plans for the work in the shops; and iii) the use of the trademarks of the foreign firm. These services are usually met by the payment of a small royalty, although there are also cases of foreign firms which contribute capital - in equipment or money - to organize or enlarge Latin American industries.

The difficulties of the region's industry as regards the selection of materials and the control of quality may partly be solved if the producers of raw materials, transforming industries and the consumers all accept detailed specifications which can act as a guide for the industrialist in choosing the basic characteristics of the designs.

The lack of professionals to carry out the tasks which aid higher productivity has already been remarked. Although this shortage is a serious obstacle, a greater barrier is probably that many industrialists ignore these problems and therefore do nothing to remedy the situation. A combination of these circumstances is clearly the most important factor governing the low average level of productivity at present. Greater attention will be given to these problems as industry develops and as a solution is found to current difficulties, such as the shortage of raw materials and electric energy, which generally constitute handicaps in Brazil and particularly in the State of Sao Paulo.

### Chapter III

#### THE MECHANICAL AND METALLURGICAL INDUSTRIES OF COLOMBIA

##### 1. Introduction

The degree of development reached by Colombia's mechanical and metallurgical industry is considerably influenced by the exceptional topography of the country. The existence of several zones separated from each other by poor and therefore costly, communications, helped to develop independent centres. They are largely self-sufficient and only insignificant economic relations are maintained between them. Such geographical conditions gave rise, within each zone, to its own urban and industrial centre. Hence four industrial centres of relatively similar importance have grown up in Colombia. At each centre, an iron and steel transforming industry has developed independently and was limited to supplying the market of the neighbouring area. The market limitation thus imposed not only reduced the number of iron and steel products that could be economically made in the country but also restricted the average size of the existing factories to very modest proportions, in many cases too small for a rational level of productivity. At the same time, the separation of the domestic market into four almost watertight compartments has also operated against the growth of certain branches of the iron and steel industry, for whose products there is appreciable demand only in larger urban centres. Such branches include those making household goods tending to replace salaried domestic services. Finally numerous mechanical and metallurgical activities require, for their development the co-existence of other complementary industries within the same field; this then completes the picture of the main obstacles opposed by geographic conditions to any expansion of Colombia's iron and steel industry.

These introductory remarks are essential since, unless they are borne in mind, it is difficult to understand how the mechanical and metallurgical industries can show such differing degrees of development in countries so similar in certain respects as Colombia and Brazil. In population (12 million inhabitants in 1953) Colombia is one of the largest Latin American republics; its per capita income in that same year was 237 dollars, as compared with the Brazilian level of 207 dollars. Consumption of rolled steel <sup>1/</sup> per inhabitant

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<sup>1/</sup> For a definition of "rolled steel" see the first page of Chapter II.

- 22 kg - was higher than in Brazil - 20 kg - and the rate of increase for steel consumption has also been very high,<sup>2/</sup> greater than that in Brazil in recent years. In Colombia, consumption of rolled steel products for every 100 dollars of gross national product rose from 6.8 kg. in 1950 to 9.3 kg. in 1953, that is, an increase of 37 per cent. In Brazil, the increase over the same period was 5.2 per cent.

In spite of these similarities between Brazil and Colombia, the iron and steel transforming industries in the latter country are much less developed, mainly for the reasons given. Rolled steel consumption is largely in the form of direct applications, without any kind of transforming by domestic industry; its main use is in constructions of all kinds. Other activities also consume considerable amounts of unfinished steel; in farming, for instance, barbed wire and galvanized iron plate, among other products, are used on a large scale.

It is not possible to predict whether the sharp rate of increase in rolled steel consumption, which far exceeds the rate of increase in the gross national product will be maintained in the future. This consumption figure, since 1937, has varied sharply each year (see Table 12). Fluctuations take place, not only in the total volume of annual imports but also in their composition. Thus there is evidently a market problem for the Paz de Rio steel mill, which is intended to replace imports of unfinished steel, but whose manufacturing programme is restricted to a very limited number of rolled steel products. For this reason the composition of demand will be analysed in greater detail later.

## 2. Analysis of supply and demand

Almost all Colombia's supplies of ferrous raw materials came, until 1954,<sup>3/</sup> from imports. The only domestic output of ferrous material<sup>3/</sup> resulted from the rolling of bars, using scrap iron as the raw material, in a small establishment on the outskirts of Medellin. Output at this works rarely exceeded 6 thousand tons a year, and was usually in the neighbourhood of 4 thousand.

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<sup>2/</sup> Table 12 should be consulted here, as it shows the annual volumes of imports since 1937.

<sup>3/</sup> In the year when this study was undertaken, and to which the remarks made here refer, the Paz de Rio steel mill had not yet begun operations; it was opened in October 1954.

Table 12  
COLOMBIA: IMPORTS OF IRON AND STEEL AND THEIR PRODUCTS  
(thousands of metric tons and percentages)

Year	Ferrous raw materials <u>a/</u>	Finished products	Total imports	Percentage of raw materials
1937	86.7	49.7	136.4	63
1938	91.3	48.3	139.6	67
1939	96.4	53.8	150.0	64
1940	71.3	45.0	116.3	61
1941	57.4	39.5	96.9	59
1942	11.0	12.0	23.0	48
1943	33.6	12.4	46.0	73
1944	77.5	21.8	99.3	77
1945	91.5	50.8	142.3	64
1946	113.1	85.5	198.6	57
1947	150.9	136.3	287.2	52
1948	91.2	105.8	197.0	46
1949	106.3	77.3	183.6	58
1950	153.7	105.6	259.3	59
1951	137.4	123.8	261.2	53
1952	132.1	120.7	252.8	53
1953	258.0	200.3	458.3	57

Source: Foreign Trade Yearbooks, Dirección General de Estadística.

a/ Includes: pig-iron, bars, sections, plate, tinplate, wires, tubes, pipes and special steels.

Table 12 indicates the evolution of imports from 1937 to 1953, broken down by ferrous raw materials and finished products. It shows a downward trend in imports of ferrous raw materials, not in absolute value, but in relation to total imports; the respective proportion fell from an average of 64 per cent for the first three years of the period reviewed, to nearly 54 per cent for the last three years. Hence, the large increases during this period in the capacity to import resulting from the improved terms of trade derived from the high price of coffee were used mainly to increase imports of finished products, particularly of certain means of road transport (cars). This situation is better illustrated by the data in Table 13. These show the evolution of the capacity to import and of imports of ferrous raw material during the same period. Although they rose on

/Table 13

Table 13

COLOMBIA: COMPARISON BETWEEN IMPORTS OF FERROUS RAW MATERIALS  
AND THE CAPACITY TO IMPORT

(Thousands of metric tons; indices; 1937-39 = 100)

	<u>A</u> Imports of ferrous raw materials Tons <u>a/</u>	<u>B</u> Index	<u>C</u> Index of the capacity to import <u>b/</u>	<u>D</u> Relation of imports to the capacity to import <u>c/</u>
1937	86.7	95	105	91
1938	91.3	100	96	104
1939	96.4	105	99	106
1940	71.3	78	79	99
1941	57.4	63	77	82
1942	11.0	12	83	14
1943	33.6	37	92	40
1944	77.5	85	94	91
1945	91.5	100	101	99
1946	113.1	124	125	99
1947	150.9	165	134	123
1948	91.2	100	140	72
1949	106.3	116	169	69
1950	153.7	168	219	77
1951	137.4	150	221	68
1952	132.1	144	226	64
1953	258.0	282	293	96

Source: Dirección General de Estadística, Foreign Trade Yearbooks of Colombia, and ECLA.

- a/ Includes pig-iron, bars, sections, plates, tinplate, wires, tubes and pipes.
- b/ Capacity to import = purchasing power of exports + net capital inflow.
- c/ Calculated by the formula  $\frac{B}{C} \times 100$ ; an idea may thus be obtained of the degree to which imports of ferrous raw materials compare with the capacity to import, in relation to the share of such products in 1937-39, the base period of the index.

/an average



an average from 91 thousand tons in 1937-39 to 176 thousand tons in 1951-53, imports of primary iron and steel products occupied a declining place among total imports, measured by the index of capacity to import.

The global volume of imports will probably decline in the next few years, as a result of the activities of the Paz de Río steel mill which has an annual production capacity of 106 thousand tons of rolled products. This is equivalent to 60 per cent of the annual average of imports during the period 1951-53. The recent fall in world coffee prices, with the consequent reduction in the capacity to import, shows the timeliness of this new enterprise in the field of basic industry.

### 3. Role of domestic industry as a supplier

Table 14 shows the proportional share of national production in supplying the domestic market in those industries covered by the 1953 Census.<sup>4/</sup> It may be seen that the value of production by the transforming industry in that year represented 7 per cent of the country's total supply. But in actual fact, if repair work is excluded, this percentage would be much lower. This undue inclusion of repair activities within the transforming industry has a greater influence on those sectors making machine parts, industrial machinery, farming machinery, cars and bicycles and other means of transport. For instance in the sector making cars and bicycles, except for one firm engaged in bicycle assembly, repair work constitutes the entire activity. In the other sectors enumerated, which form an important part of heavy mechanical industry, repairs may be estimated as being at least 40 per cent of the respective volume of operations. Once these corrections are introduced, the value of production by the iron and steel transforming industry is reduced to approximately 22 million dollars, representing barely 4.3 per cent of the country's total supply of finished iron and steel products.

The figures in Table 14 also lead to the conclusion that Colombia's industrial activities, as regards iron and steel transformation, are mainly concentrated in mechanical manufactures (construction of farming and industrial machinery and

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<sup>4/</sup> The Industrial Census of Colombia covers almost all establishments employing more than 5 persons, as well as repair shops. The data, which are not yet published, were obtained from the Dirección General de Estadística.

Table 14

COLOMBIA: PARTICIPATION OF THE TRANSFORMER INDUSTRY IN THE SUPPLY  
OF IRON AND STEEL PRODUCTS, 1953

(Thousands of dollars)

Group	<u>A</u> Imports	<u>B</u> Domestic production	<u>C</u> Percentage of domestic production in consump- tion a/
4. Cables and wire netting	1,289	-	-
5. Sundry appliances	5,193	3,180	38.0
6. Machine parts	7,399	2,814	27.6
7. Industrial machinery	56,173	1,706	2.9
8. Farm machinery	14,745	1,899	11.4
9. Power generators, excluding electrical	7,503	-	-
10. Electrical material	9,443	29	0.3
11. Railway material	2,103	-	-
12. Motor vehicles and bicycles	63,019	7,232	10.3
13. Other means of transport	1,842	2,957	61.6
14. Building materials	8,229	6,319	43.4
15. Articles for industry and commerce	11,598	5,061	30.4
16. Articles for general use b/	1,761	3,781	68.2
17. Articles for household use	18,005	1,830	9.2
18. Articles for personal use	1,390	83	5.6
Total	<u>257,678</u>	<u>33,891</u>	<u>15.7</u> c/

Source: Foreign Trade Yearbook and Industrial Census of 1953.a/  $B \div (A + B)$ .

b/ The item "unspecified metallurgical industries" is included in this group which mainly comprises activities using non-ferrous metals, such as gold and silver. The extensive share of domestic industries in the manufacture of ferrous products included in the group is therefore fictitious, since such production is practically non-existent.

c/ The percentage was obtained by dividing the sum of domestic production and imports by the total value of domestic production, excluding groups 1,2,3,4,9 and 11.

/spare parts

spare parts and some means of transport) wherein production represents approximately 45 per cent of the whole, with 16.6 million dollars; nevertheless, the part played in supplying the country is very small.

In the manufacture of sundry appliances (primary metallurgy), 38 per cent of the supply and 9 per cent of the output of mechanical and metallurgical industries represent the share of domestic industry. The remaining sectors - which cover approximately 50 per cent of the industry's activities - relate almost exclusively to secondary metallurgical activities, among which the manufacture of structures and metal furniture is particularly important.

" This evolution of industry is one that might be expected in an under-developed country. Manufacturing activity usually begins in the mechanical engineering branch, on account of the need to repair existing machinery and to produce certain spare parts. At the next stage secondary metallurgical activities develop, in particular the manufacture of metallic carpentry; a powerful incentive is provided here by such factors as lower skilled labour requirements, greater facility for introducing tariff protection, many of the products being considered as luxuries,<sup>5/</sup> and the relatively modest influence, in this branch, of the scale of operations on costs. Primary metallurgical activities develop later, only after the development of other activities in the field has created a demand justifying the installation of the appropriate industry.

Table 15 permits an appreciation of the extent to which certain productive resources are used by the mechanical and metallurgical industry. As repair activities are so important in under-developed countries as a means of training labour, these are also included in the table.<sup>6/</sup>

In 1953, the total number of workers and administrative personnel employed by industrial iron and steel transforming shops, with a staff of at least 5 persons was 12,002, distributed over 684 establishments. This gives an average figure of 18 persons per establishment.

<sup>5/</sup> Elsewhere in this study evidence will be provided of the great influence exerted by tariff barriers on these industries of Colombia.

<sup>6/</sup> Among these repair shops, the only ones excluded are those connected with the railways and the large industrial enterprises, as these work exclusively for the enterprises to which they belong. These excluded repair shops are, however, of exceptional importance in Colombia.

Table 16

## COLOMBIA: COMPARISON OF INDUSTRY IN THE FOUR MOST INDUSTRIALIZED DEPARTMENTS

(Number, thousands of dollars and thousands of kWh)

Department	Establishments	Total staff	Value added	Energy consumed
Antioquia (Medellín)	96	2,385	3,816	7,152
Atlántico (Barranquilla)	78	2,023	4,355	2,312
Cundinamarca (Bogotá)	230	3,517	5,920	4,470
Valle del Cauca (Cali)	119	1,808	2,940	1,839
Other Departments and Intendencias	161	2,269	2,457	1,018
Total	684	12,002	19,488	16,791

Source: Dirección General de Estadística.

The high costs of internal transport in Colombia are documented in Table 17, which gives some figures relating to road transport tariffs between the principal ports, such as Barranquilla (on the Atlantic) and Buenaventura (on the Pacific), and the industrial centres mentioned, as well as between these centres themselves. The costs given are for lorry freight, as in view of the greater slowness of rail or river transport, or of a combination of these two, road transport is usually preferred, at least for finished products. The other means of transport are, on an average, 10 to 20 per cent cheaper than road transport, and are used mainly for raw materials.

The high incidence of these freight rates can be better understood when it is remembered that the average cost of ferrous raw materials distributed in the interior of the country by the mechanical and metallurgical industries is nearly 160 dollars per ton. The effect on costs is further aggravated by the fact that at the country's present stage of industrialization, the only manufacturing activities are those in which the products have a relatively low value added, that is a low price per unit of volume.

/Table 17

Table 17

## COLOMBIA: LORRY TRANSPORT COSTS BETWEEN PORTS AND THE FOUR MOST INDUSTRIALIZED CENTRES a/

(Dollars per metric ton)b/

Source of freight	Destination of freight				
	Barranquilla Port	Buenaventura Port	Cundinamarca (Bogotá)	Valle del Cauca (Cali)	Antioquia (Medellín)
Barranquilla Port	-	-	33.30	81.70	41.00
Buenaventura Port	-	-	41.00	11.10	34.00
Cundinamarca	37.00	16.70	-	13.00	22.20
Valle del Cauca	41.00	5.50	29.60	-	24.10
Antioquia	20.10	14.80	22.20	14.80	-

Source: Information obtained from several road transport enterprises.

a/ Rates in force in August 1954 and for traffic densities existing at that time. Transport from the interior to the coast is cheaper than in the opposite direction, as there is vacant space in that direction. The rates are valid for packages of up to 500 kilogrammes. Larger packages bear conventional surcharges for the use of cranes.

b/ Colombian pesos converted at the rate of 2.70 to the dollar.

5. The steelmaking industry and the production of its primary derivatives

a) Production of standard rolled products. Until October 1954, Colombia's steelmaking output was limited to some 4 to 6 thousand tons a year of rolled products made in the Medellín steel mill and obtained from scrap. At that time the Acerías Paz de Río S.A. began operations with an annual capacity of almost 106 thousand tons of rolled products. <sup>7/</sup> It makes: wire - including barbed wire -, bars and sections up to certain sizes and rails for the railways. The installations at Belencito do not permit the production of bars and sections over and above certain dimensions nor of tinplate, nor will they lend themselves easily to making cast iron. <sup>8/</sup>

<sup>7/</sup> According to the first tests, the initial equipment will enable 20 to 30 per cent more to be produced in practice than in theory.

<sup>8/</sup> This difficulty is due to the high percentage of phosphorus in the ores, all of which passes into the iron during the casting process.

/The difficulty

The difficulty of obtaining a sufficient volume of foreign capital means that the installation of high capacity rolling-mills will have to be postponed until a second stage. These are essential for making larger bars and sections, plate and tinplate, all products constituting a large part of the country's total consumption of unfinished steel. As may be seen from Table 18, imports of ferrous products included within Paz de Rio's programme totalled approximately 105 thousand tons, of which 70 per cent consist of bars and sections.

The capacity of the Belencito plant will soon be fully utilized by opening a number of factories producing certain simple articles of steel transformation, such as nails, studs, tubes, etc., imports of which are still considerable. It would perhaps be possible - on the lines of developments in various steelworks in Brazil - to synchronize the present Paz de Rio programme with the installation of additional factories of higher unit value. <sup>9/</sup> Expansion of the steel production programme would have the advantage of introducing greater stability into the over-all volume of production at Belencito.

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/Table 18

<sup>9/</sup> In connexion with this expansion, two possible plans were already considered for Paz de Rio. The first is the manufacture of steel tubes, imports of which demonstrate the possibility of a scale of operations compatible with low costs. The relatively low capital-product ratio favours this plan. The second is the construction of an independent factory in some other place - where the combined costs of transport (for raw material and finished product) do not constitute an obstacle - in order to produce articles using steel from Belencito.

/Table 18

Table 18

COLOMBIA: IMPORTS OF STEEL TUBES AND OF THE PRODUCTS INCLUDED  
IN THE INITIAL PROGRAMME OF PAZ DE RIO

(Metric tons)

Year	Share of bars and sections a/	Wire of all kinds	Rails and ac- cesso- ries	Partial total b/	Steel tubes and pipes		Grand total c/
					Welded	Seamless	
1937	17,500	14,159	5,433	37,092	24,663	d/ ..	61,755 d/
1938	13,160	9,789	1,841	24,790	47,046	d/ ..	71,836 d/
1939	16,600	17,785	1,949	36,334	31,588	d/ ..	67,922 d/
1940	14,600	11,740	4,065	30,405	21,581	d/ ..	51,986 d/
1941	18,200	9,699	3,072	30,971	12,981	d/ ..	43,952 d/
1942	2,200	1,462	120	3,782	4,141	d/ ..	7,923 d/
1943	9,700	5,141	273	15,114	8,239	d/ ..	23,353 d/
1944	27,000	7,773	826	36,299	26,664	d/ ..	62,963 d/
1945	28,500	7,811	377	36,688	32,706	d/ ..	69,394 d/
1946	36,700	13,276	7,618	57,594	30,186	d/ ..	87,780 d/
1947	44,100	18,466	16,508	79,074	39,178	d/ ..	118,252 d/
1948	21,800	18,577	5,879	46,256	22,248	d/ ..	68,504 d/
1949	24,500	21,250	1,850	47,600	33,682	d/ ..	81,282 d/
1950	45,400	37,039	1,167	83,603	26,536	d/ ..	110,139 d/
1951	43,400	18,040	3,699	65,139	16,233	9,786	91,258
1952	26,900	23,320	1,620	51,840	17,844	13,731	83,415
1953	74,100	28,211	2,608	104,919	38,929	25,884	169,732

Source: Foreign Trade Yearbooks of Colombia, Dirección General de Estadísticas.

- a/ It has been assumed that the present rolling mills permit manufacture of 80 per cent of the total bars and sections imported to date. The figure in the column represents approximately that tonnage.
- b/ This represents approximately the total imports that could be replaced by the present installations, always provided that the tempering furnaces and rail rectification equipment have been completed in time.
- c/ Total imports that could be replaced by the present steel mill if the manufacture of seamless and welded tubes were added.
- d/ Includes imports of cast-iron tubes and steel fittings for pipes, which in 1951-53 averaged 87 per cent of the total imports of tubes and pipes.

/In any

In any event, it will sooner or later become essential to expand the production capacity of the Belencito steel mill; the present installations do not correspond to the country's requirements because they are incomplete and do not permit manufacture of steel plate and tinplate. These two products together have shown the most rapid growth among imports of ferrous raw material (annual geometric rate of 2 per cent in the last 15 years) <sup>10/</sup> Consideration is already being given to an expansion of the present installations, which would raise their total capacity to nearly 380 thousand tons of finished products. This figure includes the small amounts of cast iron required by the Colombian market.

Table 19 provides some idea of the size of the market for those products not as yet made in Colombia. Total imports of these amounted to 87 thousand tons in 1953, in addition to some 165 thousand tons of products included in Paz de Rio's current production programme and the proposed steel tubing. An installation of the size mentioned would not permit economic manufacture of all the products making up this volume of imports. Hence the production programme would probably cover only a part of the 1953 imports, a part that may be estimated as not exceeding 230 thousand tons, that is 60 per cent of the projected capacity, unless demand meanwhile increases.

Construction of the additional installations <sup>11/</sup> could not, in any case, be completed before 1960. Assuming that in the meantime demand continues to increase at the same average rate as during the last 15 years, the steel mill, with its expanded installations, would be assured of a minimum market of 306 thousand tons a year. This means that 80 per cent of the new capacity would be utilized.

These figures call attention to the influence on costs of the size of installations and the degree of their utilization. Table 20, which refers to this problem, was prepared on the basis of the studies presented at the Iron and Steel Meeting held at Bogotá in 1952. <sup>12/</sup>

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<sup>10/</sup> Consumption of plate has increased much more sharply in the last five years, since metal furniture manufacture began on an industrial scale in several Departments.

<sup>11/</sup> Expansion projects call for a second blast furnace, blooming mills and a flat products rolling mill.

<sup>12/</sup> Document E/CN.12/293/Rev.1 Study of the Iron and Steel Industry in Latin America, a United Nations publication.



Table 19

COLOMBIA: IMPORTS OF FERROUS RAW MATERIALS NOT INCLUDED IN  
CURRENT MANUFACTURING PROGRAMME OF PAZ DE RIO

(Metric tons)

Year	Flat products			Bars and sections		Pig-iron	Cast-iron tubes and fittings	Grand total
	Sheet and plate	Tinplate	Total	a/	c/			
	c/	c/						
1937	14,345	4,118	18,463	4,429		818		23,710
1938	11,737	2,597	14,334	3,300		317		17,951
1939	16,397	5,522	21,919	4,159		868		26,946
1940	9,919	4,650	14,569	3,613		261		18,443
1941	4,197	3,836	8,033	4,567		437		13,037
1942	1,231	1,105	2,336	587		1		2,924
1943	3,514	3,969	7,483	2,421		114		10,018
1944	4,085	1,315	5,400	6,034		2,558		13,992
1945	7,219	2,447	9,666	7,089		3,750		20,505
1946	10,873	1,815	12,688	9,246		1,498		23,432
1947	10,325	4,451	14,776	11,116		2,947		28,839
1948	7,470	6,316	13,786	5,469		996		20,251
1949	9,421	4,240	13,661	6,473		1,327		21,461
1950	21,302	6,337	27,639	10,407		1,922		39,968
1951	21,160	7,165	28,325	10,840		758	5,996	45,919
1952	28,390	7,804	38,194	6,759		949	4,572	50,019
1953	50,022	9,782	59,804	18,538		1,421	7,690	87,453

Source: Foreign Trade Yearbooks of Colombia, Dirección General de Estadística.

- a/ Approximately 20 per cent of the total for the item corresponds to the fraction not included in table 18.
- b/ In the years 1937 - 1950 these tonnages were included in the data in table 18; no attempt has been made to separate them because they are of little relative importance.
- c/ This does not include manufactured goods with a low value added, made from these raw materials, as imports of them could be easily replaced; such goods include crown stoppers and metallic structures etc.

/The data

The data show that theoretically the 380-thousand-ton mill, working at 60 per cent of its capacity, would produce rolled steel at a cost only 2 per cent higher than that of a mill producing one million tons a year, situated on the Atlantic Coast of the United States.

The data given in table 20 also show that a mill of the same size as Paz de Rio's present installations is much more sensitive to variations in the degree of its utilization. The excess costs, in relation to the United States mill used as the standard, begin with a minimum of 5 per cent, when the installations are fully utilized, and rise to 67 per cent when production does not exceed 60 per cent of capacity.

It is true that in practice, when its activities were beginning, the increase in costs may have been even higher than is indicated by these theoretical figures, because the creation of an industry of that size, in a region completely lacking in technical resources, resulted in a series of imponderables not provided for in the study mentioned, as this was an extreme case of "pioneering" which is not common in this field in Latin America. <sup>13/</sup>

b) Special steels: production and demand. Production and consumption of special steels in Colombia are very low. There are only two factories producing steel for the manufacture of castings, in particular accessories for flour mills and other equipment for treating hard substances, but output is very small. No special rolled or forged steels of any kind are manufactured. The mechanical and metallurgical industries are still in an early stage of development, and imports of this category are correspondingly few: only 707 tons in 1953, representing no more than 0.25 per cent of all standard rolled products imported in that year. The consumption coefficient of special steels in Colombia is barely one-tenth of its counterpart in

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<sup>13/</sup> Only one other Latin American mill - Acesita in Minas Gerais, Brazil - is in the same situation as Paz de Rio. The other recently inaugurated integrated steel mills - Huachipato, Monclova and Volta Redonda - were able to draw on near-by industrial cities, with abundant technical resources and skilled workers. The difficulties mentioned will certainly not arise again when either Acesita or Paz de Rio is expanded.

Table 20

COLOMBIA: INFLUENCE OF THE SIZE OF THE PLANT AND DEGREE OF ITS  
UTILIZATION ON COSTS OF ROLLED PRODUCTS IN STEEL  
MILLS INSTALLED AT BELENCITO <sup>a/</sup>

(Percentages of costs in a plant having an annual  
capacity of one million tons installed on the  
Atlantic Coast of the United States)

Utilization of production capacity	106 thousand ton mill	380 thousand ton mill
100	105	88
90	122	94
80	132	102
70	145	113
60	167	126
50	189	144

Source: Study of the Iron and Steel Industry in Latin America,  
ECLA document E/CN.12/293 Rev. 1, United States publication.

<sup>a/</sup> On the basis of productivity and monetary equivalents in 1948.  
These relationships are still valid, except that prices in the  
United States and in Colombia (expressed in dollars) would have  
varied along different lines.

/Brazil, where

Brazil, where, as has been seen, it is still very low in comparison with more advanced countries.

Although consumption at present is slight, the rate at which it is increasing - 60 tons in 1950, 585 in 1952 and 707 in 1953 - is indicative of the rising trend of production by the mechanical and metallurgical industries in Colombia.

A considerable portion of the imports is composed of stainless steels, which are used in the construction of containers and autoclaves for the chemical and pharmaceutical industries, dyes, etc. Another important part is made up of steel for dyes and tools. In view of the growth of machine-tool imports, a rapid increase in the consumption of these steels in the coming years may be predicted. There is a hitherto practically unexplored field for their application in the manufacture of machinery, especially installations for processing agricultural products.

c) Production of wire and tubes. In 1953 wire was not yet being manufactured in Colombia. But the Paz de Rio steelworks, in the following year, completed the installation of the necessary equipment for complete replacement of imports, which were then reaching a considerable volume, especially as regards galvanized and barbed wire.

The production of tubes, on the other hand, is extremely limited. Only a single enterprise manufacturing metal furniture possesses machinery for producing narrow-gauge tubing, which it uses exclusively for its own production. The remaining types of tubing, both cast iron and steel, welded or seamless, are imported. Only since 1951 have statistics given separate attention to imported tubes (see table 18). In mid-1954 several industrial groups showed interest in starting their manufacture in the country, since there is a stable market to justify it. However, a considerable part of the imported tubing is of large diameter, intended for oil pipe-lines or drinking water systems. The sporadic nature of the consumption of such tubing and the heavy investment required by its production make it advisable not to include it in an initial production programme. The latter should for the time being be limited to tubes of lesser diameter, for which there is an assured permanent market. <sup>14/</sup>

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<sup>14/</sup> In Chile, for example, there is a factory with an annual capacity of 4 to 6 thousand tons of welded tubing, which operates in satisfactory conditions.

The usual practice in Colombia has been to grant exemption from import duties for certain products intended for activities worthy of development; this system was applied to barbed wire, which is widely used in rural districts, and also to tubes imported by certain governmental or semi-governmental bodies. Clearly, such a measure did not permit the creation of an industry producing either tubes or wire. But this situation recently ceased to exist, owing to a decree by the Ministry of Finance suppressing such exemptions. It remains to be seen whether the protection offered by the prevailing customs tariff constitutes a satisfactory incentive to the establishment of industries of this kind. The combination of specific and ad valorem duties, in relation to the prices in force in 1953, represented a 3 per cent ad valorem duty on imports of barbed wire, while in the case of tubes it varied from 14.6 to 19 per cent.

#### 6. Analysis of the various sectors of the transforming industry

Few branches of Colombia's iron and steel transforming industry have attained any importance; this makes it more difficult to select some homogeneous sectors to illustrate the problems and development prospects of mechanical and metallurgical activities.

An analysis follows of the situation in certain sectors where there is activity of some size. Among secondary metallurgical industries, the sectors producing metallic structures and metal furniture were selected, and are analysed together. As regards heavy mechanical industry, the analysis rests on the building of machinery and machine parts for farming, industry and mining.

For the reasons already given, no detailed analysis is made of any sector of the primary metallurgical industry, the manufacture of the diverse items of transport equipment nor of the light mechanical industry. But the situation found in each of these branches of industry can be summed up briefly. Primary metallurgical activities are almost exclusively confined to the making of bolts and containers including crown stoppers. These activities are of little interest for this study, as the enterprises

/where they

where they take place are small and the methods used are very simple. Activities connected with cars, bicycles and other means of transport (especially shipping) are almost entirely confined to repair work. A few marine repair shops do also engage in building vessels with a displacement of up to 1,000 tons. The light mechanical industry is restricted to manufacturing small grinding mills for household use. This line of manufacture is, as a general rule, undertaken in the same shops as make machinery to process farm products, a sector included in the analysis of heavy mechanical industry. Other products of the light mechanical industry such as scales, sewing machines and electro-magnetic household appliances, are not made in Colombia.

a) Primary metallurgical industry (B-4 and B). In Colombia this sector includes, apart from the tube and wire manufacture, already mentioned, the following products: steel mesh, black plate tanks and reservoirs, crown stoppers and tinsplate containers, bolts, screws, nails and tacks. Some of these products, such as tanks, reservoirs, etc., are made in the same factories as metallic structures, so that the statistical data do not separate the two activities. There is some small-scale production of ordinary wire netting, crown stoppers and some types of containers, nails and similar items. Bolts and similar products are made only on a very primitive scale.

According to the 1953 Industrial Census, these activities together employed 746 persons, in 23 establishments, and their output represented a total value of 1.7 million dollars, that is, 2,260 dollars per person employed.

The industrial activities described are very simple, and require skilled labour only for drop-forging and machinery repairs. Hence this is one of the branches where import substitution has been more complete in Brazil, as was shown in the preceding chapter. On the other hand, for the manufacture of most of these products, the size of the establishment has no decisive effect on the level of costs. It may well be that some of these products are not made simply because of the absence of tariff protection.

/Table 21

Table 21

COLOMBIA: IMPORTS OF PRIMARY METALLURGICAL PRODUCTS IN 1953,  
AVERAGE PRICES, EFFECTS OF TARIFF PROTECTION, AND VALUE ADDED

Group	Item a/	Description	Tons	Value dol lars thou sands	Aver age price dol lars	Effect (%) b/	Value added (%)
B-5-a	723	Steel cables and ropes	1,700	1,073	630	12.8	75
B-5-b	725	Wire mesh (cloth)	77	48	624	12.8	75
B-5-b	725-b1	Metallic mesh below 3 mm.	126	87	690	11.9	75
B-5-b	725-b2	Other wire mesh	498	161	323	44.9	52
B-6-a	721	Iron tuns and drums	45	36	800	20.6	76
B-6-a	722	Unwelded steel containers	436	277	636	12.1	75
B-6-b	754-b1	Crown stoppers	1,961	1,106	563	51.3	-
B-6-b	754-ba	Tinplate containers and to 5 other tinplate products	2,027	1,772	870	26 to 51	71
B-6-c	727-a	Tacks, nails, staples (wire)	561	245	438	17.6	61
B-6-c	727-b	Nails for blacksmith	337	167	497	17.0	66
B-6-c	727-c	Forged or stamped nails	361	112	310	25.8	47
B-6-c	727-d	Nails for decoration or ornament	18	24	1,315	18.9	86
B-6-c	727-e	Other nails	844	277	328	31.4	40
B-6-c	728	Rivets	352	182	517	20.8	67
B-6-c	729-a	Wood screws	163	102	628	19.4	74
B-6-c	729-b	Coach (deck) screws	19	7	370	24.2	54
B-6-c	729-c	Screws, bolts and nuts for metal	<u>1,555</u>	<u>981</u>	<u>633</u>	<u>20.6</u>	<u>73</u>
		Totals and averages	11,080	6,657	600		71

Source: Foreign Trade Yearbooks, Dirección General de Estadística, and an unpublished study prepared for ECLA by the Dirección General de Aduanas.

a/ Customs classification

b/ Sum of the specific tax, ad valorem tax and other duties collected by the customs, expressed as a percentage of the average 1953 price.

/Import substitution

Import substitution

Apart from the scanty local output, the Colombian market consumes large imports of these products. Table 21 shows, for some of the products included in this group, imports in 1953, average prices, effect on prices of existing tariff protection and an approximate estimate of value added.

On the basis of experience in Brazil, where the present level of industrial development might be considered as a first objective to be attained in Colombia, the immediate establishment of the industries needed to ensure complete import substitution for crown stoppers and approximately 80 per cent of imports of containers and other tinplate products is considered feasible. This would reduce imports of finished articles in this group (according to 1953 data) by about 3,500 tons with a value of 2.3 million dollars. The study of this possibility will enable potential consumption of rolled products on the Colombian market to be appreciated. This is of interest in relation to Paz de Río's expansion plans,

Table 22 provides an estimate of the immediate prospects for replacing imports of products for which the raw materials - wire or bars - are already on Paz de Río's current manufacturing programme.

According to Brazilian experience, total import substitution of certain items would require approximately the following productive resources: 1.45 million dollars of capital <sup>15/</sup>, 9 to 15 technicians, <sup>16/</sup> from 40 to 45 mechanical workers with all-round training and high qualifications for work in machinery repair and maintenance shops, - apart from ...skilled workers - and a minimum installed potential of 690 kWh. Annual consumption of raw materials, allowing for sufficient reserves to cover losses and waste in the manufacturing process, would be 4.6 to 4.9 thousand tons of bars and wire.

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<sup>15/</sup> The average capital-product ratio for the group is 1.5.

<sup>16/</sup> The exact number depends on the number of factories into which total output is distributed.



Table 22

COLOMBIA: PROSPECTS FOR IMMEDIATE IMPORT SUBSTITUTION OF PRODUCTS  
FOR WHICH RAW MATERIALS ARE MADE BY PAZ DE RIO

Group	Item - Description	Tons	Value	% of value added	Value added, thousands of dollars
B-6-c	727-a 90 per cent of nails tacks and wire staples	500	220	61	134
B-6-c	727-c 90 per cent of forged nails	303	160	47	75
B-6-c	727-e 90 per cent of "other nails"	760	250	40	100
B-6-c	728 80 per cent of rivets	280	145	67	97
B-6-c	729-a 80 per cent of wood screws	130	81	74	60
B-6-c	729-c 70 per cent of screws, bolts and nuts for metal	1,050	630	73	495
	Total	4,023	1,536		961

Source: Foreign Yearbook of Colombia, Dirección General de Estadística and an unpublished study prepared for ECLA by the Dirección General de Aduanas.

These relatively modest figures raise the question as to why such industries have not been installed previously. There may have been several reasons. The very recent growth of consumption of these products, brought about by the expansion of other mechanical and metallurgical activities in the last few years, may have created this situation almost unexpectedly. And it is also possible that tariff protection does not offer sufficient incentives, either because of the generally low level of the tariff rates applied (see Table 21) or because of exemption enjoyed by several government bodies consuming those products.

b) Secondary metallurgical industry (C-14a, C-14b, C-15a to C-16, C-17a to C-18). This branch activity in Colombia includes some heavy products such as metallic structures <sup>17/</sup> and all the light products, such

<sup>17/</sup> Tanks, reservoirs etc. are also considered in sector C-15a because in Colombia these are made in the same shops as metallic structures.  
/as metal

Imports of padlocks, locks and similar items amounted to 933 tons, with a value of 1.49 million dollars. Customs protection, which ranges from approximately 22 to 35 per cent ad valorem, is possibly not high enough, as the manufacture of padlocks and locks requires a somewhat complex technique, although it is fairly common in several Latin American countries, such as Argentina, Brazil and Chile. Added to this is the frequent consumer preference for the foreign trade-mark; this helps to explain the absence of domestic manufacture.

Output of farm implements is also very low. There is in Colombia a completely installed factory for making machetes; nevertheless it has not started to produce because existing tariff protection is insufficient (9.7 per cent ad valorem, according to 1953 prices). There is also a small factory making other farm implements, which operates on a small scale. (See table 25).

Table 25

COLOMBIA: IMPORTS OF FARM IMPLEMENTS AND THEIR AVERAGE PRICES, CUSTOMS DUTIES AND VALUE ADDED IN 1953

Group	Customs item	Description	Volume (tons)	Value (thousands of dollars)	Average price (dollars)	Customs duties %	Value added %
C-15-c	741	Spades	348	218	620	10.9	68
C-15-c	741	Hoes	160	110	690	10.8	71
C-15-c	741	Picks and tips	267	128	480	11.5	67
C-15-c	741	Machetes and similar items	358	937	2,620	9.7	79
C-15-c	742	Axes and hatchets	141	118	797	11.4	75
Total			1,274	1,511	1,190	—	75

Source: Foreign Yearbook of Colombia, Dirección General de Estadística and an unpublished study prepared for ECLA by the Dirección General de Aduanas.

/Imports of

Imports of machetes totalled 358 tons, of flat products (spades and hoes) 508 tons, and those of products made with high-carbon steel bars (picks, points and hatchets), 408 tons. Customs duties on the last two types of products are low, from 10 to 11 per cent, because of the general policy of fostering agriculture by low-priced supplies of the products it uses.

No machetes are made in Brazil, but other types of farm implements are made there, in large factories with a minimum capacity of 1,000 tons a year.

These factories are usually associated with steelmaking activities, as a means of ensuring an adequate supply of raw materials. Manufacture in Colombia cannot be undertaken on a comparable scale, because the market is too small. And since none of the three types of implements would use materials made by Paz de Río, there is no justification for first-priority manufacture of such items in Colombia.

Neither are steam boilers made in Colombia. Total imports in this sector in 1953 amounted to 1,568 tons. Of this total, 268 tons corresponded to boilers for central heating and standard types of tubular boilers, which in Brazil are made in small factories. The remaining 1,300 tons of imports correspond to products requiring a more complex technique, manufacture of which began only recently in Brazil; import substitution is not yet complete in that country. Table 26 shows Colombia's imports, average prices etc. of products in this group, in 1953.

The greatest obstacle to the introduction of this industry into Colombia appears to be the low customs tariff, which is 15.3 per cent ad valorem for central heating boilers and 6.8 per cent for tubular boilers. Nevertheless, the domestic manufacture of part of the 1953 supply deficit, might well be feasible, using a technique similar to that employed in Brazil.

Table 27

COLOMBIA: IMPORTS OF METALLIC STRUCTURES AND SIMILAR ITEMS,  
AVERAGE PRICES, CUSTOMS DUTIES AND PROPORTION OF VALUE  
ADDED IN 1953

Group	Customs item	Description	Volume (tons)	Value (thousands of dollars)	Average price (dollars)	Customs duties (%)	Value added (%)
C-14-a	719	Doors, windows, curtains	63	31	500	127.0	68
C-14-a	719-b	Structures for buildings	1,510	772	512	16.9	69
C-14-a	719-c	Other structures	9,324	3,375	363	18.6	55
B-6-a	720	Tanks, buckets and containers	5,328	2,357	443	22.0	86
		Total	16,225	6,535	402	—	60

Source: Foreign Yearbook of Colombia, Dirección General de Estadística and an unpublished study prepared for ECLA by the Dirección General de Aduanas.

It should thus be possible to expand present production in such a way as to cover total imports, always provided that no special models or sizes are involved, this could be done without undertaking any new investments but simply on the basis of a disproportionate increase in the labour supply. As imports consist mainly of heavy mass-produced pieces, their manufacture within the country would represent a valuable means of increasing labour productivity.

Some characteristics of the industry

	<u>Colombia</u>	<u>United States</u>
Value added as a percentage of production value	53	52
Labour expenditure as a percentage of value added	59	56
Value added per man-year (dollars)	2,360	5,500
Average annual wage (dollars)	1,391	3,120
Production per man-year (tons)	8,700	—
		<u>/The industry's</u>

The industry's problems. Labour participation in value added is higher in Colombia (59 per cent) than in the United States (56 per cent), this indicates that the margin available for covering the remaining production factors, after paying labour, is probably lower than in other sectors of the mechanical and metallurgical industry, where comparison with the United States usually leads to an opposite result. There may be two reasons for this: low customs protection and the modest use of mechanical means in the production process. In 1953, customs duty (adding together specific and ad valorem duties) on import prices for finished structures was, on an average, only 16.8 per cent, whereas it amounted to 127 per cent for doors, windows and metal shutters. Hence there is constant pressure on selling prices and therefore a lower value added as a percentage of production value. The low utilization of machinery per unit of product might have the same effect, as it would result in a relatively low remuneration of factors other than labour, and in particular for capital.

In Colombia the market available to the industrial establishments in this sector is irregular, because orders are sporadic. Moreover, in 1953 it even tended to fall off as a result of imports made by public and semi-public enterprises, which enjoy customs exemption. This is the only explanation for the fact that imports can be made of finished doors and windows, which have to pay a customs duty of 127 per cent ad valorem.

For some activities included in this sector, particularly doors and windows, the manufacturing series is small because the products are not standardized. In civil building, each architect currently proceeds to prepare special designs for these elements for each job, and gives them to a metallurgical establishment for execution. Nevertheless, there are ample possibilities for standardizing the designs of these building elements; it only requires collaboration between manufacturers and consumers. One of the largest establishments of its kind in Colombia is already taking steps in this direction; it will probably reap the fruits thereof within a short period, in the form of greater productivity brought about by larger production series, and by the more economic manufacture of the intermediate products.

Until Paz de Río began its activities, these factories worked exclusively on the basis of imported raw materials. They usually kept stocks of the more common rolled products sufficient for 6 months' production. This meant a heavy surcharge on costs through the tying-up of capital. In future, part of the raw materials used will be supplied by an iron and steel centre, but the small range of products to be made there at first will mean that all the heavier plate and sections will continue to be imported; it will therefore still be largely necessary to keep considerable stocks, with the consequent surcharge on costs.

The proportion of technical staff (engineers, designers etc.) within the total labour force is low, and in several shops is limited to the proprietor himself. It is probable that this state of affairs is largely the result of the uncertainty prevailing on the market and the small margin of utilization of available capacity. This means that most factories are financially unable to employ highly qualified staff.

On the other hand, because of the special features of this type of manufacture there is a high proportion - 35 per cent - of skilled labour within the total labour force. Colombian workers quite easily acquire the special knowledge needed for these activities and only drop-forgers require more lengthy training.

The building of Paz de Río greatly facilitated the supply of skilled labour for other industries. That steel mill, when it began its activities, organized among its own installations a school for the rapid training of nearly 1,000 workers. Most of these had previously been engaged in subsistence farming in that area. Three years later, when the steel mill had been erected part of this personnel was used by private enterprises in the transforming industry which, if left to their own devices, would have had some difficulty in training the skilled labour they required. This is an outstanding example of the way in which increased productivity in one activity often depends to a very great degree on what takes place in other activities.

ii) Metallic furniture (C 15c) Products made. This sector in Colombia includes office and household furniture, of both the type using steel plate only and that using steel tubes and wood. Furniture for  
/sanitary use

sanitary use and safes were not yet being made on any considerable scale in the year to which this study refers.

Market and supply. Colombian production of metal furniture amounted to 4,700 tons in 1953, with a value of 5.1 million dollars, that is, an average price of 1,085 dollars per ton. In the same year, imports were 2,352 tons, with a value of 2.9 million dollars, or an average price of 1,220 dollars per ton. The price of imports is higher in relation to domestic production because of the special characteristics of imported metal furniture; such as sanitary fittings. (See Table 28).

Table 28

COLOMBIA: IMPORTS OF METAL FURNITURE AND SIMILAR PRODUCTS, AVERAGE PRICES, CUSTOMS DUTIES AND VALUE ADDED, IN 1953

Group	Customs item	Description	Volume tons	Value (thousands of dollars)	Average price (dollars)	Customs duties %	Value added %
C-15-b	738	Safes	454	418	923	17.3	73
C-17-b	739	Metal furniture for household use	41	68	1,660	117.1	85
C-17-b	739	Metal furniture for office use	35	40	1,150	128.0	83
C-17-b	739	Other metal furniture	175	260	1,490	39.9	84
C-17-d	740-c	Tinned and galvanized cookers	97	97	1,000	51.1	80
C-17-d	740-d	Enamelled cookers	314	339	1,070	78.6	82
C-17-d	735-b	Steel stoves, heaters.	1,236	1,641	1,343	43.1	85
Total			2,352	2,863	1,220	-	84

Source: Foreign Trade Yearbook of Colombia, Dirección General de Estadística and an unpublished study prepared for ECLA by the Dirección General de Aduanas.

As might be expected, imports are higher of those products where customs protection is lower, such as safes, enamelled cookers and steel stoves and heaters.

Some characteristics of the industry

	Colombia	United States
Value added as a percentage of production value	54	-
Labour expenditure as a percentage of value added	49	59
Value added per man-year (dollars)	1,750	5,370
Average annual wage (dollars)	925	1,750
Production per man-year (tons)	3	-

/The industry's



The industry's problems. The overwhelming predominance of manufacture to order makes it impossible - even to a small degree - to standardize the production of furniture and other products in this branch; very small series are run off and this is probably the most serious problem in the sector. Nevertheless, efforts to remedy this situation are proceeding in a number of factories, and much progress was made in 1954.

Except for a small number of establishments, this sector has rather a low proportion of machinery, and much of it is antiquated. The fact is that the industry in Colombia is relatively new, and in sharp contrast to most of the country's other mechanical and metallurgical activities which usually have a large proportion of modern machinery.

Raw materials used in this branch are imported, except for wood and cotton. Flat steel products which, together with other ferrous raw materials, constitute almost 80 per cent of the average weight of metal furniture, are all imported, as the Belencito steel mill does not make them. This heavy dependence on imports will continue for several years yet, as the expanded programme of Colombia's steel mill does not include production of steel plate.

The manufacture of metal furniture and similar items is rather simple, and except for staff engaged in making moulds, the workers required are of the semi-skilled type. Moreover, this type of labour is usually quite easily trained in the factories themselves.

The proportion of technical staff in relation to total labour is small, and mainly consists of a high number of master craftsmen. These are required because of the nature of the work itself and the very small series run off. Engineers and technicians are very few and are employed principally in preparing designs. Hardly any trained staff are engaged in organizing production, which is unplanned, no account being taken of costs and the normal time needed to make each piece.

c) Heavy mechanical industry (D)

After ferrous raw materials, the products of the heavy mechanical industry account for a larger amount of imports within all articles made from iron and steel. Table 29 shows the volume of imports in 1952 and 1953 together with average prices for the second year.

purchased equipment, the manufacture of which would be beyond the present possibilities of Colombia's mechanical industry, has been omitted.

Above all, it is particularly noteworthy that tariff protection is practically non-existent, most of the import duties ranging from 3 to 6.8 per cent. The only exceptions are threshers for coffee and other grains, and coffee graders, where duty is nearly 25 per cent; forrage crushers and small mills, nearly 30 per cent; crushers and wood-working machines nearly 15 per cent.

In spite of the low Customs duties, those mechanical industries covered by the study of this sector are engaged precisely in making all the above products.

Excluding from table 29 the imports of road transport vehicles, it may be observed that of the remaining imports, which are included in table 30, approximately 21 per cent by weight and 23 per cent by value could be replaced by domestic production.

The last part of this chapter includes an estimate of the production factors needed to replace this amount of imports; it is evident that such productive requirements could not over a short period be covered within the country. Moreover, not even Brazil has reached the degree of technical progress needed to attain total import substitution in this sector. In these conditions, it would appear advisable to make another list of those products currently imported and which, because of their less complex manufacturing technique, could be made in the country in the near future. This has been done in table 31; here the more complex products were excluded from each group's total in the preceding table as well as imports on too small a scale to justify domestic substitution. In the final part of this chapter, an estimate is also given of the productive resources needed to attain this more conservative goal of import substitution.

Table 30

COLOMBIA: IMPORTS, AVERAGE PRICES, CUSTOMS DUTIES, PERCENTAGE  
REPRESENTED BY VALUE ADDED AND VALUE OF IMPORTS IN 1953

Group	Customs items	Product	Tons	Value (thous ands of dol-lars)	Average price dol-lars	Customs duties	Value added thous ands of dol-lars
C 6c	827a	Pumps for petrol and liquids	84	236	2,800	9.3	86
C 6c	827b	Centrif. & other petrol. pumps	502	1,195	2,400	6.2	83
C 6c	827c	Piston & centrifugal pumps	855	1,289	1,530	6.3	69
C 6c	827d	Hand-operated pumps	158	233	1,490	6.3	67
C 6c	828	Electric fans	113	296	2,620	6.3	84
C 7c	830	Mangles of all kinds	61	100	1,640	6.5	82
C 7c	831	Hydro extractors of all kinds	79	262	3,300	3.0	82
C 7c	832	Hydraulic presses	286	425	1,470	6.5	73
C 7c	832	Hand presses	2	3	1,500	6.7	80
C 7c	832	Other presses	79	135	1,710	6.5	82
C 8b	834a	Manure spreaders	15	14	935	3.0	64
C 8b	834a	Sowing and planting machines	153	126	885	3.0	78
C 8b	834b	Animal-drawn ploughs	177	104	590	3.0	66
C 8b	834b	Cultivators, harrows, etc.	788	580	735	3.0	73
C 8c	835b-2	Coffee threshers	5	8	1,600	25.4	82
C 8c	835b-1	Cottons gins	83	151	1,820	3.0	83
C 8c	835b-2	threshers and de-husking apparatus for other grains	188	241	1,270	26.1	78
C 8c	835c-1	Coffee graders	29	69	2,380	24.7	83
C 8c	835c-2	Other graders	65	116	1,880	3.0	78
C 8c	836b-1	Crushers	80	55	690	18.8	58
C 8c	836b-2	Forrage choppers and cutters	139	80	576	29.9	64
C 8c	836b-3	Grain mills up to 100 kg.	12	13	1,090	30.5	72
C 8c	837	Machinery and apparatus for milling	687	1,025	1,490	6.5	73
C 7a	840	Ore crushers	539	681	1,260	6.6	75
C 7d	840	Concrete mixers non-self-driving	429	708	1,650	6.5	76
C 7d	840	Moulding machines	262	321	1,230	6.6	75
C 7d	840	Other machines for treating hard materials	246	248	1,008	6.8	70
C 7c	841	Tanning machines	314	564	1,800	6.4	78
C 7c	843	Machines for graphic arts	812	1,938	2,390	6.3	75
C 7c	845a	Shuttle looms	816	926	1,150	6.7	74
C 7c	848b-1	Planes and similar items for wood-working	36	56	1,560	14.3	74
C 7c	848b-2	Other wood-working machinery	238	358	1,500	6.5	74
C 7c	848b-3	Metal-working machines	1,173	2,267	1,940	6.4	74
C 6b	855a	Cast-iron bobbins, valves and nozzles	1,007	1,712	1,700	12.0	83
C 6a	857b	Camshafts	105	239	2,280	6.3	78
C 6a	857c	Steering wheels	9	24	2,670	6.3	89
C 6a	857d	Iron or steel pulleys	131	140	1,070	6.8	72
C 6a	857d	Clutches and couplings	78	70	900	6.9	66
C 10a	859a	Electric motors and generators	6,084	6,575	1,070	3.0	63
C 10a	859b-1	Transformers	1,502	2,427	1,620	3.0	75
C 11c	886a	Railways wagons and flat cars	1,161	553	478	3.0	69
C 11c	886b	Small trucks	302	119	496	3.0	70
C 11c	887d	Parts for wagons	392	640	1,640	3.0	63
C 13b	898c-1	Hand-carts	634	247	388	3.0	58
C 13b	898c-1	Parts for hand-carts	29	36	1,240	3.0	84
		Grand total	20,939	27,635	1,320		

Source: Anuario de Comercio Exterior de Colombia, Dirección General de Estadística and an unpublished work prepared for ECLA by the Dirección General de Aduanas.

Table 31

COLOMBIA: IMPORTS OF HEAVY MECHANICAL PRODUCTS THAT COULD  
PROBABLY BE REPLACED OVER A REASONABLE PERIOD

Group	Customs Item	Per- cen- tage	Description	Tons	Value (thou- sands of do- llars)	Value added (thou- sands of do- llars)	Value added (thou- sands of do- llars)
C-6-c	827-c	70	Piston and centrifugal pumps	598	902	69	622
C-6-c	827-d	100	Hand-operated pumps	158	233	67	256
C-6-c	828	50	Fans	57	148	84	124
C-7-c	832	60	Hydraulic presses	172	255	73	186
C-8-b	834-a	80	Manure spreaders	12	11	64	7
C-8-b	834-a	80	Sowing and planting machines	122	102	78	79
C-8-b	834-b	100	Animal-drawn ploughs	177	104	66	169
C-8-b	834-b	50	Cultivators, harrows, etc.	394	290	73	212
C-8-c	835-b-2	100	Coffee threshers	5	8	82	7
C-8-c	836-b-1	50	Crushers	40	28	58	16
C-8-c	836-b-2	100	Forage choppers	139	80	64	51
C-7-a	840	50	Ore crushers	269	340	75	255
C-7-d	840	80	Concrete mixers	343	566	76	430
C-7-d	840	50	Moulding machines	131	160	75	120
C-7-d	840	50	Other machines for treating hard materials	123	124	70	87
C-7-c	843	40	Machines for graphic arts	125	775	75	611
C-7-c	848-b-2	40	Other wood working machines	95	143	74	106
C-7-c	848-b-3	30	Metal-working machines	352	680	74	503
C-6-b	855-a	70	Iron bobbins and valves	821	1,198	83	996
C-10-a	859-a	40	Electric motors and generators	2,433	2,630	63	1,556
C-10-a	859-b-1	60	Electric transformers	900	1,456	75	1,092
C-11-c	886-a	80	Railway wagons	929	442	69	305
C-11-c	886-b	100	Small trucks	302	149	70	104
C-11-c	887	50	Parts for wagons	196	320	63	202
C-13-b	889-c-1	100	Hand-carts	634	247	58	142
C-13-b	889-c-1	100	Parts for hand-carts	29	36	84	30
Total				9,556	11,427	67	8,068

Source: Foreign Trade Yearbook of Colombia, Dirección General de Estadística and a report prepared especially for ECLA by the Dirección General de Aduanas.

/Some characteristics

Some characteristics of the industry

	<u>Colombia</u>	<u>United States</u>
Value added as a percentage of production value	55	53
Labour expenditure as a percentage of value added	49	59
Value added per man-year (dollars)	1,505	5,100
Average annual wage (dollars)	741	3,000
Volume of production per man-year (tons)	6.3	-

The industry's problems. Most of the establishments in this field have to contend with poor market. During the visits made by ECLA's team of experts to the 18 principal establishments engaged in these activities, it was found that with two exceptions, none of them utilized all their capacity. It was also observed that most of these enterprises were not obtaining satisfactory economic results. This situation may be the result, firstly, of too many factories making products of very similar design, and secondly of competition from similar imported products, often having a lower weight for a given yield; these, as already noted, enter the country upon payment of low duties. But the enterprises continue to operate because their principal activity is repair work; actually machinery manufacture in these shops is only a means for increasing the degree of utilization of their installations and to stabilize the working rhythm.

Most of the medium and small size establishments are run by the proprietors, who started work in this field on the basis of their mechanical experience and ability. Few shops enjoy the co-operation of technicians and engineers, hence the steady reproduction of antiquated models. But there are also some progressive establishments; there is the exceptional case of coffee pulping machines which are made in the industrialized countries for export to those countries producing coffee with a bulky grain, and which are reproductions of a model designed especially for Colombian coffee by a factory in the city of Medellin.

/The establishments

The establishments in this branch work principally with standard imported raw materials, such as cast iron and mild carbon steels. There are no supply difficulties, except the need to accumulate abnormally high stocks - which is quite common in Latin America - and this in turn increases costs. This situation may quite possibly become more serious in future, as the industry develops and produces on the basis of designs requiring the use of special steels, of which there are generally few stocks on the market.

A high proportion of skilled workers is needed for this activity in view of the multiplicity of work that has to be executed in a repair shop and the small length of the production series. This explains why the country's shortage of skilled personnel is becoming more serious. The number of workers trained each year by the technical schools is very small and is not conducive to a short-term solution of this problem. The rapid growth of metallurgical activities in recent years and the incipient mechanization of farming are constantly attracting skilled workers; this particular branch is unable to retain them, because the precarious market situation with which it has to contend prevents it from paying good wages. Hence there is a continuous staff turn-over, to the serious detriment of the industry's level of efficiency. During the visits made by the ECLA team, data were obtained showing that the staff in enterprises of this kind is, on an average, renewed entirely every three years. As a result, these establishments have involuntarily become schools for mechanics to service the country's other activities, in spite of the serious difficulties which they themselves encounter because of insufficiently trained labour.

There is an almost complete lack of any systematic observance of the principles of rational working organization and of the auxiliary administrative elements conducive to higher productivity, such as cost accounting. The reason for this lies apparently in the background of most proprietors, the shortage of trained staff for planning production and the heterogeneous nature of production, which at best consists of small series interrupted to permit repair work.

This situation makes it impossible to calculate delivery periods or to fulfil them with any degree of accuracy, and this in turn sharply restricts the market. In these conditions, the textile mills, breweries etc. of a

/certain size

certain size prefer to organize their own repair shops. These shops usually have much better and more efficient machinery than the repair shops working for the public; but the sporadic nature of the repairs that they undertake causes the equipment to be very poorly utilized.

d) Light mechanical industry (E)

This industry covers the manufacture of such products as typewriters, accounting machines, cash registers, sewing machines, scales, all kinds of electrical apparatus for household use, refrigerators, etc. In Colombia, however, the only industrial activity in this field is the production of small hand-operated mills for cereals; of these one single enterprise makes one thousand units a day in addition to heavy machinery for processing agricultural products. In Brazil, by contrast, almost all such articles are made in the country, except for typewriters, calculating machines and precision scales.

Import substitution. There are considerable possibilities for import substitution in this branch. Table 32 shows imports in 1953 of those groups of products whose manufacture appears more feasible, together with the respective average prices, customs duties and estimate of value added by the industry. These imports totalled 6,150 tons, with a value of 12 million dollars.

The initiation of industrial activities in this branch, as well as in certain sectors of heavy mechanical industry whose products are made in fairly long series, has a high educational value, as was observed in Brazil. In that country, the "pioneer" efforts in these activities resulted in the introduction of certain standards of working organization which are essential for raising productivity in the iron and steel transforming industry. The low degree of technical development achieved in Colombia makes it advisable to establish a more modest level as the goal for short-term import substitution of products in this group.

Table 32

COLOMBIA: IMPORTS OF PRODUCTS OF THE LIGHT MECHANICAL INDUSTRY,  
WITH AVERAGE PRICE, CUSTOMS DUTIES AND PERCENTAGE  
OF VALUE ADDED IN 1953

Group	Customs item	Description	Tons	Value (thousands of dollars)	Average price (dollars)	Customs duty %	Value added %
E-17-C3	839	Refrigerators (iceboxes)	3,309	6,299	1,910	90.0	45 <sup>a/</sup>
E-17-g	847-a	Complete sewing machines	1,427	2,290	1,600	25.5	83
E-17-g	847-b	Sewing-machine bodies	453	1,498	3,210	6.2	85
E-17-g	847-d	Spare parts for sewing machines	470	588	1,260	6.7	76
E-15-e	850-a	Weighing machines	151	161	1,067	9.7	72
E-15-e	850-c	Balances	137	195	1,420	14.1	72
E-17-c	862-b	Electro-magnetic household appliances	247	1,150	4,670	9.3	86
Totals			6,190	12,181	1,950		

Source: Foreign Trade Yearbook of Colombia, Dirección General de Estadística and an unpublished study prepared by the Dirección General de Aduanas for ECLA

a/ It has been assumed that the mechanical unit is imported as raw material.

Table 33 was prepared with this in view.

Table 33

COLOMBIA: IMPORTS OF LIGHT MECHANICAL PRODUCTS WHICH COULD  
PROBABLY BE REPLACED WITHIN A REASONABLE PERIOD

Group	Customs item	Per-cent age	Description	Tons	Value (thousands of dollars)	Value added %	Value added (thousands of dollars)
E-17-c3	839	80	Refrigerators (iceboxes)	2,646	5,039	45 <sup>a/</sup>	2,267
E-17-g	847-a	80	Complete sewing machines	1,141	1,832	83	1,520
E-17-g	847-b	80	Sewing machine bodies	362	1,198	85	1,018
E-17-g	847-d	80	Spare parts for sewing machines	376	470	76	357
E-17-c	862-b	80	Electro-magnetic household appliances	197	920	86	791
Totals				4,722	9,459	62	5,953

Source: Table 32 -

a/ It has been assumed that imports will be in sealed units.

/Some 2,600



Some 2,600 tons of refrigerators are included in the table, as manufacture could begin with the enamelled metal, as is currently done in other Latin American countries. This could be followed some years later, by manufacture of the units, consisting of motor and compressor. Customs protection in Colombia for this line of manufacture is 90 per cent ad valorem which will probably be sufficient, since transport costs to the hinterland to be borne by domestic output do not reach this margin. As in the case of many other similar products, the large volume of finished products to transport and the high costs of internal transport will make it very difficult to concentrate the industry into a small number of factories with a large volume of production.

Table 33 also shows 1,500 tons of sewing machines and their metal parts, corresponding to almost 30 thousand units. Visits made by the ECLA team of experts in Brazil included one to a factory which was producing approximately 2,700 units per year, at a high level of productivity, despite the short time - 16 months - which had elapsed since its inauguration. This enterprise had begun operating with 8 foreign specialists and some 15 to 20 skilled Brazilian workers, employed particularly in drop-forging. The several hundred operators of specialized machines consisted of former farm workers, who were trained by the enterprise in a combination of practical and theoretical work. This observation suggests that this industry's installation in Colombia might not be accompanied by insuperable difficulties. Probably the most serious problem would be the low tariff protection, which in 1953 did not exceed 25 per cent for finished sewing machines and 6.7 per cent for parts of the machines.

This same table also shows imports of 197 tons of small electrical apparatus for household use: fans, polishers, vacuum cleaners, mixers and similar items. The manufacture of these products in Colombia would probably be feasible. The principal component consists of a small single-phase electric motor, and the base on which it is mounted. Once this manufacture begins in the country it may well prove, as was the case in Brazil and Chile, it to be the starting point for a heavy growth of domestic demand for such

7. Productivity in the mechanical and metallurgical industries

It has not been possible to draw up a comparison of the productivity of each branch of Colombia's mechanical and metallurgical industry with that of the corresponding activities in the United States. On the one hand, the sectors whose characteristics could be analysed were few; on the other, the small number of establishments forming each sector had to be reduced still further, in order to eliminate those which, despite the fact that they play an important part within the sector under review, produce in addition other types of commodity. Nevertheless, table 34, which gives some data in this connexion, shows interesting statistics which may provide a basis for appraisal.

Table 34

COLOMBIA: COMPARISON OF PRODUCTIVITY, IN PHYSICAL AND MONETARY UNITS, WITH THAT OF THE CORRESPONDING INDUSTRY IN THE UNITED STATES AND BRAZIL  
(Percentages)

	A		C	E	
	In monetary terms	In physical terms		In monetary terms	In physical terms
	Comparison of productivity in Colombia and in the United States		Relation between productivity in physical and in monetary terms	Comparison of productivity in Colombia and in Brazil	
	a/		B : A		
Metallic structures	39.5	21.2	53.4	128	..
Metallic furniture	49.0	21.7	44.2	107	119
Arithmetic average	44.2	21.5	48.8		
Heavy mechanical industry	29.5	..	..	65	..

Source: ECLA, based on data provided by the Dirección de Estadística de Colombia, by Inquerito Industrial 1953 (State of Sao Paulo) and by the U.S. Census of Manufactures, 1947, vols. I-IV.

a/ These percentages differ from those appearing in the estimate by sectors, because of the elimination of certain combined activities.

/The difference

The difference between productivity as expressed in physical and in monetary terms, in the two sectors of Colombia's industry for which complete data are available, falls within the limits already established for Brazil in a similar comparison. (See table 11.) Yet if the averages for the two countries are examined, it will be seen that the difference resulting from a comparison of the two units of expression of productivity - monetary and physical - is less in Colombia than in Brazil (48.8 as against 42.6 per cent). Despite discrepancies, on the whole these results confirm the efficacy of the method adopted, which consists in making inter-country comparisons, as a preliminary approximation, based on the productivities concerned as expressed in monetary terms, and afterwards introducing a coefficient which, apart from currency conversion rates, takes into account the price levels of products in the appropriate sectors.

In physical terms, the productivity of the above two sectors of the secondary metallurgical industry fluctuates around 21 per cent of that existing in the same activities in the United States in 1947. This shows that the achievement of an increase in average productivity is as important a problem in Colombia as in Brazil. For this reason, an analysis will later be made of some of the factors determining so low a productivity.

On the other hand, a comparison between man/year yields in Colombia and in Brazil in secondary metallurgical activities under discussion reveals that figures are higher for the former than for the latter country. As a matter of fact, the Colombian industrial establishments included in the sample are as a rule quite well organized; on an average, making allowance for size, they reach a level equivalent to the average for the Sao Paulo industry. The more favourable figures for Colombia are probably due merely to differences in the assortment of products manufactured. For example, of the Colombian activities that combine to form the metallic furniture sector, 80 per cent is represented by bedsteads, while office furniture, which employs more labour, accounts for the remaining 20 per cent.<sup>18/</sup> As far as structures are

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<sup>18/</sup> Nevertheless, if more restricted and completely homogeneous sectors are considered, there still remains a difference, because Colombian industrialists import sheet with a surface specially prepared for the manufacture of enamelled or painted furniture, whereas Brazilian industry mainly uses sheet produced in Volta Redonda for general use, and has to employ labour to smooth off the surfaces.

concerned, in Brazil the group under review includes a high percentage of doors and windows for buildings, which are light, whereas in Colombia in the year of the survey the two biggest factories had produced several bridges and other large works of considerable weight, which helped to raise the number of tons transformed per man/year.

The relatively favourable findings embodied in the statistics for the manufacture of metallic furniture and structures in Colombia corroborates what has already been observed in the chapter on Brazil: the size of plants has less effect on productivity than other factors, such as organization.

In the sectors described, where the better type of Colombian factories, whose influence on the averages recorded is relatively great, are up-to-date and seldom more than four or five years old, productivity is high as compared with the current situation in Latin America. The same is not true, however, of the heavy mechanical industry, represented, with very few exceptions, by artisan workshops, which have undertaken a few manufacturing lines in very small series, and whose average monetary productivity registers a figure equivalent to 65 per cent of the value of the same branch of industry in Sao Paulo. (See again table 34.)

A survey will now be made of some of the factors determining productivity in Colombia. As for Brazil, the following are analysed: a) the size of the market; b) existing equipment and machinery; c) labour, and d) organization and technique.

a) Size of the market. In the metallurgical industries, except where the specialized equipment required is not constructed on a small scale, the size of the market exerts its main influence on productivity through the length of the series, which, if large, facilitate a more efficient organization of the flow of work.<sup>19/</sup> This is also true of the light mechanical industries, which are as a rule confined to mass production of a few articles, and of heavy mechanical industry in the case of those activities which operate within a restricted framework, as, for instance,

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<sup>19/</sup> See table 11 for a comparison between Brazil's two screw factories, one with 9 operatives, which manufactures a few types at a high rate of productivity, and another large one which aims at producing the most comprehensive assortment possible to serve the market.

the manufacture of agricultural machinery for soil preparation, of railroad material, of spare parts for motor vehicles, etc. In mechanical industries engaged in the production of industrial machinery to order or in short series, the need to carry division of labour far enough to cover the payment of the technical experts responsible for designing the machinery introduces a new factor which precludes plants of extremely small dimensions. This is likewise the case, though for different reasons, with the manufacture of certain primary metallurgical products, where investment in equipment is considerable.

From these considerations it can be inferred that at a specific stage of its development Colombia's metal transforming industry, if it is to operate at a satisfactory rate of productivity, will have to base its production no longer on the requirements of the departmental markets but on those of the country as a whole. It has already been explained that the chief stumbling-block is constituted by the deficiencies of the internal communications system. Again, if it is borne in mind that consumption of iron and steel and their products is mainly concentrated in the industrialized areas, as is also the case in Brazil (see table 1), it becomes patent that the solution of the problem will largely depend on the improvement of the means of communication between the urban centres of some considerable size. It must also be taken into account that in the future a substantial proportion of the supply of ferrous raw materials will presumably no longer come from the ports but from Boyacá, situated almost in the middle of Colombia's most populous districts. This circumstance will provide an incentive to the improvement of existing transport routes, since it will ensure a basic traffic capable of justifying works of such a nature.

The standardization of certain products so as to reduce the assortment to be manufactured, and the raising of some customs duties to guarantee a larger domestic market for specific activities, are problems which affect the size of the market but are analysed elsewhere in the present study.

b) Machinery and equipment. The visits paid to Colombian industrial establishments revealed that those of any considerable size are well-endowed with machinery, unlike those of artisan type, which, in contrast, lack the equipment needed to carry out their work at an acceptable rate of productivity and with the degree of precision that is to be desired.

/In the

In the course of the programme of visits it was observed that as a general rule the production capacity of equipment was not efficiently utilized, except in sectors like that of the manufacture of metallic furniture and structures. The degree of utilization was much lower still in the factories belonging to certain large industrial establishments - textile factories, breweries, etc. - which were abundantly provided with highly-perfected up-to-date machinery.

This does not mean that it would be possible to instal new industries and activities without importing new machinery, but only that the existing activities, as a general rule, are not handicapped by lack of machinery and could considerably expand their current production with little or no additional equipment. If new sectors are to be added, especially the manufacture of electric motors and others pertaining to the light mechanical industry, relatively large imports of specialized high-yield machinery will be indispensable.

c) Labour force and training problems. During recent years a vigorous impetus has been given to the mechanical and more particularly the metallurgical industries in Colombia. If the censuses of 1945 and 1953 are compared, and the modifications necessary to place them on equal bases are made, it becomes evident that the number of personnel employed increased to very much the same extent as in Sao Paulo over the period 1946-53, that is, at a cumulative annual rate of 8.5 per cent.

The skilled and semi-skilled workmen have been trained: i) within the industry itself; ii) in the small artisan factories engaged in the repair and construction of machinery, especially for agricultural improvement purposes; iii) at Faz de Rio, in the case of nearly a thousand operatives who have qualified for work on metal constructions, and some of whom have gone into the private transforming industry; and iv) in the various grades of vocational schools which exist in the country, this applying to a small contingent which has received both theoretical and practical training. The part played by these schools will be analysed later.

The Colombian workman is very quick to learn. Those who have acquired their skill only within the industries themselves have not received any

/systematic training,

systematic training, and as a general rule those who have only a few years of experience lack the necessary knowledge for interpreting plans and for producing parts with such precise adjustments as are necessary in the manufacture of tools and matrixes or in the production of interchangeable parts in the mechanical industry.

An analysis of the problem of training skilled workers in Colombia, made by ECLA through one of the SENAI authorities, included an estimate of present requirements if Colombian industries are to be enlarged by some 900 workers yearly, in all branches of occupation. In 1953, 41 educational institutions for the training of workmen and technicians, ranging from the elementary to the higher grades, and with different designations according to the number of years covered by the course, were functioning in Colombia.<sup>20/</sup> The total number of pupils in these establishments amounted to 4,880, with an annual enrolment varying from 800 to 1,000, while about 400 left each year after completing their studies (416 in 1953). Of this total, in turn, not more than 75 per cent actually entered industry.

Of the 300 skilled workmen, foremen and technicians thus supplied to industry, those whose qualifications have no application in the mechanical and metallurgical industries must be discounted, leaving a yearly availability of less than 200 operatives - mechanics, foundry-workers, blacksmiths and electricians. A distinguished Colombian expert concludes a study of the curricula and type of instruction provided with the statement that, of the 32 national, departmental and municipal establishments, only two possess workshops adequately endowed with machinery, in which the pupils can gain practical experience and form the habit of working with precision and at a satisfactory rate of productivity, while the equipment of the remainder is made up of simplified machinery which does not allow the work to yield adequate results. On the other hand, the private schools, as they are generally short of funds - the costs of instruction are estimated at some 900 pesos per year per pupil<sup>21/</sup> -, devote too much attention to the need

<sup>20/</sup> Of these schools, 28 are national, 3 departmental, 1 municipal and 8 private.

<sup>21/</sup> In the year 1954.

office, the timely supply of raw materials, the use of the most suitable tools and auxiliary elements and the precision with which instructions are given as to the way in which the work is to be carried out.

The task of setting up and running this kind of organization is not the same in establishments which come into being as industrial entities of some considerable size, as in those enterprises which grow out of artisan workshops. With respect to the latter, one of the chief problems relates to the ability of entrepreneurs to grasp the advantages of improved organization and their willingness to delegate part of their authority to employees responsible for the various branches of activity.

In Colombia, as in Brazil, one of the stumbling-blocks is the almost total lack of engineers and technicians specializing in industrial organization. Brazil, however, enjoys the advantage of possessing industries which for several years have been producing in long series, like the electric motor industry and all branches of the light mechanical industry, where the nature of the work itself, as well as internal competition, have driven most entrepreneurs to improve internal organization so as to increase productivity and reduce costs.

In Colombia such industries did not yet exist in 1953; it is therefore natural that the universities have taken no interest in the training of professional experts of this type. If these large establishments were installed in the near future, they would, in combination with some of the better secondary metallurgical enterprises, constitute a field of activity for specialists in organization, and it would then be probable that the technical schools would find no difficulty in solving that part of the problem which falls to their share.

ii) Market factors which influence productivity. These are mainly concerned with the length of the production series, permitting better internal organization. Among them mention may be made on the one hand of the suitable choice of product and its adaptation to market requirements and raw materials, and on the other, of standardization so as to reduce the assortment of similar products manufactured.

In connexion with the first point, industrialists are faced with more difficult problems in Colombia than in Brazil because there demand is less.



On the other hand, the problem is much less serious in Colombia where the adaptation of the product to available raw materials is concerned; since these have been imported in their entirety, no import restrictions having been imposed. The only drawback of this situation has been the need to maintain stocks for a number of months, with the consequent increase in costs, though designs have not had to be continually adjusted to changes in the raw materials market, as has usually been the case in Brazil.

With respect to the standardization of products, the situation in Colombia is the same as in Brazil. What actually happens is that industry has to attempt to replace former imports and supply a market accustomed to receive a wide assortment of models, according to the country of origin of the goods that used to be imported. Both in metallic structures and in metallic furniture, which are the most widespread branches, a tendency towards the specialization of products appears to be making itself felt. A factory for doors and windows in the Valle del Cauca, and another for domestic furniture in Bogota, are confining their respective production to specific designs made up of parts which can be combined with one another. Nevertheless, there is no general movement in this direction, despite the fact that those industrialists who were interviewed recognized the advantages it would afford them for the improvement of productivity.

Almost all the mechanical plants manufacturing agricultural machinery are engaged in reproducing old models, on the one hand because of the shortage of engineers specializing in designs of this type, and, on the other, because the size of most of these establishments is too small to allow them to defray the cost of such services, even if they were able to find any one who could render them.

#### 8. Resources required to replace certain imports

Reference has been made in the course of this study of Colombia's mechanical and metallurgical industries to the volume of import replacements estimated as possible, in view of the present state of technique in the country. The situation in Brazil was taken as a point of reference in order to set up a criterion for the technical standards currently existing or easily attainable. The actual state of affairs is that industry is in

/general much

general much more fully developed in Brazil than in Colombia, although there are some branches in which no difference exists. Those imports have been regarded as susceptible of replacement in which the technical level is the same in both countries, as well as others where, although the level is lower in Colombia, there would be no difficulty in raising it by means of specific imports, either of equipment or of human material provided with the relevant technical knowledge. The volume of replaceable imports, estimated on the basis of 1953 figures, and the resources essential for the achievement of such replacement, are summarized in the following section of the present study. It is clear that besides the material resources in the form of man-power, machines, technique and energy which are indispensable for the creation of the industries concerned, their installation would in many cases require the existence of an atmosphere favourable to their initiation. Among other factors, incentives, an assured supply of raw materials and a protectionist policy would be needed.

Table 35 shows the tonnages and values of the proportion of 1953 imports which are estimated as replaceable, by sectors, and likewise the capital, the installed electric capacity and the total staff of the hypothetical industries which could put such production into effect.

The establishment of the industries required to replace imports to a value of 26 million dollars figuring in the table would call for a labour force almost equal to that at present existing in Colombia, which leads to the conclusion that none of these additional branches of manufacture will be totally covered by existing industry, even if a marked improvement in productivity takes place. But a better utilization of current resources, and the marginal expansion of certain activities, would enable some of the imports appearing in the table to be replaced, without the need for additional resources, provided only that sufficient incentives were supplied for launching out in the new directions suggested.

With this saving clause, a brief analysis will be made of the aggregate volumes of the resources required and of their availability within the country, on the understanding that the figures given correspond to a possible maximum.

Table 35

COLOMBIA: IMPORTS OF MECHANICAL AND METALLURGICAL PRODUCTS  
WHICH COULD BE REPLACED BY DOMESTIC INDUSTRY AND RESOURCES  
REQUIRED FOR THEIR MANUFACTURE<sup>a/</sup>

(Tons, thousands of dollars, percentages, kilovolt-amperes  
and number of persons)

Types of product	Imports		Percent- age of value added	Total capital (thousands of dollars)	Installed KVA	Total labour force
	Tons	Values (thousands of dollars)				
Bolts and screws	4,023	1,534	60	1,660	610	436
Tooled products	411	452	79	640	82	146
Padlocks, locks and decorative products	933	1,487	87	2,070	240	420
Steam boilers	268	382	81	640	194	230
Metallic structures <sup>b/</sup>	16,225	6,535	60	6,230	1,031	2,470
Metallic furniture	2,352	2,863	84	2,950	1,020	910
Heavy mechanical industry	9,556	11,427	67	1,760	4,470	3,200
Light mechanical industry	4,722	9,456	62	22,200	1,600	2,370
<u>Total</u>	38,490	26,038		38,150	9,247	10,181

Source: ECLA, on the basis of data in the Anuario de Comercio Exterior.

a/ Prices of products and the percentage of value added correspond to the conditions prevailing for Colombian imports in 1953; the characteristics of the industries, to average conditions in similar industries in Brazil.

b/ This corresponds to a lighter assortment than the average manufactured in Colombia.

/The capital

The capital required for the industries comprises the value of the ground, building, machinery, machines, general installations and operating capital, calculated on the basis of stocks of raw materials for six months and of finished products or goods in process of manufacture for three months. Part of such investment will be in foreign and part in national currency. On the assumption that the raw materials will be imported in their entirety, which is an exaggeration, as it leaves out of account those supplied by Paz de Rio, and given the high percentage represented by value added in such products, it may be estimated that the value of the stocks of raw materials imported for six months will certainly be lower than that of the imports which trade actually maintains. Thus when manufacturing begins there will already be a net saving on this count. It seems justifiable that of the investment of 38 million dollars which it is estimated will have to be made in the industry as a whole, from 25 to 35 per cent will be earmarked for machinery. A reasonable average would probably be 30 per cent, and on this basis, investment in machinery would stand at about 11 million dollars. This investment would produce an annual saving of 26.7 million dollars.<sup>22/</sup>

The total electric energy which this industry will require, if it should not prove possible to improve the utilization of some of the existing installations, will amount to 9.2 thousand kilovolt-amperes, with a 50 per cent utilization during 2,400 hours of work annually. Given the present state of the country's availabilities of energy, this additional demand will doubtless give rise to problems with respect to the localization of the new industries, as among the most fully industrialized departments only Antioquia (capital: Medellin) and Santander (capital: Bucaramanga) were adequately supplied with energy in 1953-54. In Cundinamarca (capital: Bogota), the situation was restricted, but not actually difficult. On the other hand, it was extremely bad both in Atlántico (capital: Barranquilla) and in El Valle (capital: Cali), although projects for expansion were under way in both districts.

Owing to the marked increase in consumption, it is quite possible that the projects under construction may not suffice to ensure the smooth

<sup>22/</sup> On the assumption that the average value added, which has not been accurately estimated, will be equivalent to 70 per cent of the import price.

functioning of new industries which will be large consumers. In this case a situation would arise similar to that existing in the State of Sao Paulo, in Brazil, where industry has frequently had to resort to installing its own generators, which absorb at least a considerable proportion of the demand. Such a policy, apart from implying the need for additional investment in equipment over and above that envisaged in table 35, has the drawback of producing energy at a cost a good deal higher than that of the energy purchased from public utility enterprises. Even in these conditions, a complicated system of rationing exists in Sao Paulo, with one limit for the maximum peak demand, another for the total energy that may be consumed within a month and, finally, another relating to schedules and compelling the establishments concerned to begin their working day at different times. In Colombia such a policy would involve industrialists in the difficulty of having to establish working-hours at times when it is legally obligatory to grant the staff extra pay, a situation which does not exist in Brazil.

The labour force required, which in table 35 seems to amount to about 10 thousand persons, has been broken down by skills in table 36.

/Table 36

Table 36

COLOMBIA: CLASSIFICATION OF STAFF REQUIRED TO ESTABLISH  
INDUSTRIES FOR IMPORT SUBSTITUTION. a/

(Number of persons)

Branch of industry	Administra- tive staff	Engineers, technicians and fore- men	Skilled workers	Semi-skilled workers and labourers	Total
Bolts and screws	28	8	26	373	435
Die-stamps	9	3	14	120	146
Padlocks, locks and ornaments	30	15	75	300	420
Steam boilers	12	5	60 b/	153	230
Metallic structures c/	170	205	435 b/	1,660	2,470
Metallic furniture	54	23	46	787	910
Heavy mechanical industry	322	322	890	1,666	3,200
Light mechanical industry	237	94	600	1,439	2,370
Totals	862	675	2,146	6,498	10,181

Source: Dirección General de Estadística.

- a/ The table is based on the average distribution of the better enterprises of each branch in Brazil.
- b/ Welders, and draughtsmen. The former can be trained with less effort than good mechanics of all-round knowledge or technical specialists in the management of a particular type of machinery (lathes, hobbing-cutters, etc.), who constitute the majority of the group.
- c/ Among the products assigned to this group is a certain proportion of light products (doors, windows, etc.), which is higher than present production by the appropriate industry in Colombia.

There would be no difficulty in Colombia in finding administrative staff, estimated at about 900, since, broadly speaking, apart from a small proportion of bookkeepers, who can also be found, no more training is needed than is given by the secondary schools.

Of the 675 engineers, technicians and foremen, about 230 to 250 of the last-mentioned should be discounted, since they could be skilled workers

/who have

who have shown ability in staff handling, leaving about 400 or 420 professionals. Although the present universities and technical schools would find no major difficulty in increasing the numbers trained annually, the main difficulty will consist in persuading graduates to work with a good grace in machine shops, which frequently connotes social inferiority in Latin America. Another problem is to convince entrepreneurs of the benefits of improving their organization, and thus their productivity, by allotting intermediate functions to this type of staff and improving their salaries, so as to ensure them a more lucrative career. A similar situation in Brazil was resolved by engaging foreign personnel for the basic posts, and by staffing the intermediate cadres with Brazilians, as soon as they became available to industry.

If the requirements of skilled workers - to whom should be added the approximate total of 240 classed as foremen, in order to arrive at about 238.0 persons more - are compared with the training rate for skilled mechanical workers leaving Colombian schools, the conclusion is reached that this is one of the most serious obstacles to a more speedy development of these industries.

This total includes some 500 skilled workers for the metallic construction and boiler-making industries, of which about 300 could be trained through brief courses, as experience has shown in the case of Paz de Río. But even then the problem would still be serious. Teachers in industrial schools concur in suggesting that courses should be shorter and in insisting that single-branch specialists should be trained in many of the business schools. Assuming that under this system a qualified operative can be trained in three years of apprenticeship at an average cost of 900 pesos per pupil per year, the total capital required for investment in such training would be less than 2 million dollars over a course of several years. The figure is clearly insignificant in relation to the desired results. The problem is less simple than it appears, however, since it presupposes better mechanical equipment in the workshops of the existing schools and the appointment of teaching staff more familiar with the needs of industry, at least so far as practical training is concerned.

/There are

There are, of course, several other alternatives, one of which would be the introduction in Colombia of an apprenticeship system on the lines of SENAI in Brazil, for which it has been estimated that it would be sufficient to train one per cent of all the established posts in industry. This system meets with stubborn resistance from industry, however, which for better or worse has already solved its training problems and is financing staff training for new industries, because of the fact that the apprentices often take French leave. A third system might be that which is used in some European industrial countries, where enterprises whose total man-power is above a certain limit are obliged to maintain schools for training a certain percentage of their staff.

Finally, there is a possibility of leaving the solution of the problem to each individual entrepreneur. In other Latin American countries where the matter has been investigated, it is found that under this method the average productivity of industry and the quality of its products are very low, with consequent detriment to the consumers.

As regards staff in the fourth group, unskilled and semi-skilled workers, who are the most numerous, few difficulties arise because even the semi-skilled, whose most usual functions consist of the supervision of constantly repeated machine operations, can be trained by industry itself without great efforts.

#### 9. Some ideas on priorities and the establishment of new industries

Shortage of techniques and qualified man-power is the principal factor which militates against the simultaneous implementation of all the measures required. It would therefore be advisable to draw up an order of priorities as between the industries it is desired to encourage.

Chief interest attaches to industries utilizing the raw materials provided under the present Paz de Río programme. These include the manufacture of bolts and screws, almost all requirements of which could be so covered, the remainder consisting of a small number of special steel bolts for use by the motor industry. Another proposal would be the manufacture of metallic  
/structures, which



structures, which would have the additional advantage of helping to solve, through the widening of the market, many of the problems now facing the industry as a result of unused capacity. The manufacture of bolts and screws, on the other hand, would require the erection of new factories.

In the second place would come activities permitting better utilization of installed capacity. Apart from the aforementioned metallic structures, some of the simpler manufactures of heavy engineering, which could be produced in small series, would find a place; they would include pumps, valves and meters, presses, electric motors, transformers and machinery for various industries. Such activities at the present time are helping to solve the problem of staff training for other industries, but if the quality of their products is to be improved they must be equipped with better machinery and suitable staff.

Lastly come those industries which result in some indirect benefits, such as various activities of light mechanical engineering, which, although they require heavy investment, have the advantage for the country of constituting focal points whence would radiate notions of scientific organization of the work and greater productivity, as has occurred in Brazil.

No mention is made here of purely economic factors, such as the advantages for the country of possessing industries which would to some extent enable capital goods imports to be replaced. Such is the case with the majority of machine tools and machinery for the transforming industries.

## Chapter IV

### GENERAL CONSIDERATIONS

A number of conclusions arise from this report insofar as they refer to the specific cases of Brazil and Colombia. They will be presented to the expert meeting planned for Sao Paulo in 1955 for discussion and analysis there when they have been enlarged and completed. Some problems have also arisen for which no definite answer has yet been found, because many factors play a part in this study and very little information is available. Furthermore, when comparing the similarities and discrepancies of the situation in the two countries, it may be assumed that they consist of more or less general phenomena. But other features are lacking, which can only be discussed when similar studies have been made in other countries. While more material is still being collected on this subject, it is nevertheless suitable to provide some preliminary conclusions at this stage. They refer to the terms in which economic development is to be defined to ensure supplies of iron, steel and their products under the best possible conditions, to the required techniques which should be used for the best possible use of these industries and to the institutional problems which the mechanical and metallurgical industries face.

1. The terms in which the economic development is to be defined

The method of studying input and the product in this analysis can obviously be applied to any other industrial activity.

Nevertheless, without the help of other considerations which

/exceed the

exceed the scope of this study, the type of industries to be given priority in the first stage of industrialization cannot be defined. The following statements therefore refer exclusively to a definition of growth in the iron and steel producing and transforming industries.

As regards the product-capital ratio and the influence of the size of operations, an iron and steel industry producing rolled steels has very different characteristics from those observed for a group of transforming industries which manufacture the same product. The doubt thus arises whether it is better to begin by establishing a steel-making industry or whether transforming industries to produce finished consumer goods should be developed first, leaving primary activities for a later stage.

The arguments in favour of priority for the steel-making industry are as follows: a) that, almost without exception, the establishment of a steel-making industry in an under-developed country has strongly encouraged an expansion of steel consumption, and b) that the development of transforming activities, enough to affect the costs of possible steel production, requires an over-all rise in the technical level which can only be achieved over a number of years even when adequate and timely institutional measures are adopted. Conversely, the reasons advocated for postponing the establishment of steel-making industries are based on a) the substantial capital resources necessary for its establishment and b) the decisive importance of the size of operation upon costs.

/Chile may

Chile may be cited as a recent example of the way in which a steel-making industry affects the demand for steel. Annual consumption has risen from about 120 thousand tons of rolled products in 1950, when the Huachipato mill entered production, to about 290 thousand tons in 1955. The lack of capacity of the steel industry to produce a still larger volume is one of the factors which now limits an enlargement of the transforming industry.

The influence of the steel-making industry upon transforming industries must be borne in mind when projecting the size of the former, because the size of plant exerts a very substantial influence on production costs. In this respect, the study presented to the expert group at Bogota,<sup>1/</sup> gives the following index data, based on costs per ton of a mill producing one million tons annually:

<u>Annual capacity of the mill</u> (Tons)	<u>Production cost per ton</u> (Index)
50,000	241
250,000	134
500,000	101
1,000,000	100

It is clear that the cost of production per ton at a plant with one million tons capacity is almost identical as that for 500 thousand tons capacity, but it is two-and-a-half times greater at a small mill producing only 50 thousand tons.

This last argument should be given some consideration. It is based on the fact that a very small steel mill - with a capacity of 50 thousand tons annually for example - cannot achieve a high level of productivity. A country with this consumption should give serious thought to the possibility of

<sup>1/</sup> See document E/CN.12/293/Rev.1, op. cit.

first expanding its transforming industries on the basis of imported rolled products. Conversely, a country which consumes 200 thousand tons or more annually would be justified in first establishing a steel-making industry, since operating costs would not exceed acceptable limits, particularly in view of the influence exerted by a steel-making industry upon consumption.<sup>2/</sup>

Among the more pertinent arguments for postponing the establishment of a steel-making industry and developing these activities on the basis of transforming industries, the most important is the large investment required. In the study mentioned earlier, investment in a steel plant with an annual capacity of 250 thousand tons under average conditions, was estimated at about 422 dollars<sup>3/</sup> per ton of rolled products each year. This hypothetical mill would add a value of 75.7 dollars per ton of annual production, so that the product-capital ratio would stand at 5.58, with a tendency to increase in practice. In contrast, according to over-all calculations made for the sectors studied in Brazil, the product-capital ratio in the iron and steel transforming industries stands at 2.1. This implies that with the same investment, the transforming industry replaces 2.7 times more imports than the steel-making industry, an important finding for countries with limited foreign exchange availabilities.

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<sup>2/</sup> These general considerations may be modified to some extent by raw material availabilities - iron ore and coking coal - and the distances of these supplies from the projected steel-making centre. In this respect, Colombia is among the most favourable situations in the world today.

<sup>3/</sup> Excluding additional costs - almost always indispensable - for iron ore, coal and limestone supplies, means of communication (ports, railways and others), camps and community services.

Moreover, for transforming industries, the scale of operations does not cause, because of the greater divisibility of the mechanical means of production, such a pronounced reduction of costs as for the steel-making industry. Broadly speaking, an increase in transforming activity is followed by the need for new units of the same size as the original facilities.

3. The required techniques for the mechanical and metallurgical industries in Latin America

According to the Inquerito Industrial of the State of Sao Paulo, in 1953 the transforming industry employed an average of 64 persons in each establishment, with an average value added of 2,200 dollars per man-year. These data show that to produce the same value added as an integrated iron and steel industry with an annual capacity of 100 thousand tons, it would be necessary to establish from 70 to 80 different transforming units, employing from 4,500 to 6,700 persons, 5 per cent of whom would probably have to be technicians. Problems of some gravity arise in connexion with the choice of a suitable number of entrepreneurs, with financing, with the availability of technicians and with the choice of end goods and of production processes.

Most Latin American countries have only small, artisan-type factories engaged mainly in repairs; in addition, they undertake the manufacture of certain parts, either individually or in short series, to maintain a regular work-load by using slack periods when there is no work in the chief activity. In many cases, these shops represent one of the spheres in Latin America where, without heavy social loss, a selection can be made which enables a number of entrepreneurs of large industries to be trained among the ranks of employers. The major difficulty, however, is to instill into these small establishments those notions of modern techniques

which combine higher quality with a satisfactory rate of productivity. The same problem also exists in the larger industries, owing to the general lack of resources and technical methods.

In the course of this study reference is made to the importance of technical knowledge as a means of raising the level of productivity and improving the quality of production in the metallic and metallurgical industries in Brazil and Colombia. To simplify an analysis of these problems, the functions of technique within the production process have been divided into two main groups: a) those related to the management of enterprises, which are controlled by entrepreneurs, and b) those of a more general nature, which can only be solved at the national level or, better still, by means of some system of inter-American co-operation.

i) In the section referring to productivity in Brazil, a detailed study of the technical requirements of enterprises is made, dealing particularly with the way in which technical knowledge enters those establishments which begin as artisan industries and at the different stages of their evolution. It is noted there that technicians qualified to carry out such functions efficiently are very scarce in Brazil, in particular technical engineers specializing in the organization of production are practically non-existent. The situation is even worse in Colombia.

Generally speaking, the curricula in technical and engineering schools where specialists of this type could be /trained are

trained are unsuitable. A further difficulty is that certain prejudices prevent most of those who leave such schools from entering industry to carry out work of this kind. Entrepreneurs are also responsible for another shortcoming, as they frequently choose to entrust delicate aspects of industrial management to employees unaccustomed to this type of work, and, still more often, who fail to grasp the importance of gradually introducing modifications into the organization as it expands.

Under such conditions, the progress made in organizing the work is necessarily slow. In Brazil, such principles have been applied to certain branches of the heavy mechanical industry and especially to the light mechanical industry where production is effected in relatively long series and is subject to severe internal competition.

Another source of spreading these concepts is that some enterprises operate with foreign capital and introduce methods of factory management of those countries. A similar tendency is to be observed in specific domestic enterprises which have concluded technical agreements with foreign firms specializing in the same products; they have obtained from them designs, specifications of materials, plans for carrying out the work and often, in addition, principles of organization or the right to use trade-marks of a foreign firm.

Some countries have signed contracts with the United States Inter-American Co-operative Institute, which, by supplying United States experts and by training local personnel in the countries concerned, has assumed responsibility for the organization of a



a few model enterprises, courses of lectures to foremen and advisory services dealing with minor problems. In face of the serious difficulties existing in most Latin American countries, there can be no doubt that there is ample room for action on the part of associations of entrepreneurs at the national level and also for international co-operation in this sphere. Among the steps which might be taken, mention should be made of the following: convincing entrepreneurs by means of lectures and practical demonstrations; the modifications of the programmes of study in technical educational institutes of the medium and higher grades, so as to give more importance to these branches; intensive courses of supplementary training for young technicians interested in these branches; the provision of detailed plans to operate the machinery and to manufacture the more common products on a co-operative basis; and the provision - also on a co-operative basis - of information as to the time theoretically required for the carrying out of specific operations under normal working and equipment conditions, etc.

ii) There are three outstanding types of technical problems which cannot be individually solved by the entrepreneur, but require the joint consent of a majority of those engaged in a particular activity, or, again, for which a still better solution could be found on the national or even on the inter-Latin-American plane. They may be classified as follows: a) the standardization of specific products so as to simplify the assortment of models manufactured and thus enable the work to be carried out in longer series, with the consequent advantages; b) the preparation of /specifications for

specifications for the required qualities of ferrous raw materials, in accordance with the uses to which they are to be put; and c) the technological research whereby technique may be perfected and the available raw materials may be amplified or improved.

a) Standardization of products. As a general rule, those Latin American industrialists who undertake activities designed to replace former imports feel it is desirable to produce substitutes for goods originating from the various exporter countries, and the pressure of consumers and marketing calls for an attempt to replace the greater part of such commodities. It therefore frequently occurs that one and the same establishment produces a given article in several models and a wide range of sizes. It is also true that on occasion an individual industrialist, in the two countries under review, has begun to impose certain limits on the sizes and designs produced, but as their market quota is not high and they have not achieved a standard of productivity which enables them to reduce prices and so eliminate competition, the consumer public has reaped but little benefit.

Because any measure adopted on a considerable scale requires the joint consent of the principal manufacturers and distributors, and also, in many lines, that of the consumer, only chambers of commerce, societies of industrialists or standardization bodies can assume the responsibility of solving problems of this nature. If this were so, it would be useful to know what similar steps were being taken in other Latin American countries, since, in the

/case of

case of certain products at least, there would be much interest in the possibility of achieving uniformity throughout all the countries of the region where such norms had been established.

b) Specifications for steels in relation to their application. In several Latin American countries there are standardization bodies for technical norms concerned with preparing specifications for the most widely-used steels. Unfortunately, the number of such norms is low and even those which do exist have failed to exert any great influence upon iron and steel production or upon mechanical and metallurgical industries. As a rule, they are confined to applications related to civil engineering. It is desirable that such specifications should cover most sectors of the iron and steel industry and that, as far as possible, because this policy is in its initial stage, the standards which are being prepared in the various Latin American countries should be co-ordinated along uniform lines.

c) Technological research. Some Latin American countries possess institutes for technological research which, in relation to iron and steel industries, undertake the analysis of materials submitted by industrialists, so that the quality of the product may thus be improved. They also carry out research into the characteristics of certain raw materials existing in their respective countries, such as limestone, refractory materials, manganese ores, etc. But their resources are scanty and the scope of their action limited. Again, given the relatively backward state of the techniques in these countries, industrialists do not use them sufficiently to enable their functions to be fulfilled with greater efficiency.

3. Institutional problems confronting the industry

It may be seen from the present study that - except in a few Brazilian industries where productivity reaches a high level thanks to a satisfactory organization based on the production of uniform articles in long series within a régime of domestic competition - the mechanical and metallurgical industries of the two countries are not in a position to compete with foreign products on their own markets, without an adequate system of tariff protection.

The proposed incentives to economic development are not always consistently applicable to systems of import control, where two conflicting objectives often exist; the first is to assist the equipment (or re-equipment) of industry and the second to protect the end consumer. In many cases, the market reserve obtained through the application of an unfavourable rate of exchange to a specific finished product, while it is essential if domestic manufacture of the product concerned is to be begun, would for a time raise the price of the commodity, during the initial phases of the local industry. Nevertheless, the initial increase in cost would in many cases be offset over the short term by the relief of the balance of payments and by the fact that labour would be attracted from activities where productivity was lower, and, moreover, from those whose marginal productivity was nil. If the manufacturing series were sufficiently lengthened, the price would soon cease to be higher than that of the imported product. The failure of the authorities to face up to this dynamic aspect of the problem often leads them to pursue a policy

/of lowering

of lowering the price of finished imported goods, thus imparting a false magnitude to the cost differences between the domestic and the imported product, and considerably retarding the initiation of its local manufacture. Brazil offers a clear case in point, namely, that of agricultural machinery, domestic production of which is very scanty, on account of the preferential treatment accorded to imports. The same remark is applicable, up to a point to the manufacture of coachwork and other means of transport, as well as, in certain cases, to special steels.

Another aspect of the problem lies in the inconsistency of the system of import controls, which especially affects the manufacture of machine-tools. As these are widely used in the different branches of the mechanical and metallurgical industry, exchange and import control measures designed to facilitate the re-equipment of the industry producing finished goods also involve the stagnation of the branch of domestic manufacture concerned. It is for this reason that in Brazil little progress has been made in the replacement of imports as far as machine-tools are concerned. This example shows how advisable it is to study the possibility of applying flexible systems of exchange and trade control, taking into account not merely the nature of capital goods imports but also the use to which they are to be put.

The same is true of customs tariffs. If these are to be freed from the defects of the exchange systems currently in force, they must envisage the need not only to benefit or paralyse this or that type of consumer, but also, and mainly, to create the market reserves indispensable for the inauguration of new branches of the transforming industry.

/This is

This is undoubtedly a point which lies outside the scope assigned to this study. In fact, to decide between one policy and another it is necessary to ascertain the possible foreign exchange availabilities and the rate of national growth which it is desired to achieve. Here the question can only be suggested as a subject for reflection.

Furthermore, in the course of the present study much information is given, whereby the industrial potentiality of each of the two countries can be assessed and some indication is given of procedures and measures that could be applied to raise technical standards and productivity, to shorten the distance they must travel before they can meet their operating costs with a minimum degree of protection or even with none at all. Special attention has been devoted to this problem in the case of Colombia, where the lack of skilled labour constitutes a serious obstacle to the growth of certain activities.

## APPENDIX

CLASSIFIED LIST OF INDUSTRIES INCLUDED IN THE STUDY AND OF  
THOSE EXCLUDED FROM ITIndustrial products and sectors studied in detail:<sup>1/</sup>B. Primary metallurgy<sup>2/</sup>

## B-4. Cables and wire netting

B-4-a steel cables and ropes

B-4-b wire netting and mesh

## B-5. Sundry appliances

B-5-a steel sheet tanks and containers

B-5-b black sheet and tinplate  
containers and lidsB-5-c nails, bolts, nuts, screws,  
rivets and similar itemsC. Secondary metallurgy

## C-9. Power generators

C-9-a boilers and boilermaking

## C-14. Building materials

C-14-a metallic structures

C-14-b iron and steel sanitary  
appliances

C-14-c heating equipment

## C-15. Articles for industry and commerce

C-15-a hand tools for various trades

C-16-b metal furniture

C-15-c farm implements

## C-16. Articles for general use

C-16-a padlocks and locks

C-16-b lamps and lanterns

C-16-c chains

C-16-d ornaments and similar small  
items

<sup>1/</sup> The symbols, composed of combinations of letters and numbers, before the names of the industrial sectors, appear in a systematic form in Appendix II and are frequently used in the course of this document.

<sup>2/</sup> Production of wire, tubes and pipes, which really belongs in this sector, is the object of global study only, because in several Latin American countries they are produced in the steel mills themselves.

C-17. Articles for household use

- C-17-a cutlery and knives
- C-17-b steel enamel ware
- C-17-c cookers, stoves and heaters
- C-17-e metal bedsteads and spring mattresses
- C-17-f steel wool for floors

C-18. Articles for personal use

- C-18-a penknives, scissors and similar items
- C-18-b needles, pins, nibs and similar items

D. Heavy mechanics

D-6. Machine parts

- D-6-a axles, pulleys, bearings and similar items
- D-6-b meters, valves, etc.
- D-6-c pumps, ventilators and compressors

D-7. Machinery and spare parts for industry, mining and building

- D-7-a machinery for mining
- D-7-b machinery for the petroleum industry
- D-7-c machinery for the transforming industry
- D-7-c2 cast-iron parts for machinery
- D-7-c3 machinery for industrial refrigeration
- D-7-d machinery for building
- D-7-e weight-lifting machinery
- D-7-f machinery for the mechanical industry (machine tools)

D-14. Building material

- D-14-c lifts and elevators

D-8. Farm machinery

- D-8-b machinery for soil preparation
- D-8-c produce harvesting machinery (particularly for large areas)
- D-8-e smaller agricultural equipment (pulverizers, equipment for poultry, bee-keeping and similar industries)

/D-9. Power generators



## D-9. Power generators

D-9-b steam and internal combustion engines

D-9-c hydraulic and steam turbines

## D-10. Electrical material

D-10-a generators and transformers, electric motors

D-10-b other electrical apparatus made from ferrous material

## D-11. Railway material, excluding rails

D-11-a steam locomotives

D-11-b diesel or electric locomotives

D-11-c freight and passenger wagons

D-11-d railcars, autorails and smaller rolling stock

## D-12. Road transport equipment, bicycles and similar items

D-12-a automobiles, lorries, omnibuses and similar items

D-12-b bicycles, motorcycles and tricycles

D-8-a farm and other types of tractors

## D-13. Vessels and other means of transport

D-13-a animal traction vehicles

D-13-b vessels, dredgers and similar items

E. Light mechanics

## E-15. Articles for industry and commerce

E-15-d typewriters and similar office equipment

E-15-e scales, balances, weighing machines and similar items

## E-17. Articles for household use and their parts and spares

E-17-cl electro-magnetic household appliances, unspecified

E-17-c3 domestic refrigerators

E-17-c4 washing machines

E-17-c5 polishing machines, vacuum floor-cleaners and similar items

E-17-c6 ventilators (fans)

E-17-g sewing machines

Products and sectors studied only in a global manner

A. Steelmaking industry

A-1. Pig-iron for casting and for making ordinary steels

A-1-a pig-iron

A-2. Ordinary steels and their products

A-2-a ordinary steel ingot

A-2-b semi-manufactured products made  
from ordinary steels (strip,  
thin sheet, etc.)

A-2-c bars and sections

A-2-d black plate and sheet, cold or  
hot rolled

A-2-e tinplate

A-2-f galvanized sheet, flat or  
corrugated

A-2-g rails and accessories

A-3. Ferro-alloys and special steels

A-3-a ferro-alloys

A-3-b unspecified special steels

A-3-b2 special tool steels

A-3-b3 stainless steels in bars and  
sheet

B. Primary metallurgy

B-1. Wire of all kinds

B-2. black or galvanized wire,  
plain or barbed

B-3. Tubes and pipes

B-3-a cast-iron tubes, centrifuged  
or not

B-3-b seamless steel tubes

B-3-c welded tubes, black or  
galvanized

B-3-d cast-iron accessories for pipes

B-3-e steel or malleable cast-iron  
accessories

Products and sectors not studied at all:

A. Primary production of non-ferrous metals: 3/

A-21. aluminium ingot

3/ The non-ferrous metals not mentioned in this list, such as tin, etc., are each characterized by a numeral placed before the corresponding numbers of the primary and transforming industries related to iron and steel.

/A-31 Copper ingot

- A-31 copper ingot and its alloys
- A-41 lead slab
- A-51 zinc slab
- A-22 rolled aluminium products
- A-32 rolled products of copper and copper alloys
- A-42 rolled products of lead and lead alloys
- A-52 rolled products of zinc and zinc alloys

B. Primary metallurgy of non-ferrous metals

- B-21 aluminium wire
- B-31 copper and copper-alloy wire
- B-41 lead wire
- B-23-b aluminium tubes
- B-33-b copper and copper-alloy tubes
- B-43-b lead tubes
- B-24-a aluminium cables and ropes
- B-34-a copper cables
- B-34-b copper and brass wire mesh and netting

C. Secondary metallurgy of non-ferrous metals

- C-316-c copper and brass chains
- C-316-d copper and brass ornaments and small items
- C-217-b stamped aluminium ware, for home use
- C-317-c domestic heaters of copper and brass

D. Heavy mechanics of non-ferrous metals

- D-36-b registers, valves and copper alloys and copper
- D-36-c pumps of copper and copper alloys
- D-37-c machinery (or parts) for the copper and copper-alloy transforming industry
- D-39-a copper and copper-alloy boilers and autoclaves
- D-310-b sundry electrical apparatus made of copper and copper alloys
- D-212 aeronautical manufactures

Light mechanics of non-ferrous metals

- E-315-e precision scales of copper and copper alloys

