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THE STEEL INDUSTRY IN COLOMBIA^{1/}

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S U M M A R Y

The steel industry in Colombia is different from the steel industry in other Latin American countries in the sense that all installations belong to companies whose capital has been paid by a great number of stockholders in various corporations.

The main companies are the following:

Acerías Paz del Río, S.A., which has the only integrated installation having its own iron ore, coal, and limestone mines. In 1972 this company produced 274,000 t of steel ingots.

Siderúrgica de Medellín, S. A., having a semi-integrated plant in the second largest city of Colombia, produced 33,000 t of finished products out of which 26,000 t were tin plate. This company has an electrolytic tinning line. It also produced in 1972 3,000 t of balls etc.

Metalúrgica Boyacá, S. A., which is being transformed from a strictly rerolling plant into a semi-integrated plant. This company produced 32,000 t of finished products in 1972.

Siderúrgica del Muña, S. A., Siderúrgica del Norte, S. A., Siderúrgica del Pacífico, S. A., and Futec, located in Bogotá, Barranquilla, Cali, and Medellín respectively. All together these companies produced in 1972, 60,000 t of rounds and sections, using steel from electric furnaces.

The most important expansion programs are envisaged by Paz del Rio including a 300,000 t per year cold rolling mill and a increase in the steel ingot production, up to one million tons per year. This is in order to satisfy its own needs and to sell billets to the semi-integrated plants. The Colombian Government will study with other countries within the Andean Group the integration of the regional steel industry, having in mind a rational market distribution and the best utilization of the natural resources.

So far as raw materials are concerned, Colombia has, in contrast to the other Latin American countries, abundant coal reserves of different types of coal, within which the good coking coal reserves are of special importance. On the contrary, Colombia has relatively small iron-ore reserves.

This fact has brought about that the iron and steel development of this Country is based on the Paz del Rio projects as this company owns the iron-ore deposits.

On the other hand, a new steel plant of large dimensions must be envisaged to be installed on either one of the two coasts using iron ore exchanged for coal with other countries on the continent. Scrap is scarce, as in any other developing country. Ferromanganese and ferrosilicon production is being started but importation of these ferroalloys must continue, in order to satisfy needs. Electrical energy supply will not be a limiting factor owing to the way this field is being developed and the planned development of electric plants for the near future.

The market, which is located mainly within the interior of the Country, has grown at an average rate of 6.8% per year and shows a per capita consumption of 36 kg in 1971. A supply of 85% of the country's needs has been envisaged for 1980, having in mind the expansion of Paz del Rio and the expansion of the semi-integrated plants in the rest of the Country.

The expansion programs have been based on supplier financing for the foreign exchange and on internal credits for the local exchange. Financing resources in the country are not abundant, as in most of the countries on the continent, and for this reason the industrial development, including the steel industry development, is very slow.

So far as personnel resources are concerned, the present situation is very different from the one Paz del Río had to face when starting up, during which Paz del Río had to bring foreign technicians in order to train its personnel in various activities in which it had no experience. During that time, high personnel rotation indexes were noticed because the available manpower in the region where the installations were located did not have any industrial tradition. These problems were not experienced in such magnitude by the semi-integrated plants installed in the most important cities of the country, where workers already in contact with industrial activities were available, having sufficient basic knowledge which was available to them to learn their new activities. Nowadays, Colombia has established the Servicio Nacional de Aprendizaje "SENA" with initial and final training centers where the personnel are being trained in such a way that the workers arrive to the different industrial areas with acceptable basic knowledge, with a well developed state of mind, and with specializations appropriate to the industrial activities. Besides, there are Technical Institutes and Universities where specialization concerning industrial aspects are taught.

As far as the technological resources are concerned, there exists a large number of professionals, most of them with knowledge acquired in foreign countries who are ready to take care of important projects. For the fabrication of equipment one could count on workshops and foundries to be trusted with important jobs but which are not in the

position to afford dead periods and long-term payments due to the lack of sufficient operating credit. This can be granted by foreign firms. Consequently, the national industries are not for the construction of new plants or the extension of existing ones. Research is slow in development, although some research has been made by Paz del Río, the Universities, and the National Institute of Technological Research. What has been said does not mean that there is a lack of interest in the technological development. On the contrary there is an evident desire of the companies and their managements to be up to date in know-how in order to apply it to their respective installations, but with the caution demanded by the lack of economical resources of a developing country, which can not afford to adopt systems without sufficient foreign experience.

1. PRESENT STATUS

The Steel Industry in Colombia is different from the other Latin American Steelworks in the sense that all the works belong to private corporations whose capital have been formed by the investments of a large number of stockholders.

The main companies and their installations are as follows:

- ACERIAS PAZ DEL RIO, S. A.

Its capital belongs to stockholders numbering close to half a million. It is the only integrated plant in the Country having its own iron ore, coal, and limestone, being self-sufficient in raw materials.

The industrial installations are located at Belencito, 210 km north of Bogotá. Within a radius of 30 km, with Belencito the center, the iron ore, coal, and limestone mines are found.

The principal installations are as follows :

- One Koppers Underjet 43 ovens Coke Plant for processing 1000 t of coal per day and its corresponding By-Product Plant.
- One sinter plant having a 68 m² grate surface and capable of producing 1200/1450 t of super-fluxed sinter per day.
- One 5.94 m hearth diameter Blast Furnace presently producing 850 t of iron per day.

- One steel plant consisting of three 20/22 t Thomas converters blown with oxygen-enriched air and one 7500 kVA electric furnace.
- One reversible two-high blooming mill with 1060 mm diameter X 2750 mm rolls.
- One Steckel mill with 690 mm diameter, 1350 mm X 1450 mm rolls, and one shear and slitting line.
- One three-high, three-stand rolling mill with tilting tables for medium sections. The first stand with 710 mm diameter by 2040 mm rolls and the other two stands having 660 mm diameter by 1800 mm rolls.
- One merchant mill consisting of five stands having rolls as follows: 450 mm diameter by 1400/1000 mm; 300 mm diameter by 890 mm; 240 mm diameter by 650 mm; 200 mm diameter by 660 mm and 250 mm diameter by 380 mm.
- One hand sheet mill consisting of one three-high reversible mill, two high reversible mills and two temper stands.
- One wire mill for producing bright, galvanized, and barbed wire, including two galvanizing lines.

The annual capacity of production of non-flat products is 200,000/220,000 t. All steel used is produced by the company.

During 1972 the production was: 280,000 t of pig iron, 274,000 t of steel ingots (85% thomas and 15% from electric furnace). Of 220,000 t of steel products for sale, 13% were semifinished products, 12% were flat products, 12% wire rod and 63% corresponded to reinforcing bars and sections. .

The steel mill whose installation has been finished will be tested and started during the second half of 1973. This mill has a nominal capacity of 400,000 t per year and will work with imported slabs until the construction of a second blast furnace is achieved.

- SIDERURGICA DE MEDELLIN, S. A.

This company owns a semi-integrated plant situated at the second biggest city of the Country and consisting mainly of:

- Three electric furnaces, 12500, 3000, and 2500 kVA respectively with a total annual capacity of 90,000 t.
- One blooming finishing mill having nine stands with 420 mm, 300 mm, and 250 mm diameter rolls.
- One wire-rod mill having four stands with 280 and 250 mm diameter rolls.
- One installation for the production of welded 10 mm to 100 mm diameter pipe with a capacity of 34,000 t per year.
- One electrolytic continuous tinning line with a 50,000 t per year capacity.
- One installation for producing forged balls etc. for pulverizing equipment. Its capacity is 6,000 t per year.

During 1972 this plant produced 33,000 t of construction bars for reinforced concrete, 500 t of minor sections, 26,000 t of tinplate, and 3,000 t of balls.

- **SIDERURGICA DEL PACIFICO, S. A.**

This company has its industrial installations located in Cali, the third biggest city of Colombia, and has the following main equipment:

- . Two 12 t electric furnaces for the production of carbon steel and alloy steels for the national consumption and for export.
- . One blooming finishing mill having 450 mm diameter rolls for the production of sections up to 100 mm and rods up to 90 mm diameter.
- . One rolling mill having 320 mm diameter rolls.
- . One rolling mill having 250 mm diameter rolls for the production of rounds from 12 to 25 mm diameter and angles from 20 mm to 40 mm.

The capacity of production is 50,000 t of steel ingots per year and that of the mill is 59,000 t per year.

During 1972 this company produced 29,000 t of finished products out of which 84% were sections and 16% rounds.

- **SIDERURGICA DEL MUÑA, S. A.**

This company owns a semi-integrated plant located at the industrial area south of Bogotá, consisting of:

- . Three electric furnaces 5000, 2000 and 1000 tVA, the last-named being used for the production of steel for foundry work.
- . One 450 mm diameter rolls rolling mill working as blooming and finishing mill for the production of rounds bigger than 15 mm diameter and also for small sections.
- . One rolling mill with 300 mm diameter rolls for producing 12 mm rounds.

The steel production capacity of this plant is 33,000 t per year and its rolling capacity is 20,000 t per year.

In 1972 this plant produced 11,200 t of reinforcing bars.

- **SIDERUGICA DEL NORTE, S. A.**

This company has an installation located at Barranquilla close to the Atlantic Coast consisting mainly of:

- . Two electric furnaces: one 10 t and the other 8 t.
- . One rolling mill for the production of reinforcing bars.

It is estimated that the annual capacity of this plant is 40,000 t of ingots and 24,000 t of products. In 1972 the production was 6,000 t of rounds.

- FUNDICIONES TECN CAS, S. A.

This company is part of the biggest textile corporation of the Country; it was originally installed for producing spare parts and machines for the textile industry and today is equipped as follows:

- . One 1750 KVA electric furnace.
- . One 300 mm diameter rolls rolling mill for the production of rounds from 9 up to 35 mm.

The capacity of steel production is 13,000 t per year and the rolling capacity is 20,000 t per year. In 1972 this plant produced 10,000 t of rounds for concrete.

- METALURGICA BOYACA, S. A.

The plant belonging to this company is located at 150 km north of Bogotá and normally works rerolling billets supplied by Acerías Paz del Río or imported. The main equipment consists of:

- . One five-stand rolling mill having 250 mm diameter rolls.
- . One four-stand rolling mill having also 250 mm diameter rolls.

Its rolling capacity is estimated to be 45,000 t per year. In 1972 this plant produced 32,000 t of finished products out of which 24,500 t were small sections and the rest reinforcing bars.

Tables Nos: 1 and 2 show production figures since 1965 for pig iron, steel ingots and finished products.

T A B L E No. 1

COLOMBIA - PRODUCTION OF PIG IRON AND STEEL INGOT - DISTRIBUTION BY PROCESSES

(Thousands of Metric Tons)

I T E M	1965	1966	1967	1968	1969	1970	1971	1972
PIG IRON	195,5	167,1	202,9	193,1	195,3	229,3	243,1	285,4
- End use:								
Foundry	0,9	1,0	1,4	1,6	2,6	-	-	-
Steel Making	194,6	166,1	201,5	196,5	192,7	229,3	243,1	285,4
- By Processes:								
Coke blast furnace	195,5	167,1	202,9	198,1	195,3	229,3	243,1	285,4
STEEL INGOT	241,8	216,0	257,7	259,5	271,6	309,7	324,9	359,4
- Thomas	16,7	137,2	171,8	161,8	168,0	200,9	211,4	233,7
- Electric	74,9	78,8	85,9	97,7	103,6	108,8	120,5	125,7

Source: ILAFA

T A B L E No. 2

COLOMBIA - PRODUCTION, IMPORTS, AND EXPORTATION OF STEEL
(Thousands of Metric Tons of Finished Products)

Y E A R	TOTAL	NON - FLAT PRODUCTS				FLAT PRODUCTS			
		BARS & SMALL SECT.	WIRE ROD	RAILS & MEDIUM SECT.	TOTAL NON-FLAT	PLATES & SHEETS	TIN- PLATE	TOTAL FLAT	
PRODUCTION									
1965	206,8	111,7	72,8	4,2	188,7	18,1	-	16,1	
1966	235,5	80,6	28,0	3,2	211,8	23,7	-	23,7	
1967	221,3	121,5	75,1	3,2	199,8	21,5	-	21,5	
1968	200,9	129,1	48,0	1,8	178,9	17,8	4,2	22,0	
1969	281,4	133,8	96,3	5,7	235,8	24,0	21,6	45,6	
1970	313,2	200,3	66,8	4,6	265,7	22,4	25,1	47,5	
1971	n.a	221,9	41,5	10,6	274,0	34,5	n.a	n.a	
IMPORTS									
1965	125,8	17,2	5,1	3,0	25,3	75,0	25,5	100,5	
1966	265,4	33,1	19,1	12,8	65,0	145,4	55,0	200,4	
1967	153,7	67,1	7,6	9,6	84,3	47,7	21,7	69,4	
1968	167,5	33,0	9,1	10,4	52,5	88,0	27,0	115,0	
1969	228,3	41,6	4,4	40,9	91,9	112,6	23,8	136,4	
1970	261,8	48,9	16,2	41,6	106,7	135,0	20,1	155,1	
1971	270,8	n.a	18,0	n.a	95,4	155,4	20,0	175,4	
EXPORTS									
1970	3,5	0,5	2,2	-	2,7	0,4	0,4	0,8	
1971	2,0	2,0	-	-	2,0	-	-	-	

Source: ILAPA

2. EXPANSION PROGRAMS

The most important expansion programs are those planned by Acerías Paz del Río, S. A., which is presently building a new Koppers Gun Flue 57-ovens Coke Battery. This battery will start working in 1975 and will replace the present battery whose useful life will end that year. With the new battery a 40% increase of coke and by-products production is expected.

During the second semester of 1973 will be signed the contracts for the supply, installation, and start up of one Cold Rolling Mill which will work using the coils produced by the steckel mill already installed.

The installation and facilities will be installed in two stages. The original installation is to produce 200,000 t/year of cold-rolled sheets to commercial sizes and quality; and a later expansion with additional facilities to increase up to 300,000 t/year. The production capacity for cold-rolled sheets and to produce black plate for the tinning line of Siderúrgica de Medellín.

The first stage includes: one pickle line, one 1370 mm four-high single-stand reversing mill, one 1370 mm four-high single temper mill, annealing facilities, one coil-slitting line, one shear line, and general plant facilities. The equipment for the expansion in the following: a new reduction mill duplicate of Cold Mill No. 1, and electrolytic cleaning line, additional annealing facilities, a second temper mill duplicate of the No. 1 and an additional shear line; the basic portions of the general plant facilities and services will be furnished and installed under the initial program.

The first stage will start operations in 1976 and the second one will be finished in 1980. The steckel and cold mill will work initially on the basis of imported slabs until the iron and steel production capacities of the company are increased.

Acerías Paz del Río has already complete studies for balancing the rolling-mill capacities with those of the iron and steel production installations using raw materials from its own mines. Such studies include plans for the expansion of the mines, one new coke-oven battery, a second sinter plant, a second blast furnace, a new pure oxygen steel plant plus the additions to general services such as maintenance, transportation, electrical energy supply, etc.

This project is presently under revision. The Colombian Government has asked Acerías to study the possibilities which would enable the company to produce one million tons of steel ingots per year. The steel would be used to make Acerías selfsufficient in terms of its own needs and to sell semifinished products to other companies with rolling facilities but with a deficit of steel ingots. In this way, the Government will try to replace the scrap importation (scrap is very scarce in Colombia), stop the erection of electric furnaces, and produce steel mainly from native raw materials.

During the second semester 1973 Acerías Paz del Río will hand to the national authorities the corresponding study in which it will be established if, from the technical and economical points of view, the expansion of up to one million tons is feasible. The other steel producing companies have projected expansion programs which would lead them to reach a combined total rolling capacity of 300,000 t per year of profiles and construction rods.

Whichever solution is adopted the future development of the steel industry in Colombia will be projected studying with each one of the countries of the Andean Group with the purpose of obtaining a rational market distribution and the best utilization of the natural resources.

3. RAW MATERIALS

The most important and economically exploitable iron-ore deposit of the Country belongs to Acerías Paz del Río and is located 30 km north of the Belencito Plant. Its Fe content is 42% natural base and variable SiO₂ (9 to 13%) and its P content is 1%; for this reason the iron must be processed in Thomas converters.

Initially, open pits were used for the iron ore exploitation but nowadays underground mining is being used. This has brought about relatively higher exploitation costs which have been compensated with continuous increments of productivity because of better quality and more consistent SiO₂ content. (Close to 9.5%) and with low transportation costs due to the proximity of the mines to the blast furnace.

The explorations and geological studies made by the company ensure a satisfactory supply of this raw material to meet the requirements of the expansion programs.

Other known deposits show an iron ore of better quality but in very small quantities. For this reason the development of the integrated steel industry of the Country is being based exclusively on the Acerías Paz del Río expansion program.

The coal situation is completely different. The coal deposits are distributed in five regions covering half of the Country's territory.

More than one thousand million tons of proven reserves make Colombia the Latin American Country with the largest coal deposits. Close to 300 million tons of such deposits correspond to coking coal. This fact ensures the selfsufficiency of coal and coke to meet the requirements of the steel, iron, and chemical industries. Furthermore, the National Government has already set up large plans to export coal to other countries in the continent.

Total national production of coal is now 3.5 million tons per year, out of which 20% correspond to Acerías production. This company owns the largest coal-mining installation in the Country. The rest of the coal is exploited by other private enterprises which number close to one hundred.

Limestone is abundantly found in the Country. Its exploitation reaches 5 million tons yearly including the exploitation made by Acerías. This company owns deposits large enough to meet its future needs plus the requirements of a cement plant, which Acerías intends to install at Belencito very shortly.

Imported ferromanganese is being used because the manganese-ore deposits found are very small and their quality is not good enough to be used in the steel industry. At present a small 15,000 t per year plant for ferromanganese production is being started. This plant is located 130 km north of Bogotá and will also be used for the production of ferrosilicon.

The only important dolomite customer could be the Belencito blast furnace. Nevertheless the dolomite exploitation and transportation costs are very high, so this raw material is not being used. Nevertheless, the geological studies started some years ago are being continued in order to find dolomite deposits close to the Belencito plant.

Without an important source of recirculating scrap in each one of the already mentioned installations, recent studies show a scrap availability of 50,000 t per year. This low availability of such an important raw material is due, like in any other developing country, to low capital availability which results in the utilization of machinery for longer periods than the expected life of the industrial installations in developed countries. This can be easily proven by the old models of the automotive equipment or the old age of the consumer goods.

The foregoing facts have led to the importation of scrap to feed the electric furnaces with increased costs due to the inland location of such furnaces, and the high inland freights. It must be hoped that there will be an improvement in this situation in the future but it can not be affirmed, that in the short term a selfsufficiency of scrap can be obtained.

The availability of electrical energy has been growing steadily from 911 MW or 62 Watts per capita in 1960 to 2500 MW or 105 Watts per capita in 1977. Present installation being made plus additional plans would take the above mentioned figures to 4800 MW (100 Watts per capita) in 1980, and to 6900 MW or 210 Watts per capita in 1985. As may be observed, the electrical power availability is not considered to be an obstacle to the development of the steel industry.

Besides, as a large proportion of the electrical energy will be produced in hydroelectric plants, it is hoped that its price will be substantially lowered. The same thing can not be said for natural gas, whose availability decreases continuously due to the fact that present deposits are being exhausted. This problem presents no easy solution, due to the large investments required. Nevertheless the problem is being treated by companies whose capital is formed by government and foreign contributions.

4. THE MARKET

There is a close relationship between the steel plant locations and the main cities where the national steel market is established. It can be said that the distribution and the geographical concentration of the steel market is similar to that of the Colombian manufacturing industry. The reason is that a high percentage of the industry is similarly concentrated within the Country and it is possible to say that this behavior of the industry will determine the concentration of the steel market.

This location of industry in general, and that of the steel industry in particular, follows in more or less direct way the population concentration in the large cities. This leads to the fact that Bogotá and its zone of influence show the largest steel consumption as a result of being the largest commercial and industrial center of the Country. From this point of view the largest steel producer of the Country, Acerías Paz del Río, is located at a short distance from the raw-materials deposits and close to the consumption center, Bogotá, and its zone of influence. This can be easily verified when it is found that 50% of the demand satisfied by Acerías Paz del Río is in Bogotá and the surrounding areas and 75% of all its sales cover the area located between Bogotá-Cali-Medellín-Bucaramanga-Sogamoso.

Although the national steel production has shown a yearly increase of 9.8% for the period 1960-1972, the per capita consumption, which in 1971 was 36 kg has been growing at the rate of only 2.8% per year. This low consumption is directly related to the high rate of population increase and an increase in industrial economy. From the analysis of the National Gross Product for the same period (see Table No. 3), it can be deduced that

T A B L E No. 3

COLOMBIA - BREAKDOWN OF THE GROSS NATIONAL PRODUCT

SECTORS	MILLION OF PESOS (1)		PERCENTAGES	
	1962	1971	1962	1971
Primary	9,047	12,407	35,3	39,6
Secondary	5,760	10,010	22,4	24,6
Tertiary	10,808	18,193	42,3	44,8

(1) Pesos of 1958

Source: Banco de la República - Estudios Económicos

the contribution of the primary sector formed by the agriculture, cattle production, mining, construction and amelioration of the agriculture, hunting, fishing and forest production, is in the neighborhood of 30%. This contribution has decreased to the benefit of the other sectors of the economy more directly connected with city life.

It also must be considered that a large percentage of the workers who contribute in the generation of more than 30% of the National Gross Product is not directly related to the main consumption centres' economics due to their close relation to the agricultural and cattle business activities. This can be seen from Table No. 3. Although the agricultural and cattle productivities have been growing during 1964-1970 as compared with 1951, new employment possibilities have appeared in the manufacturing industry. Nevertheless, this is not reflected in an increase of the per capita consumption of steel, possibly because the income of the displaced persons from the agricultural sector to other sectors of the economy do not allow them to assign such income to enable them to buy consumer goods.

Table No. 4 shows the apparent consumption in terms of finished products from 1960 to 1970 with an average yearly increase of 6.8%. Also it illustrates the way how the market of flat and non-flat products has been satisfied. Such market allowed net savings of 50 million dollars in 1972.

With a growth rate of 7% per year the figure corresponding to non-flat products will reach 560,000 t and the one corresponding to flat products will be 360,000 t including black plate for tin-plate. The planned expansion of Acerías will cover then 95% of the market for non-flat products and 83% of the market for flat products.

T A B L E No. 4

COLOMBIA - APPARENT CONSUMPTION OF STEEL

Y E A R	TOTAL	NON - FLAT PRODUCTS				FLAT PRODUCTS			
		BARS & SMALL SECT.	WIRE ROD	RAILS & MEDIUM SECT.	TOTAL NON-FLAT	PLATES & SHEETS	TIN-PLATE	TOTAL FLAT	
		In thousands tons of ingots							
1965	444,0	168,8	99,2	3,2	277,2	130,0	30,5	160,8	
1966	672,2	149,0	187,5	20,3	356,8	238,0	78,6	513,4	
1967	496,7	247,0	105,5	19,2	368,7	97,0	31,0	128,0	
1968	492,0	212,4	71,9	15,5	299,8	147,6	46,6	192,2	
1969	680,1	229,9	134,8	39,1	423,6	191,3	65,0	256,3	
1970	763,8	325,8	95,4	58,6	479,8	213,0	64,2	254,0	
		In thousands tons of finished products							
1965	332,5	128,9	77,8	7,2	213,9	93,1	25,5	113,6	
1966	500,9	113,7	147,1	16,0	276,8	169,1	55,0	224,1	
1967	375,1	188,5	82,8	12,8	284,1	69,3	21,7	91,0	
1968	367,3	162,1	56,4	12,2	230,7	105,4	51,2	135,6	
1969	509,3	175,4	105,6	46,6	327,6	136,6	45,4	182,0	
1970	571,0	248,7	74,8	46,1	369,6	157,0	45,0	202,0	
1971	n.a	n.a	59,5	n.a	n.a	191,8	28,2	210,0	

Source: ILAFA

In this way, as foreseen by the national authorities, by 1980 a new steel plant must be put into operation. Such plant will be installed very surely close to either of the two seacoasts of Colombia, and will be working with imported iron ore in exchange of coal with other countries in the continent.

5. FINANCING

The financing system used in Colombia for its most important steel plant is a good example of what can be done in a developing country, whose credit sources are very frugal.

The geological studies were started by the Colombian Government. After arriving at positive results, the government sponsored the establishment of a semi-official company which contributed with 2,5 million dollars in 1948. One year later, with the objective of obtaining investments from the private sector, the government set up a system by means which half of an already established additional income tax would be not charged to the Colombian taxpayers provided they would invest an equivalent quantity in stocks of the new steel company. Nevertheless, as the acquisition of the capital coming from the taxpayers would take a relatively long time in view of the time required for a fast construction of the steel plant, the financing was established on the basis of the of bonds issued by the steel company and taken by the Bank of the Republic, having the previous approval of the National Government.

The equipment was obtained through a loan granted by the Banque de Paris et du Pays Bas, to the extent of 25 million dollars.

The steel plant started operations in October 1954.

In 1955 the government authorized that the bonds issued by the steel company, for financing the steel plant construction, be converted into stocks in favor of the State and for a value of 300 million pesos.

During the same year, and in order to facilitate the company reorganization into a regime of purely private enterprise, the government signed a contract with the Bank of the Republic and Acerías Paz del Río, by which the State would sell its stocks to the Bank. It also was agreed that the contributions made by the Colombian taxpayers as the extra income tax when they decided to buy stocks from the company, instead of paying the additional tax established by the law, 50% of said contributions would be assigned to the progressive transfer of the stocks from the Bank of the Republic to the investors and 50% for the issue of the steel company stocks.

In this way, at the end of 1961, the authorized capital of 600 million pesos was completely subscribed and Acerías Paz del Río became a private enterprise which belongs to close to 500 thousand stockholders, the Colombian Government being one of them, but in a proportion of a little less than 1%.

This system, which could be considered a good system for the installation of a new plant, is not practical for its expansion. The success within the private industry can not be compared with the low efficiency of the government-owned companies. Due to the above-mentioned reasons, the programmed extensions have been planned on the basis of foreign credit obtained from multinational banks or from national banks in the countries which will supply the equipment, plus internal credits, following the common practice in the continental steel industry. This does not mean that such credits

are easy to obtain. The irregularity of the national resources limits debts-contracting capacity so the initiation of new plants and the expansion of existing plants projects are subject to retarding factors and the projects must be developed in various steps which, in the majority of the cases, do not lead to the best economics of the whole project.

Although at present the Colombian credits could be granted by national organizations such as the Instituto de Fomento Industrial, the Fondo de Programación de Exportaciones, or private organizations constituted as financing corporations, the credit in Colombia is very frugal.

6. MANPOWER AVAILABILITY

When dealing with this aspect, a distinction must be made between the situation that Paz del Río had to face ever since its initiation, and the problems that in this sense one could find in semi-integrated plants in the industrial zones located close to the big cities. Due to the location of the raw materials, Acerías had to install the processing plants in a zone whose inhabitants were normally working in agricultural or cattle-raising activities. This is the reason why, during construction and start up, it was necessary to bring specialized workers from other regions of the Country and from other Countries while the adaptation and training of the natives was started, to convert them into miners and steel plant operators and their mentality was guided towards the industry.

In order to achieve this change many problems had to be overcome. As the preference of such natives was towards agriculture, a high rotation

T A B L E No. 5

COLOMBIA - BREAKDOWN OF THE LABOUR FORCE

(Thousands)

	1 9 5 1		1 9 6 4		1 9 7 0	
		%		%		%
Agriculture and Cattle Raising	2.024	53.5	2.426	47.3	2.444	39.7
Industry	467	12.3	656	12.8	949	15.2
Construction	133	3.5	221	4.3	257	4.1
Others	1.211	30.3	1.831	35.6	2.576	41.4
		100.0		100.0		100.0

Source: Banco de la República - Departamento Nacional de Estadística XII y XIII
Censo Nacional de Población

of personnel was experienced as well as high incidence of accidents due to lack of adaptation and training. Large school construction plans were started. Also, the existing schools received money from Acerías in order to expand their facilities in the whole region.

This work was started, reducing the illiteracy indexes, by giving practical conferences about mining and steel plant activities and forcing safety rules concerning this type of industry. In parallel, seminars were carried out for qualified workers who later on would replace foreign workers. On the other hand, other personnel were sent to foreign countries for their initial or final training in universities and companies which were practicing similar processes.

At present Acerías is directed and operated by Colombian personnel, and of this personnel close to 80% have been born in the region. Most of the personnel have a high degree of stability, their productivity is increasing steadily, and the formation of a family tradition in certain types of trades is being noticed.

On the other hand, the other steel industries in the country started operations with workers who had been trained in an industrial environment or whose normal activities were related to their new activities or had enough basic knowledge which facilitated their training.

For steel industry personnel training, Colombia has at present training centers, initial and advanced technical training schools under the direction of Servicio Nacional de Aprendizaje "SENA". Their students come out with sufficient basic knowledge, with a well developed attitude, and with specializations which fit the industrial needs. This allows the students to be adapted easily to their new jobs. Besides, there are technical institutes and universities offering specialized courses in each one of the aspects of the steel industry.

At present there exists a high availability of trained personnel for the replacement of workers who leave industry activities and for filling the positions opened by the expansion programs.

7. TECHNOLOGICAL RESOURCES

In most countries the basic and ancillary equipment design is intimately linked to its construction because the manufacturing companies design their own equipment. When a country tries to build some equipment because it possesses a manufacturing industry which is able to do so, but tries to use the design belonging to a foreign country, in most of the cases, this objective is not achieved. The foreign country wishes to export not only the main ideas and the design together with the equipment under the basis of special credits to the client. On the other hand, the buying countries or companies wish to resolve their financial problems by taking the best advantage of the foreign credits. This happens very frequently in the developing countries.

The technology is a process of slow development which consolidates at the same time as the countries are industrialized. In the Colombian case, it can be said that industrialization began after the second world war simultaneously with Paz del Rio starting up in 1954. Paz del Rio original design, engineering equipment, construction, and installation was granted to various foreign companies demanding that, for the construction, a large part of Colombian should be used.

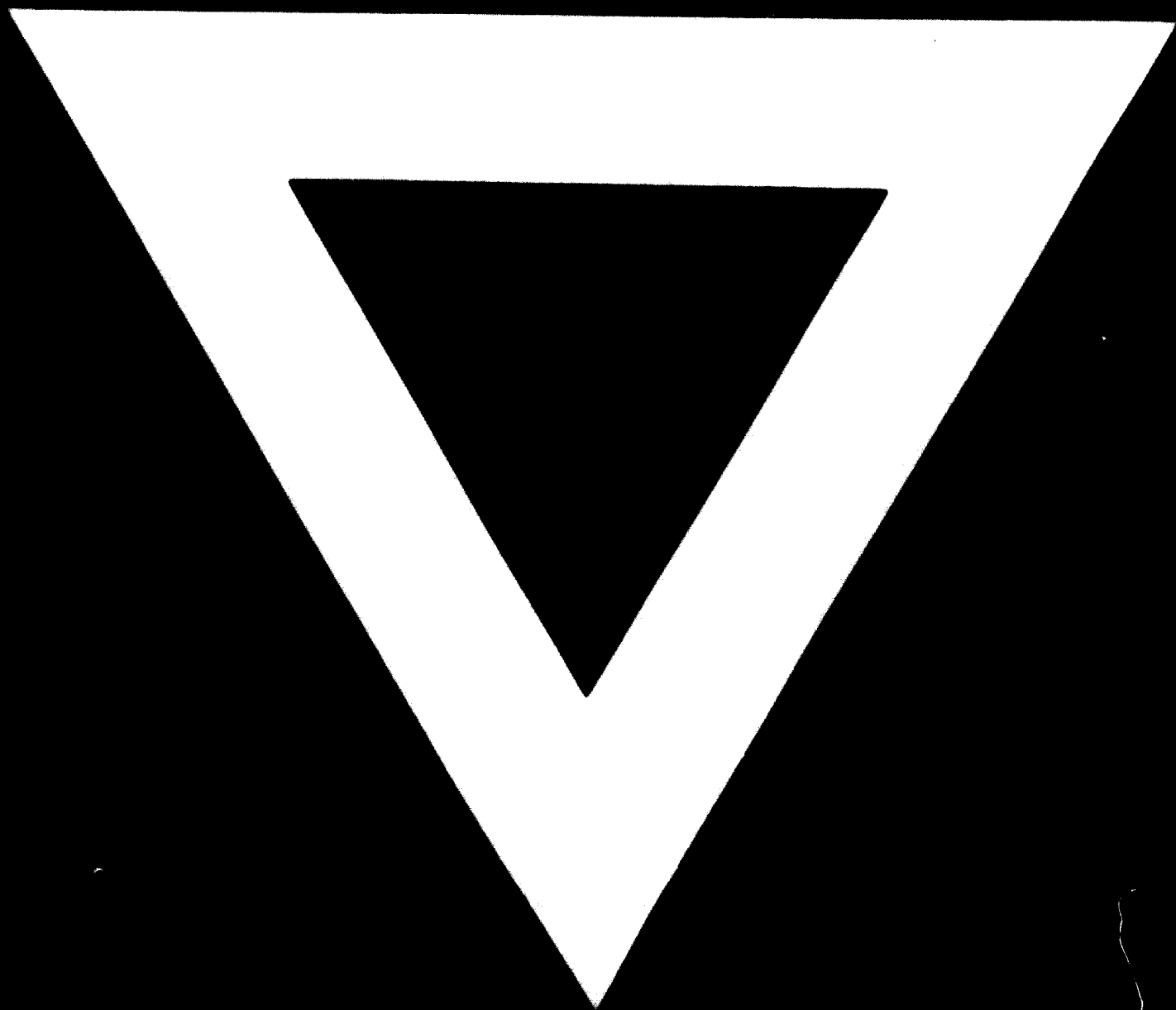
Today's situation is very different: the advances obtained in general design and steel plant engineering are evident. Paz del Rio, for instance, is doing engineering for important projects such as the coke plant by-products plant, and the modernization of the blast-furnace blast air system, for which a foreign company verified and approved the blue-prints. Civil engineering design can be made in the country and for the mechanical, electrical, and structural installations there are various competent national firms. These companies, working under the direction and supervision of supplier's specialists, are taking care of important jobs in different industrial outfits.

For the fabrication of steel industry equipment the country has a series of workshops that could take care of important jobs. Nevertheless, they require the designs but, as it was said before, in most of the cases these designs are impossible to obtain. The production of certain ancillary equipment such as boilers, fans, crushers, conveyor belts, pumps and small electrical motors and compressors is being made by an important sector of the national industry. Nevertheless, these companies and workshops do not have enough financing facilities which would allow the buying companies to obtain the equipment in similar conditions to those offered by foreign outfits, that is, with dead periods and long-term payments. It could be affirmed that the supply of capital goods originated within the country depends more on the financing than on technological resources.

So far as research is concerned, there is very little being done in the country; one could only mention some research made by the universities having metallurgical faculties, by the National Institute of Technological Research, and by Paz del Rio. This company makes some research in the field of imported raw-materials substitution such as dolomite and research for the improvement of the coke quality by decreasing the low-volatile coal used in the coal mix sent to the coke battery.

What has been mentioned above does not mean that there is not interest for the new technological development. On the contrary, it is evident the interest shown by the companies and the management for being up to date in know-how looking always forward for any new developments that could be used in their installations with the care demanded by the lack of economical resources of a developing country which can not risk adopting technology not sufficiently proven. This makes the dependance on foreign technology which can be obtained through a consulting company or through the equipment manufacturing or producing companies a necessity.





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