

Issued provisionally at
the Bogotá Meeting as
ST/ECLA/CONF.1/L.O
February 1953

ENGLISH
ORIGINAL: SPANISH

A D D E N D U M 5

Note: This document is based on the paper presented to the Expert Working Group on Iron and Steel Industry in Latin America, by Ingeniero Ramón Suárez of the Empresa Siderúrgica Nacional de Paz de Río, Colombia, in collaboration with the United Nations Economic Commission for Latin America, under the symbol ST/ECLA/CONF.1/L.O

BRIEF OUTLINE OF STEEL INDUSTRIES
IN SOME LATIN-AMERICAN COUNTRIES

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/CHILE

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L A T I N A M E R I C A



BRIEF OUTLINE OF STEEL INDUSTRIES IN SOME LATIN-AMERICAN COUNTRIES

INTRODUCTION

The purpose of this paper is to give a brief outline of existing iron and steel industries and resources in some Latin-American countries, viz: Argentina, Brazil, Chile, Colombia, Mexico, Peru and Venezuela. They comprise nearly 87 per cent of the area and about 81 per cent of the total population of Latin America. Three of them — Brazil, Chile and Mexico — already have integrated steel plants; Argentina has a well-developed rolling industry; integrated plants are being built in Colombia and Peru, while pertinent studies are being conducted in Venezuela.

Broadly speaking, Latin America has plenty of high-grade iron ore and a considerable supply of cheap labour which could easily be trained for steelmaking. With some exceptions, the market at present is small, although it tends to expand rapidly. But the shortages of capital and of good coking coal are two main deterrents to steelmaking.

A brief summary is given, for each of the countries, of the extent and quality of iron ore and coal reserves, the main features of existing or projected iron and steel plants, and some indications concerning the size and location of domestic markets. No special mention is made of minor raw materials, such as limestone.

The tables below summarize income, wages, present steel consumption, recent production of finished steel and future prospects thereof in the seven countries.

/Table 1

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Table 1 Income, Wages and Steel Consumption in some Latin American Countries

Countries	a/ Population (Thousands of inhabitants)	National Income (1948 dollars per capita)	c/ Wages (1948 dollars per hour)	b/ Steel Consumption Total (thous. of tons)	d/ Per capita (kgs.)
Argentina	17,100	365	0.57	1,200	70
Brazil	52,600	120	0.53	870	17
Chile	5,800	200	0.44	206 d/	35
Colombia	11,300	140	0.60	160	15
Mexico	25,400	130	0.49	600	24
Peru	8,330	105	0.41	60	7
Venezuela	5,000	340	2.00	400	80

a/ According to the United Nations Statistical Yearbook 1949/50

b/ Average wages paid in the petroleum or steel industries of the respective countries.

c/ Figures comprise finished steel, including wire, tubes and other simple steel products. Steel contained in machinery and equipment has been omitted.

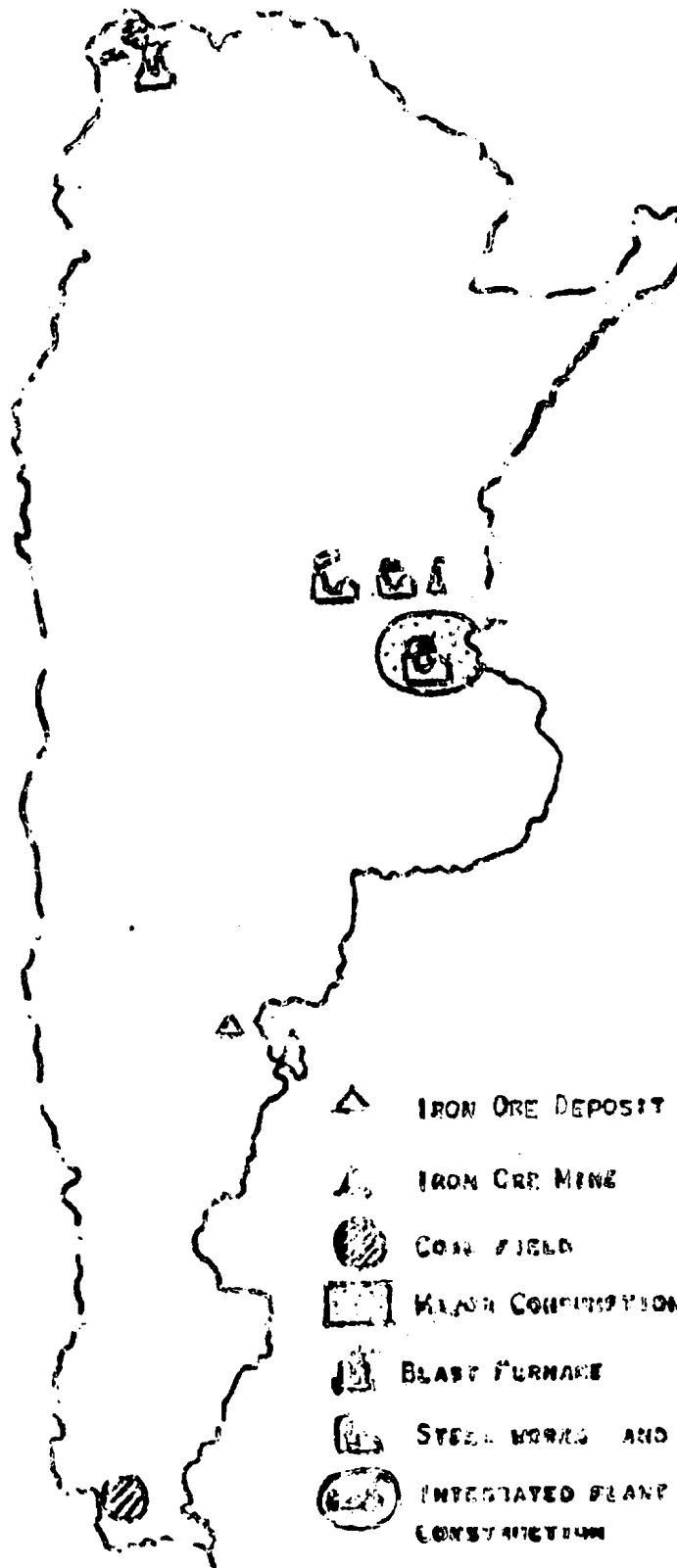
d/ Consumption of 1951

Table 2 Production of Finished Steel and 1955 Forecast

Countries	(thousands of tons)			Forecast for 1955
	1940	1946	1951	
Argentina	4.5	116.0	300.0 ^{a/}	700
Brazil	141.2	342.6	700.0	1,500
Chile	23.0	32.6	148.0	250
Colombia	-	-	3.0	110
Mexico	130.1	268.3	400.0 ^{a/}	700
Peru	-	-	-	53
Venezuela	3.0 ^{a/}	3.0 ^{a/}	4.0 ^{a/}	..
Total	301.8	762.5	1,555.0	3,313

a/ Estimates

ARGENTINA



IRON ORE DEPOSIT



IRON ORE MINE



COAL FIELD



HEAVY CONCENTRATION ZONE



BLAST FURNACE



STEEL WORKS AND ROLLING MILL



INTEGRATED PLANT UNDER
CONSTRUCTION

ARGENTINA

1. General Background

Argentina's market for iron and steel is exceptional for Latin America. Since the war, imports have ranged between 600 and 800 thousand tons a year, while estimated domestic production has exceeded 300 thousand tons. Thus consumption of finished steel products^{1/} is about 1,100,000 tons annually, representing close to 70 kilogrammes per inhabitant.

Considering the prevailing difficulties for obtaining basic raw materials and limitations in foreign exchange availabilities to pay for imports, which Argentina shares with most countries in the region, potential demand may be much greater.

A high percentage of total consumption exists in the Buenos Aires and Rosario zones, the most industrialized and where a large proportion of constructional steel is used.

2. Iron Ore

Argentina's position for iron ore supplies has recently shown a marked improvement. Pre-war surveys led to pessimistic conclusions, but deposits since mined at Cerro de Zapla (to the North-west of Jujuy Province) have estimated reserves exceeding 200 million tons, with an average grade of 48 to 50 per cent. Production in 1950 was about 58 thousand tons.

Prospects of further improvement are due to the discovery of a deposit at Sierra Grande (Río Negro Territory), close to the sea, some 1,000 kilometres south of Buenos Aires. Present estimated reserves are about 80 million tons of 55-57 grade iron ore.^{2/}

Another deposit being prospected is at Sapita, on the Chilean border.

^{1/} For the purpose of this paper, the expression "steel products" refers to the products of the rolling mill and the primary transforming industries, thus excluding steel contained in manufactured goods, equipment, etc.

^{2/} Report from Fabricaciones Militares Argentinas to the World Geology Congress at Algiers, September 1952.

3. Coal

The largest coal formation is at Río Turbio, in the south, with proven reserves of about 250 million tons and some 350 million of probable reserves.

The quality of this coal may be judged from the following comments by Engineer Luis Calliari:^{1/}

"Río Turbio coal, according to A.S.T.M. classifications, range from sub-bituminous A to bituminous high-volatile C. A typical analysis of run-of-mine coal from the Dorotea bed is as follows:

Moisture	7.72 per cent
Volatile matter	30.62 per cent
Fixed carbon	43.72 per cent
Ash	17.94 per cent
Upper heating value	5,768 calories
Total sulphur	1.5 per cent ^{2/}

A washing plant is projected to reduce the ash content. Poor transport facilities, which prevented large-scale production, were overcome by a 260 kilometre railway to the Atlantic port of Río Gallegos. Previously, production was low, about 20 thousand tons a year, for domestic consumption. Output for 1952 was forecast at 400 thousand tons, while future production is expected to reach the two million ton mark.

4. Steel Industry

Although Argentina's position for basic raw materials was considered unfavourable, it has been no obstacle to the development of rolling mills. Their main raw materials are: about 150 thousand tons of scrap a year, supplemented by about 40 thousand tons of charcoal pig iron from Zapla, and

^{1/} "El yacimiento Presidente Perón, en la cuenca carbonífera del Río Turbio". Lecture given at the Buenos Aires Faculty of Economic Sciences, Faculty Review, October 1951.

^{2/} The Dorotea bed contains about 70 per cent of the proven reserves of the formation.

also by imports of pig iron and steel billets (over 180 thousand tons in 1951).

Total steel production for 1951 was estimated at over 300 thousand tons.

The National Steel Plan provides for Zapla's expansion up to a capacity of 150 thousand tons of rails, bars and shapes, not including plate, and for the installation of a plant at San Nicolás, with an annual capacity of 500 thousand tons of finished steel.

Two alternatives have been envisaged for the production of blast furnace coke: either to import all the coking coal required, or to use a blend of Río Turbio coal and imported low-volatile coking coal. There would also be the possibility of importing rich iron ore from the Brazilian deposit of Urucum (Corumbá), on the upper Paraguay river, or from Mutum, in Bolivia, on the other bank. In either case, the Paraguay, and probably also part of the Paraná river, would have to be dredged for a considerable distance.

/BRAZIL

BRAZIL

1. General Background

Steel consumption has considerably increased, rising from an annual average of about 400 thousand tons in the years 1935-39 to over 660 thousand tons annually during 1945-49; in 1950 it exceeded 870 thousand tons. Domestic steel production has multiplied fivefold since the pre-war years. Nevertheless, per capita consumption is still low, the 1950 figure being less than 17 kilogrammes.

Consumption centres around Sao Paulo and Rio de Janeiro, where most of the new steel transforming industries are located and where the building activity is highest.

2. Iron Ore

Brazil's National Geological Service estimated in 1937 that the iron ore reserves in Minas Gerais State alone amounted to about 15 thousand million tons; there are also large reserves in other parts of the country, such as the Urucum deposit in Corumbá. On the basis of these estimates, Brazil has about one sixth of the probable world's total reserves.

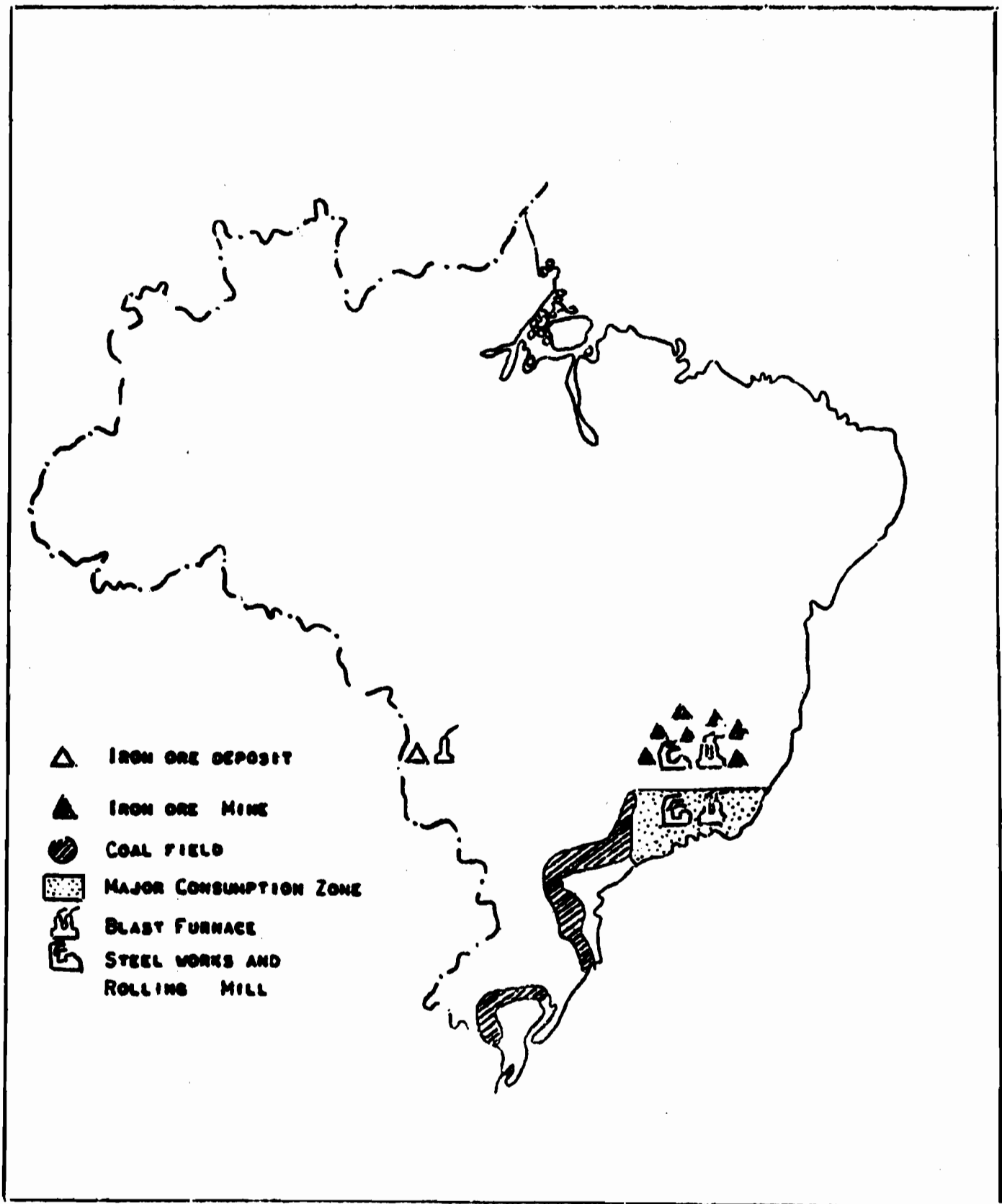
As regards quality, the ores found in Minas Gerais are among the best in the world. Exports in 1949 (675 thousand tons) had an average grade of 68.78 per cent of iron and 0.017 of phosphorous. Reserves of this high-grade ore, known as "compact hematite", in Minas Gerais exceed 1,000 million tons, mostly in deposits suitable for open-pit mining.

There are other high-grade ores, such as "jacutinga", which, although more brittle and with a higher phosphorous content, have been successfully used after sintering; and silicious "canga", very porous, with a considerable moisture content, containing approximately 55 per cent of iron, 11 per cent SiO_2 , and varying quantities of phosphorous. This "canga" ore is blended with hematite to increase silicon in the blast furnaces, particularly in those operating on charcoal.

3. Coal

Brazil's principal coal mines are in the southern States of Santa Catarina, Rio Grande do Sul, Paraná and Sao Paulo, with reserves very
/conservatively estimated

BRAZIL



conservatively estimated at about 500 million tons. The largest known deposits are in Santa Catarina, where the Companhia Siderurgica Nacional produces the local coal for its Volta Redonda Plant.

The coal is classified as low to medium volatile bituminous,^{1/} with such a high ash and sulphur content that two very different types of coal have to be produced in the washing plant, i.e. a cleaner fraction amounting to about 30 per cent of the total, which is blended with imported coal to produce metallurgical coke, and the remainder, with a very high ash content, used as steam coal. Coking coal is costly due to mining difficulties and to the small proportion recovered as metallurgical coal. Moreover costs are increased by transport as the deposits are far from the steel plant.

There are other coal reserves in the Piaui zone, in the north and in the State of Pará; both are too far away from the consuming centres to be considered.

4. Steel Industry

Brazil is the largest steel producer in Latin America, and is planning a substantial expansion of present facilities and construction of new plants. Once these plans are completed, probably within three years, production will exceed a million and a half tons of finished steel annually.

In 1951 output slightly exceeded 700 thousand tons, about two thirds of it being produced by two large companies, Companhia Siderurgica Nacional, owning the Volta Redonda plant, and the Companhia Belgo-Mineria, with plants at Monlevade and Barbansón.

Volta Redonda is the only plant operating on coke, blending at present about 30 per cent of domestic with 70 per cent of imported coal. Belgo-Mineria, like the remainder, operates on charcoal. Most of these plants are located in Minas Gerais, with the advantage of the proximity of forests and iron ore.

^{1/} The Coal Industry of Brazil (United States Department of the Interior), Technical Paper 713.

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The smaller plants usually confine their activities to producing charcoal pig iron, of which Brazil is the world's largest producer.

In Sao Paulo, several re-rolling mills use the available scrap and benefit by their location close to the main markets.

Volta Redonda's present expansion plans include a million ton production of crude steel by 1957. In 1951 finished steel output amounted to:

Rails and accessories	42,000 tons
Bars and shapes	78,000 tons
Heavy bars	46,000 tons
Plate	133,000 tons
Tinplate	<u>43,000 tons</u>
	342,000 tons

Output for 1952 was estimated at 360 thousand tons, which will rise to 460 thousand tons a year when present expansion plans are completed.

Belgo-Mineria's production in 1951, apart from charcoal pig iron, totalled 172 thousand tons of crude steel, mainly bars, wire, galvanized sheet and tubes. Expansion plans envisage doubling the present output. In addition, the company has embarked upon a vast re-forestation programme to ensure future charcoal supplies.







Next in size, with an annual capacity of 55 thousand tons of special steels, is the Companhia Aços Especiais Itabira (Acesita), producing stainless steel sheets and bars, high silicon steels and other special steel products.

Some of the important new projects being carried out are:

- a) an integrated steel plant at Belo Horizonte for the manufacture of seamless tubes, with an initial capacity of 100 thousand tons a year, rising to 500 thousand tons;
- b) an integrated 250 thousand ton plant for assorted steel products at Sao Paulo, and another of similar capacity at Santos; both will probably use metallurgical coke, but the possibility of using an electric reduction furnace is being considered at one of them.

/CHILE

CHILE

-  IRON ORE DEPOSIT
-  IRON ORE MINE
-  COAL FIELD
-  MAJOR CONSUMPTION ZONE
-  BLAST FURNACE
-  STEEL WORKS AND ROLLING MILLS



CHILE

1. General Background

Until 1949, Chile imported most of its steel supplies, but those from domestic sources have increased considerably, since 1950, when the Huachipato plant entered production. Consumption in 1951 was about 200 thousand tons of finished steel, of which 113 thousand were domestically produced and 93 thousand tons were imported, as compared with imports of 110 thousand tons in 1947.

Santiago, the capital, is the main consuming centre, although new steel transforming industries are being installed around the steel plant.

2. Iron Ore

Chile's iron ore reserves, exceeding 50 per cent grade, are estimated at between 250 and 450 thousand tons. The principal deposits, explored with a view to export, are located in the North in a belt running close to the coast.

El Tofo, in Coquimbo Province, is the only deposit now being worked, mainly for export to the United States, as only a small quota of its output is delivered to the two domestic blast furnaces. It is owned by a French company and worked by the Bethlehem-Chile Iron Mines Company.^{1/} Nearly 40 million tons have been extracted since 1914, 97 per cent of which has been exported. This deposit is now nearing exhaustion.^{2/}

About 50 kilometres south of El Tofo, Bethlehem-Chile Iron Mines Company owns a deposit known as "El Romeral", with proven reserves of 20 million tons, and the following analysis:

Fe	63.25
Si ₂	5.24
P	0.245

Development work is under way so that deliveries may start in 1953 and gradually replace El Tofo's diminishing production.

^{1/} A subsidiary of Bethlehem Steel Company.

^{2/} It is expected to last until 1956-57 for commercial working.

3. Coal

The Tertiary Age coal-beds in the Gulf of Arauco are the most important from the standpoint of quality and quantity.^{1/}

Lota and Schwager are the largest mines, producing 85 per cent of the coal mined in the country. An interesting feature is that seams run under the sea, present working faces being located about 6 kilometres from the coast. Test drillings south of the Gulf prove the continuity of the beds, so that total reserves may be estimated at a minimum of 300 million tons. The coal has the following analysis:

	Moisture	Ash	Fixed carbon	Volatile matter	Ash and moisture-free coal			Specific gravity
					Car- bon	Vol. mat.in free coal	Upper heating value, calories	
	%	%	%	%	%	%	%	%
Lota	2.38	5.06	51.1	41.5	55.2	44.8	8,010	1,270
Schwager	<u>2.77</u>	<u>4.41</u>	<u>52.3</u>	<u>40.4</u>	<u>56.4</u>	<u>43.6</u>	<u>8,370</u>	<u>1.285</u>

During 1951 these mines produced about two million tons. To increase production and reduce extraction costs, both mines contemplate mechanization, with aid from the International Bank for Reconstruction and Development

Further to the south there are higher bituminous coals and lignites, those of Magallanes being the largest formations, total reserves of which are estimated at several thousand million tons.

4. Steel Industry

The first blast furnace was installed in 1914, at the southern port of Corral, using the Prudhomme process, where fresh wood was the reducing and heating agent.^{2/} This blast furnace, transformed to charcoal in 1938, is now operated by the Company owning Huachipato. Production in 1951 was about

^{1/} This led the Compañía de Acero del Pacífico to install its Huachipato plant nearby.

^{2/} This process was not economic, due mainly to the extremely high moisture content in the region's timber. Another problem was the limited Chilean market at that time. The plant was shut down after a few months' operation.

20 thousand tons of pig iron, using a blend of about 25 per cent of Huachipato metallurgical coke and charcoal. Output will shortly be increased to some 29 thousand tons per year.

The Huachipato plant is using coke made from a blend of about 36 per cent low-volatile American coal and 64 per cent Chilean coal.

Production of finished steel in 1951 was as follows:

Bars, light shapes, wire rod and strip	74,700 tons
Plate, sheet, black and galvanized, and tinplate	<u>51,600 tons</u>
	126,300 tons

The plant is currently being expanded to raise ingot capacity from 180 thousand to 280 thousand tons a year.

Before Huachipato began operations, there were four small rolling mills in the country. The one at Corral with open hearth furnaces using charcoal pig iron and scrap, was shut down as uneconomic, only the blast furnace remaining in operation. The other three, re-rolling scrap, were located in Santiago. One has now ceased operations and the other two have been slightly expanded. These are: Fábricas y Maestranzas del Ejército, with a 16 thousand ton capacity of bars, but producing only 6 thousand a year, and Establecimientos Metalúrgicos Indac, with 24 thousand tons capacity, but producing only 16 thousand tons of bars a year.

/COLOMBIA

COLOMBIA

1. General Background

Post-war imports of steel have ranged from 100 to 160 thousand tons annually, with a maximum per capita consumption of 15 kilogrammes. This represents a considerable increase over any other previous period, but is still low compared with other Latin-American countries.

The main consumption centres are the industrial city of Medellín, and Bogotá, the capital.

2. Iron Ore

Several deposits are known to exist, but complete information is available only for that of Paz de Río. Proven reserves there amount to about 100 million tons, of which 20 million have been blocked out, giving the following average analysis:

Fe	48.2 per cent
P	1.2 per cent
SiO ₂	8.0 per cent
Calcination losses	11.5 per cent

Some small high-grade iron ore deposits with low phosphorous content also exist in the neighbourhood for production of foundry pig iron.

Other large deposits near Medellín, are only about 35 per cent grade, and also contain chromium and nickel.

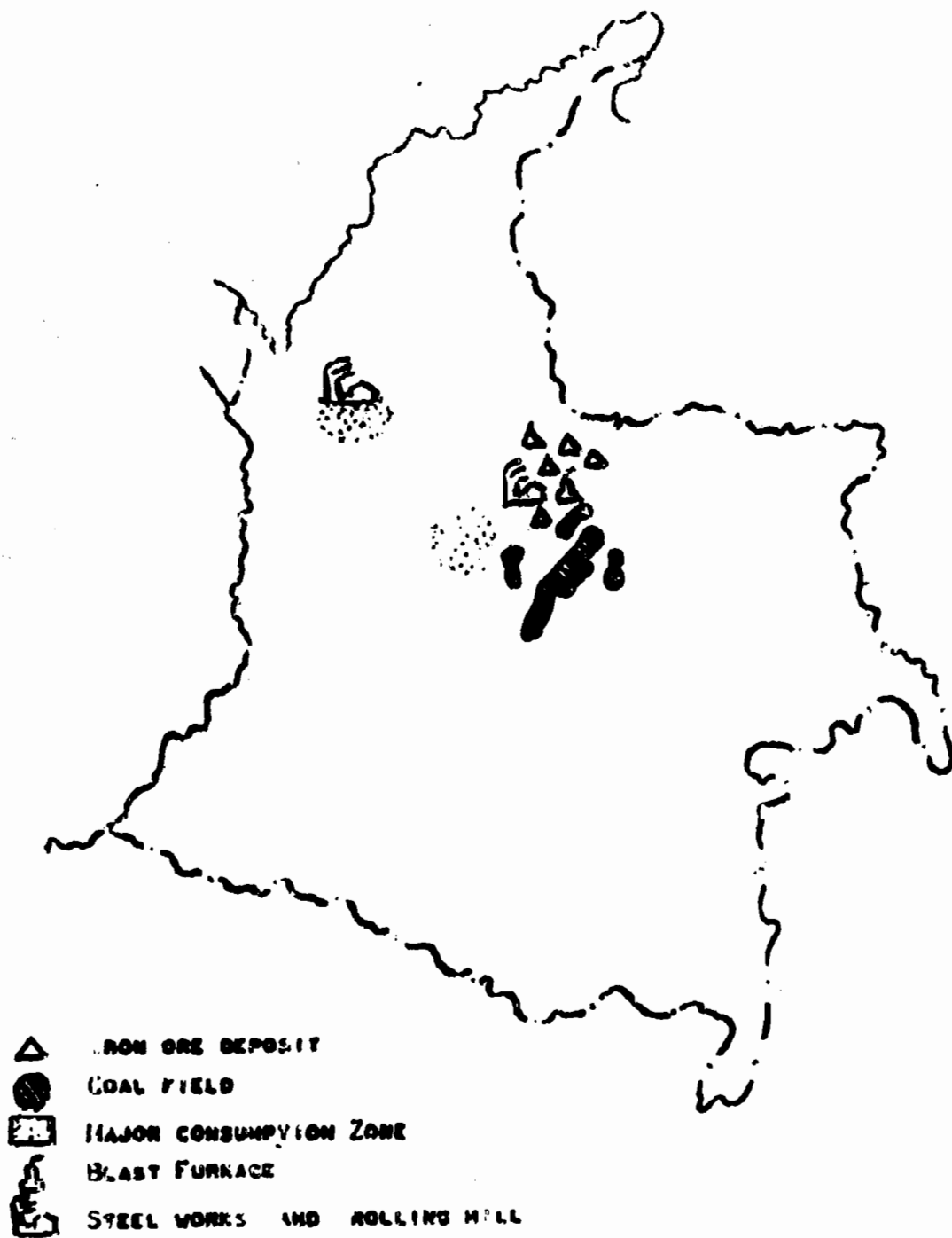
3. Coal

Total coal reserves are estimated by the National Geological Service at 12,000 million tons, of a great variety of types and qualities. Most of them have a high heating value and, in addition, some are suitable for coking. Production at present is only about one million tons a year.

Proven reserves of coking coal around Paz de Río are about 18 million tons, estimated probable reserves exceeding 130 million. Qualities range from high and medium to low-volatile bituminous; the analysis, according to A.S.T.M. classifications, is as follows:

/Proximate Analysis

COLOMBIA



<u>Proximate Analysis</u>	<u>High-Volatile Group "B"</u>	<u>Medium to High- Volatile Group "A"</u>	<u>Low to Medium- Volatile</u>
Moisture	1-4 %	1-4 %	1-4 %
Volatile matter	35-42%	28.35%	18-25%
Fixed carbon	44-55%	52-60%	66-76%
Sulphur	0.7-1.6%	0.7-1.6%	0.4-1.0%
Ash	6-10%	6-15%	0.4-1.0%
Heating value	12,500-13,500 BTU	13,500-14,500 BTU	14,000-15,000 BTU

4. Steel Industry

At present, a scrap re-rolling mill exists at Medellín; although its capacity is about 15 thousand tons, it produces only 4 thousand tons of bars a year.

The Paz de Río plant already under construction will have an initial capacity of about 100 thousand tons of bars, wire rod, wire, light shapes and rails. Flats will not be produced at the start, but have been considered as a later development.

The blast furnace will have a rated daily capacity of 500 tons of pig iron, Thomas converters being used for steelmaking.

All the important raw materials are found within a 50 kilometre radius of the plant, but the mountainous terrain of Colombia will constitute a problem for the transport of finished products. It has, however, been proved that the total expenditure involved in distributing Paz de Río steel products within the country will be lower than those corresponding to distribution of imported steel from the ports to the interior.

/MEXICO

MEXICO

1. General Background

Per capita steel consumption is only slightly higher than that of Brazil. Post-war steel imports have fluctuated considerably, being at their lowest in 1948 and 1949, when they stood at 170 thousand tons, while in 1947 and 1951 they exceeded the 300 thousand ton mark. The two largest domestic steel plants, Monterrey and Monclova, from a total of eight, produced over 200 thousand tons a year. As substantial imports continue, total consumption exceeds 650 thousand tons of finished steel. A high percentage of the consumption is centred around the Federal District.

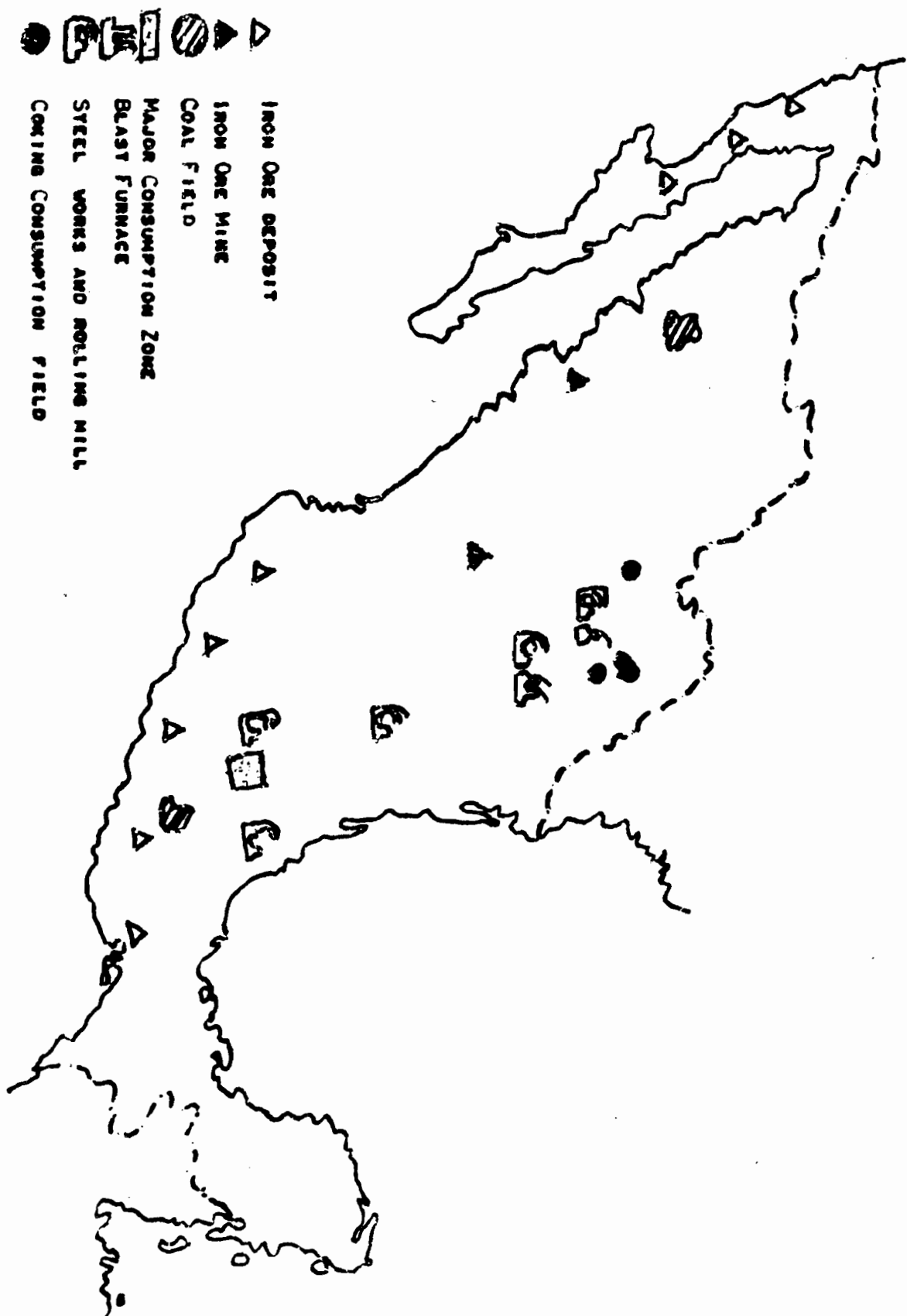
2. Iron Ore

Estimates of iron ore reserves vary considerably, but according to information from the Sociedad Mexicana de Geografía y Estadística^{1/} total reserves should be about 230 million tons, distributed geographically in five groups:

- a) Northern Group: includes deposits at present supplying the Monterrey and Monclova plants; they are located fairly close to the coking coal formations. The largest is that of Cerro de Mercado, with estimated reserves of 50 million tons of 60 per cent iron ore and 0.30 per cent of phosphorous. Total reserves for this northern group are estimated at 75 million tons.
- b) Northern Pacific Group: located mainly near the coast, with no present transport facilities; they are estimated to exceed 47 million tons. The largest deposit of this group, "El Volcán", with about 7 million tons of 66 per cent grade iron ore, but with a high phosphorous content.

^{1/} Bulletin, July-October 1949.

MEXICO



- c) Central Pacific Group: this is probably the largest potential source of iron ore. Reserves at the Maney deposit are estimated at some 20 million tons of 60 per cent ore, with low phosphorous and sulphur contents; the Aguila deposit has also 20 million tons of high-grade reserves.
- d) Southern Group; information is still incomplete, but the largest deposit is at Zaniza, with reserves estimated at 20 million tons.
- e) Central Group: composed of small deposits such as those at Tatalila and Las Minas, with estimated reserves of 6 to 8 million tons of high-grade ore, located close to existing communications.

3. Coal

To the Mexican steel industry the most important coal formation is the "Cuenca de Sabinas" in Coahuila, which up to now has provided all coking coal. Its estimated reserves are about 1,000 million tons.

Other reserves are difficult to assess, since only a few formations have been prospected, and estimates vary considerably. The following estimate, in millions of tons, was taken from La Industria Siderúrgica en México, a study made by a group of engineers and economists:^{1/}

Bed	Conservative Estimate		Maximum Estimate	
	Total Coal	Coking Coal	Total Coal	Coking Coal
Sabinas	1,000	1,000	1,300	1,300
Lampacitos	260		260	
Esperanzas	160	80	200	100
Santillito	165	80	200	100
Fuente	90	90	300	300
Blas				
San Patricio	<u>500</u>	<u> </u>	<u>1,000</u>	<u> </u>
	2,175	1,250	3,260	1,800

^{1/} Joaquín de la Peña, Laszlo Radvanyi, Jorge Heyser, José Crowley, Eli Cami and Alberto Frost.

/The largest

The largest deposits within the "Cuenca de Sabinas" formation are those of Rosita and Palau, with the following average analysis:

	Rosita Coal		Palau Coal	
	Run-of-mine %	Washed %	Run-of-mine %	Washed %
Volatile matter	21.5	24.5	19.8	21.6
Fixed carbon	50.4	60.5	54.5	61.2
Ash	28.1	15.0	25.7	17.2
Sulphur	1.0	0.8	1.25	1.0

4. Steel Industry

Mexico has the oldest steel industry in Latin America. The largest plant is at Monterrey, which has been in operation since 1903. Although this company has two blast furnaces, with a total capacity of 290 thousand tons of pig iron per year, and steelmaking facilities for 180 thousand tons of steel ingots, production has been considerably lower, mainly due to transport difficulties for raw materials.

Production in 1951 was as follows:

Rails and fishplates	22,200 tons
Bars and shapes	80,000 tons
Chromium steel bars	1,700 tons
Wire products	11,000 tons
Nails, screws, nuts, etc.	<u>3,000 tons</u>
	117,900 tons

Next in size is the Monclova plant, which entered production in 1945 and reached the following output by 1951:

Tinplate	13,700 tons
Black sheet	52,600 tons
Plate	39,300 tons
Welded pipe	<u>11,700 tons</u>
	117,300 tons

There are smaller rolling mills in various parts of the country, using scrap and/or imported billets. The largest are either near Mexico City or the United States border, whence scrap was imported. La Consolidada is the
/most important

most important, with plants in the capital and at the border. Overall production, including the two integrated plants mentioned earlier, is some 350 thousand tons of finished products.

Finally, Hojalata y Lámina S.A., has re-rolling mills in Monterrey and is expanding cold rolling facilities to produce tinplate. To supplement scarce steel scrap, this company installed, during 1952, a sponge iron tunnel kiln with a capacity of 12 thousand tons annually and which is to be expanded to 30 thousand tons in view of the good results obtained. This is apparently the first steel plant in Latin America to produce sponge iron on an industrial scale.

/PERU

PERU

1. General Background

Steel supplies are all imported, post-war imports having fluctuated between 50 and 80 thousand tons a year. Per capita consumption in 1949 was only about 7 kilogrammes.

2. Iron Ore

The main deposit is at Marcona, south of Lima, about 20 kilometres from the port of San Juan. Preliminary surveys gave 40 million tons of proven reserves and 170 million tons of probable iron ore reserves, the average grade being 53 per cent with 0.18 per cent phosphorous. The projected integrated steel plant at Chimbote would use this ore, and part of it will probably be exported to the western United States.

Two other deposits have been found, Tambo Grande in the north, near the coast, with reserves estimated at 20 million tons, and Huacravilca, high up in the mountains at an altitude of over 4,600 metres, with estimated reserves exceeding 70 million tons.

3. Coal

Estimated coal reserves exceed four thousand million tons, with types ranging from high-volatile bituminous to anthracites. Among the bituminous and semi-bituminous (170 thousand tons were mined in 1950) are the coking coals, which require special washing because most of them have a high ash and sulphur content. As these coal formations are located high up in the Andes, all coke produced from them until now, has been consumed by the non-ferrous metal industry, particularly by the Cerro de Pasco mines.

The Santa region anthracites are of good quality, and located on the western slopes of the Andes. Those of Ancos, Galgada and La Limeña have been explored with a view to large-scale exploitation. Several of these deposits are being worked, the coal being taken by railway to the port of Chimbote, a hundred kilometres away. Production in 1950 was about 27 thousand tons. The anthracites of this zone have been classified as meta-anthracite, anthracite, semi-anthracite and semi-bituminous coal. The following are their /average analyses:

average analyses:

	<u>Anthracite</u> ^{a/}	<u>Semi-anthracite</u> ^{b/}
Volatile matter	3.5 to 3.7	8.0 to 12.0
Moisture	1.0 to 3.5	2.5 to 4.0
Fixed carbon	87.0 to 89.0	80.0 to 85.0
Ash	4.0 to 9.0	6.0 to 10.0

^{a/} Includes the meta-anthracites.

^{b/} Includes the semi-bituminous coal.

4. Steel Industry

To-day Peru has no steel industry, but an integrated plant is now under construction at Chimbote, with a total annual capacity of 53 thousand tons, of which 38 thousand will represent bars, light shapes, wire, etc., and the remainder sheet.

Pig iron production with Tysland-Hole electric reduction furnaces is contemplated for this project, electric furnaces to be also used for steelmaking. Anthracite will be employed as a reducing agent, either as such, or as coke made with a blend of asphalt.

/VENEZUELA

Issued provisionally at
the Bogotá Meeting as
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1. General Background

Per capita consumption of steel is high in Venezuela. Post-war imports have increased considerably, rising from about 200 thousand tons in 1946 to 500 thousand tons in 1949. Tubes for the petroleum industry constitute a large percentage of imports, amounting to over 260 thousand tons in 1949.

2. Iron Ore

Venezuela has large iron ore reserves, the best known ones lying along the Caroni river, near its junction with the Orinoco.

The search for new deposits continues, but figures for those already explored may be summarized as follows:^{1/}

High-grade ore (55 to 65 per cent of iron)

Proven reserves	477 million tons
Probable reserves	670 million tons

Low-grade ore (40 to 55 per cent of iron)

Proven reserves	125 million tons
Probable reserves	1,000 million tons

The El Pao deposit, with proven reserves of 70 million tons of high-grade ore, has been worked since 1951, the output being exported to the United States; Cerro Bolívar ores, with 400 million tons proven reserves, is being developed for large-scale export production. There are also other deposits, such as Cerro San Isidro near Cerro Bolívar, held as a national reserve by the Government, with partly explored reserves of 100 million tons.

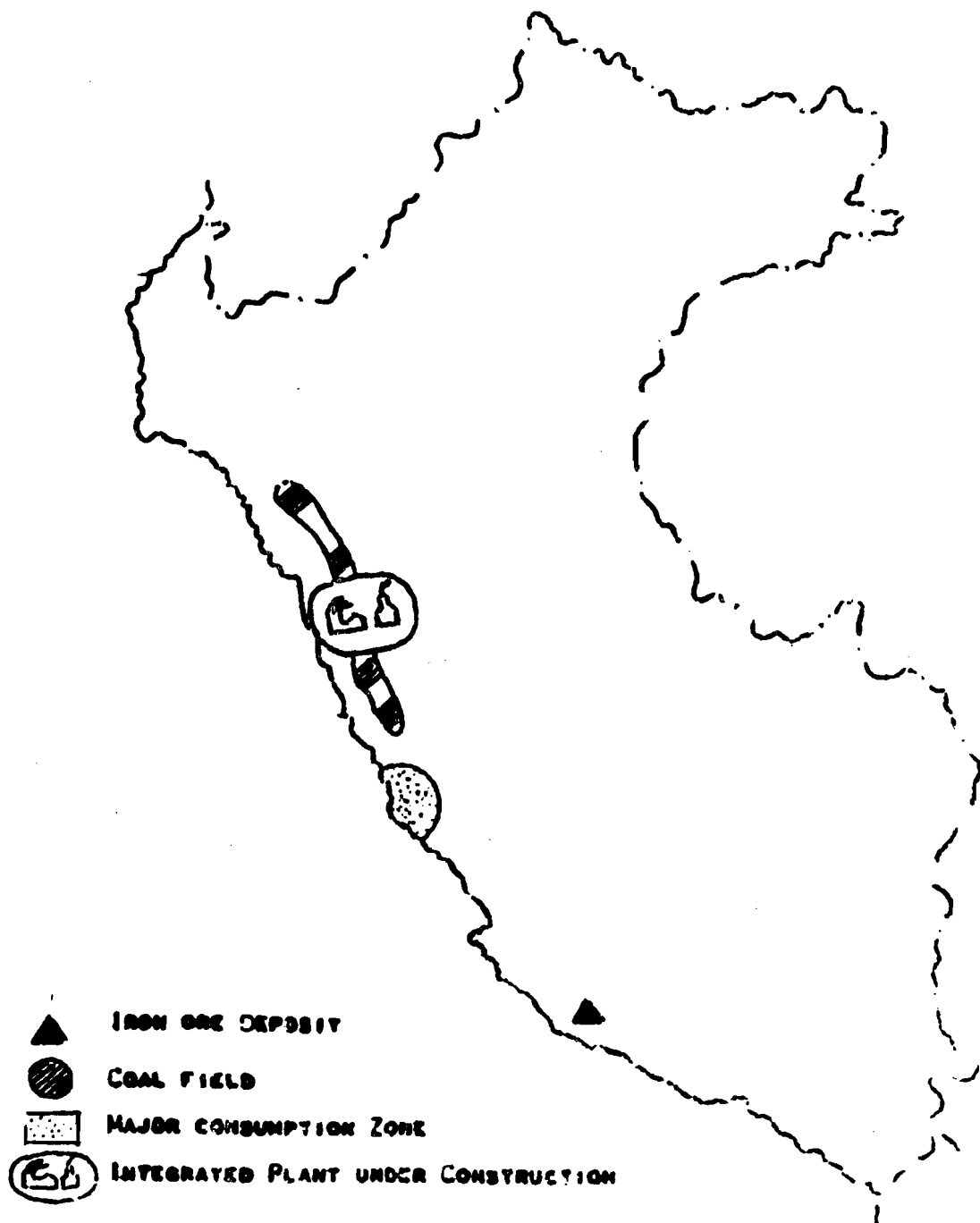
3. Coal

Due to Venezuela's vast petroleum resources, little exploration of coal deposits has been made. Those of Naricual (Anzoategui State) and Coro (Falcon State), in the central region, have been mined until recently. It is estimated that this area contains several hundred million tons of high-volatile bituminous A and B types of coal. Previous tests have indicated

^{1/} Revista de Hidrocarburos y Minas, Ministerio de Fomento, June 1950.

/that these

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that these are non-coking, but such results should not be taken as final since there is no certainty of the actual value of the samples tested.

4. Steel Industry

Benefiting from the abundance of scrap, Venezuela has produced about 8 thousand tons a year of bars, etc. for construction, using a small electric furnace to melt the scrap.

For some time consideration has been given to the development of an integrated steel industry, but as yet no final plans have been reached. Many solutions have been proposed for the production of pig iron, such as using the surplus gas from the nearby "Oriental" petroleum district; electric furnace reduction, using power potential from the Caroni river; blast furnaces using metallurgical coke made from petroleum residues or from natural asphalts, or, finally, coke made with imported coking coals, taking advantage, if possible, of the return loads of ore export ships.

VENEZUELA



△ IRON ORE DEPOSIT

▲ IRONORE MINE

● COAL FIELD

⊞ MAJOR CONSUMPTION ZONE

⌒ STEEL WORKS AND ROLLING MILL

⌒ INTEGRATED PLANT UNDER CONSTRUCTION