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IRON AND STEEL INDUSTRY OF DEVELOPING COUNTRIES

(The survey has been compiled in accordance with the UNIDO order No IE 69/2)

MOSCOW
1969

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CENTRAL RESEARCH INSTITUTE OF INFORMATION AND TECHNICAL
AND ECONOMIC INVESTIGATIONS OF THE IRON AND STEEL INDUSTRY
under
THE MINISTRY OF THE IRON AND STEEL INDUSTRY OF THE USSR

IRON AND STEEL INDUSTRY OF DEVELOPING COUNTRIES

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M.KULESHOV
Director of the Institute

M O S C O W
1969

C O N T E N T S

F O R E W O R D

The survey "Iron and Steel Industry of Developing Countries"has been prepared by the Central Research Institute of Information and Technical and Economic Investigations of the Iron and Steel Industry under the Ministry of the Iron and Steel Industry of the USSR as per contract concluded with the United Nations Industrial Development Organisation (UNIDO).

The survey characterizes the development of iron and steel industry in Latin America, Asia and Africa for the period of 1955 to 1967, and contains certain forecasts for the neareat future.

The literary sources available in the U.S.S.R., materials of the UNO, the shorthand records of reports made at the Second Symposium held in Moscow (September-October 1968), as well as separate documents furnished by the UNIDO to the Institute were used when preparing the survey.

The survey is composed of the following parts:

1. General characteristic of iron and steel industry of developing countries (Chapter I);
2. Technical progress in iron and steel industry (Chapter II);
3. Iron and steel industry of separate countries according to continents and regions (Chapters III-VI);
4. Foreign trade and consumption of ferrous metals in developing countries of Asia, Africa and Latin America (Chapter VII); and
5. Conclusions.

The survey on the iron and steel industry of separate countries was as a rule carried out according to the following pattern: raw materials, production of ferrous metals, iron and steel works, consumption of ferrous metals, and foreign trade in ferrous metals.

The Institute was faced with certain difficulties arising from the fact that a shortage of adequate materials on a number of questions, and some inconsistency of the available data occured in the course of preparing the survey.

This especially pertains to tabular data as given in the present survey. This is why in some cases aeparate columns are not completely filled by the Institute.

This is also responsible for the development of ferrous metallurgy in separate countries to be described not sufficiently amply, and for the volume of the reported material to be not always on a level with the importance of respective countries.

CHAPTER I

GENERAL CHARACTERISTIC OF IRON AND STEEL INDUSTRY OF DEVELOPING COUNTRIES

Many developing countries of Asia, Africa and Latin America started their industrialization programmes in the period of 1955 to 1967.

The industrial output of the developing countries increased by 75 %, including the output of process industries by 67%, over 1958 to 1965. New branches of industry have been originated in a number of countries. Some countries are in the course of developing the domestic production of capital goods. The output of ferrous metals has substantially increased. Large fully integrated iron and steel plants have been constructed in India (four plants), in the UAR (a plant in Helwan), in Tunisia (a plant in Menzel-Bourguiba), in Brazil (two plants), in Venezuela (a plant in Matanzes), in Argentina (a plant in San Nicolas), in Malaysia (a plant in Irai),etc. Many small non-integrated steel plants have been also constructed. The metallurgy of quality steels is in the progress . In Iran the construction of a first works intended for the production of large-diameter steel pipes has been completed. The output of steel made in the developing countries increased from 5.1 m.tons to 18.7 m.tons (1), while their share in the world production (excluding the USSR and other socialistic countries) increased from 2.0 to 5.3%, accordingly for the decade (1957 to 1967). The construction of the iron and steel works is carried out, and it has been announced about constructing another series of plants in the developing countries.

Some countries have expressed great interest in the development of domestic iron and steel industry which is considered as a basis for the many-sided development of the national economy as a whole.

A considerable portion of capital spent on the construction of iron and steel plants was obtained at the expense of foreign loans and credits in the developing countries. These resources were used for paying the preliminary operations and services of foreign experts, for buying machines and equipment, and for covering the expenses on training the technical personnel and skilled labour.

In many developing countries, it is the state which plays the principal role in creating the iron and steel industry. The state budget carries the main burden of expenses required for constructing plants, buying machines and equipment, whereas the firms participating in the construction operations, are given various financial, tax, and transport exemptions and privileges.

The iron and steel plants of a number of the developing countries are their state property completely or partially, because private companies prefer to invest their capitals into less expensive enterprises and in those branches of the industry, which are likely to ensure a profit within much shorter terms.

The significant difference in production levels per capita between developing and developed countries was not essentially reduced in spite of relatively high rates of the industrial production growth in the developing countries for the last decade. In this respect, the developing countries lag behind the developed countries for the industry as a whole by more than 18 times, and for the process industry by more than 23 times (2). The apparent consumption of ferrous metals per capita in the developing countries is lower than that in the advanced countries by as much as 20 to 25 times (3), being even lower as to the consumption of high-quality metals.

The developing countries differ very much from each other as to their population, area, and level of economical development. There are 112 countries classed by the UNO as developing. The population of the countries is spreaded as follows: less than 15 m. persons live in each of 91 countries and among them less than 5 m. live in each of 65 countries whereas the population of

India amounts to as high ae 511 m. pereons and that of Brazil amounts to 80 m. persons.

Brazil has the territory of 8.5 m. eq.km; India, 3.3 m. sq.km; Argentina, 2.8 m. sq.km; whereas Rwanda has the territory of only 26,300 sq.km; Lebanon, 10,400 sq.km. Such a stats as Western Samoa has the territory of 2,800 sq.km, and Maldive Islands, evsn not more than 300 sq.km.

It is poasible to dietinguieh only a small group of countries having a relatively advanced iron and steel industry, such as: Algeria, Argentina, Brazil, Venezuela, the UAR, India, Columbia, Mexico, Peru, and Chile, which are possessed of rich natural resources and in most cases an edvanced mining industry.

Argentins increased its output of steel from 200,000 to 1,300,000 tons; Brazil, from 1,300,000 to 3,700,000 tons, Mexico, from 700,000 to 3,000,000 tons, Venezusla, from 20,000 to 700,000 tons, India, from 1,700,000 to 6,600,000 tons from this group of countries in the period of 1957 to 1967. Only the afore-mentioned countries increased their total output of stesl by ee much as 11 m.tons of the total increase for all the developing countries which is equal to 13,6 m.tone over the decade.

There are about 30 countriee posseeeing small semi-integrated and non-integrated steel plants, such as Burma, Ethiopia, Chana, Guatemala, Morocco, Pakistan, Philippine, Thailand, Uruguay, etc. in addition to this group of countries.

Three types of plants are characteristic of these countries, viz. non-integrated plants with rolling shops processing imported blanks; eemi-intsgrated plants with electric steel-making shops (provided with rolling mille), processing ecrap; and non-integrated plants for manufscturing galvanized steel sheet of imported coils.

The plants processing imported blanks and the plants with electric steelmaking shops are mainly engaged in manufacturing reinforced bars and wire rod, some of them are manufacturing pipee.

The developing countries are faced with great difficulties in the way of their industrialization, set up by several causes, the most important of them being as follows: limited capital (especially in foreign currency as required for buying equipment, patents, and for engaging experts); limited possibilities for a proportional development of various branches of the national economy, low rate of metel consumption, responsible for a largely incomplete utilization of the productive capacities of a gradually developing industry, shortage of sufficient domes ic personnel, e.g., experts and high-skilled labour, etc.

The amount of nationel income is eo small that it proves to be insufficient evsn for the conetruction of indispenaable small industrial snterprises in a number of developing countries. The yearly gross national product of elmost half of all the developing countries does not reach 1,000,000,000 in each according to the data of the UNO. Meanwhile, the construction of only one modern fully integrated iron and eteel plant of annual capacity of 1 to 2 million tons of steel requires capitel investmsnt not less than $ 300,000,000 to 600,000,000 (3).

According to the estimate of the UNO, the average national income per capita of the developing countries amounted only to $ 142 as compared with 1,700 in states with developed economics in 1965 (2).

The limited scope of the internal market and an insufficient competitivenees of products of theee enterprises on the internal market of the developing countries es compared with ths products of tha advanced countries are conduced to a considerable decrease in the efficiency of large-size and seriee production even in more powerful developing states that have already constructed relatively large industrial enterprises. For instance, in India, according to data of the Central Statietical Bureau of the country, the capacities of industrial enterprises are utilized to an extent not more than 75%, and in some branches of the industry, to an extent of not more than 35%.

The capacities of most metallurgical plants are utilized to an extent of 40 to 50 per cent in the countries with a less advanced iron and steel industry. /1/ .

The economical cooperation between the developing countries is one of the preconditions en-

suring the efficient industrialization thereof. Being short of finances, technical experience and high-skilled personnel, these countries are faced with difficulties in developing their national economy independently from each other, under conditions of competition with separate large, industrialized states.

Hence, the tendency to integration is caused by a vital necessity of the daveloping countries.

The interstate industrial cooperation based on specialization and separation of labour allows the production to be extended in already existing branches of industry and the utilization of their productive capacities to be increased. This offers considerable scope for creating naw branches, which would prove to be economically inefficient within the limits of a national market under conditions of such a cooperation. Enlarging the scale of industrial production, as connected with an expansion of the market, in turn, contributes to a dacrease in costs and an increase in profitableness.

There is a number of trade-and-economical groupings of the developing countries, which have been already practically engaged in the problems of creating joint or "integrated" branches of industry. The necessary market is secured for tha products of euch branches either with the aid of concluding long-term trada agreements or through creating "common markete" for some or other goode. The "integratad" branchas of this kind are being established within the scope of the common market of countries of Central America, Latin-American Association of free trade, Eastern-African common markat, Organization for regional cooperation of Turkey, Pakistan and Iran, and othar trade-and-economical groupings.

In 1955-1967, many industrially daveloped countries rendered assistanca to the developing countries in constructing iron and steel plants.

The Socialist countries rendered technical assistance and are now continuing to render assistance to the devsloping countries in mining mineral resources and in constructing a number of iron and steel plants on the basis of intergovernment agreements and other documents. The organizations of the Socialist countries therewith perform operations requiring especially high expenditure of resources, vast experienca and special technical skill. For example, they carry out design services, delivery of squipment and materials, which the developing countries are not possessed, technical supervision of machinery installation and commisioning of plants and units. The plants and units of the iron and steel industry constructed with the assistance rendered by the Socialist countries, remain in a full property of the developing countries.

The Soviet Union, starting from 1955, has been rendering technical aesistance to the developing countries in designing and constructing the plants and units of the iron and steel industry, and at present has the appropriate agreements with eight developing countries, namely: Algeria, Afghanistan, India, Iran, Iraq, the UAR, Turkey and Ceylon.

In these countries, there have been dasigned, constructed and are at the stage of conatruction 15 units of total annual capacity (in thousand tons) ore mining - 13,400; production of sinter - 11,900; production of coke - 7,200; making iron - 9,100; making steel - 9,500; and manufacturing commercial rolled products - 8,300 /4/.

The credits granted by the Soviet Union to the developing countries for the progress of iron and steel indueti-y, are long-term and of favourable character.

In India, the USSR has rendered assistance in constructing Bhilai Integrated Iron and Steel Works with the annual capacity of 2.5 m.tons of steel (after enlarging the works).

In the UAR, an iron and steel works is constructad at Helwan with the assistance rendered by the USSR, the GDR, Roumania and Czechoslovakia, tha first stage of the works was commissioned in 1958. The Helwan project comprises a number of large industrial enterprises, such as iron and steel works and coke oven and by-product plant, a sintering plant, a forge works, and a plant for manufacturing electrically weldad chains. After stepping up the annual capasity of the Helwan works up to 1,500,000 tons of staal, the iron and steel industry base of the UAR will be definitely created /5/.

In 1965, at Agra (India, Uttar Pradeeh etate) there was commieeioned a wire-rod mill, whicM was constructed with the aeeietance of Poland under the contract with Prakash Enginsering Company and Rolling Mills . /6/

In 1966, Poland concluded a contrsct for building a ssmi-integrsted works with eteelmaking shops in Kham (Syria), the annual cspacity of which amounts to 75,000 tons of reinforcing bare and caetings./7/

In 1966, Czechoelovakia and Iran entered into an agreement on working the project out and rendering technical assistance in conetructing a metallurgical and mschine-building combine in Tebriz. Czechoslovakia will furnieh the complete plants and equipment for this combine on the baee of an economical cooperation agreement concluded with Iran earlier. /8/

Measures are planned to be taken for a further expansion in cooperation between Yugoslavia and Iran with a view of prospecting and exploiting oil fields, as well ae of developing mining industry. /9/

The USA, the FRG, Great Britain, France and Japan also invsst coneiderable capital in the national economy of the developing countries.

The USA havs aleo exerted a grest influsnce on the dsvelopment of the iron and stsel industry in Latin American countriee. The Brazil largset iron and eteel works of the Cia Siderurgica Nacional at Volta Redonda wae constructed with ths financial and technical assistance of the USA. Almoet all the large iron and etsel works in Latin American countries wsre granted credits for ths conetruction. Recently, the Export-Import Bank of the USA hsve approvsd a loan to ths Argentina company of SOMISA ($ 33,700,000) for enlarging the iron and steel workein San Nicolas; a loan to the Brazilian company of Vale do Rio Doce ($ 17,700,000) for expanding the iron ore mining capacities; a loan of $ 36,000,000 for enlarging the iron and steel worke at Volta Redonda; a loan of $ 50,000,000 for incrsaeing the ore mining capacity of the Orinoco Mining Company in Venezuela, etc.

On the whole, the Export-Import Bank to date has aeeisted in financing loans for the iron and eteel works in excess of three billion dollars with direct capital loans, exporter credits, and financial guarantees.

Recently, Japan has etarted to invest ite capital into the development of the iron and steel industry of Latin American countries. The Japanese companiee hsve participated in the construction of an iron and stsel worke of the Brazilian company USIMINAS in Ipatinga,40 per cent of etocks thereof being owned by Japan. The Japaneee company Nippon Kokan has granted to the USIMINAS s crsdit of $ 24,000,000 for the purpoee of expanding the annual capacity of this works from 600,000 to 1,400,000 tons of etesl, which should be reached in 1972. Moreover, the Japanese companiee participate in the development of the iron and eteel industry of Chile , and Columbia and install rolling facilities in some countries of Centrsl America.

The Federal Republic of Germany also invest capital in the iron and steel industry of the dsveloping countriee, some of the FRG companies being co-ownsre of the conetructed works. In Columbia an iron and steel works will socn be commissioned, which ie being built with the financial and technical assistance of the FRG. Up to 1970 the Demag furnish to the Mexican company Altos Hornos equipment for constructing s blast furnace operating with high top pressure, and the equipment for constructing the first in Mexico oxygen converter shop with the annual capacity of 500,000 tons of steel. All the equipment will bs instslled at ths works in Monclova. Two banke of the FRG finance the eupply of the equipment.

The French Societe anonyme Fives-Lille-Cail will furnish the equipmsnt for constructing an oxygen converter shop for the Acero del Pacifico (Chile), which will be financed by the Banque de Paris et Pays-Bas .

The same situation exists with rendering assistance to the developing countriee of Africa and Aeia in constructing iron and steel works.

The efforte being mads by the developing countries for increasing their output of ferrous

metals, as well as the assistance rendered to them by the industrially developed countries, permitted an assumption to be made to the effect that the growth of the metal production output in the developing countries in the next years to come will continue to be well ahead of growth of their metal demand as it took place up to the present. As a result, the demand for ferrous metals will largely be met by the home production of the developing countries.

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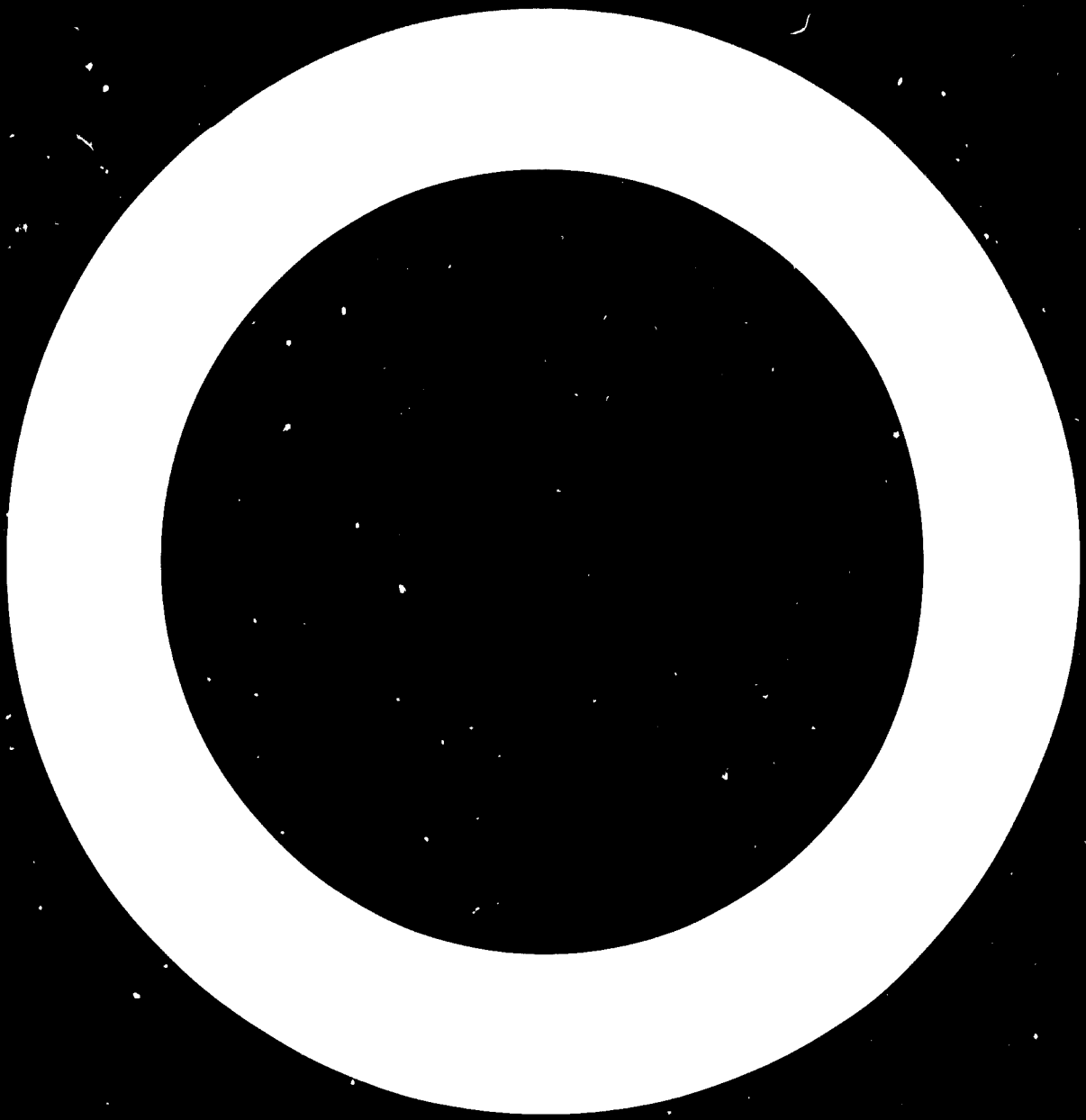

CHAPTER II

TECHNICAL PROGRESS IN THE IRON AND STEEL INDUSTRY

The technical progress in technology and machinery of the mining and metallurgical industries is realized with a heightened rate mainly at the enterpriees of high capacity.

At the same time small iron and steel works which as a rule are non-integrated ones (without blast furnace plants) keep on operating in all developed contriee and soms measures of technical progrees are also carried out in these works.

The undermentioned progressive eolution of technical problems in the large and small enterprises of different countries may be useful for the iron and steel industry of developing countries in Asia, Africa and Latin America both having an iron and steel industry or planning its creation.

Ferrous Metal Ore Mining

The wide introduction of open pit mining of ore deposits everywhere when geological conditions are favourable is a principal trend in developing the mining industry on the way of technical progress in the last two decades. This technique is more progressive than underground mining since it allows high technical and economic indices of mining to be attained at the relatively smaller material and labour costs, the better labour conditione to be created and the commodity production to be produced more rapidly.

The world practice shows that at the preeent level of engineering in open pit mining the productivity of labour is by 2.5–3 times higher and cost of mining of one ton of useful minerals ie by 1.5–2 times lower than in underground mines.

A share of iron ore of open pit mining was increased during the last 15–20 yeare in all countries of the world and continues to rise.

The underground mining of ferrous metal ores is mainly used to work deep-lying natural ores.

A trend to build mining enterprises using a powerful and high productive technological equipment has been kept up in open pit mining for a long time since the large ecale of production and the high level of its mechanization provide better results of the work to be achieved.

When mining the deposits of ferrous metal ores and overlying burden without blasting powerful diesel tractors, 200–400 HP, equipped with 2-3 rippers as well as self-propelled scrapers, power shovels with 3–6 cu.m buckets, 35–60 t dump trucks are widely used.

The use of diesel equipment in open pit mining especially at the time of open pit mine construction and during initial years of their work is greatly effective when the extension and the ruling grades of haulage roads aren't yet large enough.

Walking draglines with a range of bucket capacity up to 25 cu.m having booms up to 100 m long find use in stripping when burden of considerable thickness is soft or insufficiently consolidated.

Continuous stripping complexes (a bucket-wheel excavator, a conveyor system of a considerable length and a self-propelled stacker) are used to mine friable burden. Their output totals from 1,000 to 11,000 tons per hour.

If the mining and hauling open pit equipment is electrified the working of rocky ores and wastes is carried out employing the cyclical or continuous-cyclical methods of drilling and blasting.

Percussion drills with compressed air supplied by the portable diesel rotary vane compressors are widely used in small open pit mines.

Self-propelled rotary rigs are employed to drill blastholes with a diameter up to 320 mm and up to 35–40 m deep in rocky ores and burden. Self-propelled jet piercing drills find use for drilling ores and burden with high SiO_2-content. These drills permit chambers up to 500-

600 mm in diameter to be produced in any pert of blastholss.

Self-propelled loading trucks are ueed to charge blastholes with mixture of granular ammonium nitrate-fuel oil or with water-bearing explosivea.

A highly progressive technique of iron ore breaking is used in the USSR. A delay-action blasting of a great number of charges is carried out simultaneously on the height of two or three benches at squeezed space (when the fragmented rock having been broken by the prevailed blasting isn't hauled yet). Up to 1.5-2 million cu.m of well fragmsnted rock may be broken by one blast.

At cyclical method of rocky ore and weste mining a number of shovels with a range of 6 to 12 cu.m. bucket capacity is used as well as different haulage equipmant, viz. electric (d.c. or a.c.) or diesel-electric locomotives with the weight up to 150 t and dump cars having capacitiea up to 100 t.(in the USSR dump cars with a capacity of up to 180 t were developed). There are also 100-120 t dump trucks (in the USA haulage trucks of 200-t capacity are used).

Employing the combined transportation is a charachteristic feature of the continuous-cyclical method of surface mining. The most economic kind of this transportation widely used in developing countries ia a combined truck-and-belt conveyor system. The continuous-cyclical technology is effectively used in iron ore open pit mines of India, Liberia and Peru.

The technological schedule of these mines includes: blasted ore loading by shovels in hauling trucks, ore hauling by trucks to a fixed screen installed at the charging end of belt conveyor system, ore hoisting from open pit mine and hauling it by belt conveyors to a concentrating plant or to a storage (hopper) in a harbour or at a railway station.

The Barsua Mine (India) having the annual output of 3 m. tons employs ore loading by 3 cu.m shovels in 34-t.diesel trucks, hauling it to the cherging hopper of a belt convsyor system more than 2 km long. The output of thia system hauling the ore to the railway station is 6,500-7,000 tons per day. The conveyor system having an inclins to the direction of tns railway station operates with electric power recuperation and returns back into distribution system up to 600kWh per day. /1/

The Nimba Mine (Liberia) with the annual production of 7 m. tons employs 3-5 cu.m shovels and 38-t dump trucks. Ore hauling to the cruaher plant is carried out by trucks and from it to the reilway station by means of a conveyor syatem more than 3 km. long. The average angle of belt incline is 18° owing to the conveyor system recuperates up to 2000 kWh per day. /2/

The most powerful and high productive mining and handing equipment is used in the Marcona Mine (Peru). Ths annual output of this mine excseds 7 m. tons snd would reach 10 m. tons per year by 1970.

The continuous-cyclical method of mining is also used in this mine. Broken ore is loaded at the faces of this mine by 7.6 cu.m shovels into large trucks. The capacity of trucks amounts to 100 tons. The conveyor system of a great length (about 14 km) is employed there. Its output totals 12 m. tons per year. A considerable part of this system is inclined and it also recuperatea energy when hauling the ore. /3-4/

Lately a version of the continuous-cyclical method with travelling screen and crusher (in a number of cases crushers are self-propelled) is employed in open pit mines in a number of countriea. This veraion permits the uae of trucks to be eliminated resulting in considerable economic effedt.

When des gning the modern open pit mines a special consideration should be given to the layout of ore atorages. It would provide separate stockpiling the different grades of ore and shipping the merchantable ore with average, minimum and maximum content of components with the help of simple and high productive means of mechanisetion.

The present ore storages ars of open type: 1) ground storages with the ore stockpiling by the reversible belt conaol stackers and the ore shipping by bucket-wheel excavatora and 2) bin storages with the ore loading into bins and following stockpiling over them by reversible belt conaol atackers and the ore shipping by belt conveyors running under bins.

Iron Ore Beneficatio1

The technical progress in treating iron ore to produce a more desirable blast furnace feed is characterized by continuous growth of merchantable grade ores production and improving their quality.

Low grade and hardly beneficated ores are involed in treating to extend the raw material resources of the iron and steel industry. For this purpose, benefication processes are developed and improved for producing the high-grade concentrates containing over 65% Fe.

To increase the metallurgical value of iron ores high-grade ores are also beneficated now, in some countries rich ores fines are pelletized. There are pelletizing plants producing pellets of high-grade ores in operation in several countries, including Brazil and Liberia. High-grade ores such as magnetits, martite and hematite ores (those containing 50-55% iron) as well as sidsrite and limonite ores with up to 50% Fs are used in blast-furnace burdsn without treating.

To produce high-grade concentrates from low-grade orss, various high-efficisnt flowsheets have been dsveloped and are in operation. The main raw materials for this purpose are magnetits quartzites, beneficated through magnetic flowsheets which provide for 64-66% Fe concentratea. The high-efficient magnetic [illegible]-4 and C3-209 ssparators have been designed in the USSR; they allow to recover 97-98% magnetic mineral from ores.

Some multistage and combined benefication flowsheets developed in the USSR involving ore- and ore pebble grinding which make it possible to produce 66-71% Fe concentrates from magnetite quartzites. When using a floatation process, it is possibls to increase Fe-contents in the concsntrates by 5-6%.

At the Erie Mining's complex (the USA) 0,1 mm vibrating slit scresns are utilized for gravity concsntration, it provides silica contsnts decrease over than 2% (abs.). /5/

To bsneficate oxidized ferrous quartzites reduction-roasting process followed by magnetic separation could be successfully ussd. Such one is applisd at the Krivoj Rog Central Mining and Ore Concentration Complex, where they trsat oxidized fsrrous quartzites containing 32-34% iron in kilns. The concsntrates containing 61.5-62% Fe are producsd by the flowsheet including three stagss of roasted ore grinding and four stages of magnstic separation.

Coarsed disseminated hematite-quartzites are beneficatsd on spiral ssparators (Canada, the USA).

Combined gravity-floatation and magnstic-gravity-floatation methods of bsnsfication of oxidyzsd ferriferrous quartzites have been developed in the recent years in the USSR. The first method is carried out on spiral separators, the second one - on polygradient separators with high-intensive magnetic field. The both methods allow to obtain 63% Fe concentrates at iron recovering over than 83%.

Mixed hematite-magnetits quartzitss ars successfully beneficated at the Liberia's Bong-Range Mining works. The flowsheet includes autogenous ore grinding, spiral screen separating and spiral scrssn tails benefication in psrmanent magnet separators. The process results in recovering the ore with 38% Fe and 40% SiO_2 contents to the concsntrate containing 65.5% Fe and 6-7% SiO_2. /6/

Low grads magnstite iron ores, containing basic rocks are treated according to simple magnetic flowshsets at grinding coarseness up to 90% passing -0.074 mm.

If any associated valuable contents or detrimental impurities in thess ores optimal benefication should provide for recovering those elements and securing natural basicity.

The tschnology dsveloped in the USSR allows to separate hematite-martits ores, containing 45-57% Fe by polygradient separators with high-intensive magnetic field. Other typss of the same separator are designed in the USA and an Australia.

High-grade hematite ores are processsed according to gravity flowsheets, including gravity suspension-, spiral screen- and jigger separating. Thus, at the Marcona Mining's bsnefication plant in Peru, which processes high-grade and impoverishsd hsmatite and pyritiferrous ores, a widsn flowsheet is utilized with magnetic separators, spiral screens, jigging machines and gra-

vity suspension separsting. The flowsheet allows to beneficate ore of all gredes and to gain concentrates with 60-62% and 66-67% Fe contsnts.

Now efficient flowsheets have been developed for treating the most grades of the iron ores available in the developing countries.

Coke Production

The technical progress in the coke and by-product production is characterized by the extensive construction of coke-oven batteries with coke ovens of a high capacity (volume of 30 cu. m and more).

The underjet-fired,side-fired and combine-fired (both rich and poor gas)coke ovens of high capacity are developed, constructed and operated in the USSR.

The Soviet coke-oven batteries are characterized by nigh level of the mechanization and automation of the coke oven operation (charging, handling of doors, as well as of vertical channsls and gas collectors, discharging and quenching coke and so on), by the availability of the system for a smokeless charging of coal into the ovens and by the use of the hydraulic operating conditions, which makes it possible to increase the oven life. The output of one coke oven battery amounts to 830,000 ton per year. /8/

Two coke oven batteries with the world greatest coke ovens (volume of camera is 39.6 cu.m) are constructed in the last few years at the works Midzushima of the Kawasaki iron and steel in Japan according to the project of the Ksrl Still Co,(the FRG), however the output of the batteries, the level of their mechanization and automation are lower than that in the USSR and the smoksless charging of coal into ovens is not used there. /9/ At the availability in the developing countries of sufficient reserves of coking coals and at the regional cooperation - even on the basis of imported coals it seems expadient to construct there modern coke oven batteries of high productivity with the ovens of high capacity. It is possible to construct battsries with coke ovens of medium capacity too and with the full cycle of chemical by-products collecting and treating. These coke and by-product plants have been constructed or are constructed with tha technical assistance of the USSR, for example in India (works in Bhilai and in Bocaro), in Iran (works in Isfahan) and in other countries. The coke oven batteries consisting of 61-69 ovens of the system ПВР-55 designed by the Institute "Giprokoks" are up to 500,000 ton per year capacity.

The availability of the cycle of the chemical by-product collecting and treating in the coke and by-products production plants makes it possible to produce fertilizers (ammonium sulfete, diammonium phosphate, ammoniac water), raw matsrials for the development of the own chemical industry (benzol, naphtalene, phenol and others) and gas for industry and utilities.

The effactive methods of the coal benefication in haavy media and the methods of the selective grinding, drying and preheating of coals are developad and used for the enlargement of the reserves of the raw materials for coking. This allows the local poor-caking and non-caking coals in the coking charge to be introduced and thus the import of the coking coals to be decressed.

The method of selective grinding of coals dapending on their petrographic analysis is used successfully in industry not only in the developed but in the daveloping countries too (India, Algeria). /10,11/

The drying and preheating of coals are usad on industrial scale at some plants. /12-14/ Putting into practice new methods of coal preparation for coking permits coke oven productivity to be increased too and sometimas the coke quality to be improved.

The process of the continuous production of coke from poor-caking coals with getting of formed or briquetted coke have been developed in some countries. The choice of the production method depends upon the quality of the available coals and upon the raquirements of coke users.

Two methods for the production of blast furnace coke are preferable: the Soviet method of

the production of formed coke, consisting in rapid heating of coal to the temperature of the plasticity, in forming it and in the following caking of the coal formings, and the American method, including the preheating of the coal, semicoking it in the fluidized bed, briquetting of the semicoke with a binder and coking of the semicoke-briquetts.

The experimental melting of iron in the blast furnace with the coke, produced by these methods, was successful. The Soviet method of the production of formed coke is tested successfully in India on the local coals.

The method of the coal coking on the travelling grates is used in the world practice for the production of coke, used as reducer for the smelting of ferroalloys, phosphor, and carbides. The output of the travelling grates varies from 220 to 290 kg/sq.m .h depending on charge quality.

The production of the formed coke good for using as a mixture with usual coal coke in low shaft blast furnaces is put into practice in the German Democratic Republic with the use of the brown coal. The output of the plant, calculated for the coal charge, is 2.5 mil. tons per year. The process consists of briquetting the brown coal and the following drying and coking the briquettes in the retort-furnaces.

The process of the production of the foundry formed coke from the energetic coals is developed and widely used on industry scale in Poland. The formed coke not to be used for the blast furnace operation is produced from the anthracite with the addition of 10% of coking coal in Canada, the Federal Republic of Germany, Morocco, Peru, Venezuela.

Thus, the modern technology of the coal preparation and coking makes it possible as a matter of fact, any types of coals to be used in the iron and steel industry if their production is profitable.

Ironmaking

Blast furnace ironmaking In the whole world the blast furnace process is characterized by the continuous increase of the blast furnace volume both in the case of their new erection and reconstruction, by the improvement of ore preparation for blast furnace feed, the introduction of various effective measures directed to the increase of the blast furnace output and the reduction of coke consumption, mechanization of labourous operation and automatic control of the blast furnace operation.

In the recent years large blast furnaces were built in the developing countries as well as in the developed ones. Accordingly, blast furnaces with the hearth diameter of 8,5-9,1 m were built in some Latin American countries, Turkey and India. The largest furnaces with useful volume of 1719 cu.m were built in India. /15/

The modern blast furnaces are operated on a well prepared burden which includes the high-strength fluxed sinter, pellets and crushed and screened lump ore. For the homogeneous chemical analysis of the ore burden its components are subjected to careful blending. Blending stockyards equipped with high-efficient stackers and reclaimers have been built at the iron and steel works and at the mining enterprises.

High capacity sintering machines with the sintering area up to 312 sq.m are operated in the developed countries (the USSR). In the developing countries large sintering machines have not got wide use. The sintering machines with effective area more than 100 sq.m operate only in India and Mexico.

In many countries of the world (the USSR, the USA, Canada, Sweden, Peru, Liberia and Japan) there are iron ore pelletizing plants.

Conveyor type roasting machines are widely used for the pellets hardening, and such machines with useful area up to 350-400 sq.m are put in operation at new enterprises (Liberia, the Netherlands, Australia). /16-17/

The pelletizing plants with annual capacity of 2 m. tons of naturally rich ore pellets equipped with modern facilities are operated in Liberia and Brazil. The conveyor type machines

with the floor area 354 and 278 sq.m respectively are used for the pellet roasting.

In Liberia the slurries from the washing plant come to the pelletizing plant and in case of more laan ore being used the slurries are floatated. /18/ Other types of roasting machines, e.g., the combination of the grate and kiln and circular machines have found use as well.

The methods of non-roasting pellets hardening are in the stage of development and implantation. In Sweden a pelletizing plant with annual capacity of 1.6 m. tons pellets hardened without roasting is being erected. A fine grinding cement clinker will be used as a hardening additive. A pelletizing method with ths use of carbonate bond and low temperature treatment is under development in the USA. /20/

The work on decreasing the coke rate is being carried with differant success in all countries. For this purpose the additional fuel injection (particularly the natural gas and oil) into the furnace hearth is widely used, and with some furnaces injected fuel includes coal dust, coal-fuel oil suspension or coke gas.

For the more efficient utilization of ths additional fuel at the number of iron and steel works the blast is being enriched with oxygen. The additional fuel injection is most widely used in the USSR, Japan and the USA and the combination of this kind of injaction with oxygsn-snriched blast is used in the USSR.

Low-shaft blast furnaces have found use in some countries of tne world. Their main advantage is tha possibility to utilize the low-strenth coke in the burden, as well as iow-temperature coke, lignite, and other types of non-deficient fuel. The low-shaft furnaces are used for the production of ferroalloys (ferromanganase, ferrochrome and ferrosilicochrome) as well as of iron.

For intensifying the procass the blast could be enriched with oxygen in the same way as in the case with the common blast furnace.

Electric furnaces for iron smelting operate in a number of countries where the electric power is of low cost. /21/ Thase 60,000 kva furnaces are usad for the production of iron with a higher or lower content of silicon, manganese and phosphorous as well as the common open-hearth iron and cast iron. Low-shaft furnaces of Tysland-Hole type are most often used as they permit to utilize as a reducing agent coke and less deficient types of fuel (coke breeze, gas coke, anthracite, brown coal and lignite). The consumption of reducing agent depends on the type of molten iron produced and the quality of the ore being used and it ranges from 300 to 800 kg per ton of iron. The power consumption fluctuates from 2,500 to 3,000 kWh per ton of iron. /20/

Non-coke metallurgy Along with the development of the blast furnace process, the continuous effort is baing made in the production of iron from ores by-passing the blast furnace. Unfortunately the most part of the available methods of the direct reduction of iron are still in the laboratory stage.

In a number of countries there are commercial units for the production of partly reduced iron ore materials with a different dagree of metallization. For instance, the commercial units at Hojalata y Lamina's works in Mexico are used for the production of sponge iron from rich iron ore. Convertad natural gas is being used as a reducing agent. The sponge iron is used for the arc furnace steel production. The charge includes 57% of sponge iron and 43% of scrap./23/

Metallized materials are used in the electric pig iron and electric arc furnaces for iron-making and in open-hsarth- and electric arc furnaces for tha steelmaking. In case of the utilization of partly raduced and preheated materials in the electric blast furnaces and arc furnaces, the furnace output increases by almost 1.5-2 times, and the power consumption is reduced from 2,500-3,000 to 1,000-1,800 kWh per ton with corresponding decrease in electrode consumption.

Prereduced charge is used in electric furnaces for smelting iron in Venezuela and Portugal.

Method D-LM for the production of hot metal is developed in the USA. This method permits pellets to be producad from ore sized to less than 0.83 mm, limestone and coal in a disk pelletizer with further hardening and partial reduction in conveyor type machine. Such pellets with

the basicity of 0.8-1.2 have Fe-content of 13.8-26.9%, S-content of 0.05-0.3% and non-volatile carbon content of 7.9-11.0%.

The hot pellets are loaded into arc furnaces.

By the end of 1968 McWane Cast Iron and Pipe Company planned to put in operation a plant in Mobile, the USA, with the iron production by the D-LM process. /24/

In Canada the Steel Company of Canada has constructed a plant for metallization of pellets by SL-RN method. Pellets metallized by this method in a rotary kiln were used in experimental heats run in blast furnaces. The experiments showed that the output of the furnace was increased by 21.7% and coke rate (in the operation without injecting fuel additives) was decreased by 20.8%, the burden containing 30% of pellets at 90.6% degree of metallization.

Metallized pellets were used in the charge of 45 t electric arc furnace, 95 t oxygen converter and 360 t open-hearth furnace at the works of this company.

Experimental heats with the use of metallized pellets were also carried out in other countries. /23/

Selecting the ironmaking process is determined by available resources of metallurgical raw materials, fuel and electric power which are adviseble in one or another country.

The construction of blast furnaces is available when iron ores and coking coal are available, and in a number of occasions it is expedient even when coking coal is imported.

At the availability of iron ores and coals unsuitable for coking purposes or other kinds of non-scarce fuel low-shaft blast furnaces could be constructed. If inexpensive electric power is available electric pig iron smelting may be developed.

One or another of numerous direct-reduction process may be used in many developing countries.

Steelmaking

The world's steelmaking is in the progress towards the more and more wide use of oxygen-converter steelmaking. The world's output of oxygen-converter plants exceeded 180 m.tons of steel per year. /25/

Oxygen-converter process is used both in the devsloped countries and in the developing ones, viz. Brazil, India, Peru, Tunisia, and other countries.

Existing oxygen converters have different capacities up to 300 tons that permite appropriate units for any required output to be selected.

For instance, there are oxygen converters of 12-100 t capacity operating in India, 13.5 t - in Malaysie, 27 t - in Peru, from 22 to 100 t in Spain, 13 t in Tunisia. The share of steel made in open-hearth furnaces is decreased. This is due to the fact that the capital investments for constructing oxygen-converter shops are less by 30-40%, than those for the open-hearth shops of equal capacity. The cost price of oxygen-converter steel is somewhat lower than that of the open-hearth steel owing to significantly reduced (by 4-6 doll/tons) production costs. /26/ The steels of practically the whole open-hearth range, viz. low-carbon (rimmed, semi-killed, killed), medium-carbon and high-carbon, low-alloy, alloy steels including ball-bearing, electrical, stainless and other steels are made in oxygen converters.

The oxygen-converter process makes it possible to produce quality steel through the treatment of low-phosphorus, high-phosphorus, low-manganese and naturally-alloyed iron.

In majority of converter shops the iron with low (0.1-0.3%) phosphorus content is treated and steel scrap (20-30% of the total metallic charge) is used as a cooler. The oxygen of 99.5% purity is blown through multi-jet lances. Deoxidising the blown metal is mostly done in ladles.

In the countries of West Europe high-phosphorus iron conversion is carried out by injecting oxygen with powdered lime into the bath (LD-AC and OLP processes). As this takes place, the early formation of slag and the quick transition of phosphorus into the slag occur. As a result, the high-quality low-phosphorus steel and phosphate slag are produced. The phosphate slag is a valuable fertilizer for the agriculture. /27/

Of particular interest for the developing countries is ths operation of oxygen converters at the works having no hot metal. To do this, hot-blast cupolas are used in which synthetic iron from scrap and coke is produced. The cupolas are of high output reaching 50 t/h and can meet the requirements of converters for molten iron. /28/

In the last few years, studies on creation the system of automatic control of converter process are widely carried out.

The etatic system of converter heat control were developed and found use in a number of countries. However, the systems are insufficiently reliable and the dynamic systems of the process control using the data of current conditions of a heat are now being developed. /29,30/

In the last few years, oxygen-converter process was started to bs used together with continuous casting of steel. In the Soviet Union the converter shop of high-output in which all molten steel is cast on continuous casting plants is operating at Novolipetsk Iron and Steel Works. /11/

Two small double-strand steel continuous casting plants are in operation at the works in Manzel-Burgiba (Tunisia). Steel for those plants is produced in 12 t oxygen converters with the annual capacity of 77,000 tons per year.

When resources of electric power are available in the developing countries the production of steel by scrap melting in electric arc furnaces is successfully used. Electric furnace steelmaking is characterized by rather low capital investments and high quality of steel.

20 t electric arc furnace with the annual capacity of 36,000 tons of steel is in operation at the works of Machindra Company in India.

The electric arc furnaces of 3–12 t capacity are in operation at the works of Siderurgica Riograndense in Brazil. /33/ Two 10 t electric arc furnaces are in operation in Ghana. Their total capacity amounts to about 60,000 tons of steel per year. /34/ Two 25 t electric-arc furnaces are in operation at the works in Karakas (Venezuela). Electric arc furnaces are also in operation at the works in Chimbota (Peru). /35/

In a number of the developing countries the open-hearth steelmaking process is used. Small furnaces of 15–50 t charge are usually in operation, but larger furnaces work at some works constructed with rendering the assistance by the industrially developed countries. Thus, five 250t and five 500t open-hsarth furnaces of the total annual capacity of 2.5 m.tons of steel constructed with the assistance of tho Soviet Union are in operation at the Indian works in Bhilai. /36/

The efficiency of the open-hearth steelmaking can be increased by the use of basic refractory materials for lining the roofs and regenerative checkerworks, by conversion the furnaces to firing with high calorific value fuel (natural gas, fuel oil), by the use of oxygen for the enrichment of air blast and for blowing the bath.

Continuous casting of steel is finding increasing favour in many countries of the world. In 1968, the world total capacity of the steel continuous casting plants amounted to 27 m.tons per year. /37/

In the last few years three types of plants gained the most spread, viz. vertical, vertical with bending the casting into horisontal position and bow-type plants. There are continuous casting plants in which it is possible to cast over 1 m.tons of steel per year, depending to the casting cross sections and number of strands and also continuous casting plants of only 20,000–50,000 tons annual output.

The vertical continuous casting plants are the most universal. The technology of casting practically all steels from low-carbon rimmed to high-alloy steels for producing blooms of any cross-section from 50 to 2100 mm is carried out at the vertical plants developed and perfected in the USSR.

The continuous casting plants with bending the casting after withdrawal rolls is generally used for producing billets of small cross-sections. The total height of the plants is 5–6 m less

as compared to the vertical ones. Such continuous casting plants are in operation in Peru (four-strand plants for producing blooms of 80–150 mm.sq.from a ladle of 25–28 t capacity),in India (one-strand plant for blooms of 90 mm sq.from 7 t ladle),in Mefico and other countries.

In the last few years, the bow-type continuous casting plants became widely spread. The plants of this type are characterized by small height. Such continuous casting plants were constructed in India, Tunisia, Argentina, Australia, Brazil, Turksy and other countries.

The use of continuous steel casting makes it possible to increase yield by 8–10% and to construct iron and steel works withoutcogging mills.

A new process of combining continuous casting of steel with rolling holds greatest promises especially for developing countries. In so doing, the inner structure and surface quality is improved, yield is increaced, reheating billets for rolling is eliminated. /38/

Rolling

In the recent years the distinguishing features of the progress in rolling are continuous operation and high speed of metal working, mechanization and automation of operations, widening the range of rolled products and improving their quality.

In the last few years the share of sheets and plates in the total output of rolled products was rather high in the developed countries.

In the last few years continuous wide-strip hot mills characterized by high speed of rolling and large rolls body length are installed in a number of countries. In new rolling mills the systems of automatic control of technological process (from slab charging into the furnace to coils removal) are widely used, thickness and width of strip, its temperature, rolling schedule are controlled. Recording the operational conditions of the mill is carried out.

Cold-rolling mills are installed to meet the demand in cold-rolled sheets are strips as well as black plates. Coils of up to 40 tons are produced in the new continuous cold-rolling mills and the rolling speed reaches 30 m per sec. Many mills are equipped with automatic facilities for the control of strip thickness. 1420 mm continuous five-stand cold-rolling mill is in operation at the works of Hindustan Iron and Steel Company in Rurkela (India). The diameter of work rolls is 585 mm, the diameter of back rolls is 1420 mm. The maximum speed of rolling is 30.5 m per sec. The mill is equipped with automatic gauge of strip thickness. The power of the main electric motors amounts to about 21,000 kW. /39/

The British company Davy and United Engineering manufactures 2200 mm five-stand four-high cold-strip mill and 2200 mm one-stand four-high temper mill for the Netherlands.It is planned to roll band of 0.01-3.17 mm thick and 580–1050 mm wide in coils weighting up to 45 t, the five-stand mill speed will be up to 25.3 m per soc. Entry bridles providing for minimum idle times in feeding the coils will be used in the mill. The temper mill is designed for rolling the coils of the same weight with the speed of up to 28.3 m per sec.

1170 mm combination blooming-slabbing two-high mill, plate four-high mill, 1670 mm Steckel reversing hot-strip mill, 1670 mm continuous four-stand cold-strip mill, 1670 mm temper mill were installed in the rolling shops of the works of the Erdemir Company in Eregly-Karadenis (Turkey). The annual output of the works amounts te 110,000 tons of blooms and slabs, 55,000 tons of plates, 50,000 tons of strips, 46,000 tons of hot rolled flats and 77,000 tons of cold rolled sheets, 50,000 tons of tin plate. /40/

Multiroll mills are installed for cold rolling of stainless and electrical steels.

Different section and wire rolling mills are installed in a number of countries.Mills of low output depending on the production scale and the range of rolled products are among them.

A light-section mill designed for the annual production of 65,000 tons of angles, strips and other light shapes from billets of 60x60 and 80x80 mm cross-sections was recently put into operation at the works of the Iranian Rolling Mills in Ahvas (Iran). This first Iranian rolling mill consists of two three-high roughing stands and six finishing stands. It is planned to bring

the annual output of the mill up to 150,000 tons after commissioning its second stage. /41/

800 mm reversing primary duo mill for rolling billets from 1.8 t ingots, 450 mm Belgian-type medium section mill having changlable vertical-roll etand for rolling wide flange beam,a wire-rod mill are installed at the rolling mill of the iron and steel works in Seixal (Portugal). /42/

A universal combination mill of the annual output of about 180,000ttons is in operation for rolling beams and strips at the works of Norrbottens Järnverk in Lulea (Swsden).

The mill can roll strips 150-1000 mm wide and 7-60 mm thick or beams including H-bsams up to 400 mm heigh. The mill deeign makes it poeeible to carry out quickly resetting which is eesentisl for it. The combination mill necsssiating only one half capital inveetments as againet two eingle specialised rolling mills is practicable for a medium capacity works.The surface finieh and tolerances of the rolled products made in this mill are not woree than those of the rolled products made in special mills. An installation for welding H-beams up to 1000 mm heigh can be added to the mill. The costs on the installation ars repaid when the volume of orders attains 3,000-5,000 tons per month. /43/

The rolling mill shop of the new iron and steel works of the Aços Anhanguera S.A. in Mogy das Kruzes (Brazil) compriees 865 mm blooming mill, a four-stand medium section mill as well as heat-treating and finiehing lines. Apart from carbon and alloy structural steels, ball-bearing steel is produced at the works. /44/

1150 mm blooming mill, a continuous billst mill, a rail-and-structural mill, 350 mm medium section mill and 250 mm wire mill are installed at the rolling mill ehop of Bhilai Iron and Steel Works (India).

Pipe and Tube Production

A major portion of pipes is manufactured as welded ones in developed countries.The method of producing welded pipes of up to 1220 mm diameter for gas pipelinee from two semi-cylinders was developed and put into operation in the USSR. /45/

A unit for manufacturing electric-welded etraight seam pipee of 406-1066 mm diameter and 12 m long from strips 6-16 mm thick ie in operation in the Great Britain. The sheet after treating its eide edges is fed into a 3,500 t prees and then is traneferred to a 16,000 t prees. Welding ie performed under flux layer first on the ineide wall and then on the outside. After welding the pipe is subjected to hydraulic expanding (the pipe diameter is increased by 1.3%).All the pipes are ultra-sonic and X-ray flow detected. /46/ In that country there is a shop for producing helical weld pipes from hot-rolled etrips 1525 mm wide. The ehop is designed for producing oil and gas pipee of 406-1066 mm diameter, 7.92-16.15 m long, and with wall thickness of 12.7 mm. The annual capacity of the ehop is 30,000 tons. /47/

The worke with pipe mills in Hanaur (Indie) has annual capacity of 120,000 tons of eteel galvanised and non-galvanized pipes of 12-150 mm diameter.At the works two resistance-weld pipe mills and facilities for galvanizing and finiehing pipes are installed.Pipes of 32-150 mm diameter are welded with speed of 70 m per min.in one mill and pipes of 12-25 mm with speed up to 50 m per min in the other mill./48/

In a number of countries different pipe mills as well ae pipe presses are used for seamless pipe production.

Many developing countries have rolling mills including hot section and plate mills, cold sheet mills. There are also lines for producing tin platss and galvanised sheet. There are pipe mills in a number of countries.

The technical level of rolling in some developing countries increaeed in the last few years. As regarde to the technical level of the rolling mills, such enterprises as Bhilai works (India) equals to the beet world iron and steel works.

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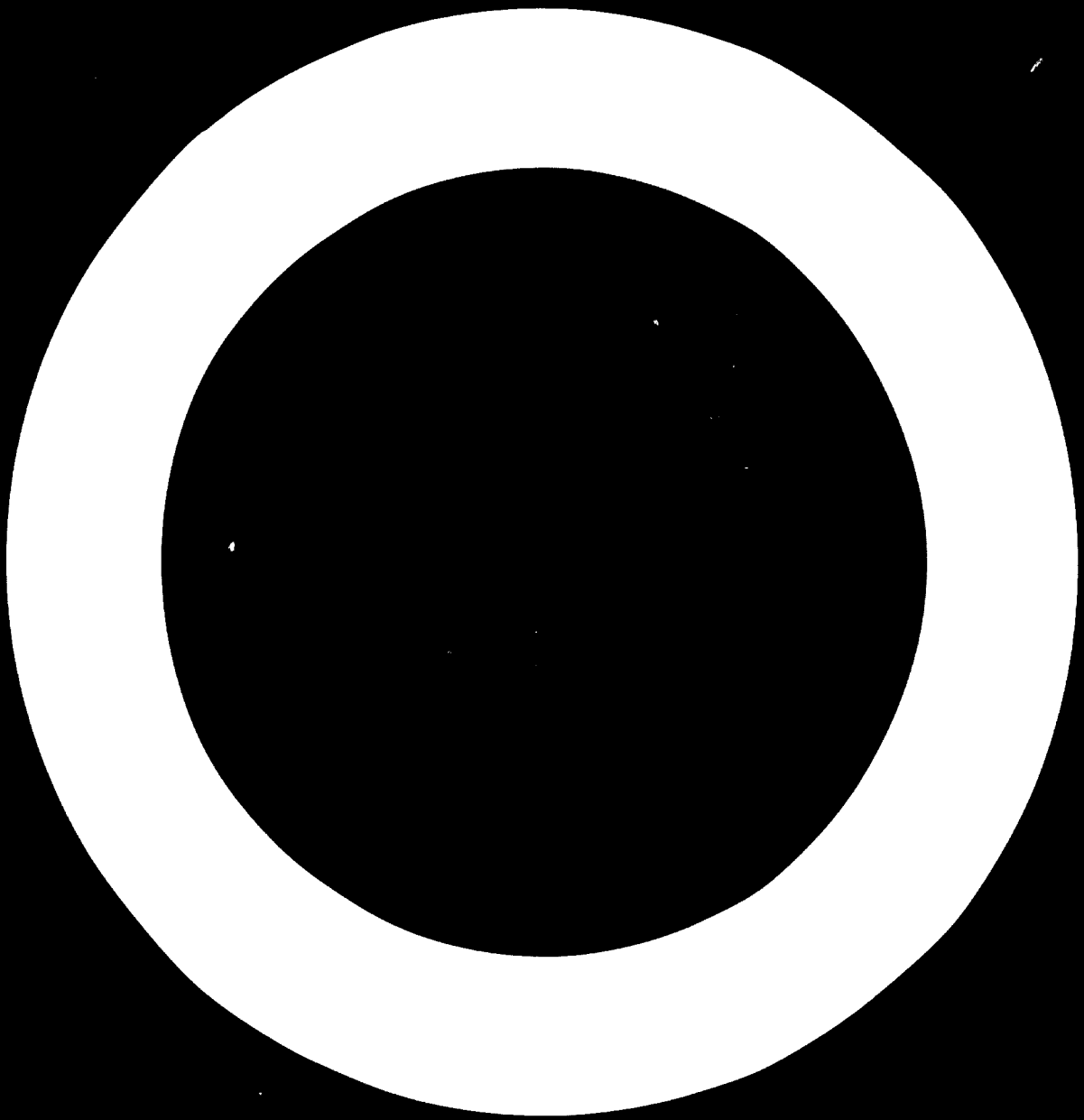

C H A P T E R III

IRON AND STEEL INDUSTRY OF LATIN AMERICA

The production of ferrous metals in the countries of Latin America began to develop in the post-war yeers only. In the period of 1950-1967 the steel output increeeed from 1 m.tons to about 10 m.tons as a consequence of grewing demand for ferrous metals at the home markets of these countries. The most important consumers of ferrous metals in this area are building, agriculture, mining industry, transportation.

Creating and developing their domestic iron and steel industry the Latin American countriee are to overcome great difficulties. Theee countries, as a rule, are agrarian ones having the weakly developed induatry. Solving the general problems of industrialization the Latin American countries attached a great importance to the development of the iron end steel industry.

A considerable part of financial resources, required to build the iron and eteel works being preeently operated in this aree, has been received through the foreign loane and credits. Paying the preliminary operations and services of foreign experts, buying machines and equipment, covering the expenses on training the technical pereonnel and skilled workers for home enterprises were realized on account of these loane and credits. Since the iron and steel industry began to develop in this area yet not long ago the enterprises suffer the lack of skilled workers and all expenses for their training are paid by employers.

A shortage of coal creates some difficulties for developing the ferrous metal production. The majority of the iron and steel works has to import all coking coal or a large part of it needed for operation. It ia a heavy burden for the balance of payments for developing countriee.

Having vast territories the Latin American countries are insufficiently provided with waye of communication that raises the price of raw material deliveries to the worke and makes it quite difficult and sometimee impossible the exploitation of iron and manganeee ore deposits and coal fields.

All afore-mentioned affects the cost price and the quality of ferrous metels. The prices of the domestic ferrous metals are higher than those of the world. Hence users have some advantages when buying steel and rolled products of higher quality and at lower prices being imported from the USA.

Most countries have eccordingly taken some legislative acts directed towards the decrease of import.

The countries of Latin America posses immense iron ore resources that are eetimated at 86,700 m.tons (as of January 1, 1968). The richest in iron ore countries are Brazil, Venezuela, Chile and Peru (Table 1)/1-7/.

Nearly 40% of total iron ore resources of the world (excluding the USSR and other eocialist countries) are concentrated in these countriee.

The Fe-content of the ores is high and eome deposits with ores containing more than 60% Fe are presently mined. In 1967 the iron ore production in Latin America was more than 65 m. tons with Brezil's share being 24 m.tons, that of Venezuele -17 m. tone, Chile-10 m.tone, Peru-8 m.tons and Mexico-3 m.tons /2/.

The countries of Latin America ere large exporters of iron ore. Thus in 1966 Brazil exported 12 m.tons, Venezuels 17 m.tons, Chile 10 m.tons, Peru 7 m. tons of iron ore. The domestic ore consumption is negligible. The total consumption of iron ore in Latin America amounted to only 10.8 m.tons (the ore production was 59 m.tons). The iron ore consumption should be increased in the future according to the growth of the iron and steel industry in this area and may be estimated at 13.5 m.tone in 1970, at 20.7 m.tons in 1975 and at 30.4 m.tone

Table.1. Some economic data on the developing countries of Latin America

Countries	General data			Resources of raw materials, 10^6 tons								Production									
	Population	Area 10^3 sq. km	National income bil. U.S. dollars	Iron ore		Manganese ore		Oil	Coal	Iron ore 10^6 tons	Manganese ore 10^6 tons	Oil 10^6 tons	Coal 10^6 tons	Electric energy 10^9 kwt-h	Iron 10^3 tons	Steel 10^3 tons	Rolled products 10^3 tons	Pipes and tubes 10^3 tons	Import of ferrous metals 10^3 tons	Export of ferrous metals 10^3 tons	Apparent consumption of ferrous metals 10^3 tons	Per capita consumption of ferrous metals kg
	1966		1967	Potential	Proved	Potential	Proved	Potential	Proved	1967	1966	1967	1967	1967	1966	1967	1967	1966	1967	1966	1966	1966
Brazil	84679	8512.0	13.2[xx]	30000	10000	150	135	6000	2200	24446	1455	6900	3.4	32654	2963	3665	2255	147	259	184	4092	49
Mexico	44145	1972.5	21.9	900	600	7.2	338	4000	500	2900	185	18500	1.3	19024	1285	3013	2500	343	153	165	2455	57
Argentina	22691	2776.7	15.0[x]	750	300	100	393	415	270	150	25	16350	0.3	15400	617	1726	1327	212	565	61	3409	84
Venezuela	9030	912.0	6.4[x]	2130	1600		2354	3070	28	17000		134000	0.04	8735	422	640	329[x]	157	380	52	1104	122
Chile	8750	756.9		1000	200	22	24	700	60	4795	18	1550	1.6	6662	498	631	486[x]	26	30	15	630	72
Columbia	18650	1138.9		120	50		230	12500	210	750		10000	3.0	6350	203	258	235[x]	15	102	4	514	28
Peru	12012	1285.2		1170	500	54		600		8000	0.6	3150	0.1	4050	51	80	68[x]	10	174		346	33
Uruguay	2749	186.9		300	30									1811		13		4	117		49	18
Ecuador	5362	283.6	1.2				2					300		700					75			
Bolivia	3748	1098,6		250	50	20	68					2000		584					26			
Paraguay	2094	406.7	0.4[x]											205					7			
Costa Rica	1486	50.7												697								
Salvador	3037	21.4												477								
Guatemala	4575	108.9	1.0											520					64			
Honduras	2363	112.1	0.5											304					21			
Nicaragua	1715	130.0		50	n.a									555								
Panama	1287	75.6												472					38			
Haiti	4485	27.7								150				73					8			
Dominican Republic	3750	48.7		45	8									617					32			

x - 1966, xx - 1965

in 1980 /8/.

The iron ore production is expected to rise to about 95 m.tons in 1975 and to 108 m.tons in 1980.

The total resources of manganese ores are estimated at 350 m.tons or 30% of the total resources of the world (excl. the U.S.S.R. and other socialist countries). The Mn-content in these ores is 25-50%. Brazil has the largest resources of manganese ore and the highest level of its output among the countries of Latin America (Table 1).

Latin America is rich in the ores of alloy metals. The main deposits of alloy metal ores are in Brazil.

Even though comparatively large resources of coal are available in some countries of Latin America the industrial resources of coking coals are practically absent. The coal mining in Brazil, Mexico and Argentina can be used for coke production, as it allows by the technique now available, only being blended with imported coking coals (40% of indigenous and 60% of imported coals). The principal coal requirements in this area are provided with the import from the U.S.A.

The proved oil resources in the countries of Latin America amount to more than 3,500 m.tons. More than 2,300 m.tons or 2/3 of all resources of the oil are concentrated in Venezuela that is one of the largest countries in the world in oil production.

Considerable resources of hydropower are in the Latin American countries but the river energy utilization is insufficient for the time being. In 1966 the electric energy production amounted to about 100,000 m.kwt-h including about 50% of the hydroelectric power. The electric energy attains more and more importance for development of the iron and steel industry in the countries of Latin America due to the development of the electric furnace iron smelting in Brazil, Peru and Venezuela and electric steel and ferroalloy making in Argentina, Brazil, Chile and Mexico.

In Mexico where the process of direct iron ore reduction has been developed natural gas is used as a reductant (Mexico has the richest natural gas resources).

The countries of Latin America differ largely not only by the size of area occupied and by their population but also by the level of economic development and that of the iron and steel industry in particular.

The iron and steel output in these countries and a share each of them in 1967 are characterized with the following data /10/.

	Iron		Steel	
	10^3tons	% to the total	10^3tons	% to the total
Brazil	2963	46.7	3665	37.8
Mexico	1285	25.4	3023	31.2
Argentina	617	9.7	1326	13.8
Venezuela	422	6.7	690	7.1
Chile	498	7.8	631	6.5
Peru	31	0.5	80	0.8
Urugusy	-	-	13	0.1
Total	6019	100.0	9687	100.0

The share of Brazil, Mexico and Argentina among the afore-mentioned countries is about 82% of total iron output and 83% that of steel.

In 1967 20 integrated iron and steel works were in this area incl. 10 in Brazil, 4 in

Mexico, 2 in Argentina and by 1 in Venezuela, Chile, Columbia and Peru /11/. Their share in total iron and steel output was more than 90%.

In accordance with some estimates the steel output in the countries of Latin America will increase to 18.6-19 m.tons by 1970 and to 28.1-28.4 m.tons by 1975 /12/. The U.N. Economic Comission for Latin America (E.C.L.A.) estimated the possible steel production in these countries at 16-25 m.tons in 1970 incl. that in Argentina - 3.2, Brazil - 6.3, Mexico - 3.4, Venezuela - 1.2, Columbia - 0.8, Chile - 0.7, Peru - 0.5 and Uruguay - 0.2 m.tons. The nearest future shows as practicable these forecasts are. In 1968 the steel output was only 11 m.tons in this area.

The countries of Latin America meet more than 2/3 of their requirements for ferrous metals by domestic production. According to an estimate of E.C.L.A. Argentina, Brazil, Mexico and Chile can meet their requirements for ferrous metals by domestic production.

Some data concerning per capita consumption and production of steel in 1966 are show in Table 2. Venezuela has the highest per capita steel consumption that may be explained by the significant development of the oil industry being the large consumer of steel tubes, fittings, heavy and small sections

Table 2. Per capita steel production and consumption in 1966

Countries	Production		Consumption	
	Total 10^3tons	Per capita kg	Total 10^3tons	Per capita kg
Brazil	3713	43	4092	49
Mexico	2787	61	2955	67
Argentina	1266	56	1909	84
Venezuela	537	73	1101	122
Chile	577	66	630	72
Columbia	216	13	514	28
Peru	80	7	396	33
Uruguay	10	n.a.	49	18

A minimal diffsrence between steel production and steel consumption has been reached in Mexico, Chile and Brazil.

An increase of apparent consumption of steel connected with the development of domestic production of ferrous metal since the level of import was practically unchanged in last years (in 1967 a decrease of import took place).

The ferrous metals import to Latin America amounts to 3,100,000 tons in 1955 2,858,000 tons in 1960, 2,981,000 tons in 1965, 2,897,000 tons in 1966 and 2,335,000 tons in 1967.

The pattern of ferrous metal import is given in Table 3.

Later on the demand for ferrous metals in the countries of Latin America should be increased.

Some data representing an outlook of demand for the period by 1980 according to the forecast of E.C.L.A. are given in Table 4.

To meet a growing demand for metal production the governments of some Latin American countries realize measures directed to develop the domestic iron and steel industries. For instance, a state invests the capital for expanding the available iron and steel works and constructing the new ones, grants credits or guarantees loans fordeveloping the national private companies.

Leading integrated iron and steel works in the countries of Latin America are completely or partly state-owned. Some iron and steel works are properties of the private national companies (in Mexico and Brazil). Only two Brazilian metallurgical companies (Cia. Siderurgica Belgo-Mineira and Cia. Siderurgica Mannesmann) have been created at the expense of foreign capital. Industrially-developed countries especially the U.S.A. take part in the development of the iron and steel industry in the countries of Latin America by rendering them financial and technical assistance for construction and operation of enterprises.

The U.S.A. financial assistance data are tabulated in Table 5 /13/.

Table 4. Projections of demand for rolled steel products in the countries of Latin America (Thoueands ingot tons)

Countries	Years		
	1970	1975	1980
Brazil	5590	8486	12890
Mexico	3949	5898	8807
Argentina	3410	4820	6816
Venezuela	1247	1878	2830
Chile	944	1558	2485
Columbia	838	1233	1810
Peru	488	740	1123
Uruguay	190	250	328
Ecuador	115	172	257
Bolivia and Paraguay	75	105	148
Central America	419	636	966
Total	17265	25776	38460

Table 5. The financial assistance of the U.S. Export-Import Bank to a number of the metallurgical companies of Latin America (as of September, 1967)

	Steel output in 1966 10^3 tons	Credits of the U.S. Export-Import Bank 10^6
Argentina. Sociedad Mixta Siderurgia Argentina (SOMISA)	722	82
Brazil. Cia Siderurgica Nacional	1231	112
Chile. Cia. Acero del Pacifico	540	140
Mexico. Altos Hornos de Mexico, S.A.	1185	78.6
Hojalata y Lamina, S.A.	422	5.6
Cia. Fundidora de Fierro y Acero de Monterrey, S.A.	533	79.8
Venezuela. Siderurgica del Orinoco, C.A.	420	10.5

Table 3.Pattern of the ferrous metal import to the countries of Latin America (without Cuba) in 1967 (10^3 tons)

Countries	Ingots and semis	Railway track materials	Heavy and light sections	Wire rode	Strip	Plates	Sheets	Steel tubes and fittings	Wire	Tin plate	Wheels, tyres and axles	In all
Brazil	0.5	54.1	14.7	3.3	6.8	13.6	100.0	8.1	19.1	35.4	3.4	259.0
Mexico	13.5	26.6	23.7	0.1	3.3	2.7	16.7	27.6	7.9	10.3	20.3	152.7
Argentina	213.9	1.2	40.7	0.2	6.1	40.5	127.7	40.0	1.8	88.8	3.8	564.7
Venezuela	16.8	1.3	63.9	3.1	5.1	46.3	158.1	21.4	19.3	44.9	0.1	380.3
Chile	-	9.9	7.4	-	0.4	0.9	4.3	5.6	0.7	-	0.4	30.3
Colombia	2.3	-	5.2	1.1	3.1	13.8	27.4	32.3	1.2	15.5	-	101.9
Peru	2.1	9.2	17.7	5.3	13.1	31.3	58.9	19.3	3.0	12.8	1.6	174.3
Uruguay	-	0.6	31.5	0.1	0.3	13.0	24.5	32.7	5.2	9.1	-	117.0
Ecuador	7.5	0.1	21.8	6.1	1.4	1.8	11.7	10.0	9.4	5.4	-	75.2
Bolivia	-	0.2	6.7	-	0.1	1.4	9.2	5.2	1.4	1.6	0.1	25.9
Paraguay	-	-	1.4	-	0.1	0.1	1.0	0.3	0.6	3.3	-	6.8
Guatemala	13.4	-	7.0	3.7	1.4	4.0	26.2	2.1	1.9	4.5	-	64.2
Honduras	6.5	-	3.6	-	0.4	2.2	2.7	3.7	1.5	-	-	20.6
Panama	15.3	-	6.7	1.2	0.2	3.8	2.2	3.1	1.9	3.7	-	38.1
Haiti	-	0.1	3.9	-	0.1	-	2.6	0.4	0.3	0.2	-	7.6
Dominican Republic	0.2	0.1	27.8	-	-	1.5	11.5	4.9	2.6	2.8	0.2	51.6
West-Indies	-	0.2	2.5	1.9	-	1.1	4.0	0.6	-	3.1	-	13.4
Others countries	39.9	1.8	74.0	13.7	4.0	22.4	58.9	19.3	3.0	12.8	1.6	251.4
Total	331.9	105.4	360.2	39.8	45.9	200.4	647.6	236.6	80.8	254.9	31.5	2335.0
Share in total import,%	14.2	4.5	15.4	1.7	2.0	8.6	27.7	10.1	3.5	10.9	1.4	100.0

Last years Japan increased its financial and technical assistance for devsloping iron ore deposits in a number of countries of Latin America and for constructing small plants to produce galvanized sheet..

Plans have been worked out in some of the Latin American countries to enlarge the production capacities of the iron and steel industry. These plans having been carried out the steel production capacities will increase /6/:

in Brasil (1972*) to 7,500,000 tons per year
in Mexico (1970) to 4,500,000 -"-
in Argentina (1974) to 4,000,000 -"-
in Venezuela (1974) to 1,350,000 -"-
in Chile (1972) to 1,060,000 -"-
in Columbia (1974) to 720,000 -"-
in Peru (1970) to 350,000 -"-

Two integrated iron and steel works are prsently constructed, one of Cia. Propulsora Siderurgica in Ensenada, Argentina, having a capacity of its first stage 500,000 tons of rolled steel per year, the other of Hoyalata y Lamina, S.A. in Puebla, Mexico, designed to produce 240,000 tons of rolled products per year.

The contemplated construction of more than 30 iron and steel works has been announced in the countries of Latin America. The largest of them are two integrated iron and steel works in Brazil each of 500,000 ton steelmaking capacity per year and one of the same capacity in Mexico. New iron and steel works are expected to produce metal for export. All these works are expected to be constructed on the sea coast.

The Survey of the iron and steel industry in a number of Latin American countries is given below.

BRAZIL

Brasil is the largest country of Latin America but it takes only the fifth place among the countries of this area by the level of steel production and per capita steel consumption.

The iron and steel industry of Brazil is represented with ten integrated iron and steel works and twenty semi-integrated works with steelmaking and rolling shops. Other non-integrated works have either steelmaking or rolling shops.

The first integrated iron and steel works of the state-owned Cia. Siderurgica Nacional in Volta Redonda was brought in operation in 1946.

The characteristic feature of the Brazilian iron and steel industry is its strongly evidenced territorial concentration.

The iron and steel works (incl. ten largest ones) are situated mainly in three states in the East of the country, namely in Minas Gerais, Cão Paulo and Rio de Janeiro. The share of these states in all ferrous metal production in the country is more than 90% /14/. The concentration nearly all iron and steel industry in such small area is explained with the availability of raw materials and fuels, the nearness of the large harbours of Rio de Janeiro and of Vitoria as well as the relative development of transportation.

Such companies as Cia. Siderurgica Nacional, Sidsrurgica de Mogi das Cruzes, COSIPA and others are state-owned ones.

Steel production in the state-owned works is expected to be amounted up to 3,5 m.tons by 1975 /15/.

It is planned to spend in 1966-1972 for developing the iron and steel industry of Brazil

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* The year of the plan completion.

about 600 m. dollars /16/.

Raw material, fuel and energy resources

The total iron ore resources in Brasil are estimated at 80,000 m.tons incl. the proved resources at 10,000 m.tons. The ores are of high quality having an average Fe-content of 55% /1/. The largest deposits are in Itabira and in Congolias. They are located in the state of Minas Gerais (resources of 16,200 m.tons, Fe-content up to 69%).

The iron ore deposits are also in the states of Mato Grosso (resources of 1,300 m.tons) and of Bahia(50 m.tons)but they have not been mined yet/17/. All iron ore production in the country is concentrated in the state of Minas Gerais. Some data of the iron and manganese ore and coal production are shown in Table 6 /18-20/.

Table 6. The mining of iron and manganese ores and coal (10^3tons)

	Years											
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967
Iron ore	242	582	1987	3382	9345	10220	10778	11218	11430	18159	23253	24446
Manganese ore	262	172	195	213	1047	1016	1171	1254	1352	1396	1455	1132
Coal	763	1897	1959	2349	2230	2390	2508	2828	2930	3137	3380	3400

Basically, iron ore deposits are exploited by three companies, Cia. Vale do Rio Doce, Cia. Siderurgica Nacional and Mineira.

A share of the state-owned Cia. Vale do Rio Doce in total iron ore output in the country is roughly 60%. The company operates some mines in Itabira (100 km from Belo Horisonte) as well as in Caye, Conceicae and Dos Corregas where the iron ore mining is completely mechanised.

The iron ore production at the mines of Cia. Vale do Rio Doce is represented in the last years with the following data (10^3tons) /21/.

Year		Year	
1960	5219	1964	9066
1961	5510	1936	11452
1962	5368	1966	13040
1963	6974	1967	14300

More than half of iron ore being mined in the country is exported to the different countries of the world (Table 7) /20,22,24/

Table 7. Iron and manganese ore export of Brasil (10^3 tons)

Year	Export of	
	iron ore	manganese ore
1955	2565	177
1960	5240	866
1961	6282	868
1962	7564	760
1963	8207	841
1964	9730	833
1965	12731	1068
1966	12980	957
1967	14300	542

Cia. Vale do Rio Doce is a principal supplier producing iron ore for export. Its share in total iron ore export in 1967 was more than 75% (Table 8). Up to 1960 the USA was the largest consumer of the Brazilian ore but since 1961 the priority came to the Federal Republic of Germany and Japan /21,25/.

Table 8. Iron ore export by Cia Vale do Rio Doce[x] (10^3 tons)

Countries-importers	Years 1960	1966	1967	1968
Total export	4270	10099	10816	12575
	100	100	100	100
incl.				
to the FRG	911	2652	3278	
	21.3	26.3	30.3	
to Japan	383	1768	2271	
	9.0	16.5	21.0	
to the U.S.A.	1234	1451	512	
	28.9	14.4	4.7	
to Italy	51	771	1020	
	1.2	7.6	9.4	
to Great Britain	678	719	770	
	15.9	7.1	7.1	
to France	107	525	966	
	2.5	5.2	8.9	
to Canada	153	198	15	
	3.6	2.0	0.1	
to Netherlands	99	131	1037	
	2.3	1.3	9.6	

x) In numerator - 10^3 tons, in denominator - %

Iron ore exported by Cia. Vale do Rio Doce is believed to be amounted to 20 m.tons per year by 1970 /26/.

By this time the reconstruction of the harbour Tubarao (near the large harbour of Vitoria, Esperito Santo) is planned to be completed.

Companhia Siderurgica da Guanabara (COSIGUA) constructs a new harbour in Santa Cruz to export iron ore and to import coal. It was projected to be put in operation by the end of 1969 /27/.

Due to the increasing quality requirements for the iron ore supplied Cia. Vale do Rio Doce enlarges the capacities for producing the agglomerated iron ore. In 1966 this company made a contract with VOEST AG, Austria, for constructing a pellet plant with an annual capacity of its first stage of 2 m.tons. Later on its capacity should be increased to 5-6 m.tons per year. It is expected to be brought in action in 1969 /28/.

Iron ore mining capacities in Brazil are believed to be enlarged up to 30 m.tons per year by 1970 and to 77 m.tons per year by 1975. The annual pellet producing capacities will

amount to 9 m.tone by 1970 and to 18 m.tons by 1975.

The large iron ore deposits in the Paraopeba Valley are planned to be put in exploitation. Brazil has large deposits of manganese ores. The total resources of then are estimated at 150 m. tons /1/. As a rule, the manganese ore deposits are concentrated in the areas of iron ore bedding. The largest of them are situated in Mato-Grosso. Not long ago manganese ore deposits have been discovered in the north-west part of the territory of Amapa. In Minas-Gerais where mining has been carrying out for a long time the deposits have been already exhausted to a considerable extent.

The total resources of chrome ore are estimated at about 5 m.tons (the principal deposits are in Bahia).

The resources of tungsten ore are ettained 20,000 tons and half of them are known and probable ones. The ore contains 0.5-1.0% of tungsten oxide (WO_3). Brazil has also the resources of ores containing niobium and tantalum. The large part of alloy metal ores being mined is exported to the USA.

The total resources of coal in Brazil are estimated at 6,000 m.tons including the known ones at 2,200 m.tons.

The principal coal deposits are in the states of Sante Catarina and Rio Grande do Sul. In spite of high contente of ash and sulphur this coal may be used to produce coke providing its blending with imported coking coal (40% of indigenous and 60% of imported coking coals).

Brazil imports from the USA 1.3-1.5 m. tons of coal annually.

Hitherto forest resources have a great importance for developing the iron and steel industry of Brazil since many blast furnaces operate with the charcoal.

The natural gas resources in Brazil are estimated at 9.9 billion e^3. The proved oil resources are determined at 135 m.tons. The principal oil areas are in Agya-Grandi (about 63% of total oil output in the country) 1/.

The installed capacity of electric power stations was 7, 566,000 kwt in 1966 /4/.

Ferrous metal production

The total data of ferrous metal production in Brazil are given in Table 9 /10,19,20,89/.

More than 50 companies are engaged in ferroue metal production in the country. The largest of them are Companhie Siderurgice Nacional, Siderurgica Pauliste (COSIPA) and Usinee Siderurgica de Minas Gerais (USIMINAS).

Table 9. Ferrous metal production (10^3 tons)

	Years												
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967	1968
Iron	98	371	729	1069	1838	1977	2009	2323	2487	2538	2889	2963	3369
Steel	76	343	789	1162	2260	2443	2565	2832	3073	3017	3713	3665	4436
Rolled products	71	230	623	982	1704	1829	2065	2227	2328	2097	2520	2255	3301

The largest integrated iron and steel works in the country of the Companhie Siderurgica Nacional in Volta Redonda has the iron production capacity near 1 m.tons per year, that of steel - 1.4 m.tons per year and that of rolled products -1.2 m.tons per year.

There are four coke batteries, two blast furnaces, eight 200 t openhearth furnaces, an oxygen plant with a capacity of 30 tons per day, two electric furnaces, two crucible furnaces, a slabbing mill, two plate mills, one continuous hot strip mill, two cold strip mills two electrolitic tinning lines and two galvanizing lines in this works /11/. In 1968 all works of this company produced 966,000 tons of iron and 1,344,000 tons of steel /90/.

COSIPA founded in 1960 has an integrated iron and steel works at Piaçaguera (320 km southwards of Rio de Janeiro). Production capacities of this works comissioned in 1966 were (tons per year): iron -466,000. steel-500,000, rolled products-370,000. The construction of the second stage of the works having been finished its capacities will increase to 800,000 tons of steel per year, the final steel production capacity of the works will amount to 2.5 m.tons per year. This works has two coke batteries (each of 31 furnaces) and the largest blast furnace in Brazil with a 8.54 m hearth diameter and a daily production of 1650 tons, coke rate is 621 kg per ton of iron. Its output is projected to be enlarged up to 2000 tons per day. Oil injection and high top pressure operation are provided to be used on it. Two 75 t oxygen converters have been installed at a steelmaking plant as well as some mills (1100 mm slabbing, 2800 mm plate mill, 1675 mm semicontinuous hot strip mill, 1675 mm cold strip mill) and other equipment at rolling plants /11,31/.

The second slabbing mill, a plate mill, a 1525 mm hot strip mill and a 1525 mm cold strip mill are projected to be constructed in this works /34/.

In 1968 COSIPA produced 493,000 tons of iron and 557,000 tons of steel /90 /. Constructing an integrated iron and steel works of USIMINAS started at Ipatinga in 1956. The first stage of this works was completed in 1958. The works has two coke batteries, two blast furnaces, two oxygen converters with an annual capacity more than 600,000 tons of steel and some rolling mills.

In 1968 USIMINAS produced 605,000 tons of iron and 649,000 tons of steel /90 /. A programme of this works enlargement is being carried out. As a result of that its steelmaking capacity will increase to 1.2 m.tons per year and later on to 2.4 m.tons per year /29/.

The same company plans to build a cold strip mill at the plant in Belo-Horizonte. A new special steel plant with a capacity of 70,000 tons per year of Açoe Anhanguera, S.A. was comissioned in Mogi das Cruzes in April,1966. Its steel output will rise to 200,000 tons per year in the nearest future. Two or three 30-37 t electric furnaces having been constructed, its steel capacity will increase to 500,000 tons per year /32/.

An USIBA plant with a capacity of 600,000 tons of rolled products per year and a COSINOR plant with a capacity of 120,000 tons of steel per year are being constructed now. A project to build a plant of Metamig Co in Parapeoba Valley has been prepared and approved, its capacity being 2 m tons of sections per year. The cost of construction is 250 million U.S. dollars /29/.

There are 38 blast furnaces to produce iron in the country (the majority of them has small working volumes and operates on charcoal). About 3 m.tons of iron were produced in 1967.

Before the World WarII iron was produced in small blast furnaces operated on charcoal but since 1946 coke was used in some furnaces and already by 1964 more than half of total iron produced in the country was obtained in the blast furnaces operated on coke.

Nearly 1.7 m.tons of coke was produced in Brazil in 1967. Iron production data according to the types and the production processes are tabulated in Table 10. The principal part (nearly 90%) of the blast furnace production is iron for steelmaking.

Table 10. Iron production according to the types and production processes[x)]

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total iron	1838 / 100	1977 / 100	2009 / 100	2323 / 100	2487 / 100	2538 / 100	2889 / 100	2963 / 100
cast	239 / 13.0	300 / 15.2	307 / 15.3	368 / 15.8	4100 / 16.5	482 / 19.0	345 / 11.9	311 / 10.5

x) Numerator -10^3 tons, denominator - %

Table 10 (continued)

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
open-hearth	1599	1677	1702	1955	2077	2056	2544	2652
	87.0	84.8	84.7	84.2	83.5	81.0	88.1	89.5
coke	793	863	808	1154	1358	1408	1787	1870
	43.1	43.7	40.2	49.7	54.6	55.5	61.8	63.1
charcoal	966	1042	1132	1106	1070	1043	1011	1017
	52.6	52.7	56.3	47.6	43.0	41.1	35.0	34.3
electric furnace	79	72	69	63	59	87	94	76
	4.3	3.6	3.5	2.7	2.4	3.4	3.2	2.6

Brazil is one of a few countries of Latin America producing ferroalloys. Some data of ferroalloy production in Brazil are given below (10^3 tons) /33,34/.

	1965	1966	1967
Ferromanganese			
75-80%	25.85	30.8	30.8
80% and more	0.5	0.6	0.4
Ferrosilicium			
50-55%	4.11	8.0	8.4
70-85%	5.3	5.3	6.5
85% and more	0.64	0.2	0.7
Silicomanganese	9.1	6.0	4.7
Ferronickel	3.7	3.7	4.2
Ferrochrome	2.03	3.0	1.7
Ferrotitanium	0.01	0.03	-
Ferrotungsten	0.01	0.1	0.1
Others	0.06	-	-
Total	51.31	51.73	57.50

Ferroalloys are mainly produced at the plants of Mineraçao Geral do Brasil in Nova Iguacu and Homorio Gurgel and at the plant of Companhia Siderurgica Nacional in Lafayette.

Companies Brasimet and Ferro-Ligas da Bahia contemplate to build a new ferroalloy plant /35/. In 1967 the steel production capacities in the country totalled 4.6 m.tons. These capacities are believed to reach 7.5 m.tons by 1972 /18/.

Some companies contemplate to raise raw steel production capacities as follows (10^3 tons).

	1966	1972
Cia.Siderurgica Nacional	1400	2500
COSIPA	600	1000
USIMINAS	600	1000
Siderurgica Belgo-Mineira	400	520

The most part of steel being produced is open-hearth steel (Table.11) /10.19). The share of oxygen converter steel has been sharply increased in recent years. In 1966 the oxygen converter steel production capacities totalled 2 m.tons per year.

The first two oxygen converters were installed in Brazil at the Cia. Siderurgica Belgo Mineira plant in Monlevade in 1957. Presently six large companies have oxygen steelmaking plants.

Flat products (sheets and plates) take a signficant place in a product mix of rolled

steel being produced in Brazil. A share of flat products in the total output of rolled steel in the country amounted to 56% in 1966 (Table 12)./19/.

Table.11. Crude steel production according to the production processes[x)]

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total crude steel produced	2260	2443,2	2565,2	2831,8	3072,9	3016,8	3712,6	3665,3
	100	100	100	100	100	100	100	100
Open-hearth	1529	1624,4	1736,8	1819,4	1786,0	1709,2	1731,2	1717,8
	67,7	66.5	67,7	64,2	58,1	56,7	46,6	46,9
Electric	495,3	559,8	575,2	619,6	629,2	524,5	607,6	575,7
	21.9	22.9	22.4	21.9	30.5	17.4	16.4	15.7
Bessemer	0,4	0,8	3,7	10,0	5,6	15,2	17,2	26,4
	-	-	0.2	0.4	0.2	0.5	0.5	0.7
Oxygen converter	235,0	258,2	249,5	382,8	652,1	767,9	1356,6	1344,9
	10.4	10.6	9.7	13.5	21.2	25.4	36.5	36.7

x) Numerator - 10^3 tone, denominator - %

Table.12. Production of rolled products, tubes and some goods of the further conversion (10^3 tons)

	Years						
The type of rolled product	1960	1961	1962	1963	1964	1965	1966
Rails and accessories	13.9	31.7	39.4	29.5	47.6	92.2	106.2
Wire rods	170.3	166.3	231.2	262.8	235.5	281.2	162.1
Heavy sections	94.8	77.7	89.5	77.3	125.2	91.5	93.2
Reinforcing bars	256.1	279.0	300.9	345.9	425.5	231.3	251.7
Other bars and rods and light sections	310.9	296.5	335.7	367.1	428.4	307.6	420.7
Hoop and strip	60.4	66.6	44.1	49.6	41.6	43.4	32.5
Plates (over 4.75 mm)	97.0	179.9	156.5	192.6	239.5	281.2	352.5
Medium plates (3-4.75 mm)	89.7	107.5	727.9	793.3	747.7	750.7	1057.4
Sheets (under 3 mm)	456.6	520.9					
Other rolled products	36.2	28.6	51.3	17.9	37.4	17.7	44.3
Semis for sale	117.9	74.4	88.8	91.8			
Electrical sheets	13.6	15.8	18.1	18.5	26.6	12.0	14.1
Seamless tubes	53.2	61.2	68.2	75.3	67.0	52.5	72.0
Total	1770.6	1906.1	2151.5	2321.3	2422.0	2161.3	2520.3

According to an estimate of the National Bank of Economic Development of Brazil rolled product capacities totalled 3,730,000 tons in 1965.

The largest producers of flat products in Brazil are Cia.Siderurgica Nacional, Cia. Siderurgica Belgo-Mineira and USIMINAS, the principal producer of tubes is Cia. Siderurgica Mannesmann.

The foreign trade of ferrous metals

At present Brazil is completely provided with the iron of domestic production and meets 80% of the rolled products requirements. A considerable part of import consists of sheets and plates.

Table.13. The foreign trade of ferrous metals (10^3 tons)

	Years						
	1960	1961	1962	1963	1964	1965	1966
Import							
Iron	0.2	0.2	0.3	0.4	0.5	0.5	0.9
Ferroalloys	1.2	1.4	1.8	1.5	0.8	0.6	2.8
Iron tubes, pipes and fittings	0.4	0.1	2.6	14.8	6.0	0.1	0.2
Steelproducts incl.	360.0	241.1	177.2	382.7	211.9	210.8	267.2
Ingots, billets, blooms and slabs	0.5	0.4	0.5	4.5	0.3	10.3	0.4
Bars and rods		17.0	12.1	47.4	9.6	10.0	27.1
Heavy sections	4.4	1.8	2.6	4.7	1.8	5.5	6.7
Strip	5.4	7.5	5.2	8.3	5.9	4.2	7.0
Plates and sheets	162.9	144.6	133.6	263.7	122.1	120.2	129.3
Railway-trackmaterial	142.6	42.8	4.7	29.9	49.2	41.7	32.2
Tubes, pipes and fittings	14.3	14.9	9.5	9.8	14.2	9.5	11.7
Wire	10.2	12.0	9.1	14.4	8.8	9.4	12.0
Total	361.8	242.8	181.9	399.4	219.2	212.0	271.0
Export							
Iron	14.6	38.5	-	47.0	149.0	101.3	2.0
Ferroalloys	-	0.1	5.0	-	1.6	10.4	2.1
Ingots and semis	1.5	-	4.8	0.2	49.0	199.7	30.3
Bars and rods	6.4	5.5	0.1	0.1	0.9	5.0	3.4
Heavy sections	8.9	2.2	0.1	-	4.8	1.6	6.3
Plates and sheets	1.2	-	-	0.1	34.7	158.0	96.5
Tubes, pipes and fittings	0.6	4.3	0.5	6.3	10.0	6.4	6.1
Total	33.2	50.6	10.5	53.7	250.0	482.4	146.7

The main suppliers ofrolled products are Japan, the FRG, the USA, Great Britain, Yugoslavija. A small part of the rolled products being produced in the country is exported to the other Latin American countries mainly.

The Government of Brazil has taken a number of measures directed to limit the ferrous metal import and to improve the conditions of export by means of allocation of different privileges and lowering duties.

MEXICO

Mexico takes the second place among the countries of Latin America (behind Brazil) by its population and amount of ferrous metal production and the first place by the level of national income. The iron and steel industry of Mexico is represented with four integrated and some non-integrated steel works.

The country is rich in iron ores. The total resources of it are estimated at 900 m.tons /14 The largest deposit is Sierra de Mercado (the state of Durango) with the known resources estimated at 150 m.tons. of magnetite-hematite ore containing in average 60-67% Fe and up to 0.2%S.

Not long ago a new large deposit of iron ore was discovered in Pena Colorado on the Paci-

fic seacoast (the etate of Celima). Its resources are estimated at 130 m.tons with Fe-content up to 69% /27/. The other deposite, Las Truchas (resources 145 m.tons, Fe-content more than 60%), Nuevo Leon (100 m.tons and 58% Fe) /17/.

Some data of iron and manganese ore and coal production in Mexico are given in Table 14 /4,19,20/

Table 14. Production of iron and manganese ores and coal (10^3 tons)

	Years										
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966
Iron ore	132	275	417	712	939	1209	1720	2090	2549	2909	2825
Manganese ore*	n.a.	11	14	36	72	69	63	54	64	59	31
Coal	1242	983	912	1342	1772	1049	1110	1224	1272	948	1260

* Mn-content

Iron ore production is expected to be conaiderably raised in the nearest years due to the mining a new deposit in Pena Colorado where 2 m.tons of iron ore are planned to mine annually /36/.

The total resources of manganese ore are estimated at 7.2 m.tons. Only one depoeit Autlan (in the state of Jalisco) is now being mined. Mn-content in the ore totals 41-45% /1/. Mining the manganese ore deposit of Molango (the state of Hidalgo) was to be started in 1968.

Nearly total iron and manganese ore being produced is consumed in the country. Only a negligible part is exported abroad mainly to the U.S.A. The total coal resources are estimated at 4,000 m.tons incl. the known resources at 500 m.tons.

The principal coal dsposits are situated in the states of Oaxaca, Coahuila, Sonora. The coal production data are given in Table 14.

The total resources of natural gas amount to 283,200 m.cu.m. The principal resources are concentrated in the north-eastern part of the country. Mexico takes the fourth place in the world* by the amount of natural gas production. A part of gas produced is exported to the other countries.

The proved oil resources are determined at 338m.tons. The principal deposits are concentrated on the Gulf of Mexico. The state-owned company Pemex controls the oil production and refining.

Some data repreeenting the ferrous metal production in 1960-1967 are given in Table 15 /19,20,37,38/

Table 15. Production of ferrous metals, 10^3tons

	Yeare							
	1960	1961	1962	1963	1964	1965	1966	1967
Iron	669	758	801	833	926	946	1137	1285
Sponge iron	115	174	166	170	203	213	266	326
Ferroalloys	16	26	26	26	43	43	n.a.	55
Crude steel	1492	1693	1711	2026	2326	2455	2787	3023
Rolled products	997	1028	996	1275	1513	1562	2063	2300

* Excl. the U.S.S.R. and other socialist countriee

Steel is produced only in open-hearth and electric furneces (Table 16) /20,34,38/.

Table 16. Steel production according to production processes •

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total crude steel	1491.8 / 100	1693.1 / 100	1710.7 / 100	2026.0 / 100	2326.5 / 100	2454.7 / 100	2787.5 / 100	3023.2 / 100
Open-hearth	905.5 / 60.7	1057.9 / 62.5	1052.9 / 61.5	1289.5 / 63.6	1478.7 / 63.6	1558.0 / 63.5	1717.9 / 61.6	1878.5 / 62.1
Electric	586.3 / 39.3	635.2 / 37.5	657.8 / 38.5	736.5 / 36.4	847.8 / 36.4	896.7 / 36.5	1069.6 / 38.4	1144.7 / 37.9

• Numerator -10^3 tons, denominator - %

The most part of rolled product range consists of sheets and reinforcing bars (Table 17) /19/

Table 17. Range of rolled products •

	Years						
	1960	1961	1962	1963	1964	1965	1966
Rails and railway materials	23.1 / 2.3	11.3 / 1.1	8.7 / 0.9	16.8 / 1.3	12.2 / 0.8	14.5 / 0.9	12.3 / 0.6
Wire rods	119.1 / 12.0	128.0 / 12.4	133.5 / 13.4	136.5 / 10.7	171.3 / 11.3	192.5 / 12.3	193.9 / 10.5
Reinforcing bars	228.5 / 22.9	246.6 / 24.0	254.4 / 25.6	309.1 / 24.3	333.7 / 22.0	397.6 / 25.5	40.34 / 21.8
Other bars and rods	3.4 / 0.3	4.4 / 0.4	5.8 / 0.6	6.4 / 0.5	8.5 / 0.6	34.3 / 2.2	75.8 / 4.1
Light sections	110.6 / 11.1	116.0 / 11.3	129.6 / 13.0	125.4 / 9.8	165.5 / 10.9	108.5 / 7.0	154.7 / 8.4
Heavy sections	48.5 / 4.9	61.4 / 6.0	50.3 / 5.1	60.6 / 4.8	69.7 / 4.6	64.7 / 4.1	92.6 / 5.0
Plates	154.5 / 15.5	132.1 / 12.8	85.6 / 8.6	192.9 / 15.1	232.3 / 15.4	248.1 / 15.9	304.6 / 16.5
Sheets	281.5 / 28.2	272.1 / 26.5	317.1 / 31.8	385.4 / 30.2	489.7 / 32.4	493.8 / 31.6	590.5 / 32.0
Strip	27.8 / 2.8	56.4 / 5.5	10.3 / 1.0	42.2 / 3.3	30.1 / 2.0	8.0 / 0.5	20.5 / 1.1
Total	997.0 / 100.0	1028.3 / 100.0	995.5 / 100.0	1275.2 / 100.0	1513.0 / 100.0	1562.0 / 100.0	1848.3 / 100.0
Tinplate	62.0	67.8	72.6	85.4	89.0	116.2	118.0
Welded tubes	125.9	123.9	93.7	146.3	141.7	118.2	178.1
Seamless tubes	123.2	109.0	120.0	127.1	141.6	127,8	162.8
Steel castings and forgings	11.0	16.7	9.4	11.7	25.8	33.8	38.3

•Numerator -10^3 tons, denominator -%

The tube production in Mexico amounts to 2/3 of total tube production in Latin America. Nearly 60 companies are engaged on the ferrous metal production. The share of the four largest, Cia. Fundidora de Fierro y Acero de Monterrey, S.A., Altos Hornos de Mexico, S.A., Hojaleta y Lamina, S.A. and Tubos de Acero de Mexico, S.A. (TAMSA) amounts to 85-90% of total steel produced in the country. All these companies excluding Cia. Fundidora de Fierro y Acero de

Monterrey, S.A. were created in the period of the World War II.

Altos Hornos de Mexico, S.A. is a state-owned company. In 1967 ths iron and steel works of this company produced nearly 70% of total iron and more than 40% of totsl stesl in the country.

The company has three iron and stesl works in Monclova, Pedras Negras and Mexico.

The iron and steel works in Monclova is an integrated one. It has a coke plant with 114 coke furnaces and a completely mechanized sinter plant with s capacity of 4500 tons of sinter per day. The ores of the deposits La Psrla and Sierro de Mercado are used for sinter producing. Three furnsces are in a blast-furnace plant. Sinter is basically used only in the third blast furnsce blown in 1967. Thie furnace having bsen blown, the company's iron production capscities amounted to 1,150,000 tons per year /35/. An opsn-hearth plant has eight furnacee with a total capacity of 1.4 m.tons per year. A blooming-slabbing mill with a capacity of 1.4 m.tons per year, a rougher (700,000 tons per year), a plats mill (400,000 tons psr year), four revereing cold strip mills having productivity rates accordingly 60-, 70-, 70-, and 80,000 tons per year were installed st rolling plants. There are also nine hot dip tinning linee and one galvanizing line in the work.

The fourth blast furnace with a capacity of 450,000 tons per year is projected to be build as well as blooming, an oxygen converter plsnt having two 60 t oxygen convertere with an annual capscity of 500,000 tons with increasing it to 1 m.tons in future /39/.

The steel output in the iron and steel worke of the Altos Hornos de Mexico, S.A. was nearly 1,35 m.tons in 1967 /47/.

The steel production capacities of the company's iron and steel worke are projected to increase to 2 m.tons by 1970, to 2.8 m.tons by 1975 and to 4 m.tons by 1980.

Altos Hornos de Mexico, S.A. plans to build new iron and steel worke in Las Truchas thst is in one of the most important iron ore producing aree (the state of Michoacan).

A einter plant, ten electric ore reduction furnaces, an oxygen comverter plant and some rolling mills are projected to be build /41/.

The iron and steel works of the Fundidora de Fierro y Acero de Monterrey, S.A. has three blast furnaces (incl. one producing fsrromanganese), eight opsn-hearth furnacee (four 90 tons and four 225 tons), a blooming-slabbing mill, rolling mills, a billet mill, a plate mill, a continuous hot strip mill, s rail and structural mill, thrse cold strip mills and e continuous galvanizing line /11/. The third blast furnace with a hearth diameter of 8.5 m. and s production rate of 2,500 tons of iron per day started by conetruction in 1965 was blown in 1968. 1320mm continuous cold strip mill was put in operation in 1968. In 1966 the company's iron and steel works in Monterrey produced 372,000 tons of iron, 563,000 tone of steel and 420,000 tons of rolled products /42/. Its stsel production capacities are expected to amount to 1.5m.tons by 1975 and to 2 m.tons by 1980.

Hojalata y Lamina, S.A. is one of the world's largest producers of sponge iron. It has an iron and steel works in Monterrey having a sponge iron producing plant, a steelmaking and a rolling plants. Iron ore is delivered to the works from the mines et El Ensina. Sponge iron is produced in two direct reduction installatione with a daily production of 200 and 500 tons. The Fe-content in finished output is about 85% /44/.

Sponge iron is used in the steelmaking plant with seven arc furnacee having a total capacity of 450,000 tons per year. Ths furnaces operate with the charge consisting of 50-75% of sponge iron and 25-50% of scrap, about 58% of steel produced in the works in Monterrey is low csrbon one /45/.

The Hojalata y Lamina process has some sdvantages: firstly, the iron and steel scrap requirements is lowered with sponge iron use in the charge of electric furnace, secondly the capi-

tal investment to produce 1 ton of sponge iron in Mexico's conditions is about half of that requiring to produce one ton of iron, thirdly, cheap natural gas is used as fuel and reductant at sponge iron production and a need to have coke is fallen away. Furthermore, the quality of steel is improved by the addition of sponge iron to the charge of steelmaking furnsces.

The works in Monterrey has two revsrsing hot sheet mills, two cold strip mills, a temper mill, a hot dip tinning line and an electric tinning line with the capacity of 60,000 tons per year put in action in 1966.

By the end of 1966 the steel production capacities of the Hojalata y Lamina, S.A. steel works were amounted to 500,000 tons per ysar /46/.

In the spring of 1967 this company began to build a new integrated iron and steel works in Puebla at the distance of 115 km from Mexico City. The construction of first stage of this works is plannsd to complete in 1969. It was foreseen to build a sponge iron production plant with the productivity rate of 200,000 tons per year, an electric steelmaking plant having three 60 t arc furnacss with the total annual capacity of 285,000 tons and two four-strand continuous casting plants as well as a rolling plant /47/. The initial production capacity of this worke totels 240,000 tons of finished rolled producte annualy. The investments costs are estimated at 42 m. dollars /48/. When the first stage of the iron and steel works will be put in operation in 1970 the steel production capscities of the Hojalata y Lamina, S.A. should be amounted to 1.5 m.tons per year by 1975 and to 2 m. tons per year by 1980.

Tubos de Acero de Mexico,S.A. hae an iron and steel works in Vera Cruz (a harbour on the Gulf of Mexico seashore). The works has thrse 50t electric furnaces with the annual capacity of 230,000 tons of steel and three rolling mills with the total capacity of 120,000 tons per year. The works produces different types of rolled products and is specialized in seamless tube production. The third in Mexico direct reduction sponge iron plant by Hojalata y Lamina's process was put in operation in this works in 1967. Its productivity rate is 500 tone per day /49/.

The steel production capacities of TAMSA amounted to 250,000 tons per year in 1966. After carrying out a propo sd enlargemsnt ths steel production capacity would be raised to 350,000 by 1970, to 600,000 tons by 1975 and to 800,000 tons by 1980. TAMSA projects to build a blast furnace and to incrsase the coke production capacity up to 500 tone psr day in the works of Vera Crux.

The Government of the state of Colima has announced its decision to build a new integrated iron and steel works with the capscity of 1 m.tons of steel per year on the base of the iron ore deposit of Pena Colorado /34/.

A company of Aceros San Louis Potoci constructs a plant to produce rolled products for construction /34/.

The ferrous metal production in Mexico meets the domestic requirements of ths country to about 80% including those of sheets to 100%, seamless tubes to 96%, sections and structural to 87% /34/. Some figurss of the ferrous metal import are given in the Table 18 /19/.

Table 18. Import of ferrous mstals and scrap, 10^3 tons

	Years										
	1937	1950	1955	1960	1961	1962	1963	1964	1965	1967	
Scrap	52	106	236	382	368	289	455	735	64	716	n.a
Total ferrous metals	197	165	256	173	124	127	105	180	264	271	152
including											
Rails	15	54	66	95	39	58	47	89	121	97	27
Tubes,pipss and fittings	72	76	46	18	17	9	10	6	10	11	28
Plates and sheets	41	30	18	15	11	10	12	16	19	20	19

The main Mexico's suppliers of ferrous metals are the USA and Canada. A small part of Mexico's iron and steel production is exported mainly to the countries of Latin America. In 1966 156,000 tons of ferrous matals(iron,semi-products,plates,sheets and tubes) were exported /50/.

ARGENTINA

The iron and steel industry of Argentina is represented by two integrated iron and steel works, ten works having steemaking plants and nearly 50 worke with rolling plants. At the beginning of 1967 their total productivities totalled, 10^3tone per year; iron - 850, steel -1704, rolled products- 2500 /53/. The statue of the raw material base is deecribed below.

Among the Latin American countries Argentina takes the fourth place by the per capita production of steel and the second place (behind Venezuela) by its per capita consumption.

The total resources of iron ores in Argentina are estimated at 750 m.tons including the known and probable ones at 300 m.tons/1/. The average Fe-content in the ore is 45%. The largest deposits are in the provinces of Rio-Negro and Jujui, in the north-west and in the east parts of the country. The ore resources in the territory of Rio-Negro are estimated at 200 m. tons (the average Fe-content is 55%) and in the territory of Jujui 110 m.tons of ore and 40-45%Fe accordingly. The iron ore deposite are also in the provinces Salta (50 m.tons) and Sierra Grande.

The production of iron ore in Argentina isn't large and doesn't meet the requirements of the blaet furnace production (the iron production in 1967 was more than 600,000 tons and the iron ore production only 150,000 tons). The iron ore reguired ie imported from the Latin American countries mainly from Brazil (last years more than 500,000 tons), Chile, Peru and Venezuela.

A pellet plant with the productivity of 1 m.tons per year is planned to be build at the deposit of Sierra Grande /51/.

The total reeources of manganese ore are estimated at 100 m.tons. The most of the deposits are not large, they have low quality ores containing 20-30% of manganese. The most important deposits are in the provinces of Catamarca, Mendoza and Salta. The manganese ore is mined underground. The tungsten ore deposits are in the central part of the country.

The brown coal deposits are estimated at 415 m.tons. The principal resources are concentrated in the basin of Rio-Turbio (the province of Santa-Cruz). The coal isn't of high quality.

The coal production ien't large and doesn't meet the requirements of the country. In 1965 eome 1,657,000 tons of coal and 82,000 tons of coke have been imported to Argentina. The figures about the iron and manganese ores as well as the brown coal production are given in Table 19./19,20/.

Table 19. Production of iron and manganese ores and brown coal, 10^3tons

	Years											
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967
Iron ore	2.5	51.7	39.9	76.3	137.0	138.6	122.6	99.9	94.5	115.0	154.0	150.0
Manganese ore	0.6	4.1	1.2	2.8	14.7	39.9	29.2	29.2	37.3	27.0	25.4	n.a.
Brown coal	n.a.	3.1	26.5	136.0	271.2	235.0	212.0	208.7	208.7	374.0	356.4	425.0

The development of iron and steel industry in Argentina in the post-war period is characterized by the figures of Tabls 20 /19.20,52/.

A share of the Stats amounted to 96% of iron production capacities, to 64% those of steel and to 38% those of rolled products /53/.

A principal part of the iron being produced is the iron for steelmaking.

Table 20. Production of ferrous metals, 10^3 tons

	Years											
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967
Iron	-	12.3	17.3	35.0	180.1	398.5	396.5	422.5	388.3	663.2	521.9	617.3
Crude steel	2.0	133.0	130.9	217.7	277.0	441.5	644.6	894.7	1265.1	1368.2	1256.6	1325.7
Rolled products	n.a	109.6	238.2	620.6	701.2	812.2	666.3	713.9	1300.7	1451.0	1274.2	1326.9

Table 21. Production of steel by different processes[x)]

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total crude steel	277.0	441.5	644.6	894.7	1265.1	1368.2	1267.4	1325.7
	100	100	100	100	100	100	100	100
Open-hearth	275.4	441.0	632.6	809.5	1072.3	1087.0	1010.9	1015.9
	99.4	99.9	98.1	90.5	84.8	79.4	79.7	76.6
Electric	1.6	0.5	12.0	85.2	152.6	215.7	202.6	238.5
	0.6	0.1	1.9	9.5	12.0	15.8	16.0	18.0
Bessemer basic	-	-	-	-	30.3	57.0	58.9	71.3
					2.4	4.2	4.2	5.4
Bessemer acid	-	-	-	-	9.9	8.5	-	-
					0.8	0.6		

x) numerator, 10^3 tons, denominator, %

The relation between the different steelmaking processes in Argentina is characterized by the figures of Table 21 /19/.

The open-hearth process of steelmaking prevails in the country. The largest open-hearth furnaces have been installed in the iron and steel works of SOMISA in San Nicolas (five 225-t open-hearth furnaces with the total capacity of 850,000 tons per year). In the last years electric steelmaking is developing relatively rapidly, its share in the total steel production almost doubled in the period of 1963-1967.

The principal producers in the country are Dalmine Siderca, Altos Hornos Zapla and Establimientos Metalurgicos Santa Rosa, S.A. Two 15t electric furnaces were put in action at the steelmaking plant of Santa Rosa in Buenos Aires in 1967 /54/.

In the nearest years the oxygen converters process is expected to be used in Argentina. It is planned to build two 100t oxygen converters at the plant of ASINDAR in Villa Constitucion and a oxygen converter plant in the works of SOMISA in San Nicolas with a total capacity more than two million tons of steel per year /55/.

The most part in the range of rolled products are sections and sheets (Table 22) /19/.

The largest metallurgical companies of the country are Altos Hornos Zapla, Sociedad Mixta Siderurgia Argentina (SOMISA), Industria Argentina de Aceros, S.A (ASINDAR).

Altos Hornos Zapla is owner of an intsgrated iron and steel works in Palpala having four charcoal blast furnaces with the daily productivity of 60-150 tons, three Thomas converters, two 12t electric furnaces and rolling mills.

The annual steel production capacities of this works is believed to rise to 200,000 tons by 1970 /56/.

In 1966 the annual production capacities of SOMISA totalled 650,000 tons of iron, 890,000 tons of steel and 750,000 tons of rolled products /53/.

Table 22. Range of rolled producte, 10^3 tone

	Years						
	1960	1961	1962	1963	1964	1965	1966
Rails and railway materials	7.9	0.2	0.1	2.5	0.2	5.4	24.0
Wire rods	175.3	207.7	184.0	211.9	265.1	258.8	195.5
Reinforcing bars	181.7	213.2	161.7	138.1	212.0	257.3	249.2
Other bars and rods and light sections	220.2	231.6	174.0	121.8	230.3	295.7	190.1
Heavy sections	18.5	29.7	38.6	22.2	48.1	41.8	26.8
Strip	77.3	102.2	78.1	66.4	125.8	69.6	55.4
Plates (over 4.75 mm)	12.5	13.6	23.4	1.5	22.5	54.6	46.4
Sheets (4.75 mm and under)	0.7	0.1	3.8	141.4	378.3	441.0	367.0
Tyres	7.1	3.7	0.5	3.8	6.3	7.2	n.a.
Other rolled products	-	10.2	2.1	4.3	12.1	19.6	19.8
Total	701.2	812.2	666.3	713.9	1300.7	1451.0	1264.2
Cold rolled strip	25.8	27.3	13.4	13.4	16.0	15.2	n.a.
Cold rolled sheets	-	-	-	-	220.1	266.6	n.a.
Seamless tubes	95.2	98.9	89.4	62.2	84.2	92.9	99.2

This company owns an integrated iron and steel works in San Nicolas constructed in 1962. The works has a blast furnace (hearth diameter of 8.53 m and productivity rate of 817,000tons of iron), five open-hearth furnaces with the total annual capacity of 1,125,000 tons of steel /11/, a tinplate shop. The company projecte to enlarge the works in San Nicolas and to raise the steel production to 2. a .tons by 1973. According to the project it is planned to build the second blast furnace, a coking plant, an oxygen converter plant (two 118t oxygen convertere) and some steel continuous casting plants.

The capital inveetments for these purposee are nearly 200 m. U.S. dollare /58-60/. The enlargement of the worke is planned to carry out by stages. The first stage. Construction of a sinter plant with the daily production of 1600 tone and modernization of rolling equipment. The second stage.Construction of an oxygen converter plant, a degassing-unit and continuous steel casting installations.

The third stage. Putting in operation the equipment for charge preparation, construction of the second blast furnace and a coking plant.

Apart from SOMISA the companies of ASINDAR, Propulsora Siderurgica and Dalmine Siderca are engaged on enlargement of their enterprises.

ASINDAR is planned to convert its works in Rio Parana near Villa Constitucion into an integrated iron and steel works. A blast furnace, an open-hearth furnace (with a capacity of 70,000 tons per year), a basic oxygen converter plant, a continuous casting plant and rolling mills are planned to be build. The cost of construction is estiaated at 77 m .dollare.

A new integrated iron and steel worke was started to build by Propulsora Siderugica in Ensenada (the province of Buanoe-Aires in 1967. The cost of construction ie 230 m. dollars /6//. A cold strip rolling mill with a productivity of 300,000 tons per year is expected to be constructed in 1969, a hot strip mill with a productivity of 1 m.tons per year by 1972, a blast furnace and an oxygen converter plant by 1974. The initial

capacity of this works will amount to 500,000 tons of cold rolled strip per year. This works capacity is planned to raise up to 1-2 m tons per year /64/. The works is favourably situated nearly raw material sources and sale markets.

Dalmine Siderca put in operation a four strand continuous steel casting plant in July, 1968. The company projected to increase special steel production capacities to 300,000 tons per year by the middle of 1969 /61.62/.

Steelmaking capacities of Argentina is expected to be amounted to 4 m.tons per year by 1974.

The steel demand of the country isn't presently met completely with domestic output and Argentina has to import ferrous metals (Table 23) /19/.

Table 23. Import of ferrous metals, 10^3 tons

	Years									
	1937	1950	1955	1960	1961	1962	1963	1964	1965	1966
Total incl.	973	928	1527	1343	1625	927	498	702	1834	505
Iron	52	93	190	42	42	12	n.a.	23	142	n.a
Ingots, semis etc.	-	n.a	606	450	732	275	82	152	609	208
Plates and sheets	173	144	295	340	522	348	118	205	260	165
Tinplate	81	59	107	90	87	88	94	115	112	84
Bars and rods	n.a,	na.	n.a,	110	156	102	37	95	180	32

The principal suppliers of ferrous metals to Argentina are Japan, the U.S.A., the FRG Great Britain and Brazil.

VENEZUELA

Venezuela takes the first place among the countries of Latin America by the level of per capita steel production and steel consumption.

The iron and steel industry of Venezuela includes an integrated iron and steel works, two steelmaking and rolling plants and a galvanizing sheet production plant.

The country has considerable iron ore reserves. The total resources amount to 2,100 m.tons of ore containing more than 50%Fe including the proved resources of 1,600 m.tons /1/. The richest deposits are El Pao (resources of 250 m.tons of ore containing 68%Fe) and Sierro Bolivar having 1,400 m.tons and 63%Fe accordingly /17/. Not a long ago a new large deposit near Guri was discovered. Its total resources are estimated at 200 m.tons of ore containing 48%Fe /65/. Iron ore mining at the deposits of El Pao and Sierro Bolivar is carried out by two companies, Orinoco Mining (85% of production) and Iron Mines (15% of production) with the participation of the United Stated Steel Corp. and Bethlehem Steel Corp.

Venezuela takes a second place in Latin America by the amount of iron ore produced (behind Brazil). Nearly all iron ore (97%) is exported mainly to the FRG. the U.S.A. and Japan /9/.

Iron ore production and export figures are given below, 10^6 tons.

Year	Production	Export
1950	0.2	na.
1955	8.4	n.a.
1960	19.5	n.a.
1961	14.6	14.6
1962	15.2	13.2
1963	11.8	12.3

Year	Production	Export
1964	15.6	14.9
1965	17.5	17.0
1966	17.8	17.0
1967	17.0	n.a.

x) Excl. the USSR and the other socialist countries

The proved resources of coal are negligible. The coal production totalled 31,000 tons in 1965 and 34,000 tons in 1966 /1/. Indigenous coals may be used for coke production providing their mixing with imported coal.

Venezuela takes the second place in the world[x)] by the level of oil production and the first place by the amount of its export. In 1967 the oil production amounted to 185 mil. tons /3/.

Considerable resources of natural gas are in the country (934 billion m^3) but they are not used practically.

Some figures concerning the production of ferrous metals in the country in the period of 1961-1967 are given in Table 24 /19/.

Table 24. Production of ferrous metals, 10^3 tons

	Years						
	1961	1962	1963	1964	1965	1966	1967
Iron	5.2	172.8	283.2	323.5	333.6	351.0	422.2
Crude steel	70.8	142.2	358.4	440.8	625.0	537.0	690.4
Rolled products	73.1	82.9	117.7	196.9	170.4	2294.4	n.a.

Ingot steel production in Venezuela is expected to reach 1.5-1.6 m.tons by 1975 and steelmaking capacities should be increased to 2 m.tons per year by that time. /13/.

Some figures concerning the production mix of rolled steel products as well as the tube output are given in Table 25 /19,38/.

Table 25. Range of rolled products, 10^3 tons

	Years					
	1961	1962	1963	1964	1965	1966
Total rolled products incl.	73.1	82.9	117.7	196.9	170.4	223.4
Wire rods	24.7	-	9.1	43.3	82.5	18.4
Reinforcing bars	48.4	82.9	106.2	183.4	151.3	189.8
Heavy and light sections	-	-	2.4	20.2	36.6	21.2
Seamless tubes	5.9	30.8	45.0	54.8	96.8	75.1

Of the three steel works one belongs to the state-owned Siderurgica del Orinoco, S.A. (SIDOR) and the two others belong to the private Siderurgica Venezolana, S.A (SIVENSA).

At the beginning of 1967 the annual steel production capacities were nearly 1 m tons, incl. those of SIDOR 800,000 tons and those of SIVENSA 200,000 tons /18/.

The list of equipment having been installed in the integrated iron and steel works of

SIDOR in Matansas set working in 1962 is given bslow.There are nine electric iron smelting furnacee with a total productivity rate of 650,000 tone per year, four 250t open-hearth furnaces wi h a total capacity of 800,000 tons per year, a blooming, and billet, rail, structural and section rolling mills. There is also a sintering plant with a capacity of 1 m. tons per year as well ss a seamless tube production plant with a cspscity of 300,000 tons per year /11/.

The eteelmaking capacities of this works are expeoted to rise to 1.2 m.tons per year.The rolling production capacities are enlarged too. A sheet rolling plant and s strip galvanizing line are being built.

Two electric furnaces and rolling mills producing eections and wire are in the works of SIVENSA in Caracas. Electric furnaces and two continuona steel casting plants with the total capacities of 120,000 tone per year installed at the eame company's plant near Carretera ds Antimano set working in 1966 /34/.

Since 1964 a plant of Lamigsl Co.with the capacity of 24,000 tons of galvanized sheets operates in Venezuela. This plant have been build with the participation of Japanese companies /29/.

Another plant to produce 12,000 tons of galvenized sheets per year is presently being built.

Orinoco Mining began to build a metallized briquette plant with a productivity of 1 m.tons. per year in Porto-Ordaz /66/ that has to be brought in operation in 1970.

Strip, plate and sheet prevaile among the items of ferrous metsl import to Venezuela (Table 26) /19/.

Tabls 26. Import of ferrous metals, 10^3 tons

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total incl.	376.9	316.7	411.4	407.1	494.2	513.3	388.9	n.a.
Plates, sheets, hoop and strip	38.1	41.0	46.0	54.6	113.8	149.4	182.6	209.5
Tinplate	48.9	45.4	64.9	51.4	63.9	71.2	56.1	44.9
Tubes, pipes and fittings	92.0	74.8	87.9	90.0	87.0	68.2	42.3	21.4

Ferroue metals are mainly exported from Japan, the Benelux countries, the FRG and the U.S.A.

CHILE

In 1966 Chile took the second place (behind Venezuela) at the list of per capita steel production in the Latin American countries and accordingly the third at the list of per capita steel consumption. The country possesses the high quality iron ore, the total resources of that are estimated at 1,000 million tons /17/.

The largest deposits are El Laco (resources of 250 m.tons of ore, 64%Fe), Algarrobo (resources of 77 m.tons, 61%Fe), Santa Fe (resources of 50-100 m.tons, 64%Fe) /17/. Not long ago a new deposit of Bequeren Chanar was discovered.

Ite resources totals 80 m.tons of high quality ore and 70 m.tons of low quality ore. The iron ore deposits of El Romeral and Eldorado may be also attributed to a number of the large ones /29/.

The principal iron ore deposits being mined are in the provinces of Atacama and Cocimbo.

These deposits are basically mined by three companies (Minera Santa Fe, Bethlehem Chile Iron Mines and Acero de Pacifico) producing 85% of all iron ore in the country.

Deposits in Cocimbo, Copiapo and Chaniaral are exploited by Minera Santa Fe. The El Laco deposit is situated in a difficult accessible locality and isn't yet mined. Some 4 m.tons of iron ore were mined at the mines of this company in 1966. In the area of Copiapo constructing a pellet plant with the capacity of 3 m.tons per year is projected. Setting it in operation is expected in 1970 /67/.

The deposits of El Romeral and El Tofo are exploited by Bethlehem Chile Iron Mines. The latter deposit has been already exhausted. A concentrating plant with the capacity of 60 tons of concentrates per hour is set working at the El Tofo mine in 1965 to process ores from the mine's dumping /68/.

The company plans to invest 20 m.tons dollars for the development of El Romeral mine in the course of five years to increase its production rate from 3 to 4.5 mil.t of iron ore per year. A new beneficating plant with the capacity of about 1,600,000 tons of concentrates per year is projected to be build. This plant is to be put in action in 1972 /69/.

The iron ore producing capacities in Chile are expected to rise to 17 m.tons per year in 1970 /29/. Nearly 90% of iron ore produced is exported mainly to the USA, Japan and the Federal Republic of Germany.

Iron ore production and export figures are given in Table 27 /19/.

Table 27. Iron ore production and export, 10^3 tons

	Years											
	1937	1946	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967
Production	1534	1177	2950	1720	6041	6990	8092	8510	9910	12721	12246	9795
Export	1473	1184	2590	1237	5191	6206	7246	7092	9114	10729	11072	n.a.

The total reserves of manganese ores are 22 m.tons (incl.1 m.tone of the available and probable ores). The principal deposits are located in the province of Cocimbo, the content of manganese changes from 27% to 53%. The annual production hasn't overcome 30-40,000 tons. The small part of ore is exported, the rest is used to produce ferromanganese /1/.

The coal resources in the country are estimated at 700 m.tons incl. the known ones totalling 60 tons. Near 80% of all coal in the country is mined near Huachipato in the province of Conception. Coal is mined by the companies of Lota and Schwager. In the last years coal production was reduced to 1.7 m.tons per year. Annualy 300-400,000 tons of coking coals are imported /19/.

Some figures concerning the production of iron, steel and rolled products in Chile are given in Table 28 /10,19,37/

Table 28. Production of iron, steel and rolled products, 10^3 tons

	Years											
	1940	1945	1950	1955	1960	1961	1962	1963	1964	1965	1966	1967
Iron	7	13	109	256	266	296	383	418	437	309	433	498
Crude steel	n.a.	27	85	312	451	391	528	522	584	476	577	631
Rolled products	10	27	66	218	303	304	438	467	458	390	486	n.a.

An integrated iron and steel works belonging to the Compania de Acero del Pacifico is situated in Huachipato (province Conception). Its construction was started in 1947 and finished in 1950. Three programs of enlargement and modernization of operating equipment were carried out in this works before 1963. Presently 70 coke ovens are in the coke plant of the works. Two blast furnaces with hearth diameters of 6.3 m. and capacities of 950 and 1100 tons per day operate in an ironmaking plant. One of these blown in 1966 is equipped with an

oil injection installation. /70/.

Two 100t and two 200t open-hearth furnaces are in the open-hearth plant. A blooming mill and rolling mills to produce bars, plates, sheets and temper mills as well as two galvanizing lines and five hot dip tinning lines are installed in the rolling plant of the works.

Further development plans of this works provide the construction of the third blast furnace, two oxygen converters, two continuous steel casting plants, a light-section mill, an electro-plating tinning line and the third galvanizing line /11/.

A ferroalloy plant is located in Sant Yago. It produces ferromanganese, silicomanganese, ferrosilicon and other alloys. The total ferroalloy production totalled 9,900 tons in 1967.

Productos de Acero projected construction of a new plant to produce tubes and fittings near Huachipato. It would be brought into operation in 1968 with an initial capacity of 4,300 tons tubes per year and further its increasing to 22,200 tons per year by 1974. This company has got a credit of 2.5 mil.U.S dollars from the Export-Import Bank of the U.S.A.

Ferrous metals import from the U.S.A. and Japan totals less than 100,000 tons per year. It consists of railway materials, tubes and fittings mainly /19/.

A small quantity of metal products (20-30,000 tons per year) are exported to the countries of Latin America (Argentina, Brazil and Uruguay).

COLUMBIA

The development of the iron and steel industry in Colombia started practically in 1955 when the first in the country integrated iron and steel works was brought into operation in Belencito. Earlier only two small plants of Empressa Siderurgica producing sections and galvanized tubes operated in the country. The level of per capita steel production and steel consumption in Colombia in 1966 moved it to one of the last places among the countries of Latin America producing ferrous metals.

The country possesses relatively small reserves of iron ore. They amount to 120 m.tons incl the known and probable ones having 50 m.tons of ore with an average Fe-content of 47%/1/. Resources of Pace delRio deposit situated at the north of the country are estimated at 100 m. tons of ore containing in average 48% of iron /17/. The iron ore deposits in the vicinity of Medellin are also known.

The iron ore production in Columbia for the period of 1955-1967 is characterized by the following figures, 10^3 tons /1,19/.

Year	
1955	250
1960	655
1961	673
1962	643
1963	690
1964	731
1965	706
1966	660
1967 x)	750

x) Estimation

The small deposits of manganese ore in the country are not mined yet. Not long ago two large deposits of nickel bearing ores were discovered in the department of Cordoba. It allows the ferronickel production to be organized. The capital investments to exploit these deposits were estimated at 44 m.U.S.dollars /72/.

The total resources of coal in Columbia are estimated at 12,500 mil. tons incl. the known ones at 210 mil.tons. There are some deposits of coking coal but they have been insufficiently studied. The principal coal deposits are located at the north-east of Bogota. The output of coal is so high (about 3,0 m.tons per year)that Columbia takes one of the first places among the countries of Latin America.

The known resources of oil totals 230 m.tons. The principal deposits are in the basin of the river Magdalens and the lake Maracaibo. In 1967 it has been produced 10 m.tons of oil.The large part of oil is exported.

Some figures concerning the ferrous metal production in Columbia are given in Table 29. /10,19/.

Table 29. Production of ferrous metals, 10^3 tons

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Iron	176.2	168.6	144.8	203.2	190.5	199.5	167.1	202.9
Crude steel	172.3	192.1	157.0	222.3	229.9	241.8	216.0	257.7
Rolled products	113.4	139.0	145.4	187.0	198.6	206.8	235.4	n.a.

Basic Bessemer steel amounts to 70% and electric steel to 30% of total steel produced/19/.

An integrated iron and steel works of Acerias Pace del Rio in Belensito produces 85-90% of all ferrous metals made in the country.Its annual capacities are: ironmaking 210,000 tons, steelmaking about 300,000, tons,rolled products 200,000 tons.

This works has a coke plant, a blast furnace with productivity of 650 tons per day,three 20t basic Bessemer converters one 20t electric furnace, rolling mills producing billets, heavy and light sections, rails and flat products and a galvanising line.

The Belensito works is enlarged. In 1968 construction of a sintering plant,a blooming, a hot strip mill and the second galvanising line was finished.

The steelmaking capacities of the works are expected to reach 500,000-600,000 tons per year by 1970 and those of rolled product production 400,000 tons per year.

The ore and coal production capacities are believed to be increased and the ore preparation plant to be enlarged in further. A new coke plant, the second blast furnace and an oxygen converter shop should be constructed/73/.Acerias Pace del Rio intends to extend the rolling mill output to 500,000 tons by 1975 /74/.

In 1967 Empressa Siderurhica has put in operation electric furnaces, a continuous steel casting plant, two tube welding installations,and electroplating tining line in its non-integrated iron and steel works.

Construction of there new iron and steel works is foreseen to start the nearest years in Columbia /18,73/. An integrated iron and steel works at Tibate (near Medellin) with a steelmaking capacity of 300,000 tons per year, an iron and steel works at Barranquilla (a harbour northward of the country) with a capacity of 100,000 tons a platse and sheets per year and an iron and steel works with a capacity of 100 000 tons of steel per year at Sinacura (near Bogota) should be built.

In 1966 constructing a plant was projected to make 7,800 tons of high quality forgings per year at Bucaramanga (dept.Santander). The cost of its construction was estimated at 14.2 mil.U.S. dollars.

The home production doesn't meet the requirements of the country for ferrous metals. In 1967 101,000 tons of ferrous metals were imported mainly from Japan, the U.S.A., the Federal Republic of Germany and the Great Britain /5/.

PERU

The country started creating the home iron and steel industry in 1958 only when an integrated iron and steel works of a state-owned Sociedad Siderurhica de Chimbote with a capacity of 100,000 tons of steel per year was brought in operation in Chimbote. Earlier the steel output at a few small plants didn't overcome 9-10,000 tons per year. Only at the end of 1966 a plant of Cia. Aceros Aquipa having a capacity of 30,000 tons of steel per year was set working. The level of per capita steel production is exeptionally low and totalled only 7 kg in 1968.

The country has relativlly high quality iron ores. The total reaources amount to 1,170 mil. tons, incl. the explorated ones to 500 mil tons having 56% Fe in average. The principal deposits are concentrated in the department of Ica. The explored resources in this area total 200 mil. tons of ore with Fe-content of 60% /1/.

The iron ore mining was started in Peru in 1955 when 1.7 mil tons of ore with 50-58% Fe was produced. It was then aimed, 10^6 tons: 2.6 in 1958, 5.2 in 1960, 7.0 in 1966 and 8.0 in 1967. Nearly total ore produced is exported abroad. The principal user of Peruvian iron ore is Japan. Where nearly 5 mil.tons of ore was exported in 1966. A part of Peruvian iron ore is exported to the U.S.A.

The deposit of Marcona is mined by Marcona Mining Co having built a moderne iron ore complex near the harbour of San Nicolas.

A concentrating plant was built here in 1962. Later on the first in South America pellet plant with a capacity of 1 m.tons per year and the second pellet plant with a capacity of 2 m.tons per year were accordingly built in 1963 and in 1966. Hematite and magnetite iron ore are treated at these plants. The Fe-content in pellets is 67-68% /76/. A new concentrating plant is being built presently.

Some 7 mil.tons of merchantable ore incl.3 mil tons of pellets were shipped from Marcona iron ore complex in 1966 /75/.

The iron ore output in the country is expected to raise to 12 mil.tons by 1971 /77/.

The manganese ore deposits in Peru were studied badly. A negligible quantity of manganese ore is produced at the only mine being in the country. The total resources of coal 600 mil. tons, a considerable part is bituminous coals and anthracite. Not long ago the coking coal dspoeits were discovered.

The annual coal production amounts to 170,000 tons per year in average, the coke production is nearly 40,000 tons per year /29/. The only state-owned integrated iron and steel works in Chimbote situated on the sea coast in the area of coal and iron mining is supplied by energy from a hydroelectric power station in the valley of the river Santa. Three plants are in the works, an ironmaking plant where three electric iron smelting furnaces (two furnaces each with a capacity of 100 tons. per day and one-of 550 tons per day) were installed, an electric steelmaking plant having two 30t electric furnaces with a productivity of 80.000 tons per year, and a rolling plant with a breakdown mill (135.000 tons per year), a section mill (65,000 tons per year) and two sheet rolling mills (75,000 tons per year) /29/.

The Chimbote works is enlarged. An oxygen steelmaking plant with two 30t converters and a continuous steel casting installation with a capacity of 90,000 tons per year were brought in action at the end of 1967.

A slabbing mill, a section rolling mill and a cold strip mill are also projected to be built in the works. The steelmaking capacities in Paru are expected to reach 350,000 tons per year by 1970.

A possibility to build a special steelmaking plant at Caplina in the south part of the country was studied. The expected cost of its construction totals 24,000,000 /78/. A plant for producing tubes of large diameters with a capacity of 25,000 tons per year was also projected.

Ferrous metal production figures are given in Table 30. /19/.

Table 30. Pig iron, crude steel and rolled product production, 10^3 tons

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Total pig iron (electric furnace) incl.	38.5	51.4	38.0	29.0	27.2	19.9	11.8	30.6
Steelmaking	38.5	51.4	38.0	29.0	26.1	18.5	10.5	23.7
Foundry	-	-	-	-	1.1	1.4	1.3	6.9
Total crude steel incl.	59.9	74.9	71.3	76.3	81.6	93.6	79.9	80.1
Electric furnace	59.9	74.9	70.2	75.0	80.2	92.6	79.9	76.3
Bessemer acid	-	-	1.1	1.3	1.4	1.0	-	0.7
Oxygen converter	-	-	-	-	-	-	-	3.1
Rolled products	43.1	58.2	56.3	58.4	65.2	73.7	68.4	n.a

Before the Chimbote works has been started to work nearly all the requirements of the country for ferrous metals were met with import. After this works has been commissioned 30% of country's reqirements for metal are met with the home production.

Mainly sheet, plate, sections, tubes and tinplate are imported. The ferrous metal import totalled to 174,000 tons in 1967, The principal suppliers of rolled products are Japan, Belgium and Luxemburg.

Some types of ferrous metals are exported from Peru into other countries of Latin America.

URUGUAY

Only five small non-integrated plants are in the country. Among them only one plant produces steel and one-ferroalloys. Uruguay takes the last place by the per capita steel consumption among the Latin American countries producing ferrous metals.

The raw material resources of the country available for developing the ferrous metallurgy were studied very badly.

Presently three metallurgical companies having the non-integrated metallurgical plants are in Uruguay.

The only plant producing steel belongs to the Cia. Nervion Aceria y Laminacion. A 12t open-hearth furnace, a small electric furnace and a breakdown rolling mill installed at this plant /29/. Some figures concerning the steel output at the plant of Cia. Nervion Aceria y Laminacion are given in Table 31.

Table 31. Steel output at the plant of Cia. Nervion Acsria y Laminacion, 10^3 tons

	Years							
	1960	1961	1962	1963	1964	1965	1966	1967
Open-hearth steel	9.7	9.2	8.6	6.5	13.7	12.4	10.2	12.3
Electric furnace steel	-	-	-	-	0.6	1.1	0.2	1.2
Total	9.7	9.2	8.6	6.5	14.3	13.5	10.4	13.5

Cinoca S.A. has three small plants producing tube billets ans welding tubes (5,000 tons per year) and a small ferroalloy plant. Four wire rod mills with a capacity of 25,000 tons of reinfsroing steel per year are installed at the Industria Nacional Laminadora, S.A. plant /11/. An agreement between this company and a Chilean company CAR was concluded at the end of 1965 to construct a new section and wire rolling mill.

The total rolled steel output in Uruguay amounted to 26,000 tons in 1966 /80/.

The question about constructing a new integrated iron and steel works on the basis of the iron ore deposit in Valentines is being discussed/18/.

Some 13,000 tons of ferrous metals were imported to Uruguay in 1967, a mainly from Great Britain, Belgium, Luxemburg and the FRG /5/.

ECUADOR

Presently there are two metallurgical companies having only non-integrated plants in Ecuador.

A small plant producing steel sections and belonging to the Cia. Aceria Nacional del Ecuader is situated near Guito.

An Agreement to building a section mill with a designed capacity of 65,000 tons per year has been concluded by Cia. Aceria Nacional del Ecuador with a FRG's company /81/. Building a plant to produce rolled steel with a capacity of 26,000 tons per year is also projected in Guayaquil /29/.

A U.S. company is reported to project constructing a plant for stainless steelmaking in Manta or Guauaquil using titanium bearing sands of sea coast /82/.

Import of ferrous metals totalled 75,200 tons in 1967. The principal importers are Belgium Luxemburg and France /5/.

BOLIVIA

The iron and steel works are absent in the country. Some resources of iron ore were discovered there but they are not used yet.

There are tungsten ore resources. The tungsten concentrate export totalled 1,600 tons in 1967.

There are also oil resources estimated at 68 mil.tons. The oil exploration and production are carried on by foreign companies. Some 2 mil. tons of oil were produced in 1967 /1,3/.

The ferrous metal import totalled 44,800 tons in 1966 and 25,000 tons in 1967 /5/. Mainly tubes and fittings, sections and wires are imported. The principal suppliers of metal production are Japan, Great Britain, the FRG, Belgium and Luxemburg.

THE COUNTRIES OF CENTRAL AMERICA

The mineral resources of the countries of Central America were insufficiently studied. Deposits of iron ore in Honduras, Costa-Rica and Salvador are known but are not mined yet.

The little resources of chromite ore are in Guatemala. Mining of ore was started at the time of World War II and totalled 28,000 tons in 1963. The coal resources (incl. brown coal) in Honduras are estimated at 5 mil.tons. In a number of countries the charcoal production is possible /29/. The electric energy output in all countries of Central America totalled more than 2,500 million kwt-h in 1965, half of that was hydroelectric energy /29/.

Nearly all the requirements for ferrous metals in these countries are met by the import that totalled in 1966, 10^3 tons: 49 in Costa Rica, 69 in Salvador, 54 in Guatemala, 24 in Honduras, 44.6 in Nicaragua, 40.8 in Panama /83/. Sections, tubes, sheets, plates and billets are main items of imports. The principal suppliers are Belgium, Luxemburg, the U.S.A., France and Great Britain. Constructing small non-integrated works are presently projected in all countries of Central America.

In Costa Rica a steel tubemaking plant with a capacity of 6,000 tons per year is being constructed by Industrias Metallurgicas (INMECA) with the participation of Mannesmann A.G., FRG /84/. A galvanizing line was purchased in Japan, its bringing in operation will allow the country's capacities of galvanized sheets to be increased from 10,000 to 30,000 tons per year /85/.

In Salvador there is a small foundry working on scrap. A plant to produce galvanized sheets with a capacity of 10,000 tons per year and a tubemaking plant are planned to be built. A plant to produce bolts and nuts with a productivity of 50 tons per month is planned to be constructed with the assistance of Japanese companies.

In Guatemala there is a sheet galvanizing plant with a capacity of 12,000 tons per year. It has been built with the financial and technical assistance of Japanese firms /86/. There is also a small plant producing plates, sheets, common sections and special profiles /87/.

In Honduras metallurgical works are absent. Mexican company Altos Hornos de Mexico studies a possibility of building a steelmaking plant there with a capacity of 50,000 tons of steel per year /29/.

In Nicaragua Cia. Aceros Nacionales with a capital of £ 5,000,000 was established in Managua in 1965 that plans to build a plant with a capacity of 10,000 tons of tubes and sections per year /29/.

In Panama Cia. Hierro Technica purchased the equipment for a plant with a capacity of 6,000 tons of steel sheets per month in the Federal Republic of Germany. Production of this plant is designed for automobile industry /88/. Cia. Productora de Acero y Accociada was established in 1965, which is planned for building a steelmaking plant with a capacity of 100,000 tons of common steel per year. This plant production is believed to be used for home consumption as well as to be exported to other countries of Central America /29/.

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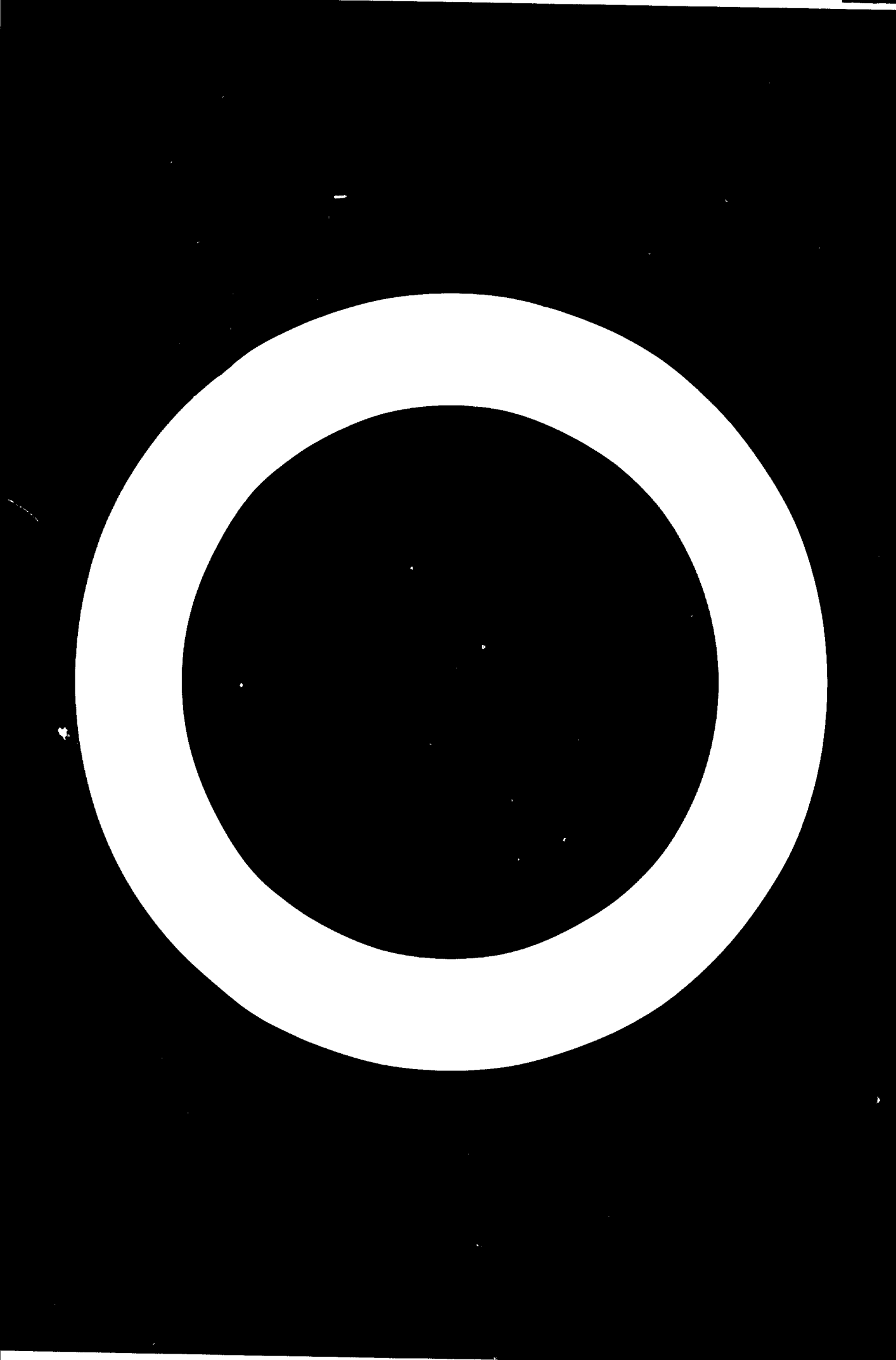

CHAPTER IV

IRON AND STEEL INDUSTRY OF AFRICA

Africa is the third continent of the world as to magnitude. Its area is 30.2 m.sq.km and its population exceeds 327 millions (1967). At present there are 48 states in Africa of which 41 are sovereign stetes.

Many countries of Africa have worked out programmes of industrial development. The programmes foresee, among other things intenaification of exploring mineral resources and constructing iron and steel works for yeare efter World War II and the time of deriving independence.

Despite the fact that mineral resources of many African countries are poorly explored, it has been found that these countries ere rich in iron and manganese ores with their total reserves (excluding those of the Republic of South Africa, Angola, Mozambique and Rhodesia) amounting to 24,000 and 300 m.t respectively /1/.

In 1967 the iron ore output in the countries of Africa was about 45.7 m.t. (10.6% of the world total[x/]), with Liberia's share being 19 m.tona, that of Mauritania - 8 mil.tone, Algeria 2.3 m.tons and Sierra Leone - 2.2 m.tone /2,3/.

The major part of the iron ore produced is exported mainly to the countries of Western Europe, the United States and Japan.

The iron ore output in the countries of Africa is expected to reach 60 m.t in 1970 /4/.

Deposits of chrome, molybdenum, nickel ores and other mineral resources required for production of ferrous metals have been discovered in Africa.

Potential resources of coal in the countries of African continent are approximately about 88,000 m.t with about 76,000 m.t being accounted for by the Republic of South Africa . /1/

Proved reserves of oil in the countries of Africa amount to 5,600 m.t /1/.

Many African countries are rich in hydroresources (the Nile, the Congo, the Niger, the Zambezi and other rivers) which have been insufficiently used up to now.

Rated capacity of power stations (thermal and hydroelectric) in developing countries of Africa are estimated at 5.3 m.kw with electric power generation amounting to 17,800 m.kwh in 1966 /5/.

Construction of new hydroelectric power stations in these countries will create necessary prerequisites for the development of the production of iron, steel and ferroalloys in electric furnaces.

Some general data charecterizing the economics of certain developing countries of Africa are given in Table 1.

Industrial backwardness of the most countries of Africa has a restrictive influence on creation and development of iron and steel industry and on expansion of ferrous metal market.

Per capita steel consumption in the countries of the African continent is the lowest one in the world (8 kg. as against 250-300 kg. in industrially developed countries), that results from the low level of per capita national income which is 10-25 times below the level of the developed countries, and from the absence of national machine-building and metal-working industries which consume approximately two thirds of ferrous metal output in developed countries. /6/

On the average, about 40% of ferrous metals are used for construction, about 30% are used to manufacture packings for agricultural goods and the rest of ferrous metals is accounted for by pipes for oil and gas industry and for irrigations purposes in the countries of Africa.

In some countries the mining industry is a major consumer of ferrous metals.

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x/ - excluding the USSR and other socialist states

Table 1. Some general data on the economics of the developing countries of Africa

	Area, 10^3 sq.km	Population 1,000 persons	National income, bil. US dollars	Reserves: Iron ore, m.t	Reserves: Manganese ore, m.t	Reserves: Oil, m.t	Reserves: Coal, m.t	Output: Iron ore, m.t	Output: Manganese ore[3], 10^3t	Output: Oil, 10^3t	Output: Coal, 10^3t	Electric power generation, mil. kwh	Per capita consumption of ferrous metals, kg
	1967	1967	1967			1967		1967	1967	1967	1967	1966	1966
Africa, total including	30200	329000	-	22825	404.5	5597.4	88156	457	4558.6	150920	55048	-	-
North Africa													
The UAR	1000	30147	3.4	950	9	202.2	190	0.5	186	7000	20[1]	5895.0	27
Tunisia	164	4560	0.6	55	-	47.8	-	0.96	-	2500	-	574.0	24
Algeria	2382	12540	2.1	1.350	-	878.0	100	2.3	-	38250	50	1119.0	15
Libya	1760	1738	1.1[1]	720	-	3867.5	-	-	-	83500	-	182.0	-
Morocco	445	14140	1.9	170	50	1.6	160	0.9	286.2	100	470	1431.0	15
Sudan	2506	14355	1.0	-	10	-	-	0.04	-	-	-	262.0	-
West Africa													
Nigeria	924	61450	3.3	300	-	481.7	500	-	-	15500	97	1279.0	6
Ghana	239	8143	2.3[1]	260	30	-	-	-	490.5	-	-	807.0	5
Ivory Coast	322	4010	0.8[1]	3.000	13.0	-	-	-	149.4	-	-	-	-
Liberia	111	1110	-	1600	-	-	-	19.0	-	-	-	339.0	-
Guinea	246	3702	-	2700	-	-	-	0.7	-	-	-	-	
Sierra Leone	72	2439	0.3[2]	400	-	-	-	2.2	-	--	-	-	
Dahomey	113	2514	-	-	-	-	-	-	-	-	-	19.6	
Upper Volta	274	5054	-	-	11.0	-	-	-	-	-	-	21.8	
Mauritania	1031	1100	-	410	-	-	-	8.0	-	-	-	-	
Niger	1267	3546	0.22	-	-	-	-	-	-	-	-	19.6	
Mali	1202	4745	-	-	10	-	-	-	-	-	-	33[4]	
Senegal	196	3670	0.6[1]	140	-	-	-	-	-	-	-	222.0	
Togo	56	1746	0.1[2]	100	-	-	-	-	-	-	-	39.8	
Central Africa													
Congo (Kinshasa)	2345	16353	0.7	9000	10	0.13	1650	-	405.0	-	116	2519.0	
Congo (Brazzaville)	342	860	-	200	-	1.0	-		-	3500	-	45.5	5
Gabon	268	473	0.1[1]	2000	200	48.0	-	-	1147.6		-	49.2	
Chad	1284	3410	0.2[1]	-	-	-	-	-	-	-	-	22.0	

Table 1 (continued)

	Area 10^3 sq.km	Population 1000 persons	National income bil. YUS dollars	Reserves: Iron ore m.t	Reserves: Manganese ore, m.y	Reserves: Oil, m.t	Reserves: Coal, m.t	Output: Iron ore, m.y	Output: Manganese ore[3] 10^3	Output: Oil, 10^3t	Output: Coal, 10^3t	Electric power generation, mil. kWh	Per capita consumptions of ferrous metals, kg
	1967	1967	1967			1967		1967	1967	1967	1967	1966	1966
Cameroons	475	5493	0.6[1]	150	-	-	-	-	-	-	-	1008.0	
Central African Republic	623	1459	-	-	-	-	-	-	-	-	-	24.6	
East Africa													
Kenya	583	10209	0.5	-	-	-	-	-	-	-	-	346.0	6[2]
Ethiopia	1222	23457	1.0[1]	-	-	-	-	-	-	-	-	238[2]	-
Uganda	236	7934	0.5	40	-	-	-	-	-	-	-	6350	6[2]
Tanzania	940	12231	0.5	45	-	-	800	-	-	-	2	267.0	6[2]
Zambia	753	3947	0.7[1]	267	1.0	-	27	-	25.3	-	100	602.0	4
Malagasy Republic	587	6350	0.5[1]	130	-	-	317	-	-	-	2	190	-
Somali	638	2660	-	440	-	-	-	-	-	-	-	14.0	6[2]
Malawi	118	4130	0.1	-	-	-	14	-	-	-	-	67.0	1
Rwanda	26.3	3306	-	-	-	-	-	-	-	-	-	48.0	
Burundi	27.8	3340	-	-	-	-	-	-	-	-	-	-	
South Africa													
Botswana	570	593	-	-	0.5	-	558	-	8	-	-	-	

[1] - 1966; [2] - 1965; [3] - Preliminary data; [4] - 1967;

Annual pig iron output in the UAR is 200.000 t[x]
Annual steel output in the UAR is 300,000 t[x]
Annual output of rolled products in the UAR is 350.000 t[x]
Annual pig iron output in Algeria is 17.000 t[x]
Annual steel output in Algeria is 18000 t[x]
In 1965 6000 t of steel were produced in Kenya
In 1965 Uganda produced 28000 t of steel
In 1968 pig iron production in Tunis was 128,000 t, steel - 80,000 t, heavy and light sections - 69,000 t.

[x] Estimate

At present, about 30 iron and steel works are in operation in the developing countries of Africa including two fully-integrated works in the UAR and Tunisia. Eight iron and steel works are under construction in the UAR, Algeria, Morocco, Kenya, Uganda and Zambia. The plants now in operation are mostly specialized in production of heavy and light sections and reinforcing rods. Recently in some countries (the UAR, Nigeria, Ethiopia, Kenya, Uganda, etc.) works producing steel pipes and hot-rolled sheets including galvanized sheets have been built or are under construction /7/.

In many developing countries of Africa construction of iron and steel works was initiated by the governments which took the major share of capital investments (including foreign currency) upon themselves.

In other countries the state encourages private companies (including foreign ones) to build iron and steel works by granting various privileges, credits etc.

Industrial countries play an important role in building iron and steel works in the developing countries of Africa by providing financial and technical assistance in the construction and operation of these plants.

The African Unity Organization (AUO) was created for coordinating the efforts of the countries of Africe in all the sphsres of activities (including economics) in Addis Ababa in May, 1963.

Under AUO a commission on economic and social problems was formed which studies and settles various economic problems of the region in cooperation with UNO's Economic Commission for Africa /8/.

African Planning Institute in Dakar (Senegal) is directly involved in development of the cooperation prospects. The Institute has prepared, among other things a project for creation of integrated iron and steel industry in the countries of West Africa.

Regional cooperation of the Magrib countries (Algeria, Libya, Morocco and Tunisia) has been also organized. In 1964 the Standing Advisory Committee of the Magrib countries was created.

The Center of industrial investigations opened in March 1968 in Tripoli (Libya) serves to the purpose of cooperation of the Magrib countries in industrial sphere. This center will be engaged in general economic problems of planning and in coordination of measures for development of industry in the Magrib countries, as well as in problems of the territorial layout of industrial plants, cost price of products, product quality control, training of national personnal of industrial specialists /9/.

To finance the intra-African trade and regional projects the Bank of Economic Development of Africa (BEDA) with US 250 m. dollar capital was organized in Abidjan (Ivory Coast) since July, 1966. 23 sovereign states of Africa are share-holders of the bank.

A report on prospects of industrial development of the African countries, was made at a conference of manufacturers and financiers held in Addis Ababa in January, 1967. Four regions in which the developing countries of Africa are located are considered in the report.

East Africa - Kenya, Ethiopia, Uganda, Tanzania, Zambia, Malagasy Republic, Somali, Malawi, Rwanda-Burundi, Rhodesia, Maurique, Raunion, French Coast of Somali, Komori.

Central Africa - Congo (Kinshasa), Congo (Brazzavilla), Gabon, Chad, Camaroons, Central African Republic.

West Africa - Nigeria, Ghana, Ivory Coast, Liberia, Guinea, Siarra Leone, Dahomey, Upper Volta, Mauritania, Niger, Mali, Senagal, Togo, Gambia.

North Africa - the UAR, Tunisia, Algeria, Libya, Morocco, Sudan.

The countries of East Africa, as is evident from the report, consums yearly 450.000 t of ferrous metals of which only 15% (about 67000 t) are supplied by local works.

Average yearly increment in ferrous metal consumption has been 3% since 1960. By 1980 the demand of the region for ferrous metals is expected to increase to 1.6 m. tons /8,10/.

The countries of West Africa consumed about 500 000 tons of ferrous metals per annum. It is

expected that consumption of ferrous metals in these countries will rise to 1 m.tone by 1970, and to 2.4 m. tons by 1980. The conference of the west-african countries held in Abidjan in October, 1965 and devoted to the problems of industrialization, upheld the idea of building two iron and steel works, viz.s semi-integrated works of 200,000 tons of steel annual capacity in Mali and a fully-integrated one of 700,000 tons annual capacity in Liberia. /8,11/

Average annual consumption of ferrous metals was 1.1 m.tons in the countries of North Africa in 1961-1963. It is expected that the demand for ferrous metals will increase to 2 m.tons by 1975, and to 4.5 m.tons by 1980. The demand for cold-rolled sheets is expected to rise from 220,000 tons in 1965 to 1.8 m.tons in 1980.

Thus, only in the countries of East, West and North Africa consumption of ferrous metals is expected to rise to 8.5 m.tons in 1980.

According to other estimates, the requirements of the countries of the African continent in steel will amount to 10.5 m.tons in 1972-1975 excluding indirect import of ferrous metals (machines, equipment) which will amount to about 3.5 m.tons /10/.

According to the estimates of UNO's Economic Commission for Africa ferrous metal demand of the African countries will be 12 m.tons in 1980 with indirect import of steel being 3.6 m.tons 6 .

It should be noted, that at present the national iron and steel industry in the developing countries of Africa does not play a decisive role in meeting the demands of the ferrous metal market not only of the whole continent, but even of the market of a limited number of steel-producing countries of Africa. Therefore the demands of the economics of the developing countries of Africa are mainly met by imports. The major part of the ferrous metal imports is accounted for by heavy and light sections (27.2%), steel tubes and fittings(23.9%), sheets (15.8%) and wire rods (5.5%) (see Table 2). /12/

At present, some African countries (Algeria, Morocco, for example) are completing construction of new iron and steel works, while some other countries (Nigeria, Ethiopia, Senegal, etc.) have prepared plans for constructing the works of 100,000-250,000 tons annual capacity which will use local raw materials and fuels.

Problems which the developing countries of Africa will have to settle, first of all consist in lack of financial resources and skilled man power. Up to now half of the required number of workers and specialists are invited from abroad by contracts that results in increasing the cost of the operation of the iron and steel works.

To meet 75% of their requirements in ferrous metals through national production in 1980 the developing countries of Africa are supposed to need about 2 bil.dollars of capital investments for constructing new and expanding now existing iron and steel works.

UNO's Economic Commission for Africa has recommended to build by 1980 subregional iron and steel works in eastern, western and central areas of the continent and to carry out certain specialization of the iron and steel works in the northern area. /6/

United Arab Republic

The United Arab Republic is an agrarian-industrial country. Since World War II, first small-scale semi-integrated works with steelmaking and rolling shops of 150,000 tons annual capacity and a few iron foundries and wire manufacturing plants have been built in the country. These plants have been disposed around Cairo and Alexandria - two biggest industrial centres of the provided with skilled man-power.

These works supply the local market with up to 150,000 tons of rolled heavy and light sections and reinforcing bars, a small amount of hardware (wire and nails), steel and iron castings.

About two thirds of the country's demand for ferrous metals(200,000-300,000 t/year)is met by imports mainly from the countries of Western Europe.

Since June, 1952, the UAR pursues a policy of fast industrial development of the country through creation of its own heavy industry-energetics, iron and steel industry and machine-building industry.

Table 2. Ferrous metel imports by the developing countries of Africa in 1967, 10^3 tons

Country	Ingots and semis	Railway treck materials	Heavy and light sections	Wire rods	Strip	Plates	Sheets	Steel tubes and fittings	Wire	Tinplate	Axles, tyres and wheels	Total
Algeria	1.6	3.3	32.4	7.5	8.6	13.3	18.8	43.1	7.4	7.6	0.6	144.2
Congo (Kinshasa)	-	1.0	18.0	1.0	1.3	5.8	14.6	4.3	1.1	2.1	1.0	50.2
Ethiopie	4.5	-	6.3	0.1	0.1	1.4	19.6	3.9	0.4	-	-	36.3
Ghana	0.4	5.3	12.1	0.5	0.3	1.0	8.7	3.3	1.3	0.3	0.8	34.0
Guinea	-	-	1.8	-	-	0.1	0.4	0.6	0.4	-	-	3.3
Liberia	-	1.5	7.6	-	-	2.8	6.0	2.8	0.8	-	0.6	22.1
Libye	-	-	73.4	1.6	0.4	9.2	10.7	159.1	4.7	0.3	-	259.4
Malagasy Republic	-	0.7	15.0	0.3	-	1.4	12.4	2.1	1.8	2.4	-	36.1
Malawi	-	-	0.4	-	-	0.1	2.9	0.4	-	-	0.2	4.0
Morocco	0.6	0.8	35.0	21.6	0.5	10.6	19.9	12.6	10.3	28.8	1.2	141.9
Nigerie	2.0	4.8	58.1	8.2	2.7	8.7	54.0	56.8	3.1	7.9	0.8	207.1
Rwanda Burundi	-	-	1.0	-	—	—	2.0	0.2	-	-	-	3.2
Sudan	-	38.6	18.5	0.3	1.7	5.1	17.7	7.9	0.3	5.9	2.2	98.2
Togo	-	0.4	2.5	-	0.1	0.2	2.2	0.6	-	-	-	6.0
Tunisie	11.0	4.4	16.7	-	0.2	8.0	12.6	14.3	5.3	2.4	-	74.9
Zambia	-	3.7	4.6	-	0.1	1.2	7.0	2.2	0.3	-	0.1	19.2
The UAR	49.6	8.6	82.9	37.9	23.7	18.0	15.4	25.7	4.0	14.2	2.2	282.2
Total	69.7	73.1	386.3	79.0	39.7	86.9	224.9	339.9	41.2	71.9	9.7	1422.3
	4.9	5.1	27.2	5.5	2.8	6.1	15.8	23.9	2.9	5.1	0.7	100.0

Note: Numerator - thousands of tons, denominator - % of the total

For this purpose the country has developed programs of expansion of geological prospecting and construction of new iron and steel works.

In accordance with the first program of development (1957-1960) fully integrated iron and steel works was commissioned in Helwan in 1958.

For the second five-year program (July 1960-June 1965) it was plenned to inveet 46.8 m. Egyptian pounds (or 10.7% of ell the cepitel investments in the industriel development) in development of the national iron and steel industry. Practically, cepital investments for development of the iron and steel industry amounted to 106 m. Egyptian pounds during this period.

In this period the UAR eccomplished constructing a ferroalloy work in Abou-Zenima (Sinei peninsula) and a plant for manufacturing welded pipes in Helwan. Now existing plants were modernized and expanded. Over 60 m. Egyptian pounds were spent on modernizetion of the iron and steel works in Helwan only. /7,13/.

While fulfilling the first and the second development programs the UAR government invited domestic and foreign private cepitel to perticipate in financing the construction of industriel plants due to the shortage of its own financial reeources. /13/.

Later on the UAR government followed the path of expansion of the etate sector in the economics as a whole and in the iron and steel industry in particulsr.[x] For these purposes along with its own capitsls, the UAR government took on foreign credits received in conformity with inter-governmentel agreements.

At the eame time the pecee of the iron and eteel induetry development were slowed down due to narrowness of the internal ferrous metel market, lack of technical "know-how," lack of skillad pereonnel of engineers, technicians, and workars and due to poor prospecting mineral reeources and insufficient development of traneportation facilities.

Nevertheless, tha gross product of the UAR iron and steel industry increased from 4 m. Egyptian pounds in 1952 to 12 m. Egyptian pounds in 1966 and per cepite steel production increaeed from 5 to 10 kg. during this period /14/.

At present the production capacitiee of the UAR iron and eteel industry are estimated in regard to production of steel et 0.4-0.5 m.tone per annum. But the evailable steel production capacities ere not amply utilized due to the leck of skilled manpower, shortage of scrap, spare parts and due to high costs of production. / 7/.

It ie axpected that as soon as 54 new iron and eteel works ere completed[xx], the steel production cepacities of the country will increase to 1.8-2.3 m.tons and those of rolled products to 1.6-1.8 m.tons by 1970 /7,14/.

The USSR and other socialist countries hava been rendaring and render now coneiderable essistance in the development of the UAR iron and steel industry in accordance with various intergovernmental agreements.

With the USSR economical and technical essietance, the UAR has conetructed, conetructs now and will conetruct in the future 13 iron and eteel works or separate shops.

In 1962, a coke and by-product shop and s einter plant were constructed at the Halwan iron and steel works; in 1963 a cast-iron fitting plant of 1200 ton/year capacity and welding electrode ehop of 25 m.t/year capacity were built; e forging plant (9500 t/year cspecity) was built in 1964.

Sheet rolling shops are undar construction at the Helwan iron and steel worke 14

Raw material and fuel-energy resources

Potentiel iron ore reserves of the UAR are estimsted et 0.95 bil.tons including 600 m.tons in Aswan, 300 m.tons in Beharia Oeeis (Western Desert), 40 m.tons on the coast of the Red Sea (Vadi Kerim)./15,16/.

Hemetite ores of the Aswan depoeits contain 47% Fe and up to 3.5% P.

Oree mined in Aswan are shippad to the Helwan iron and steel works by rsilway. Shipping of ore from Aewan down the Nile ie elso planned.

Hematite iron ore mined et Baharia Oasis contain 50-55% Fe. Iron ore mining of this deposit wae bagun in 1963. It is expected that by 1970 mines of up to 2.5-4 m.tone/year capacity will be built and put in oparation in this region.

Thie depoeit is expected to become tha main iron ore base for the Helwan iron and steel works. /7/.

Iron ore deposite in the region of Vadi Kerim on the Red See coaet consist of ferrous quartzites with about 50% Fe-content./1/

Potential reservea of manganese oree in the UAR are estimated at 9 m.tons, including 2 m tone of known and probable ores .

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x/ At preeent all the iron and steel industry works in the UAR ere under etete control.

xx/ Including 9 units for making iron and steel, 11 mills for production of eheets and wire and 15 foundriee.

The main manganese ore deposit ie in the south part of the Sinai Peninsula (Umm Bogma region) at 20 km dietance from the Suez bay. Ores of this deposit contain about 22% Mn. Ores mined here amount to 97% of total manganese ore output of the UAR.

The following are the data on the iron and manganese ore output in 1952-1967, 10^3 tons,/2, 3, 14/:

Year	Iron ore	Manganese ore
1952	-	191
1957	245	86
1960	239	286
1961	422	278
1962	461	186
1963	490	167
1964	447	328
1965	507	182
1966	440	186
1967	500	-

Ths most part of the manganeee ore mined ie exported mainly to Italy, Japan, Great Britain, FRG (Tahle 3)./14/

Table 3. Manganese ore export from the UAR (10^3 tons)

Importers	Years		
	1964	1965	1966
Italy	61.4	46.0	50.3
Japan	-	16.5	31.0
Great Britain	26.9	34.0	17.0
FRG	28.2	20.6	10.2
The Netherlands	10.2	18.3	-
Belgium	40.6	13.5	10.1
ČSSR	13.1	6.1	3.8
Total	180.4	155.0	122.4

In the UAR there are also depoeits of non-ferrous orss, refractory clays, lime, dolomite and other mineral resources required for production of ferrous metals./7/

It has heen long thought that the UAR has no coal dspoeits. Recently a fsw coal deposits have heen discovered in various parts of ths country.

The coal depoeit in Maghara (the Sinai Peninsula) has been put in operation in 1964. It was expected that coal output at this deposit will rsach 300 000 tons by 1969. /7/

At preeent the major part of the UAR requiremente in coal (that for coking including) are moetly met through imports mainly from the USSR and Poland.

Main oil field in the UAR are located on the Red Sea coaet and on the Sinai Peninsula.

Total known reserves of oil of the UAR were estimated at 202 m.tons in 1967. Oil output in the UAR during 1952-1961 period increased from 2.4 to 7.0 m.tons.

Power generation in the UAR during 1952-1966 increased from 1 to 5.9 bil. kWh or almost eix times.

When conetruction of the Aswan High Damp and hydroelectric power station is completed, power generation in UAR will reach 14 bil. kWh.

Before the World War II, Egypt exported about 40,000 tons of scrap a year. In the post-war

period the UAR faced the problem of providing the iron and steel works of the country with steel scrap that was the result of exhaustion of the scrap reserves and insufficient level of the development of the machine-building and metalworking industries. Export of scrap was prohibitsd. Now the scrap import amounts to about 45,000 -50,000 tons per annum.

Production of ferrous metals and iron and steel works

According to some reports, recent output of ferrous metals in the UAR has reached the following level: iron - 200,000 tons/year, steel - approximately 300,000 - 325,000 tons/year, rollsd products and other products of further processing - 350,000 - 375,000 tons/year (including heavy sections - up to 70,000 tons, light sections - up to 36,000 tons, reinforcing rods - up to 187,000 tons, plates - up to 30,000 tons, sheets - up to 10,000 tons, wire - up to 13,000 tons, steel pipes - up to 6,000 tons, steel forgings - up to 4,000 tons). On the average the production of steel castings during 1964-1966 was about 5,000 tons per annum, iron casting - 46,000 tons per annum. /7,14/

To-day the UAR has five iron and steel works, viz. a fully-integrated iron and steel works in Helwan, three semi-integrated works with steelmaking and rolling shops in Abou-Zabala, Mostorad and near Alexandria and a ferroalloy plant in Abou-Zenima.

Besides, a few foundries and wire manufacturing plants and shops are in operation in the vicinity of Cairo and Alexandria.

Some products made of ferrous metals (welded steel pipes, wire, iron and steel castings) are also produced at machine-building and some other plants.

When the projected programs are fully carried out, the UAR will complete construction of the Helwan iron and steel complex, an iron and steel works of 310,000 tons annual capacity of hesvy and light sections and wire in Aswan, a plant of 200,000 tons annual capacity of plates in Alexandria and a welded pipe plant in Helwan. /7,14,8/

The oldest iron and steel works of the UAR is a National Metal Industries semi-integrated plant located at 20 km. from Cairo. The steelmaking shop of this works has two 25 t open-hearth furnaces of 50,000 tons steel annual capacity. The rolling shop of the works is provided with a section mill and a drawbench. The section mill comprises a three-high cogging stand, seven two-high finishing stands, a cooling bank and finishing equipment. Total capacity of the rolling shop is about 60,000 tons of heavy sections and wire per year. Modernization of the works is planned that will increase its steel capacity to 160,000 tons per year, and rolling product capacity up to 150,000 tons per year. For this purpose a 30 ton arc furnace and a continuous casting unit will be installed at the works. /7,14/

At the semi-integrated plant belonging to Delta Steel Mill SAA in Mostorad (near Cairo) two (15 and 18t) arc furnaces are installed in the elsctric steelmaking shop. Total annual capacity of the shop is 50,000 tons. The rolling shop of the plant is equipped with a section mill consisting of a cogging stand, two roughers and seven finishing stands. In the rolling shop there is also a wire producing division equipped with automatic drawbench that produces wire in coils. The foundry shop of the plant is provided with a 4 t/hour capacity cupola furnace and two 3t arc furnaces. Machinery and equipment for this works have been supplied by British, French, Italian (arc furnaces for electric steelmaking shop) companies.

In 1963 this plant produced: steel - 50,000 tons, sections - 65,000 tons, wire - 4,000tons, steel castings - 2200 tons, iron castings - 7,000 tons.

Steel capacities of the plant are planned to be increased up to 80000 tons a year by providing one more 15-18 t arc furnace. It is also planned to organize production of alloy steels, to erect a billet mill of 72000 annual capacity, to build a steel casting shop of 20000 t capacity and to expand the wire capacities of the plant from 6000 to 13000 tons per annum. /7/.

The works belonging to The Egyptian Copper Works (near Alexandria[x/]) has a steelmaking

x/ - Besides rolled steel products the plant also produces copper, aluminium and lead rolled products, pipes and wire made of these metals.

and a rolling shops which were built with assistance of American and West-German companies. The steelmaking shop of the works has two 25 tons oil-fired open-hearth furnaces and its annual capacity is estimated at 65,000 tons.

The rolling shop of the plant comprises a cogging stand, three roughers, and five finishing stands. Monthly capacity of the shop is 6000 tons (if the shop works in three shifts). The mill is used to roll 8-28 mm diameter reinforcing bars.

By 1970 the works is planned to be modernized by erecting a 30 t arc furnace and continuous casting plant, oxygen plant of 800 cu.m/hour capacity, A section mill of 80000 tons annual capacity operated in two shifts and a heavy steel casting shop of 10000 tons anuual capacity equipped with a 15 t arc furnace. As the result of such modernization the steel capacity of the works will reach 100000 tons per annum and rolled product capacity - 150000 tons per annum. /7/

A fully-integrated iron and steel works was commissioned in Helwan in 1958. To control the operation of this works and mines in Aswan The Egyptian-Iron and Steel Company was established with 80% of its capital belonging to the UAR and 20% - to Demag Company, FRG./17/ Annusl capacity of the works was initially estimated at 265000 tons of steel and 200,000 tons of rolled products. The steel capacity of the plant is now estimated at 315000 tons per year. /14/

Further expansion of the Helwan works is now being carried out with financial and technical assistance of the USSR.

The Helwan complex comprises iron ore mines in Aswan, a sinter plant and the following shops: coke and by-products, blast-furnace, Thomss steelmaking, electric steelmaking, rolling mill, a power station, a water supply plant, a mechanical shop, an oxygen station and other auxiliaries.

The annual sinter plant capacity is estimated at 250000 tons of sinter, coke and by-product shop capacity - at 560000 tons per year (the coke and by-product shop was expanded in 1965)./13/

The blast-furnace shop has two blast furnaces with diameter of hearth - 5.1 m, working volume - 500 m^3, daily production capacity - 400 tons (each). Total capacity of the shop is 260,000 tons of iron per year.

The Thomas steelmaking shop is equipped with three 15 t basic converters and a 500 t mixer. No oxygen is used for blowing.

The shop is equipped with a plant for crushing Thomas slag. The plant capacity is up to 50,000 tons of phosphate fertilizers per year.

The electric steelmaking shop is equipped with two 12 t arc furnaces. Total capacity of the shop is 40000 tons of steel a year. /19/

Ingots are delivered from the steelmaking shops to the blooming-slabbing mill.

900 mm reversing blooming-slabbing of 480,000 t annual capacity has been manufactured by Demag and Simag companies (FRG). The mill is used for rolling the ingots into blooms (cross-section from 50x50 to 225x225 mm) and slabs 60-100 mm thick and 300-500 mm wide. /19/

The metal is delivered after scarfing at the auxiliaries to heating furnaces of the section and sheet-rolling mills of the works.

750 mm three-stand reversing heavy section mill is of 120000 tons annual capacity. This mill is used for producing up to 120 mm diameter rounds, rails, sleepers, channel irons, beams and angles. /19/

Semicontinuous light section mill installed in 1964, comprises two cogging stands, four roughers and five finishing stands. The annual capacity of the mill - 100000 tons of sections and wire rods. /19/

To roll plates of 5-25 mm thickness and up to 1500 mm width is provided a 40000 tons annual capacity mill. Sheets of 1-4 mm thickness and up to 1000 mm width are rolled on a sheet mill of 100,000 tons annual capacity. /19/

The following aquipment was undar construction and was to ba put in operation in 1968: a semi-continuous hot strip mill, a cold sheat mill, a tinning and galvanizing line.

Data on production programs of this aquipment (by stages) are shown in Table 4. /14/

Table 4. Production program of new units of the Helwan iron and steal works (thousands tons)

Rolled products	Stages		
	I	II	III
Hot-rolled sheets			
Skelps for pipes, 2-6 mm thick	40	120	170
Multipurpose hot-rolled shaats, 2-7 mm thick	40	120	170
Total:	80	240	340
Cold-rolled sheets			
Sheets for daep and extra-deep drawing	45	140	200
Hoops and band	25	70	110
Tin plate	45	45	45
Shaet iron	5	5	5
Galvanized sheet	10	20	20
Corrugated sheets	5	5	5

Long-term programs of development of the Helwan iron and staal complex will require expenditures of 190 m. Egyptian pounds. Fullfilmant of thasa programs will result in incraasing the capacity of the sinter plant up to 3.5 m. tons of sinter a year, the capacity of the blast furnace shop - to 1.5 m tons of pig iron a year, and the capacity of the staalmaking shops - up to 1.5 m. tons of steel a year. It is also planned to build the third and the fourth blast furnaces (working volume - 1033 m^3 and daily capacity about 2000 tons of iron), an open-converter shop with continuous casting plants and to install new rolling mills. /19/

The ferroalloy plant in Abou-Zanima, the only plant of that type in the UAR, was built at the coat of 12 m. Egyptian pounds with assistance of Norwegian exparts. Production capacity of this plant commissioned in 1965 are estimatad at 10,000 tons of ferromanganase and 27,000 tons of iron a year.

Foreign trade in ferrous metals

Roilad products are used in the UAR for construction purposes (80% of the total consumtion), for railways (up to 10%), for various industrial and agricultural purposas (up to 10%).

Importad ferrous metals meat about 40% of tha country demand as against 83% in 1952.

Par capita staal consumption in the UAR is supposad to reach 50 kg by 1970 as against 27 kg in 1966. /7/ The UAR imports iron, farroalloys, feeds, sheats, sactions, tin plate and galvanizad sheat, railway materials, ropas and cables, wire, pipes hoops and bands, alloyed and special steals.

Countrias of West Europa, the USSR and othar socialist countrias as well as Japan are major suppliars of ferrous metals to the UAR.

Export of ferrous metals from tha UAR is rathar low and amounted to 14,200 tons in 1963, 12,600 tons in 1964 and 3,600 tons in 1965.

Tunisia

Tuniaia ie an agrarian country with relatively developed mining industry. About 70% of the country population are engaged in agriculture and 30% - in the industry. There is a fully-integrated iron and steel works in the countrly. Potential reserves of the iron ores are estimated at 55 m.tons. At present the biggest deposit of iron ores is in Djerissa (western part of the country) with its proved reaerves estimated at 20 m.tons of iron ore of 50-54% Fe content.

Other deposits of average 50% Fe content iron ore (Douaria, Tamera-Tanara, El-Harreh) are located in the northern part of the country. /1/

Almost all the mined iron ore is exported mainly to the United Kingdom, Italy, France, Czechoslovakia, the FRG and Poland. Data on iron ore output and exports are given in the table below. (2,3,14)

	Years					
	1960	1964	1965	1966	1967	1968
Output, m.tons	1.0	0.94	1.1	1.3	0.9	1.0
Export, m.tons	1.0	0.93	1.1	1.2	not available	not available

The first fully-integrated iron and steel works belonging to El-Fouladh Company was put in operation in 1966 in Menzel-Bourguiba. The works operates on iron ore supplied by the railway from Djerisaa.

The worka comprises: an ore-dressing complex, a sinter plant of 500 tons daily capacity, a blast furnace of 4.0 m hearth diameter and 110000 tons of iron annual capacity, a 300-t mixar, two 15-t LD converters of 100000 tons annual steel capacity, two double-strand continuous casting plants and a combined medium and light section mill. Initial annual production capacity of the worka was estimated at 70000 tons of sections. The works is now supposed to increase in the future ita annual rolling capacities to 120000 tons. The works was constructed at the cost of 20 m. tunisian dinars. /19/

There are 1250 persons working at this works.

It is planned to build two new works, viz. a work for manufacture of steel pipes and a worka for manufacture of wire. /7,20/

In 1967 Tunisia imported 74900 tons of ferrous metals including sections - 16700 tons and pipes and fittings - 14300 tons. Rolled producte are exported to Tunisia mainly by France. Ferrous metals are also imported from Belgium, Luxemburg, the USA, the USSR, Italy and the FRG. /16/

Algeria

Algeria is an agrarian country with rather developed petroleum industry. Agriculture in which over 75% of the country population are engaged is the major branch of the country economics.

Potential reserves of iron ores in Algeria are estimated at 1.35 bil.tons including 620 m.tons of proved reaerves with Fe-content amounting to 50%.

In 1952 the biggest iron ore deposit of Algeria was discovered in Gara-Djebilet (South-Western part of the country). Proved iron ore reserves in this deposit are estimated at 350 m. tons. Fe-content of these ores amounts to 57%.

Another major iron ore deposit is in Quenza (north-western part of the country). Here reserves of 52%-Fe content ores are estimated at 100 m.tons. A new iron ore deposit was discovered in Garetel-Gabel in 1963.

Algerian iron ore (mainly from Quenza deposit) is exported to the United Kingdom, Italy, Belgium and Bulgaria. /1/.

Manganese ore deposit has been discovered in the Djebel-Gettare region.

Potential reserves of coal are estimated at 100 m.tons with proved reserves amounting to 9 m.tons. Main coal deposits are in the western part of the country (Colon-Beshara region). Coal output is rather negligible and amounted only to 50000 tons in 1967.

Below are data on iron ore coal output in Algeria in 1948-1968 period. /2,16,21/

Years	Iron ore[x/], mil.tons	Coal, thousand tons
1948	1.02	226
1957	1.45	236
1960	1.79	119
1961	1.49	78
1962	1.07	53
1963	1.03	38
1964	2.74[xx/]	46
1965	3.2[xx/]	45
1966	1.8[xx/]	44
1967	2.3[xx/]	50
1968	3.1[xx/]	50

x/ -Fe-content

xx/ - Merchantable ore

Proved oil reserves are estimated at 878 m.tons. Major oil fields are Central field and Fort Polignac field. In 1967 oil output in Algeria was 38.2 m.tons. Oil is exported mainly to France. /1,22/

Potential reserves of natural gas are estimated at 1416 bil. cu.m. Major gas-bearing fields are concentrated in Haesi-r'Mel, Fort-Polignac, Hassi-Tuareg and Gassi-Touil. In 1966 gas production in Algeria reached 2046 m.cu.m Natural gas is mainly exported to the United Kingdom and France. /1,21/

At present there are three iron and steel works in Algeria including a works under construction.

The "Asilor" semi-integrated works commissioned in 1941 consists of an open-hearth shop, a rolling mill shop and a hardware shop. The open-hearth shop has a 35 t and two 10 t open-hearth furnaces. Total production capacity of the shop is 30000 tons of steel per year. In recent years only the 35-ton furnace fired with natural gas-oil mixture was in operation. The rolling mill shop is of 50000 tons annual capacity. In the hardware shop there are installed several wire-drawing machines and a unit for wire-net manufacture (the use is made of spot welding method). Monthly capacity of this aggregate is 300 tons. /19/

At the Reghaia works belonging to Altumec company there are two pipe-welding units that produce pipes of 100-175 mm diameters. /19/

In 1960 construction of a fully-integrated iron and steel works was started in El-Hadjar (near Annaba) with assistance of a French company Societe Bônoise de Sidérurgie. In 1963 the construction was stopped. Next year an agreement with the USSR was concluded on completing the construction of this works.

The works will comprise a sinter plant, blast furnaces, an oxygen-converter shop, continuous casting plants, rolling mills and pipe-welding units, and a thermal and power station.

Iron ore will be supplied to this plant from Quenza mines and coke will be imported. The total cost of this plant is estimated at 1 bil. Algerian diners. /7/

First blast furnace of 400000 tons annual capacity was to be started up in 1968 and steel production was to begin in the fall of 1969. It is expected that at first the steel production

at this works will be at 350,000–450,000 tons level. The first stage of the works comprises a rolling mill shop equipped with a plate mill which will be supplied by Innocenty Company (Italy) and a pipe producing shop for which Hoesch company of the FRG will manufacture all the necessary equipment.

The pipe rolling shop will be provided with four spiral weld-pipe mills for pipes of 406–1066 mm diametera and with auxiliary equipment including that for pipe quality control. Rated capacity of the shop - 100,000 tons of pipes per annum. The shop was to be put in operation in 1969. /23/ According to some reporta this shop was commissioned in November, 1968. /24/

The second stage of the works provides for construction of a cold rolling mill, a section mill and tinning and galvanizing lines.

Hoesch Company was contracted to build a pipe manufacturing plant of 50,000-100,000 tons annual capacity in the vicinity of Constantine.

Pipes produced at this plant will be mainly used by the petroleum industry of the country. Total cost of the works is estimated at 11.5 m.dollars. /25/

According to some reports, steel output in Algeria has been at 17,000 t/year level recently, rolled products output - at up to 18,000 tons/year and pipe output - at up to 3,000 tons/year level.

Major requirements of the country in ferrous metals are met with the help of imports.

Import of ferroua metals in 1967 amounted to 144,200 tons (heavy and light sections 32,000 tons, plated 13,300 tone, sheeta 18,800 tons, steel pipes and fittings 43,100 tons). Ferrous metals are imported mainly from France, Japan, Great Britain, the United States and the FRG. /12/

Libya

Libya is an agrarian country with a developed petroleum industry. About 80% of the country population are engaged in agriculture.

There is a non-integrated steel works of annual capacity of 20,000 tons in Tripoly. This plant belonging to Libyan Metal Industry , was put in operation in 1965. The plant was built at the cost of 150,000 of British pounds. /7,19/

An iron ore deposit was diacovered in Sebh (in the vicinity of Brak) in 1961. This deposit of iron ore of 48–50% Fe content is estimated at 720 m.tons.

Proved oil reserves of the country are estimated at 3.9 bil. tons which are msinly concentrated in Tripoli and Kirenaika oil fields.

In 1967 oil production amounted to 83.5 m.tons. All the oil produced is exported. /22/

Potential reserves of natural gas in Libya are estimated at 105 bil.m^3. According to press reports Esso Company of the USA has concluded a contract to supply natural gaa from Libya to Spain anu Italy. /7/

Major demand of the country in ferroua metals ia met by means of exports which in 1967 amounted to 259,400 tons (heavy and light sections - 73,400 tons, sheets - 10,700 tons, steel pipes and fittings - 159,100 tons).

Ferrous metals are imported to Libya mainly from Great Britain, France, the FRG, Japan, Belgium and Luxemburg. /12/

Morocco

Morocco is an agrarian country with a developing mining industry. There are no iron and steel works in the country.

Potential iron ore reserves of the country are estimated at 170 m.tons. Rich iron ore deposits are in the north of the country (Uixan region, 25 km from the port of Melilla). This deposit reserves are estimated at 35 m.tons of hematite ores of 60-62% Fe-content. In the central part of the country, in Henifra, there is located an iron ore deposit with ores of 43% Fe-content and potential reserves being about 30 m. tons.

Tidzi, Tasila, Imin'-Turza, Keradid and Kenitra are other major iron ore depoaits which

amount to 100 m.tons of ore with Fe-content varying from 18 to 53%.

Potential reserves of manganese oree are eatimated at 50 m.tons. More than half of the manganese ore output ie accounted for Imini deposits the available reservea of which are estimated at 5 m. tons with Mn-content varying from 50 to 56%. At the Imini deposit, the manganese ores are mined in the underground minee. After ore separating two kinds of ore are obtained - chemical and metallurgical ores. Varioue gradea of concentratee are obtained by way of dressing; the most part of ore is agglomerated at a sinter plant in Sidi-Maruf where a Dwight-Lloyd type sinter machine ie used; sintering area of this machine ie 26 eq.m, capacity - 20 t/hour. /26/

Potential coal reeervea of Morocco are eetimated at 160 m.tons with proved reservea amounting to 100 m.tone.

Output of iron and manganese oree and coal in 1960-1967 period is characterized by the following date (thoueande tons) /2,5/

Year	Iron ore[1/]	Manganese ore[2/]	Coal
1960	874	224.7	412
1961	815	263.2	410
1962	675	207.5	370
1963	609	144.4	404
1964	525	153.6	400
1965	951[3/]	312[4/]	418
1966	1.016[3/]	285[4/]	451
1967	900[3/]	no data	470
1968[5/]	900	no deta	no data

1/ -By Fe-content; 2/ By Mn-contsnt; 3/ Raw ore;
4/ Metallurgical grade ore; 5/ Estimate

The iron ore mined in Morocco is exported tc Great Britain, Spain, the FRG and France, manganese ore - to France and the USA.

Proved reeerves of oil are estimated at 1.6 bil. tons. Oil output in 1967 amounted to 100000 tons. /22/

In conformity with the five-year program of the country economy development (1960-1964) 500-600 m. Moroccan dirhams were allotted for conetruction of iron and steel worka. /7/

Coppers Co of the USA together with British and Weet German companiue has elaborated a project of e fully-integrated iron and steel works which is now under construction in Ras-Kebdan (near Nador). Initially annual capacity of the worke will be 180000 tons of steel and then it will be increased up to 250000 tona per annuam. The total cost of the plant - 150 m.dollare.

The Ras-Kebdan worka will produce heavy and light eections, plates, galvanized sheets as well as ferromanganese (up to 20000 t/year). The works will be supplied with local iron ores and imported coke. /7/

It is contemplated to build a eteel pipe plant with up to 10000 tons of eteel pipes annual cepacity, and a plant apecialized in producing steel and galvanized eheeta in Ceeablanca. Japanese and Moroccan private companies plan to participats in construction of the Casablanca plant. /19,27/

At prasent, Morocco'e demand in ferrous metals is mainly met by means of importa.

In 1967 Morocco imported about 142000 tons of ferrous metals (heavy and light sections - 35000 tons, sheets - 20000 tons, wire rods - 21600 tons, tinned plate - 28300 tons, steel pipes and fittings - 12600 tons, wire - 10300 tons)./12/ Ferrous metels are imported to Morocco

mainly from France, the FRG, Great Britain, Japan and the United States.

Nigeria

Nigeria is an agrarian country with developed mining industry.

Since becoming a politically sovereign state, Nigeria has developed programs envisaging construction of heavy-industry works including iron and steel works.

The first country economy development plan (1962-1969) stipulates to allot 30 m. Nigerian pounds (35% of the total capital investment) for construction of iron and steel works. /7/

Up to now natural resources of Nigeria have been explored poorly.

Potential reserves of the iron ore are estimated at 300 m.tons, with proved reserves amounting to 90 m.tons.

Reserves of the largest iron ore deposit in Nigeria (in the eastern part of the country, near Enugu) are estimated at 47 m. tons of ores characterized by the following metal contents: Fe - 35-45%, SiO_2 - 14-16%, Al_2O_3 - 9-10% and P - 0.6-0.8%. Reserves of the iron deposit on the Agbadja plateau near Lokodja (in the central part of the country) are estimated at 30 m.tons of ores containing Fe - 47-51%, SiO_2 - 6-9%, Al_2O_3 -8-10%, P - 0.7-1.3%.

Nigeria possesses the world largest deposits of niobium-containing ores (columbites). Nigeria's share in the world output of these ores amounted to 75-80% in 1965. The major deposits of columbites are on the Djos platesu. Ores of these deposits also contain tin and tungsten besides niobium. Other large mines are in Egbe (Ksbba province), where besides columbites tantalites are mined too. Columbites have been mined in Nigeria since the beginning of the sighties of last century and at present its output is about 2,500 tons per year. The most part of the dressed columbites is exported to the United States and Great Britain. /1/

As to the production of coal, Nigeria is the third on the African continent following the Republic of South Africa and Rhodesia. In 1967 Nigeria produced 97000 tons of coal. Potential reserves of coal in Nigeria are approximately estimated at 500 m. tons of which non-coking coal accounts for 300 m. tons and brown coal and lignites - for 200 m. tons.

Major reserves of coal are concentrated in Enugu basin in the eastern part of the country and are estimated at 200 m. tons.

There are reports saying that special methods have been developed for coking the coal mined in the Enugu basin, and thus for obtaining metallurgical coke. (?)

Major oil fields are located in the eastern part of the country (Oloibiri, Afam, Bony, Imo-River, Korokoro, Ebubu). Potential reserves of these deposits were estimated at 482 m. tons in 1967.

The first oil refinery in Ales-Elem (25 km from Port-Harcourt) of 1.45 m. tons annual capacity was put in operation in 1964. /28/

Raw oil exported mainly to Great Britain, the FRG and Canada.

Potential reserves of natural gas in Nigeria are estimated at more than 10 bil. cu m. Major natural gas fields are in Afam, Apar and in the delta of the Niger (80 km. from Port-Harcourt). Production of natural gas amounted to 1.4 m. cu m/day; by 1968 it was to be increased two-fold. /28/

Rated power generation capacities of Nigeria are 358,000 kW with hydraulic power stations' share amounting to 21,000 kW. /5/

In 1966 lead, zinc and lime deposits were discovered in Overi, Kalabari and Abakhameki (eastern part of Nigeria).

According to some reports, molybdenum deposits have been discovered in Zaria in the north of the country. /1/

At present Nigeria disposes of five small non-integrated plants specializing in production of heavy and light sections and galvanized sheets.

At one of these plants (in Emen, near Enugu) a section mill was commissioned in 1962. This

mill of 10000 tons annual capacity rolls ingots of steel made on local scrap in the electric arc furnace. The output of the mill amounts to 10,000 t per annum. This mill rolls rounds, angles, channels and other sections. Construction of this mill was financed by the Nigerian government (49% of the total cost)and foreign companies (51%). /19/

In 1962-63 Fao Ltd company was formed by the government (20% of the total capital), French and Japanese companies. This company has built a plant for production of galvanized sheets in Ikeja. This plant of 20,000 tons annual capacity has been built at the cost of 300,000 Nigerian pounds. /7/

In 1964 a plant with two galvanized lines was built in Lagos. The plant capacity is 20000 tons of galvanized sheet per annum. Four Japanese and two British companies participated in the construction of this plant. Sheets for galvanizing were to be supplied by Nippon Kokan works in Japan . /7/

In the middle of 1965 the construction of a small works with steelmaking units was completed in Ijora with the cost of the construction estimated at 750000 Nigerian pounds. /7/

In August, 1966 another plant specialized in production of galvanized sheets was commissioned in Eastern Nigeria. Plant capacity is 500 tons a month. /7/

Possibilities of construction of a small pipe and tube works in Port-Harcourt have been studied. Annual capacity of this works was determined at the level of 3000 tons of small diameter pipes a year. The cost of this plant construction was estimated at $ 623,000. /7/

In August 1965, a decision was passed on construction of a fully-integrated iron and steel works in Onitsha or Lokoja. Its initial capacity was set at 125000-150000 tons of steel per annum. Later on the capacity of the plant was to increase to 250000 tons per annum. Construction of the works was to be started in 1966. No reports are available on the progress of this works construction. Nigeria's requirements in ferrous metals are continuously increasing. Nigeria's demand for certain types of steel bars and other reduction products for 1967 and 1975 are given below (thousands tons) /7/

	Years	
	1967	1975
Heavy and light sections	up to 6.6	10.1
Reinforcing rods	uo to 53-87	87-161
Sheet iron	up to 11.0	18.0
Corrugated galvanized sheets	up to 40.0	100.0

At present all the requirements of the country (excluding galvanized sheets) in the ferrous metals are met through imports.

In 1967 Nigeria imported 207100 tons of ferrous metals (including sheets - 54000 tons, pipes and fittings - 56800 tons, heavy and light sections - 58100 tons, wire rods - 8200 tons, tin plate - 7900 tons).

Ferrous metals were imported to Nigeria mainly from Great Britain, the FRG, Japan, Belgium, Luxemburg, France and the USA. /12/

Ghana

Chana is an agrarian country with mining being the major branch of its industry.

An iron ore deposit with Fe-content amounting to 40% was discovered in the vicinity of Shiene. This deposit capacity is estimated at 100 m.tons. Iron ore reserves in Opon-Manso (in the western part of the country) amount to about 150 m.tons. /5,17/

Potential reserves of manganese ores in Ghana are approximately estimated at 30 m. tons with proved reserves amounting to 12 m. tons. All the manganese ore reserves with average 50%

Mn-content are centered in Nauta-Dagvin deposit which has been mined since 1916. Ghana's manganese ore production by Mn-content was 277,000 tons in 1966. The ore is exported to the United States, Great Britain, Norway and Canada. /1/

In 1963 a semi-integrated steel works having two electric arc furnaces and 3000 tons of steel annual capacity was built in Tema near Accra. The works produces heavy and light sections and reinforcing rods. The works was built at the cost of 1.65 m. Ghanian pounds. Later on, the works will produce iron from local iron ores. At present, metal scrap (remnants of old ships) is used as raw material for this works. The works when it reaches its full capacity is supposed to meet the requirements of the country in the ferrous metals by 50-75%. /7,29/

Plans for 1963-1970 period call for construction of an iron foundry costing about 40 m. pounds.

When construction of the hydraulic power station on the Volta river is completed, it is planned to build two ferroalloy plants for producing ferromanganese and ferrosilicon.

Import of ferrous metals to Ghana in 1967 was about 34000 tons (heavy and light sections - 12,100 tons, sheets - 8700 tons, railway materials - 5300 tons). Ferrous metals are exported to Ghana mainly from the FRG, Belgium, and Great Britain. /12/

The Ivory Coast

The Ivory Coast is an agrarian coutry with 95% of its population engaged in agriculture.

At present only one small foundry is in operation in the country.

Potential iron ore reserves with Fe-content being 40% are estimated at 3 bil.tons. The Ivory Coast reserves of manganese ores are 13 m. tons. Mining of manganese ores was started in 1960 in Grand-Lahu. Proved reserves of this deposit are 1.4 m.tons with Mn content varying from 36 to 52%. Two new small deposits have been discovered in this region. Proved reserves of one of these deposits are 50,000 tons with Mn content being 45%; another deposit contains about 100,000 tons of ore with Mn-content being 47-48%.

About 3 m. tons of low grade manganese ores with Mn-content being 25% are located in Yauru. 4 m. tons of ores of the same quality have been discovered in Korogo. In 1962 a new manganese ore deposit was found in Ziemuguia (near Odienne). This deposit according to preliminary reports is estimated at 3-6 m. tons of high-grade manganese ores. /1,7/

All the manganese ore output is exported to the FRG, France, Canada and the United States.

In 1960-1967 Ivory Coast manganese ore output was as following (thousands tons, by Mn-content):

Years	
1960	33.1
1961	56.5
1962	48.5
1963	61.6
1964	61.3
1965	75.8
1966	79.2
1967	67.2

In the next few years it is planned to build an iron ore pelletizing plant in San-Pedro, a corrugated galvanized sheet plant in Abidjan and a fully-integrated iron and steel works, which is to be built in three stages. /30/

At the first stage it is planned to build a rolling mill shop of 28000-30000 ton annual capacity (if operated in two shifts).

At the second stage, a 15 ton electric arc furnace of 30,000 tons of steel annual capacity

(if operated in three shifts) is to be built. A medium section mill is to be built at the third stage of the works construction. At this stage another 15 ton electric arc furnace and a continuous ceeting plant ere to be built too. Dates of this works construction have not been determined yet. Thie works was designed by Companie d'etude et de gestion industrielle (France).

Imports of ferrous metals to the country amounts to 45000-50000 tons per annum with France being the major importer (40000 tons in 1966). /7/

Liberia

Liberia is an agrerian country with developed mining industry.

There are no iron and steel worka in the country.

Liberia is a major supplier of rich iron ores to the world market. Potential reserves of rich iron ores ere estimated at 1.6 bil. tons with proved reservee of 60% Fe-content ores amounting to 600 m. tons.

Iron ore depoeits ere in Bomi-Hills (to the north of Monrovia). These deposits ere eetimated at 50 m. tons of rich iron ores with Fe-content reaching 60-68%. These ores ere mainly of magnetite type. The Bomi-Hills pit ie provided with e concentretion plant of 1 m. tons of concentrate annual capacity.

Iron ore depoeits in the Mano-River region (to the north of Bomi-Hills) ere estimated at 53 m. tons of ore with Fe-content being 55-56%.

The latter deposits were put in operetion in 1961.

A deposit of relatively poor iron oree with Fe-content being ebout 37% hae been discovered in the Bong-Hill region to the north of Monrovie. Potential reserves of this deposit amount to 230-260 m. tons.

A new deposit with 250 m. ton proved reeerves of high grade (Fe-content amounts to 65%) iron ores have been diecovered in the Nimba Mountains. For indueirial exploitation of this deposit e joint venture (Lamco) was formed by ths Liberian governmsnt, Swedish and American companies. Conetruction of the benefication plant of 6-8 m. tons annual capacity was complsted in 1962. /1/

The Bong Range iron ore deposit reserves are estimated at 300 m. tons of oree with Fe-content being about 38%. Industriel exploitation of this deposit wae started in March, 1965. In May, 1965 the first etege of iron ore benefication complex of 3 m. tons of concentrate annual capacity (Fe-content - 65%, SiO_2-content - not more than 6%) was put in operetion. By 1970 the second stage of the complex (3 m. tons annual capacity) is to be completed. /31/

The Liberian government hes conducted negotiations with Bong Mining Co on conetruction of a pelletizing plant at the Bong-Range iron ore concentration complex. The coet of this plant was estimated at $ 23,000,000. Ths plant will be the second plant of that type in Liberia. The first pelletizing plant of 2000,000 tons annual capacity wes put in operation by Lamco in the port of Buchanan in November, 1967. This plant construction cost amounted to 51,500,000./32, 33/

Besides this plant, an iron ore washing plant of 10 m. ton annuel capecity was put in operation in Buchanan. /34/

Iron ore output in Liberie in 1960-1967 period is charecterized by the following data:/5/

Years	(m. tone, by Fe-content)
1960	2.2
1961	2.2
1962	2.6
1963	4.3
1964	7.0
1965	9.0
1966	10.4
1967	11.4
1968[x/]	18.2

x/ Merchantable ore shipments

All the Liberia's iron ore output is exported mainly to the FRG, the United States, Great Britain and the Netherlands. /6/

In October, 1964 the conference in Bamako epproved the project of a fully-integrated iron and eteel works of 500000 tons of iron and 700000 tons of eteel annual capacity to be constructed in Buchanan at the cost of $40,000,000-45,000,000. The project provides for construction of a blast furnace, oxygen converters, continuous casting plants and rolling mills for production of heavy and light sections, sheets and skelps for pipes.

All the countries of West Africe ere supposed to perticipete in the construction of this works and to share its products. Detes of this works construction have not been determined yet. /7/

For e long time the internel market of the country in regard to ferrous metals has been rather narrow. But as the scope of the country iron ore deposit exploitation has expanded Liberie's demands for ferrous metels have considerably increased.

In 1967 Liberia imported 22100 tons of ferrous metals (heavy and light sections - 7600 tons, sheets - 6000 tons, steel pipes and fittings - 2800 tons).

Major importers of ferrous metels to Liberie are the FRG, the United States, Belgium and Luxemburg. /12/

Guinea

Guinee is an egrarian country with poorly developed mining industry.

There ere no iron and steel works in the country.

Potential reserves of iron ores in Guinea are eetimated et 2.7 bil.tons with major deposits located on the Kelum Penirsule end in the Nimba and Simandu mountains.

The Kelum deposit reserves amount to 1.0 bil. tons with prospected reserves amounting to 200 m. tons. Chemical composition of the iron ore is as followings: Fe - 50%, SiO_2 - 2.5%, Al_2O_3 - 9.8%, S - 0.1%, P - 0.06%. In the deposit region e beneficetion plant has been built with initial annuel output equal to 1.2 tons of concentrate.

Proved reserves in the Nimbs and Simandu deposits ere 1.7 bil.tons of rich ores with Fe-content amounting to 65%. /1,7/

Guinee's iron ore output in 1957-1967 period is charecterized by the following table./5/

Yesrs	(thousands tons, by Fe-content)
1958	214
1959	171
1960	388
1961	271
1962	350
1963	279
1964	454
1965	378
1966	300
1967	300

All the iron ore output is exported to Great Britain, Poland, Czechoslovakia, the GDR, the FRG.

Up to the present moment no mineral fuel deposits have been discovered in Guinea.

Watsr power reecurcss of the country are considerabls as it can bs seen from the following table. /7/

Name of the river	Potential capacitiss in regard to elsctric power generation, bil. kwh/year
Konkur	12.0
Fatala	2.0
Kogon	2.0
Kolsnte	2.25
Tomine	6.5
Gambia	4.5
Upper Niger	23.7
Bafing	10.0

In accordance with eeven year program of dsveloping the economics of the ocuntry (1964-1970) it is planned to build an iron and eteel works of 70000 ton capaoity in Conakry.

In 1967 Guinsa imported 3300 tons of ferrous metals mainly from the USSR and Japan. /12/

Sierra-Leone

Sierra-Leone ie an agrarian country with 90% of its population engaged in agriculture. Mining is the major branch of the country industry.

There are no iron and stsel worke in Sierra-Leone.

Main reserves of the country'e iron ore are cntsred in the Marampa dsposit (400 mil.tons). The most part of iron ore are hematitss with Fe-content amounting to 57%. The Marampa dsposit is exploited by the British oompany Sierra-Leone Development. The iron ore output is subjsoted to dressing at three benefication planta with their total annual capacity bsing squal to 2 m.tons of concentrates. Fe-content in concentratse reaches 67%. /1/

A new iron ore depoeit fsaturing 40-55% Fe-content has bssn diecovered in the vicinity of Pudjekup. /35,36/

An iron ore deposit estimated at 100 m.tons of iron ore with 57% Fe-contsnt has been discovered in Tonkolili (192 km. from the port of Pepel). /37/

Iron ore output for 1960-1967 pe-iod is characterized by the following table /5/

Years	(m. tons, by Fe-contsnt)
1960	0.881
1961	1.029
1962	1.186
1963	1.147
1964	1.208
1965	1.400
1966	1.340
1967	1.380
1968x/	2.6

x/ Merchantable ore, estimate

All the iron ors output of the country is sxported mainly to ths FRG, Great Britain, Norway, and the Nethsrlands. /7/

Chroms ore reserves in Sierra-Leone are sstimated at 1.5 m. tons. Chrome ore dsposits locatsd on the Kambui hills contain ores with Cr_2O_3 content amounting to 45.4%. Chrome ore is also fully exported. The iron and chrome ore dsposits are exploited mainly by British companies. /1/

The Republic of Congo (Kinshassa)

The Republic of Congo (Kinshassa) is a country with developed mining industry.

Potential reserves of iron oree with Fe-content of ebout 45% are estimated at 9 bil. tons. In the north-eastern part of the country (in the upper reachee of the Ituri river) iron ore deposits have been discovered. Reservee of rich oree with Fe-content reaching 68% are estimated et 1.3 bil. tons.

Reserves of manganese ores with 52% Mn-content equel 10 m. tons.

In 1965 manganese ore output wes 378000 tons. Various non-ferrous aetal oree are mined in the country.

The Republic of Congo (Kinshassa)is the major supplier of highgrade tantalic concentretes to the world markets. Available reserves of niobium and tantel are estimated at 400000 tons. Major deposits of theee metals are in Manovo, Northern Lugulu and Luesh. Besic reserves of niobium raw materiale (400000 tons, Nb_2O_5 content - 1.34%) are concentrated in Luesh (Kivu Province). /1/

Jadovill-Shituru, Luilu and Panda ere metallurgicel centree where non-ferrous metsl ores are processed.

Potential reserves of coal are estimated at 1.65 bil. tons with proved reserves amounting to 50 mil. tons. (for coal - 750 m. tons and 50 m.tons reepectively). Brown coal and lignite reserves amount to 900 m. tone. Coal production in 1967 was 116000 tons. /7/

Installed power generation capacities of the country in 1965 was 659000 kw , with hydreulic power stations ehare amounting to 576000 kw ; electric power generation - 2.519 bil. kwh (hydraulic power stetions share - 2.419 kwh). /13/

In the vicinity of Kimpako conetruction of a work with steelmaking units was to be started in 1968. The initial cepacity of the works was set at 200000 tons of electrical steel per annum. The works construction coet wae eetimated at 120 mil. dollars.

In future the works capacity ie supposed to be increased to 350000 tons per annum. The works will supply its products not only to the internel market of the country, but to the Republic of Congo (Brazzaville), the Central African Republic and the Republic of Chad as well. Construction of the works is supposed to be completed by 1972. /7/

Plans call for construction in 1972-1977 period of an integrated iron and steel works in Inga. Ite initial production capacity is eet at 300000 tons of steel (ingots) and 275,000 tons of rolled products. /7/

In 1967 the import of ferrous metals was at 50200 tons level(heavy and light section - 18000 tone, sheete - 14600 tons, pletes - 5800 tone, eteel pipes and fittinge - 4300 tons).

Ferrous metals are imported to the country mainly from Belgium, Luxemburg and the FRG. /12/

Gabon

Gabon ie an agrarian country. There ar. no iron and steel worke in the country.

Potential iron ore reserves are estimated et 2.0 bil. tone. The Mekambo deposit estimated at 860 m. tone containe ore of about 64% Fe-content. The Bok-Boka depoeit (to the west of Mekambo) contains about 200 m. tons of 63% Fe-content iron ore.

In the south of the country, in Tchibanga-Millingi a new deposit of 43.5% Fe-content iron ore estimated at 100 m. tons wae discovered. A big iron ore deposit (63% Fe-content) containing about 1 bil. tons of iron ore is in the Belinge mountains. Prospecting and preparation of the major iron deposits of Gabon are carried out by Somifer company (Society des Mines de Fer de Mékambo) essisted by the U.S. Bethlehem Steel Corp. and some French coapanies.

An iron ore pelletizing plant ie planned for construction in the port of Owendo. The plant capacity will amount to 2 m. tons of iron ore pellets per annum.

Gabon poesesses big reserves of manganese ores. Major reserves of these ores (200 m. tons)

with Mn-content equal to 50% are centered in the Moanda deposit located in the vicinity of Franceville. This deposit has been exploited since 1962 by Komilog company whose share-holders are French (51%) and American (49%) private companies. Manganese ore output in Gabon in 1966 amounted to 1.268 m. tons. All the manganese ore crop is exported. /1,5/

According to some reports, a project of the first non-integrated works with section mills has been worked out recently. /7/

At present all the country's requirements in ferrous metals are met through imports.

In 1965 ferrous metal imports to Gabon was about 13000 tons. France, Belgium, Luxemburg and the FGR are major exporters of rolled products to Gabon. /7/

Kenya

There are two non-integrated steel works in Kenya.

A works for producing galvanized sheet of 25,000 tons annual capacity was commissioned in 1962 in Changamwa (near Mombasa). This plant was built by Japanese Kawasaki Steel company and Kenyan Sheet Manufacturing Ltd . The latter also owns a corrugated galvanised sheet producing plant in Shimangi. /7/

Steel Manufacturing Ltd. constructs a sheet rolling mill of 50000-60000 ton annual capacity. The cost of the mill is 4 m. pounds. The mill was supposed to operate on slabs imported from Great Britain. /7/

In the middle of 1965 East African Cables Ltd. was established to build a cable and wire producing plant in Kilmarnock Road near Nairobi. The cost of this plant was estimated at £ 270,000.

It is planned to build the first pipe producing plant for manufacturing steel and galvanised pipes. The cost of the plant is about £ 600,000. /38/

At present major requirements of the country in ferrous metals are met through imports which amounted to 84000 tons in 1966. /7/

Ethiopia

Ethiopia is an agrarian country rich in various mineral resources which are so far poorly investigated.

Not long ago an iron ore deposit with Fe-content equal to 54% was discovered in the vicinity of Kafa.

Deposits of coal, manganese and wolfram ores have been also found. These deposits are not exploited yet. /7/

A semi-integrated steel works of 12000-15000 tons of rolled product annual capacity was put in operation in Akaki (near Addis-Ababa) in 1962. The cost of the plant construction was 3 m. Ethiopian dollars. Local scrap is used by the plant.

The second plan for developing the economics of the country for 1963-1967 period called for increasing the steel production capacity of this plant to 80000 tons per annum. 56 m. Ethiopian dollars were allotted for this purpose.

In 1966 construction of a non-integrated steel works specializing in production of galvanised sheets was completed in Akaki. This plant of 12000 tons initial capacity was built at the cost of 1 m. US dollars. /7/

A semi-integrated steel works is to be built in Sebeta (30 km. from Addis Ababa) with assistance of the Italian Frisk Barbieri company.. The cost of the works construction is estimated at 1 bil. Italian lire. /7/

Sabean Metal Products formed by Nippon Kokan Company and Marubeni-Iida (Japan) and Sabean Utility (Ethiopia), plans to built the first African works specialising in production of electrically welded pipes of 13-100 mm diameters. The plant capacity is to be 1000 tons of pipes a month.

The plant construction cost is estimated at 400 m. Japanese yen. The construction of the

plant was expected to etart in spring of 1969 and to be completed in 1971. /39/

In 1967 Ethiopia importad 36300 tons of ferrous metals (shseta - 19600 tons, heavy and light section - 6300 tons, ingots and billets - 4500 tons, steel pipes and fittinge - 3900 tons). Ferrous metals are importad to Ethiopie mainly from Japan, the FRG, Belgium, Luxemburg. / 12/

Uganda

Ugande ie an agrarian country.

Potential reserves of iron ore in the country are estimated at 40 m. tons. In the Tororo iron ore deposit - Fe-content of ore amounts to 65% and in the Kigesi deposit - to 68%. Iron ore mining is not organized yet. /7/

In the fall of 1962 the first semi-integrated steel works was put in operation in Jinda. The works ie equipped with a 25000 ton annual capacity elactrical arc furnace and a rolling mill of 24000 ton annual capacity. This works was built at the coet of £ 1,000,000. /7,19/

In May, 1965 Uganda Baeti Co commissioned its plant in Kampala.

Ths plant capacity is 25000 tons per annum. The plant was built et the coet of £ 500,000. /19,40/

Uganda Stael Co has been building a galvanized sheet producing plant of 1800 tons annual capacity. The cost of the plant construction was estimated at 250000 pounds. /7/

Possibilities of building a cold rolling mill of up to 50000 ton annual capacity has been investigeted. /7/

At the beginning of 1966 a proposal was put forward to build a pipe plant in Jinda with estimated coet of construction £ 150,000.

The five-year plan of the country economical development for 1966-1971 pariod calls for conetruction of a fully-integrated iron and steel worke of 100000 tons of etael annual capacity. The works ie euppoeed to work on local iron ores. The worke conatruction cost ia estimated at £ 7,000,000 /7/.

Major requiremente of the country in ferrous metals are met through imports which are at ebout 16000 tons per annum level now (including eheets and strips about 7000 tons, pipes - 3000 tons, heavy and light sectione - 3500 tons, wire - about 1000 tons). /7/

Tanzania

Tanzania ie an agrarian country.

Potential iron ore reeervee (48% Fe-content) are estimated at 45 m. tons /1/.

Totel potential reeervse of coal in Tansania are estimatad et 800 m. tons with proved reservee amounting to 500 m. tons. In 1967 coal output was only 2000 tons. /1,3/

In 1963 a worke for production of flat and corrugated galvanized sheets of 25000 ton annual capacity wae commieeioned in Dar-es-Salam. Sheete for thia plant are supplied by the Japanese Yawata Seiteteu company. /7,19/

National Steel Rolling Mill Company plans to build a non-integrated works equipped with a 10000 ton annual capacity rolling mill in Tanga. The ebove company aeeisted by the Italian Danieli Company plane to put this plant in opsration in 1970. /19/

In 1965 Tanzania importad about 64000 tons of ferroua metels (atrip, sheets, sections, skelps and hoops, railway matsrials and wire). /7/

Zambia

Zembia is an agrarian country. Mining which plays a leading role in the country economics, eccounts for 46% of its gross national product.

Potential reserves of iron oree with Fe-content equal to 58% are sstimated at 265 e.tons; manganeee ore (50% Mn-content) reserves are sstimated at 1 m.tons with proved and potential reeerves accounting for 0.5 m.tons./1/

Total coal reserves of Zambia are sstimatad at 27 m. tons with proved reeerves accounting

for 11 m. tons. Coal output was [illegible],000 tons in 1967.

Small coal deposits have been found near Sinkandoba. It is supposed, that exploitation of these deposits will provide for the whole country's requirements in coal.

A decision has been adopted to build a fully-integrated iron and steel works (annual capacity: iron - 7,000 tons, steel ingots - 69,500 tons, rolled products 47,000-53,000 tons). 10 bil. Japanese yen - is the price of the plant construction and equipment. /41/

In 1967 a galvanized sheets and strips producing plant constructed at the cost of £ 500,000 was put in operation in Lusaka. /19/

Wrightway Steel Pips Company commissioned e pipe-producing works in Kitwa in February, 1967. /42/

All the country's requirements in ferrous metals are mainly met through imports.

In 1967 imports of ferrous metals amounted to 19,200 tons (heavy and light sections - 4,600 tons, railway materials - 3,700 tons, sheets - 7,000 tons, steel pipes and fittings - 2,200 tons). Great Britain, Japan the FRG and Sweden are major suppliers of ferrous metals to Zambia./12/

Malagasy Republic

Malagasy Republic is an agrarian country with 90% of its population engaged in agriculture.

There is only one iron and steel works in the country which specializee in production of sheets. This plant put in operetion in 1966 was to be expanded to 12,000 ton annual capacity by 1967. /7/

Potential reserves of iron ores with Fe-content varying from 30 to 65% are estimated at 130 m. tons with proved reserves accounting for 20 mil. tons. /1/

Chroms ores reserves are 4.5 m. tons. The biggest chrome ore depoeits with proved reserves of 1 m. tons is in the vicinity of Adriamena. These ores are of 30-55% Cr_2O_3 content and are easily benificated. Cr_2O_3 content in concentrates amounts to 48%. French Ugine company exploits a small deposit in Ranomena. This deposit reserves are estimated at 250,000 tons and feature 42-48% Cr_2O_3 content. Feasibility of exploitation of chrome ore deposits in the regione of Ambordirian and Bekapiriji are being investigated. Potential resarves of ores in these deposits are about 100,000 tons. In 1965 chrome ore output (by Cr_2O_3 content) was only about 1,000 tons. /43/

Potential coal reserves of the country are estimated at 317 m. tons with proved reservee accounting for 100 m. tons; brown coel reserves - 17 m. tons. Coal output was 2000 tons in 1967.

Mejor rsquirements of the country in ferrous metals are met through imports. In 1967 the country imported 36000 tons of ferrous metals (mainly, heavy and light sections and plates).

France, Belgium and Luxemburg are major suppliers of ferrous metals for Malagasy Republic. /12/

Other developing countries of Africa

Sudan Potential reserves of manganese ores with Mn-content equal to 34% ere estimated at 10 m. tons. Chrome ore deposits in Engenesse (Blue Nile Province) are exploited. In 1965 manganese ore output (by Mn-content) was 14,000 tons, chrome ore output - 30,000tons. All the ore output is exported to the countries of West Europe. /1,7/

Plans cell for construction near Khartum of a small works specielized in production of galvanized sheets. The plant capecity is to be 600 tons/month. Japanese companies are suppoeed to particlpete in the construction of this plant. /43/

Somali Potential reserves of 55% Fe-content iron ores are estimated at 440 m. tons. Two new iron ore deposits with reserves amounting to 100 m. tons have been discovered recently near Baidoa.

In 1965 Fersomala SRL company put in operation a non-integrated works of 20 tons of rolled products daily capacity. /44/

Botswana Manganese ore reserves amount to 0.5 m. tons. Major deposits of these ores are in the vicinity of Bangwaketse and Bamalete. In 1960 a benefication plant was built at the Bangwaketse deposit. In 1962 a benefication plant of 5000 tons of concentrate monthly capacity was built at the Bamalete deposit. Concentrate produced here is of 46% Mn-content. In 1966 merchantable iron ore output was 8000 tons[x/]. /1,22/

Potential coal reserves of the country are estimated at 558 m. tons with proved reserves accounting for 408 m. tons.

Rwanda-Burundi Wolframite, columbite and beryl deposits are exploited on a limited scale. In the vicinity of the Kivu Lake a natural gas fields estimated at 50 bil. cu. m has been discovered. /45/

There are no metallurgical plants in the country.

Congo (Brazzaville) Prospecting of the country's mineral reserves has been just started. In 1961 in the vicinity of Zanaga (to the north-west of Brazzaville) a high grade iron ore (65% Fe-content) deposit was discovered. Potential capacity of this deposit is estimated at 200 m. tons /1,46/. There are no iron and steel works in the country.

Cameroons Mineral resources of the country have been poorly prospected. Chaines des Mamelles iron ore deposit reserves are 150 m. tons of ore with 40-45% Fe-content. A Japanese company plans to build in Duala a plant for production of galvanized corrugated sheets. /47/

Togo There are no iron and steel works in the country.

Potential iron ore reserves are estimated at 550 m. tons. Major iron ore deposits are centered in the regions of Buem and Bangeli. /48/

Upper Volta Mineral resources of the country have been poorly prospected. Potential reserves of manganese ores are estimated at 11 m. tons. In the Gombao region there is a rich deposit containing about 10 m. tons of 52% Mn-content manganese ores.

Recently an international concern has been formed by American, Japanese and British companies to investigate the possibility of exploitation of the country's manganese ore deposits. /49/

There are no iron and steel works in the country.

Mauritania Cattle-breeding is the major branch of the economics. Modern industry, mining in particular, is just beginning to develop. There are no iron and steel works in the country. Potential reserves of iron ores are estimated at 410 m. tons with proved reserves accounting for 200 m. tons. Major iron ore resources are centered in the Fort-Gouraud deposit. Exploitation of this deposit was started in 1963.

Iron ore deposits have been also discovered in Keigleitatel-Hader (20 km. from Akdjudjtu). Proved reserves of these deposits are estimated at 15 m. tons of 52-53% Fe-content ores. /1/

Iron ore output in Mauritania was 8 m. tons in 1967. All the iron ore is exported abroad. /2,3/

An iron and steel plant of 500000 tons of steel annual capacity is planned for construction in Port-Etienne at the cost of 96 m. dollars. /27/

Senegal There are no iron and steel works in the country. The four-year plan of developing Senegal economics calls for construction of a semi-integrated works near Dakar. This plant is to be aquippped with an electric furnace and a rolling mill of 90000-120000 ton annual capacity. Imported and local scrap as well as iron ore imported from Mauritania are to be used at this plant. 1.2 bil. African francs have been allotted for construction of this works from the total sum of 17 bil. francs planned for construction of industrial works.

Senegalase de Metallurgie company in cooperation with the Belgian Sibetra company have completed the project of a works capable of producing 12000-15000 tons of steel ingots per annum. At the first stage of the works an electric furnace and a rolling mill will be installed. At the second stage of the construction a continuous casting plant and a medium section mill will be added with the steel capacity of the plant increasing up to 25000 tons per annum. /7,27/

x/ Estimate

Malawi There are no iron and steel works in the country.

Lloyd company plans to build a small steel plant in Blantai.

Mali There are no iron and steel works in the country. Plans call for construction of a non-integrated steel works of 200000 tons annual capacity in the vicinity of Louina. /27/

Imports of ferrous metals to the above mentioned developing countries of Africa in 1967 were as follows :

Sudan - 98200 tons, Malawi - 4000 tons, Rwanda-Burundi - 3200 tons, Central African Republic - 34000 tons (1965), Togo - 6000 tons, Cameroons - 35000 tons (1963), Dahomey - about 1300 tons (1963), Mali - about 9000 tons (1963), Chad - about 7000 tons (1964), Niger - 4000 tons (1963).

Annual imports of ferrous metals to Upper Volta was 6000-8000 tons, to Senegal - 35000-40000 tons.

Rolled sheets, railway materials, reinforcing rods and steel pipes account for major part of imported ferrous metals. /12/

Ferrous metals to these countries are supplied mainly from France, Japan, Belgium, Luxemburg, Great Britain.

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C H A P T E R V

IRON AND STEEL INDUSTRY OF THE NEAR AND MIDDLE EAST

The countries of the Near and Middle East took only the first steps on the way of creating their domestic production of ferrous metals. Small non-intsgratsd works, predominantly ths works with rolling and pipe mills, operating in those countries, are commiesioned only in the last few years.

Most countries of the region have considerable resources of oil and as a consequences of it the petroleum industry which is a leading branch of their industry, is in the progrsss.

Some general data characterizing the economics of certain dsvsloping countriss of the Near and Middle East are given in Tabls 1. Reserves of metallurgical raw materials are investigated insufficiently in thoss countries.

Potential reeerves of iron ore are estimated approximatsly at 1200 m. tons including thoss amounting to 1000 m. tons in Iran and Lebanon. /1/

The iron ore is minsd in insignificant volumes (60,000 tons per year).

Deposits of manganese and chrome ores have been discovered in Iran and Jordan. Annual output of manganeee ore amountsd to 3000-4000 tone in the last years in Iran, this characteristic for chrome ore output amounted to about 150,000 tone. In Jordan the above-mentioned ores are not minsd.

Of all the countriss of ths region, potential reserves of coal (including coking one) are discovered only in Iran (300 m. tons and among them probable reserves amount to 65 m. tone). In Iran the coal eutput amounted to sbout 300000 tons psr ysar in the laet few ysars.

In the countriss of the Near and Middle East rsserves of natural gas amount to 6,200 bil .cu.m including those in Iran - 3,100 bil.cu.m and in Saudi Arabia - 700 bil.cu.m.

Fixed rated power of the power plants in ths countries of this region are sstimstsd as follows (1000 kw): in Syria - 243, in Lebanon - 356, in Saudi Arabia - 94, in Iran - 791. Power gsnsration amounted to (m. kwh): in Syria - 616, in Lebanon - 765, in Kuwait - 652, in Saudi Arabia - 269, in Iraq - 1207, in Iran - 2139. /2/

As of January 1, 1968, oil rssarvss of ths countrios of the Nsar and Middle East are sstimated at about 30.8 bil. tons including thoss in Kuwait - 9.5, in Saudi Arabia - 10.4, in Iran - 7.3, in Iraq - 3.7 bil. tons /3/

In 1967 oil output in the countries of this region amounted to about 510 m. tons including that in Iran and Saudi Arabia - 258.7, in Kuwait - 115, in Iraq - 59.5, in Bahrain - 3.55 m.tons/4/

At present there are small non-integrated works with rolling and pipe mills producing sections, steel and iron pipes and tubes in Lebanon, Saudi Arabia, Kuwait, Iraq and Iran.

In Iran a fully-integrated works of 500,000-600,000 t of steel and 350,000 t of sections annual capacity is conetracted with rendering the technical assistance by the USSR.

In the last few years a number of the counties of the Near and Middle East worked out and published the projects of new iron and steel works of different capacity which are planned for construction.

Even though the countries of the Near and Middle East are behind the developing countries of Africa in respect of population quantities and territories occupied they are at the third place in the volume of ferrous metal import following the countries of Latin America, the South-East Asia and the Far East.

The volume of ferrous metal import by the countries of the Near and Middle East increased from 633,200 to 2,131,100 tons or over than 3,3 times in the period of 1955-1967 (Table 2)./6,7/. The metal is mainly used to satisfy the demand of the developing petroleum and building indust-

Table 1. Some data on the economics of the developing countries of the Near and Middle East (for 1967)

Countries	General data			Reserves				Output				Electric power generation, m.kwh	Steel production, 1,000 t (1966)	Import of ferrous metals, 1,000 t	Per capita apparent consumption of ferrous metals kg (1966)
	Populations 1,000 persons	Area, 1,000 sq. km	National income, bil. US dollars	Iron ore, m.t	Manganese ore, m.t	Oil, m.t	Coal, m.t	Iron ore, 1,000 t	Manganese ore, 1,000 t	Oil, 1,000 t	Coal, 1,000 t				
Iran	25500	1648	5.2	560	0.5	7327.8	300	60	3.6	129800	300	-	-	1,100.4	29
Lebanon	2460	10.4	0.5	500	-	-	-	-	-	-	—	864.4	-	166.0	109
Saudi Arabia	6870	2149.7	-	55	-	10448.9	-	-	-	128928	-	268	-	120.7	33
Syria	5450	185.2	0.7	100	-	205.8	-	-	-	-	-	658	-	130.3	38
Iraq	8338	434.7	-	2	-	3757.6	-	-	-	59500	-	1207	-	177.5	39
Jordan	2101	97.7	0.4	0.6	3.0	-	-	-	-	-	-	-	-	-	-
Kuwait	467.3	16.0	1.6	-	-	9501.3	-	-	-	115212	-	983	-	190.6	-
Bahrein	195.0	0.598	-	-	-	23.2	-	-	-	3550	-	-	-	14.2	-
Abu-Dabv	-	-	-	-	-	2498	-	-	-	18972	-	-	-	-	-
Neutral area	-	-	-	-	-	2190	-	-	-	35500	-	-	-	-	-
Qatar	75	22	-	-	-	502.6	-	-	-	15480	-	-	-	-	-
Maskat and Oman	565	212	-	-	-	341.5	-	-	-	2556	-	-	-	-	-

ries and agriculture.

According to this, heavy and light sections, steel pipes and tubes and fittings occupy the main place in the import structure of several countries (Table 3) /8/.

Table 2. Imports of ferrous metals by the developing countries of the Near and Middle East, 1000 tons

Countries	Years				
	1955	1960	1965	1966	1967
Iran	261.5	426.1	555.7	581.7	1100.4
Lebanon	195.1 x)	112.8	181.4	242.3	166
Saudi Arabia	58.9	50.2	243.9	181.2	120.7
Syria		93.4	67.1	164.6	130.3
Iraq	80.4	207.5	165	260.2	177.5
Kuwait	21	95.8	125	122	190.6
Bahrain	16.3	23.7	13.2	10.6	14.2
Other countries	-	-	-	-	231.4
Total	633.2	1009.5	1351.3	1562.6	2131.1

x) In 1955, together with Syria.

The principal sources of accumulating the finances for industrialisation of the region's countries inclusive the creation and development of the domestic iron and steel industry are gains from sales of oil and agricultural products as well as deductions from concessions on working oil fields.

However, these sources are not sufficiently stable for the countries of the Near and Middle East as there is the trend of the unabated growth of the gap between the prices on imported industrial goods, machines and equipment, on the one hand, and the prices on exported industrial raw materials and agricultural products, on the other hand. The world market prices on machines and equipment grow steadily, but those on raw materials and agricultural products drop.

It should be emphasized that the existing political tension in the Near East is unfavourable to the industrial development of a number of the countries of this region and could not help effecting the performance of the projects announced before for constructing new iron and steel plants in certain Arabian countries.

What is more, the problems of creating the domestic iron and steel industry are aggraveted by the shortage of the national personnel of skilled workers and specialists.

Taking into consideration those detrimental factors as well as the trend revealed to the growing demand for ferrous metals, it is felt that the import dependence of the countries of the Near and Middle East will be valid for the future too, but the volume of ferrous metal import is believed to amount to about 3 m. tons per year. /9/

Iran

Potential iron ore reserves of the country are estimated at 560 m. tons. The ore contains 37-61% Fe.

Iron ore output is insignificant. It amounted only to 60,000 tons in 1966.

Since the end of 1965 fourty four groups of geologists have been working in the country with the aim of exploring iron ore deposits inasmuch as the construction of an iron and steel works was planned in Iran.

There are approximately 15 m. tons of high-grade iron ore in Chogard deposit situated at the distance of 10 km to the north-east from Bafk oasis. Besides, some 40-50 m. tons of the ore is revealed at the depth of several hundreds of metere in the same deposit. The ore

Table 3. Ferroua metal imports by the countries of the Near and Middle East in 1967, 1,000 tons

Countries	Billets and semis	Railway track materials	Heavy and light sections	Wire rods	Strip	Plates	Sheets	Steel tubes and fittings	Wire	Tinplate	Axles, tyres and wheels	Total
Iran	29.1	16.6	392.2	4.3	5.6	104.6	182.8	273.8	69.6	20.7	1.1	1100.4
Lebanon	43.5	5.0	74.1	0.2	8.0	7.9	11.5	6.5	4.2	5.1	-	166.0
Saudi Arabia	5.6	0.1	54.8	1.2	0.1	7.6	10.3	4.1	0.3	0.3	0.3	120.7
Syria	-	0.5	65.1	2.2	2.6	5.2	7.9	38.9	3.2	3.7	-	130.3
Iraq	-	-	116.8	0.3	0.2	1.5	18.1	27.5	4.2	8.5	0.4	177.5
Kuwait	4.0	-	98.9	1.9	1.0	4.1	13.2	67.4	0.1	-	-	190.6
Bahrain	-	-	7.3	-	-	2.0	0.3	4.6	-	-	-	14.2
Other countries	13.2	7.2	98.3	3.4	6.8	5.8	12.9	77.7	3.5	2.4	0.2	231.4
Total	95.4	29.4	907.5	13.5	24.3	139.7	257.0	536.5	85.1	40.7	2.0	2131.1
% of the total	4.5	1.4	42.6	0.6	1.1	6.5	12.1	15.2	4.0	1.9	0.1	100.0

contains 58-62% Fe.

There are some other deposits in this area but they have been explored insufficiently as yet.

In Bafk-Iesd area iron ore rsserves are estimated et 80 m. tons. The ore contains 63% Fe.

Large iron ore deposits also believed to be available at 200 km distance from Isfahan. /10/

Iran has some reserves of manganese and chrome ores too.

Potential reserves of manganese ore are estimated at 0.5 m. tons including proved and probable ones - 0.1 m. tons. The ore contains 30% Mn.

Potential reserves of chrome ore are estimated at 50 m. tons.

Chrome ore deposits are now mined only in Horasan and Kerman. In 1965, manganese ore output amounted to 3600 tons and chrome ore output - 152400 tons. /1/

Potential reserves of coal amounted to approximately 300 m. tons including proved ones - to 65 m.tons. The single large coking coal field is in Hojedk Der Tangal area to the north-east from Kerman. Here, up to 20,000 tons of coal are mined annually for local consumption. The coal is produced in small mines belonging to the state. /1/

Probable natural gas reserves are estimated at 3,100 bil.cu.m;annual natural gas output amounted to 1.23 bil.cu.m in 1965.It is anticipated that natural gas consumption will increase to approximately 5.5 bil.cu.m per year after the completion of constracting the Transiranian gas pipeline.

Iran occupies the third place among the countries of the Near and Middle East in the oil reserves (proved reserves are estimated at 7.3 bil. tons). In 1965, a new oil deposit, viz. Qewpal deposit, was discovered. This deposit is an extension of the deposit having gained a reputation and being mined. /3/

There were no iron and steel works in Iran up to 1967.Ahves Pips Mills Company has completed the construction of the country's first works for making welded oil and gas line pipes of 152-1219 mm.

diameter. The rated capacity of the works having four pipe mills is 450000 tons. The cost of construction is estimated at $1,900,000. There are 220 workers and 45 specialists at the works. Another works for making pipes was planned to be commissioned by the same company in 1968. The agreement with the US Torrans Machinery Company was concluded on treining the Iranian personnel during five years for servicing those works. It is anticipated that the works with four pipe mills of 450,000 t annual capacity will cover 80% of demand for pipes for the construction of the Transiranian gas pipeline./5,11/

The Iran first rolling mill was commissioned at a works of Iranian Rolling Mills Company in Ahvas (the South ares of Iran) in 1967. The rolling mill constructed by West-German Demag company was rated at the production of 65000 tons of light sections per year from imported billets/5/

In 1967, Iranian Rolling Mills Company concluded a contract on supplying of the second section mill of 85000 tons annual capacity with West-German Demag Company and Swiss Brown and Boveri Company. After commissioning the mill, the annual capacity of Ahvas works will rise up to 150000 tons of rolled products. /5/

The total costs of constructing both rolling mills are estimated at 1.3 bil. reals including 400 m. reals , which planned to get from the shareholders (the Bank of Developing the Industry and Mines of Iran - 15% shares, Philip Brothers Company (the USA) - 37.5% shares, Ali Resiy Brothers Company - 40% shares), and the rest wae expected to be gained with the credits of the National Bank and the Bank of Developing the Industry and Mines of Iran.

In January of 1966, the Soviet-Iranian agreement was concluded. In accordance with the agreement, the iron and steel works of 500000-600000 tons of steel and 350000 tons of heavy and light sections initial annual capacity is being constructed at 40km distance to the west from Isfahan, on the Sajanderoot river. Provision is made for increasing the works annual capacity, viz. initially - up to 1.2 m. tons, later - up to 2 m. tons and by 1976 - up to 4 m. tons of steel.

Selecting the site for the works is determined by the availability of water-power resources and the vicinity of transportation ways which will connect the works with large centres of ferrous metal consumption, viz. Tegeran and Ahvas. A dam for providing the works with water will be constructed on the Sajanderoot river.

Iron ore will be delivered from Chogard deposit. The reserves of the deposit will permit the works operation for 25 years. Preliminary operations for commissioning the deposit were initiated. Since 1967, underground operations have been carried out for making a coal mine in Hojedk Dar Tangal ready to working. The work is also performed for constructing the railway connecting Isfahan with Kashan-Iesd (near Ardekan). The railway will link the iron and steel works with Togalgard village located near coal mines of four Bavk and Sarand fields. The Iranian government assign 3.3 bil. reals for constructing the railway of 700-800 km length. /12,13/

Until recently the ferrous metal demand of Iran is almost fully met by import . In 1967, the ferrous metal imports amounted to 1,100400 tons including heavy and light sections - 392200 tons, steel tubes and fittings - 273800 tons, sheets - 182800 tons, wire rods - 4300 tons, plates 104600 tons, tinned sheets - 20700 tons, wire - 69600 tons, railway-track materials - 16600 tons, strip - 5600 tons, billete and semis - 29100 tons, axles, tyres and wheels - 1100 tons. /8/

It is anticipated that the total ferrous metal demand of the country will amount to 2 m. tons by 1972-1973, and to 4 m. tons by 1976-1977.

Lebanon

Potential iron ore reserves of the country are estimated at 500 m. tons. The ore contains 40-50% Fe.

Coal fields were discovered in Vitoli and Besharre areas. Only lignite field near Tarabl... are at present worked out.

In 1966 fixed rated power of power stations amounted to 374100 kw, and the output of gene-

rated electric power - 8,44 m. kw. in the same year.

There are three works with section mills and one works with pipe units in Lebanon.

Lebanon Steel Mill Company has constructed a works of 100,000 tons of rolled products annual capacity in Tripoli. 7-t electric arc furnace and three section mills are in operstion at the works.

A works with tube mills and a galvanizing line of the Sociate National des Tubes is in operation in Beirut.

A section mill of 120,000 tons annual capacity is in operation at Amchit works of Consolidated Steel Lebanon Company.

The Tube du Lebant company owns a similar works in Beirut. /,/

In 1967, the ferrous metal imports amounted to 166,000 tons, including billets and semis-43,500 tons, railway-track materials - 5,000 tons, heavy and light sections - 74,100 tons, wire rods - 200 tons, strip - 8,000 tons, plates - 7,900 tons, sheets - 11,500 tons, steel tubes and fittings - 6,500 tons, wire - 4,200 tons and tinned sheets - 5,100 tons. /8/

Saudi Arabia

Potential iron ore reserves of the country are estimated at 55 m.tons. The ore contains 50% Fe. A deposit in Wadi Fatima with potential iron ore reserves of 30 m. tons of ore containing 45.6% Fe is best known.

In 1967, oil reserves were estimated at 10.4 bil.tons and oil output was as great as 128.9 m. tons in the same year.

Natural gas reserves are estimated at 700 bil.cu.m, and the gas output at227 m.cu.m. /14/

In 1965, power generation amounted to 268 m. kWh. /2/.

In 1967, an elevar-atand section mill with the annual capacity of 15,000 tons of sections (one-shift operating) was commissioned at the works constructed by the state-owned General Petroleum & Mineral Organization (Petromin). The equipment was suppliad by the English Loewy-Robertson Engineering. /7/

In 1966, Saudi-Arabian government concluded a contract with several Japaness companies for financing and delivering aquipment for the construction of a works producing helical-welded pipes. The annual capecity of the works is 50,000 tons. /15/

There is no further information about realization of this contract.

The ferrous metal demand of the country is generally met by imports. In 1967, the ferrous metal imports amounted to 120,700 tons,including billets and semis - 5,600 tons, heavy and light sections - 54,800 tons, wire rods - 1,200 tons, plates - 7,600 tons, sheets - 10,300 tons, steel tubes and fittings - 40,100 tons, wire - 300 tons, tinned sheets - 300 tons, axles, wheels and tyres - 300 tons. /8/

Syria

Potential iron ore reserves of the country are estimated at 100 m. tons. The ores are lean and contain 32% Fe. Oil and natural gas reserves are estimated at 205 m.tons and 14,200 m.m^3 respectively. /1,3/. In 1966, power generation amounted to 658 m.kWh.

There are no iron and steel works in the country.

In November of 1967, a contract with a Polish foreign trade organization was concluded for supplying a section mill which was planned to be installed at the works in Kazo near Ham.

The costs of the equipment for the mill of 75,000 tons of reinforcing rods annual capacity are estimated at 12 m. Syr. pounds.

The second five-year plan of developing the economics of Syria (1966-1970) involved the construction of a works for production of rails. The cost of the works amounts to 24 m.Syr.pounds including national finances - 6 m. Syr. pounds and foreign credits - 18 m. Syr. pounds. /6/

The information on the realization of above-mentioned projects are absent in the press.

The ferrous metal demand of the country is met by imports. In 1967, the ferrous metal

imports amounted to 130,300tons including heavy and light section - 65,100tons, steel tubes and fittings - 38,900 tons, sheets 7,900 tons, plates - 6200 tons, tinned sheets - 3,700 tons, wire - 3,200 tons. /8/

Iraq

Iron ores reserves are explored insufficiently. Proved reserves of well-known deposits are estimated at as low as 2 m. tons of ore.

In 1967, proved oil reserves amounted to 3.7 bil.tons, and oil output to 59.5 m.tons./3,4/

In 1966, power generation amounted to about 1,207 m. kwh.

In the same year, a works for production of iron tubes and fittings was constructed. The annual capacity of the work is 10000 tons.

The government of Iraq concluded an agreement with the Soviet Union for construction the works with the annual capacity of 60.000 tons of sections and 9.000 tons of iron casting and tubes. The works is planned to be enlarged up to 100,000 tons of heavy and light sections per year.

The ferrous metal demand is fully met by imports.

In 1967, the ferrous metal imports amounted to 177,500 tons including heavy and light sections - 116,300 tons, wire rods - 300 tons, strip - 200 tons, plates - 1,500 tons, sheets - 18,100 tons, steel tubes and fittings - 27,500 tons, wire - 4,200 tons, tinned sheets - 8,500, axles, wheels and tyres - 400 tons. /8/

Jordan

Iron ores reserves are explored insufficiently. Proved reserves of iron ore in Ajlup area amounted only to 600000 tons (the ore contains 60% Fe).

Potential manganese ores reserves amount to 3 m.tons including proved ones to 1 m.tons(average manganese content of ore is 45-50%). /1/

Jordan Iron and Steel Industry Company (in cooperation with Italian companies) constructed a works with annual capacity of 45,000 tons of sections.

The whole ferrous metal demand of the country is fully met by imports.

Kuwait

There is no information about iron ore [illegible] in the country.

In 1967, proved oil reserves amounted to 9.0 bil. tons, oil output to 115 m.tons. In 1966, power generation amounted to 983 m. kwh. /2,3/

There is a works producing helical-weld pipes in Sheba. The works has the annual capacity of 15,000 tons of tubes and was constructed with rendering the technical and financial assistance by Japanese metallurgical companies.

It is anticipated that the annual capacity of the works will be brought up to 30000 tons and the production of butt-welded and galvanized pipes will be initiated in the future.

In 1966 the Kuwait Company for Metal Pipe Industries was established for constructing a new pipe works. /5/

There is an information that an Indian Heavy Engineering Company elaborates the project of semi-integrated works with electric arc furnaces and a rolling mill with the annual capacity of 50,000 tons and subsequent increasing it to 100,000 tons. /5,12/

In 1967 ferrous metal imports amounted to 190,000 tons including billets and semis 4,000 tons, heavy and light sections 98,900 tons, wire rods 1,900 tons, strip - 1,000 tons, plates - 4,100 tons, sheets - 13,200 tons, steel tubes and fittings - 67,400 tons, wire - 100 tons. /8/

Bahrain

Iron ores reserves of the country are not explored. In 1967 proved oil reserves amounted to 23.2 m. tons, and oil output to 3.55 m. tons. /1/

There are no iron and steel works in the country.

Ferrous metal demand is fully met by imports. In 1967, the ferrous metal imports amounted to 14200 tons, including heavy and light sections - 7300 tons, plates - 3000 tons, sheets - 300 tons, steel tubes and fittings - 4600 tons. /8/

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CHAPTER VI

IRON AND STEEL INDUSTRY OF THE SOUTH-EAST ASIA AND THE FAR EAST

Among the developing countries of the South-East Asia and the Far East, only India has large fully-integrated iron and steel works. Small, fully-integrated works operate in Thailand and Malaysia. There are semi-integrated works having steel-making and rolling shops in separate countries (Pakistan and others). There are a great number of small non-integrated steel works having rolling mills in most countries of this particular region.

Such countries as Afghanistan, Pakistan, India, Ceylon, Nepal, Burma, Thailand, Indonesia, Philippines, Singapore, etc. possess considerable mineral resources (Table 1) /1/ that are, however, not yet fully explored.

There are iron-ore deposits in almost all the countries of the region; manganese-ore deposits in India, Indonesia and Philippines; chromium-ore deposits in Philippines and Pakistan; coaking coal fields in India, Afghanistan, and other countries.

There are discovered deposits of oil and natural gas in some countries (in Afghanistan, India, Malaysia, etc). Many countries are rich in water power resources for generating electric power, which are utilised but to an insufficient extent.

Until now, in many countries of this region the level of development of productive forces is low, the proportion of agriculture in economics is great and the industry is weakly developed.

Only India had two fully-integrated iron and steel works before the World War II.

During the post-war years new fully-integrated iron and steel works were built in India, and in a number of countries (in Pakistan, Ceylon, Burma, Indonesia, Philippines, etc.)there are small non-integrated steel works were built having rolling mills for production of light and medium sections.

In the last few years works were also built producing tin plate, galvanized sheets and tubes.

As a result of building iron and steel works in the countries of the South-East Asia and the Far East the primary engineering experience has been gained and domestic personnel of high-skilled workers and specialists have been created.

In India machine-building plants were also constructed capable of producing metallurgical equipment.

In the last few years, the developing countries of the South-East Asia and the Far East have produced approximately 7.2-7.5 m. tons of steel per year (including India about 6.4-6.7 m. tons; and other countries about 0.8-1.0 m. tons per year), which amounts to about 1.5% of the world steel production.

As compared with per capita consumption of steel in the developed countries totalling about 400 to 600 kg, and with the world consumption averaging 149 kg /2/, per capita apparent consumption of steel in 1966-1967 amounted to 14 kg in India, 5 kg in Pakistan, 24 kg in Philippines, 26 kg in Thailand, 5 kg in Burma, 8 kg in Ceylon, 40 kg in Malaysia and 1 kg in Indonesia.

In the period of 1960 to 1965, the apparent consumption of steel in the countries of this region increased from 7.3 to 12.2 m. tons per year, or by as much as 67 per cent, which corresponds to a yearly increase by 8.9%.

In 1965. the consumption of 12.2 m. tons of steel was distributed as follows: in India - 7.5 m. tons; in Pakistan - about 0.8 m. tons; in Philippines - about 0.8 m. tons; in Thailand -

Table 1. Some economic data on the developing countries of the South-East Asia and the Far East (in 1967)

Countries	General data			Reserves[x/]			Output				Electric power generation	Iron output	Steel[xx/] output	Import of ferrous metals	Export of ferrous metals	Per capita consumption of ferrous metals
	Population, 10^3 persons	Area, 1000 sq.km	National income, bil.US dollars	Iron ore, m. tons	Manganese ore, m. tons	Oil, m. tons	Coal, m. tons	Iron ore, m. tons	Manganese ore, 10^3 tons	Oil, 10^3 tons	Coal, 10^3 tons	m.kWh	10^3 tons	10^3 tons	10^3 tons	10^3 tons	kg
India	511,100.0	3,268.1	39.4	22,000.0 / 10,000.0	180.0 / 30.0	201.6	138,100.0 / 56,240.0	26.9	1,400.0	5,556.0	69,200.0	37,900.0	7,200.0	6,600.0	619.3	-	14.0
Pakistan	105,004.0	946.7	9.7	400.0 / 125.0	0.5 / -	6.8	190.0 / -	0.02	1.0	500.0	1500.0	3903.0	-	12.0	554.7	-	9.0
Thailand	31,508.0	514.0	4.1	29.0 / 10.0	0.3 / -	0.03	112.0 / 30.0	0.6	71.4	-	100.0	1,816.0	-	-	551.4	-	26.0
Malaysia	6,278.7	131.3	2.4	150.0 / 120.0	-	81.7	50.0 / -	3.1	2.0	5,000.0	-	24.0	-	-	254.4	-	40.0
Philippines	33,477.0	300.0	7.7	920.0 / 590.0	6.0 / 1.5	0.01	35.0 / 5.0	1.4	52.6	-	100.0	4,959.0	-	32.2	835.6	-	24.0
Ceylon	11.500.0	65.6	1.5	- / 7.5	-	-	-	-	-	-	-	522.0	-	-	86.8	-	8.
Burma	25,426.0	678.0	1.1	45.0 / 10.0	-	5.4	6.0 / 3.0	0.005	-	550.0	-	396.0	-	-	60.3	-	5.0
Indonesia	118,000.0	1,491.0	5.3	-	10.0 / -	1,204.5	500.0 / -	-	0.5	25,500.0	400.0	1,520.0	-	-	153.3	-	1.0
Afghanistan	15,960.0	647.5	-	2,500.0 / -	-	13.6	80.0 / -	-	-	-	100.0	350.0	-	-	12.0	-	-
Laos	2,770.0	237.0	-	-	-	-	-	-	-	-	-	-	-	-	2.9	-	-
Singapore	1,914.0	0.6	1.0	-	-	-	-	-	-	-	-	1,236.0	-	-	-	48.5	-
Nepal	9,413.0	140.8	0.9	30.0 / -	-	-	-	-	-	-	-	30.0	-	-	-	-	-
Cambodja	6,415.0	181.0	0.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bruney and Sarawak	107.0	5.8	0.2	-	-	-	-	-	-	5,000.0	-	-	-	-	-	-	-

Note: [x/] The numerator designates the potential reserves, The denominator - the proved reserves

[xx/] In 1966

0.45 m. tons; in Malaysia - about 0.4 m. tons; in Indonesia, about 0.3 m. tons. /2/

Hence in 1965 in all the developing countries of this region the domestic production permitted the requirements in steel to be met by about 60%, including India - by about 88%; and other countries, by approximately 21%.

In the period of 1955 to 1967 the import of ferrous metals into the countries of the South-East Asia and the Far East increased from 2.1 m. tons to 3.75 m. tons, or by 1.65 m. tons, including the period of 1960 to 1967 only by 0.15 m. tons.

In 1960-1967 the import of ferrous metals into India decreased by 240,000 tons (Table 2).

As for the range of steel products imported by these countries in 1967 the proportion of sheets, heavy and light sections, billets and semis, as well as tin plate amounted to about 80% of the entire quantity of imported metals. (Table 3).

It is supposed that in 1970 per capita apparent consumption of ingot steel in the developing countries of the South-East Asia and the Far East will amount to 20 m. tons, including that of India - 9.4 m. tons. The domestic production will meet this requirement by approximately 65% (i.e. 13 m. tons, including India - about 11. m. tons), whereas the remaining 35 per cent (about 7 m. tons) will be covered by imports. /3/

In 1975 the imports of ferroua metals in terms of steel into the countries of this region together with the countries of the Near East and the Middle East is estimated to reach the figure of approximately 8 m. to 9 m. tons. /4/

In December 1965 in Manila there was held a conference of the countries of Asia on industrialization, in the course of which a programme was worked out for the development of the iron and steel industry in the countries where the iron and steel industry is developed slightly or does not exist at all for the nearest 15-20 years. A necessity was said to exist in a regional cooperation to speed up the development of the iron and steel industry in this region.

To this effect, the Asiatic Council of Industrial Development started studying the poseibility of discussing and coordinating plans for developing the iron and steel industry in a number of developing countries of the South-East Asia.

Studies are also being conducted, concerning poesibilities of building a number of fully-integrated iron and steel works designed to yield their production for sub-regional markets existing on territories comprising Thailand, Malaysia, Singapore, and other countries. /2/

India

India is an agricultural-industrial country possessing relatively developed processing and mining industries. India has 5 fully-integrated iron and steel works and more than 100 small non-integrated steelworks, mainly those provided with rolling mills.

Raw Materials, Fuel and Power Reserves

The country possesses considerable reserves of iron and manganese ore and to a smaller extent those of coking coals.

The potential reserves of iron ore in India are estimated at 22 bil. tons; reserves of manganese ore at 180 m.tons; and the potential reserves of coal - approximately at 13.8 bil. tons./5/

The iron content in ores of both available and probable reserves amounts to about 60%

Iron ores are mined predominantly in states of Orissa (about 38% of the total output), Bihar (about 25%), Madhya Pradesh (15%), and Mysore (17%).

In the last few yesrs about 27 m. to 29 m. tons of iron ore were mined in India of which about 45 per cent (totalling 12 m.-13 m. tons) are exported mainly to Japan (in 1966-1967, 9.7 m. tons; and in 1967-1968, 10.1 m. tons).

Pellets are also planned to be exported to an increased scale.

In 1967/1968, India exported 188,000 tons of iron-ore pellets into Japan.

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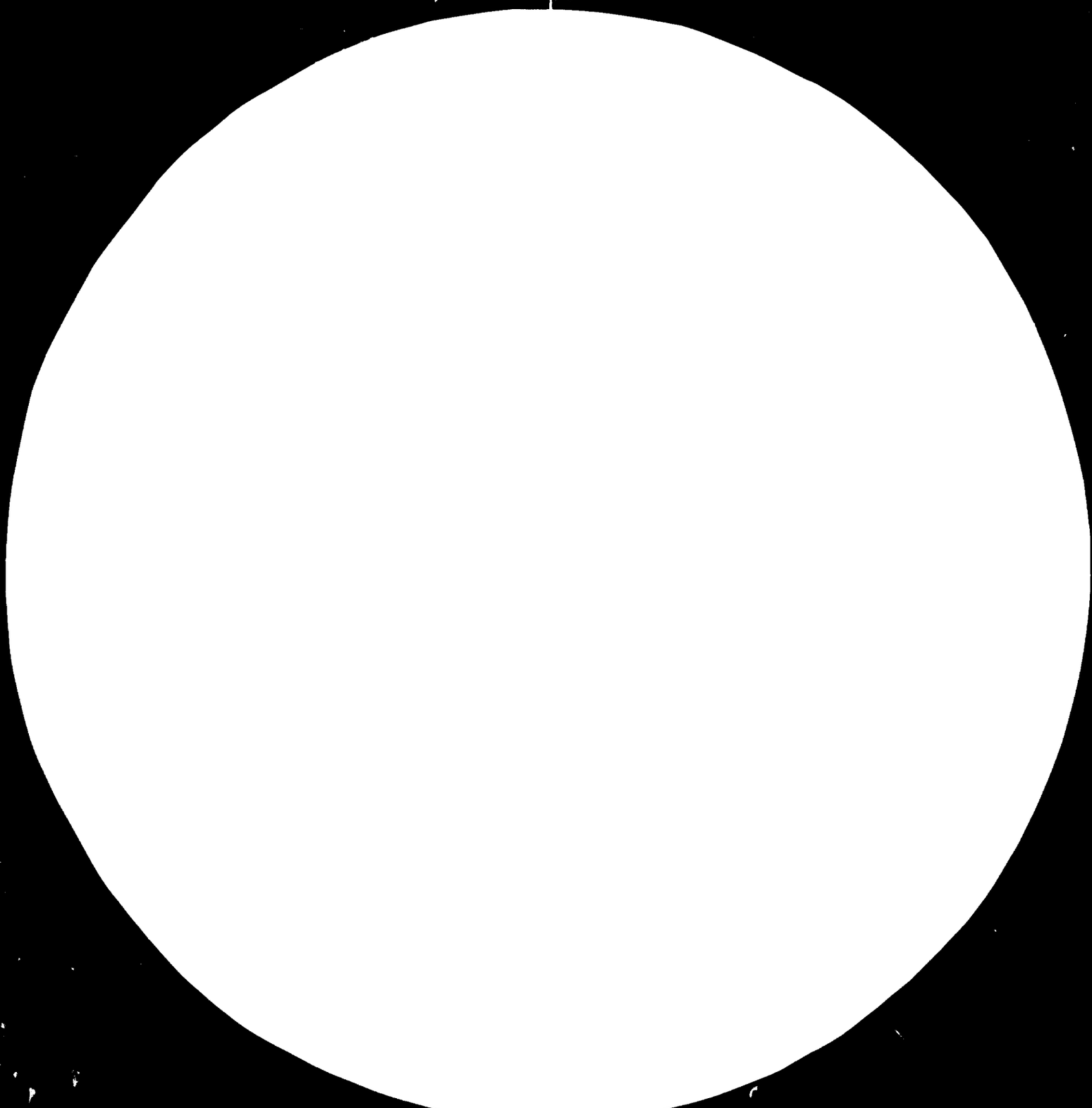

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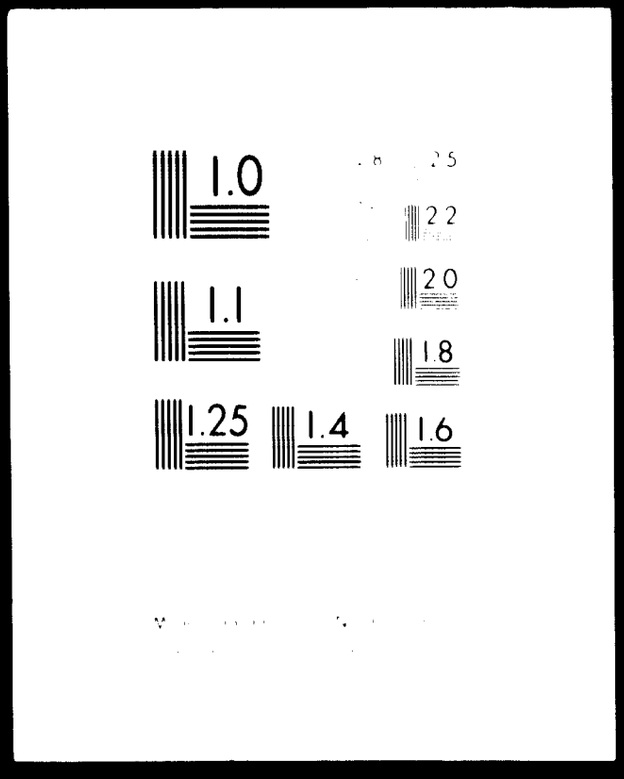

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Table 2. Ferrous metal imports by the countries of the South-East Asia and the Far East in the period of 1955 to 1967, 10^3 tons

Countries	Years				
	1955	1960	1965	1966	1967
India	886.2	1184.9	859.3	515.6	619.3
Pakistan	239.9	372.2	678.8	416.5	654.7
Thailand	123.5	167.9	353.3	537.3	551.4
Malaysia	199.5	120.2	208.0	221.1	254.4
Philippines	202.4	287.6	531.0	567.1	835.6
Ceylon	40.2	77.5	63.8	70.2	86.8
Burma	51.2	77.1	93.0	52.4	60.3
Indonesia	238.1	244.2	248.9	95.6	153.3
Afghanistan	6.2	8.6	14.8	16.2	12.0
Laos	-	2.7	0.3	1.4	2.9
Other countries	118.4	182.5	366.8	282.4	520.3
Total	2,105.6	2,725.4	3,418.0	2,775.8	3,751.0

In November of 1967 a plant for producing pellets of hematite iron ores at the mines of Pail in Goa was put in operation with an assistance of the Japanese Nippon-Kokan Company and West-German companies.

The main deposit of manganese ore (the resources of which are estimated at 140 m. tons) is disposed in the Nagpur-Bhandara-Balaghat area. About 40% of manganese ores of this deposit contain approximately 48% Mn.

The manganese ore is now predominantly mined in four states; namely, the states of Madhya Pradesh, Maharashtra and Mysore (about 300,000 tons a year in each state) and the state of Orissa (about 500,000 tons a year). The major part of the mined manganese ore is exported.

Quantities of manganese ore mined and exported are characterized by the following data in 10^3 tons.

	Years				
	1955	1960/1961	1965/1966	1966/1967	1967/1968
Mined	1609	1199	1616	1400	No data available
Exported	1252	1160	1413	1186	880

The export of manganese ore from India is hampered because large-tonnage ships cannot enter ports of Paradil, Visakhapatnam, Marmagoa and Mangalore.

The main reserves of coals are disposed in the Jaria district (about 5.8 bil.tons) and in the Bokaro district: East Bokaro (about 4.4 bil. tons) and West Bokaro (about 550 m. tons). These districts are the only principal suppliers of coking coals for iron and steel works. /6/

In 1967, the total quantity of coal mined in India was equal to 69.2 m. tons as compared with 32.8 m. tons as mined in 1950.

Table 3. Range of steel products imported by the countries of the South-East Asia and the Far East in 1967, in 10^3 tons

Countries	Billets and semis	Railway materials	Heavy and light sections	Wire rods	Strip	Plates	Sheets	Steel tubes and fittings	Wire	Tin plate	Axles, wheels and tyres	Total
India	26.4	0.1	104.3	50.8	45.7	71.4	165.9	29.3	18.6	88.9	17.9	619.3
Pakistan	283.0	28.3	53.4	4.5	22.0	33.1	158.1	24.6	10.6	32.4	4.7	654.7
Thailand	12.9	5.8	144.9	43.5	32.8	39.8	172.3	26.3	42.0	31.6	-	551.4
Malaysia	11.7	7.5	69.7	5.7	2.5	41.3	61.8	30.2	5.7	17.4	0.9	254.4
Philippines	182.8	17.7	90.8	20.8	36.4	79.2	245.3	41.0	10.3	111.2	0.1	835.6
Ceylon	28.4	0.6	20.0	0.3	0.9	6.2	15.8	2.8	9.8	0.9	1.1	86.8
Burma	17.1	0.9	4.3	0.1	0.1	2.6	7.8	13.4	11.4	2.0	0.6	60.3
Indonesia	0.1	2.6	31.3	0.5	3.7	8.8	46.1	29.5	20.5	9.7	0.5	153.3
Afghanistan	-	-	9.8	0.6	-	-	3.5	0.1	-	-	-	12.0
Laos	-	-	0.6	-	-	-	2.2	-	0.1	-	-	2.9
Other countries	45.1	4.5	87.3	30.3	28.5	61.5	137.5	30.5	26.1	-	-	520.3
Total	607.5	68.0	614.4	157.1	172.6	343.4	1016.3	227.3	155.1	362.9	26.4	3751.0

According to the fourth five-year plan of development of national economy of India, in 1970-1972 the coal is expected to be mined in an amount of about 106 m. tons.

During the recent years the production of coking coals practically remained at the same level; namely, 17 m. tons a year.

The oil potential reserves in the country are approximately estimated at 202 m. tons. In 1967 in India the production of oil totalled 5,6 m. tons. /5/

Relatively high prices of fuel oil in India do not favour its extensive application in blast furnaces.

In 1965-1966 the installed powsr of electric power stations in India was estimated at 10 m. kW, and the quantity of generated electric power, at 37.9 bil. kWh (1967).

The Indian industry produces annually about 2 m. tons of scrap which is mainly consumed at iron and steel works and partly exported (about 567,000 tons in 1966/1967).

Iron and Steel Industry

At present, the iron and steel industry of India plays an important role in the development of national economy.

In the period of 1950-1967, the production of iron increased from 1.7 m. to 7.1 m. tons; that of steel from 1.5 m. to 6.6 m. tons, and that of rolled products from 1.0 m. to 4.3 m. tons (Table 4). /4/

The production of steel pipes also increased: from 45,000 tons in 1956 to 425,000 tons in 1965/1966, the production of ferroalloys increased as follows: that of ferromanganese from 15,600 tons in 1950 to 156,000 tons in 1965/1966; that of ferrosilicium, from 2,800 tons to 20,000 tons, accordingly.

In 1967/1968 in India per capita steel production amounted to 13 kg, i.e. it increased by more than 2.5 times as compared with that in 1950.

The relatively rapid development of national iron and steel industry was ensured due to high capital investments that amounted to 610 m. rupees in 1951 (2,1% of all the capital invest-

ments made in the industry), 7.65 bil. rupees in 1956-1960/1961 (about 50% of all the capital investments in the industry or epproximately 10% of all the capital investments in the economics), and 6.4 bil. rupees in 1961/1962-1965/1966 (approximately 25% of all the capital investments made in the industry or about 5.1% of all the capital investments made in the economics)./6/

Table 4. Production of ferrous metals in India in 1950-1967, m. tons

Type of products	Years[x/]					
	1950	1955	1960-1961	1965-1966	1966-1967	1967-1968
Iron	1.7	1.9	4.2	7.0	7.2	7.1
Steel	1.5	1.7	3.3	6.4	6.7	6.6
Rolled products	1.0	1.3	2.2	4.6	4.5	4.3

x/ Since 1960, the data are stated for a financial year (from 1st April to 31st March of the following year).

During these years more than 10 bil. rupees or more than 70 per cent of all the capital investments in the iron and steel industry were spent on the construction of three new works of the State Hindustan steel company in Bhilai, Rourkela and Durgapur (3.5; 2.5 and 3.4 bil.rupees, respectively). /6/

Table 5 contains the data on the production of ferrous metals at the largest iron and steel works of India. /6/

Table 5. Production of ferrous metals at the largest iron and steel works of India, 10^3 tons

Works	Years	Iron	Steel	Rolled products
	Works of the state sector			
in Bhilai	1960/1961	736	402	24
	1965/1966	1632	1324	735
	1966/1967	2052	1852	726
in Durgapur	1960/1961	420	168	2
	1965/1966	1280	1001	532
	1966/1967	807	754	402
in Rourkela	1960/1961	412	206	30
	1965/1966	1054	1065	782
	1966/1967	934	943	689
	Works of privete sector			
Tate Iron and Steel	1955	1159	1052	551
	1960/1961	1588	1626	827
	1965/1966	1942	1979	1084
	1966/1967	1928	2000	1061
Indian Iron and Steel	1955	699	540	290
	1960/1961	1161	914	472
	1965/1966	1218	970	623
	1966/1967	1176	897	577

The construction of three state-owned works at Bhilai, Durgapur and Rourkela was started in 1955-1956. The iron and steel works in Bhilai was built with the technical and financial assistance of the USSR, that in Durgapur, with the assistance of British companies , and that in Rourkela with the assistance of West-German companies.

The initial rated capacity of each of these works amounted to as high as 1 m. tone of steel a year.

The iron and steel works in Bhilai reached its rated capacity in 1962/1963, the works in Durgapur, in 1963/1964; and that in Rourkela, in 1964/1965.

The projects were completed at the beginning of the sixties and then the work was started aiming at the enlarging these works: in Bhilai - up to 2.5 m. tons of steel per year; in Durgapur - up to 1.6 m. tons of steel; and in Rourkela - up to 1.8 m. tons of steel per year.

The enlargement of the Bhilai iron and steel works up to the capacity of 2,5 m. tons of steel a year was completed in June, 1967, that of the works in Durgapur and Rourkela - at the end of 1967. /7/

The iron and steel works in Bhilai (state of Madhia Pradesh) is supplied with iron ore from Rangara deposit located in 90 km from the works. The average Fe-content of the ore amounts to 64%.

The enlarged iron and steel works comprises the following shops and production units: a sintering plant provided with three sintering strands each having area of 50 sq.m; a coke and by-product shop composed of six batteries of 65 coke ovens in each; a blast-furnace shop comprising 3 blast furnaces each having volume of 1033 cu.m, and two blast furnaces each having volume of 1719 cu.m; an open-hearth shop of five 250 t open-hearth furnaces, and five 500 t open-hearth furnaces; a rolling mill shop comprising a 1150 mm blooming mill, a continuous billet mill, a rail rolling mill, a 350 mm light sections mill, and a 250 mm wire-rod mill.

A further expansion of this works has been started (with a view to increasing its capacity to more than 2.5 m. tons of steel a year).

A new blast furnace No 6 having volume of 1719 cu.m is under construction which is planned to be completed in 1969/1970.

The Durgapur iron and steal works (state of West Bengal) is supplied with iron ores mined at Balaos and other deposits situated at a distance of 420 km from the works, the ores containing about 60% of Fe.

Upon enlargement the works would comprise the following units: a sinter plant provided with two sintering strands each having area of 143 sq.m; four coke oven batteries of 78 coke ovens each; three blast furnaces having the working volume of 1169 cu.m each, and one blast furnace with the working volume of 1550 cu.m; an open-hearth shop composed of eight open-hearth furnaces, including seven 220 t furnaces and one 110 t furnace; a rolling mill shop comprising a 1050 mm blooming mill, a billet mill, a 600 mm heavy sections mill; a light sections mill, a strip mill; and shops for production of sleepers, axles and wheels. /6/

The iron and steel works in Rourkela (state of Orissa) is supplied with iron ore mined at three deposits: Barsud deposit situated at a distance of 80 km from the works; Baradjanda and Banspani deposit located at a distance of 225 km from the works. The iron ores of these deposits averagely contain about 60 to 62% Fe.

The iron and steel works is composed of the following shops: a sinter plant provided with two sintering strands each having the area of 127 sq.m; a coke and by-product shop composed of four batteries of coke ovens, the total number of which equals to 290; three blast furnaces having the working volume of 995 cu.m each, and one blast furnace having the working volume of 1448 cu.m; an open-hearth shop comprising four 80-t open-hearth furnaces: a converter shop composed of three 40-50 t and two 60 t ones; a rolling mill shop, comprising a 1180 mm slabbing

mill; a 3100 mm plate mill; a continuous wide-strip mill; shops for the cold rolling of electrical steels, and a weld pipe shop. /6/

In addition to three above-mentioned large iron and steel works, the state Hindustan steel company also comprises a quality steel works at Durgapur. The annual capacity of this works amounts to 100,000 tons of steel, 57,000 tons of rolled products and 3,400 tons of forgings.

The works comprises the following main production shops and units: steelmaking shop No 1 having two 50-t electric arc furnaces, steelmaking shop No 2 having one 10 t electric arc furnace, three induction furnaces, including two furnaces of 2 ton capacity each and one 0.5 t furnace, a rolling mill shop having a blooming mill, a slabbing mill, a sheet-bar and billet mill and a light section mill. The works also has a forging shop provided with powerful presses and hammers.

The Durgapur quality steel works was constructed with the assistance of Canadian and Japanese companies.

The Mysore state government is controlling a fully-integrated works in Bhadravati, owned by the Mysore Iron and Steel Company.

The works is designed to produce about 80,000 tons of iron, 20,000 tons of steel, and 50,000 tons of finished rolled products per year.

The works has a sinter plant with the annual capacity of 80,000 tons of sinter, four electric furnaces for melting iron, including two electric furnaces with the daily capacity of 100 tons and two electric furnaces with the daily capacity of 200 tons each, as well as one charcoal-fired blast furnace with the daily capacity of 80 tons; a ferrosilicium shop comprising five electric furnaces, including two furnaces provided with 1,500 kVa transformers, one furnace provided with a 9,000 kVa transformer, and two furnaces provided with 12,000 kVa transformers; a steelmaking shop having two 25 t open-hearth furnaces, five electric furnaces having capacities of 20; 6; 3.5 and 0.5 tons, and induction furnaces, as well as two 12-t converters; a rolling mill shop comprising a 680 mm blooming mill complete with a three-stand billet mill, 500/300, 520, 360/330 mm section mills, and a strip mill. /6/

The high-quality rolled products are also produced at small-capacity non-integrated steel works comprising electric steelmaking shops.

The private enterprise is represented by two large oldest fully-integrated iron and steel works of the Tata Iron and Steel Co., Indian Iron and Steel Co. and numerous small non-integrated steel works having only rolling mill shops.

The iron and steel works of Tata Iron and Steel Co., which was founded in 1907, is situated in Jamshedpur, the state of Bihar.

The works was many times reconstructed and enlarged. In 1951/1952 - 1957/1958, the programme of enlarging the works was completed, the cost of the programme amounting approximately to 560 m. rupees. According to this programme two new open-hearth furnaces were constructed, the blooming mill and plate mill shop were reconstructed; a new strip mill was constructed, etc.

The first programme was followed by the second programme of enlargement and reconstruction, the cost of which amounted to 600 m. rupees, the programme envisaged an increase in the iron capacity by 2 m. tons, steel capacity by 2 m. tons, rolled products capacity by 1.5 m. tons per year. According to this programme a sinter plant, two new coke oven batteries of the modern design, a blast furnace having the working volume of 1337 cu.m, No 3 open-hearth shop, the second blooming mill, the second continuous billet mill composed of two groups having six stands each, and a section mill were constructed; the existing mills were reconstructed. /6/

The works is supplied with iron ore mined in deposits situated at Noamundi, Gorumahisani and Joda (states of Bihar and Orissa) that are disposed at a distance of 65 to 150 km from the works. The mines are owned by the company. The iron ores of these deposits contain about 64%Fe.

In addition to the mines, the Tata Iron and Steel Company also owns coal mines at the Jaria basin, quarries of limestone and dolomite, and mines of the manganese ore deposits.

At present the works comprises the following main production shops and units: a sinter plant equipped with two sintering machines each having the daily capacity of 2,500 tons; a coke and by-product shop comprising five coke oven batteries with the total number of coke ovens equalling 256; a blast furnace shop consisting of six blast furnaces, including those with the working volume of 558, 608 (two blast furnaces), 860, 939, 1337 cu.m; three steelmaking shops: No 1 - comprising four 80 t open-hearth furnaces and two 5.5 t electric furnaces; No 2 - comprising three 25 t Bessemer converters, three 250 t open-hearth furnaces; No 3 - comprising three 32 t converters, six 200 t open-hearth furnaces and two 100 t open-hearth furnaces; rolling shops comprising: two 1016 and 1150 mm blooming mills; a continuous 800 slabbing mill; a rail mill for rolling rails, beams and channels up to No 45, square and round billets up to 200 mm in diameter; a 700 mm heavy section mill intended for rolling bars and channels up to No 18 and sectional iron (angles, squares and rounds up to 125 mm in diameter); two section iron mills (a 300 mm new one and the old medium section mill) intended for production of angles, channels, strip, squares and rounds of 12 to 56 mm diameter); a 350 mm continuous strip mill; a 2400 mm plate mill for rolling plates of 6-32 mm thick; sheet mills for production of black or galvanized flat and corrugated sheets; railway-wheel-and-tyre mill, and a department for manufacturing sleepers.

In the last few years separate units of this works were enlarged. Upon completing the development of the Noamundi mines the works began to receive the fully enriched and graded ore. The sixth coke-oven battery consisting of 54 coke ovens, and a chemical shop constructed with the assistance of the British Simon-Carves Company were put into operation.

The Tata Iron and Steel Company also comprises a wire manufacturing plant provided with a 280 mm light section-wire mill, a butt-weld pipe mill and sheet and tin plate rolling plant./6/

The works of the Indian Iron and Steel Co in Burnpur (state of West Bengal), which was founded in 1918, is supplied with iron ore from mines situated at Gua and Monokharpur that are disposed at a distance of 350 km from the works. The iron ores contain about 60 per cent of iron. These iron ore mines are incorporated in the Indian Iron and Steel Co. Moreover, this company owns the coal mines found in the Jaria and Raniganj basins, querries of manganese ore and limestone.

During the second five-year plan (1956-1960) a considerable programme on enlargement of the iron and steel works of the Indian Iron and Steel Co was completed. The cost of the programme amounted to about 200 m. rupees. This programme envisaged an expansion of the coke and by-product shop, construction of two blast furnaces with the working volume of 1060 m³ each, an enlargement of the steelmaking shop, as well as reconstruction and enlargement of the existing rolling mills (heating and finishing equipment).

During the third five-year plan the company had utilized the credit of only 34 m. rupees of 93 m. rupees available, the credit being granted to the company by the International Bank for Reconstruction and Development.

The iron and steel works comprises the following shops and units: a blast-furnace shop consisting of four blast furnaces, including two furnaces with the working volume of 1060 cu.m each and two furnaces with the working volume of 445 cu.m each; a coke and by-product shop composed of five batteries with the total number of coke ovens equalling 308; a steelmaking shop comprising three 25 t Bessemer converters, a 300 t open-hearth furnace, five 200 t open-hearth furnaces, and a 100 t open-hearth furnace; a rolling department comprising a 1000mm blooming mill, a 610/460 mm continuous sheet-bar-and-billet mill, a 860 mm rail mill for rolling rails, beams and channels up to No 40, angles, squares and rounds up to 200 mm in diameter; a 450 medium section mill for rolling light bars and channels, angles, square and round shapes up to 80 mm in diameter; a continuous light section-wire mill for

rolling rounds of 6 to 32 mm in diameter, and sheet mills. /6/

The data on the annual capacity and rolled products range of main iron and steel works of India are shown in Table 6 /6/.

Table 6. Annual capacity and range of rolled products of main iron and steel works of India, in 1000 tons

Kinds of products	Works					
	in Bhilai	in Durgapur	in Rourkela	in Jamshedpur	in Burnpur	in Mysore
Iron	2360	1700	1600	1900	1300	80
including marketable iron	327	-	-	-	-	-
Ingot steel	2500	1600	1800	2000	1000	145
Billets	315	370	-	300	150	-
Rails	500	-	-	135	105	-
Structural shapes:						
heavy	250	-	-	140	265	-
medium	-	200	-	270	-	-
Sections	500	240	-	227	160	-
Strips	-	250	-	106	-	-
Wire rods	400	-		-	-	-
Plates	-	-	280	100	-	-
Sheets:						
hot-rolled	-	-	200	42	-	11 (flat-hoop iron)
cold-rolled	-	-	260	-	-	-
galvanized	-	-	160	150	120	-
Hot-tinned plate	-	-	50	-	-	-
Electrolytic tinned plate	-	-	150	-	-	-
Transformer sheets	-	-	50	-	-	-
Tubes	-	-	75	-	-	-
Sleepers and cover plates	-	86	-	135	105	-
Axles and wheels	-	33	-	30	-	-

According to the data of 1966 to 1967 the specific coke rate was equal to 792 kg per ton of iron at the Bhilai works; 885 kg - at the Durgapur works; 889 kg - at the Rourkela works; 831 kg at the works of the Tata Iron and Steel Co.; and 977 kg at the works of the Indian Iron and Steel Co.

In India there is also a great number of private steel works with rolling mills of small capacity in addition to large iron and steel works.

In the last few years small non-integrated works of India made yearly about 300,000 to 1,000,000 of rolled products. In the period of 1955 to 1967, the production of rolled products was doubled at these small works, owing entirely to the output increase at the non-integrated works having only rolling mill shops, in which the production of rolled products increased from 210,000 tons in 1955 to 680,000 tons in 1965/1966. During the same period of time the production of rolled products at small semi-integrated steelworks having also steelmaking shops, dropped from 200,000 tons to 120,000 tons. Mainly high-quality steel is produced at these works that

are, as a rule, provided with electric arc furnaces. According to the date for 1965/1966 about 72,000 tons of electric steel were made at these works. This group of works includes (in brackets is stated the production figure of electric steel for the period of 1965/1966) the National Iron and Steel works in Calcutta (17,000 tons), the Guest Keen and Williams works near Calcutta (19,000 tons), Mukand Iron and Steel works in Bombey (6,000 tons), the D.K. Iron and Steel works in Kanpur (10,000 tons), and the Singh Engineering works (6,000 tons). /6/

Table 7. Productivity of labour at the iron and steel works of India in 1965/1966[x]

	Integrated works			Companies	
	in Bhilai	in Durgapur	in Rourkela	Tata Iron and Steel	Indian Iron and Steel
Number of employees, 1000 persons	23.6 (24.6)	16.1	15.8	29.2	14.0
Output, 1000 tons					
steel	1371(1852)	1001	1055	1979	970
rolled products	1029(1328)	684	810	1567	712
The production per employee, tons					
Steel	58(75)	62	66	68	69
Rolled products	44(54)	42	51	54	50

[x] Given in brackets are the data for the period of 1966/1967

For the last decade the development in India of non-integrated works having only rolling mill shops in India was to a considerable extent due to the existence of state-owned works supplying them with billets for rolling.

According to estimates of the Non-Integrated Works Association, their capacity amounted to as much as 1,800,000 tons in 1965/1966, whereas the production of these steel-works in this year amounted to 700,000 tons. /6/

Hence the capacity of the works is utilized to less than 50%.

The non-integreted works having only rolling mill shops mainly produce heavy and light sections. From the total output of the rolled products made by these works about 70 per cent are light sections, approximately 20 per cent - wire rods and wire, and some quantity - medium sections and small structural shapes. These works are located in all regions of India.

About 100 non-integrated works having only rolling mill shops, are registered to be in India in total.

The production of rolled products from scrap amounts to 140,000-150,000 tons a year.

Specialized tube works of small capacity are intended for manufacturing steel and iron tubes.

The Rourkela works has a shop for producing the electric weld tubes the capacity of the shop amounts to about 100,000 tons a year for the production of tubes 220-510 mm in diameter./6/

A new tube works of the Bharat Steel Tube Co. in Ganandra, state of Punjab, with the annual capacity of 120,000 tons of steel and galvanized tubes of 12-150mm in diameter, was put in

operation in 1966. The works is provided with two mills for the production of resistance weld tubes and equipment for the galvanizing and finishing the tubes.

One of the mills is intended for welding tubes of 32 to 150 mm diameter at a rate of 70 m/min, whereas the other - for welding tubes of 12-25 mm diameter at a rate of up to 50 m/min. /7/

Table 8 illustrates the structure of production costs of metallurgical products at the state-owned and private works of India in the period of 1965/1966

Table 8. Structure of production costs at the iron and steel works of India[x/]

Items of production costs	State-owned Hindustan Steel Company	Tata Iron and Steel Company	Indian Iron and Steel Company
Total production costs	2625	1195	785
	100	100	100
Including:			
raw materials and semis	673	295	188
	25.0	24.7	23.9
Wages	303	229	147
	11.2	19.2	18.7
Repair and storage costs	328	119	160
	12.2	10.0	20.4
Loan payments	183	22	11
	6.8	1.7	1.4
Excise duty	361	225	107
	13.4	18.8	13.6
Amortization	418	104	44
	15.5	8.7	5.6

x/ The numerator designates millions of rupees, the denominator - %

Ferromanganese is mainly produced at works of the following companies (indicated in brackets are the production figures for 1965/1966): Ferroalloys in the state of Andhra Pradesh (39,600 tons); Joda Ferromenganese Plant in the state of Orissa (35,400 tons); Kandelvel Ferro-alloys in the Nagpur district (35,000 tons); Universal Ferro- and Allied Chemicals in the state of Maherashtra (19,000 tons); Jeypore Sugar in the state of Orissa (14,600 tons).

A considerable proportion of ferromanganese is exported. In 1965/1966 ferromanganese exports amounted to about 58,000 tons.

Until 1966 ferrosilicium was produced only at the works of the Mysore Iron and Steel Works Co in the state of Mysore. /8/ In 1966 a new works of the Indian Metals and Ferro-Alloys Co was built in Therubali, state of Orissa. /9,10/; the works has the capacity of 10,000 tons a year and is intended for production of 45% ferrosilicon.

Consumption of Ferrous Metals and Further Trends in the Development of the Iron and Steel Industry

In the last few years, the apparent consumption of ferrous metals in India is estimated to be about 7,500,000 tons of ingot steel, which corresponds to 14 kg per capita consumption. From this quantity of steel, about 88 per cent are now met by the local production, whereas about 12 per cent are met by imports.

In the last few years, the proportion of rolled products in the structure of ferrous metal imports was high (Table 9) /6/ owing to the local production being insufficient.

Table 9. Imports of rolled products for the period of 1951 - 1965/1966 x/

Rolled products	Years xx/			
	1951	1956	1960/1961	1965/1966
Total	143 100,0	1302 100.0	1238 100.0	833 100.0
Including:				
heavy and light sections among them beams and channels	66 44.0	715 55.0	176 14.2	144 13.3
rails	34 23.8	114 8.8	176 14.2	- -
Railway materials	no data no data	no data no data	150 12.1	19 2.3
Wire	14 9.8	70 5.4	146 11.8	81 9.7
Plates and sheets	32 22.4	403 31.0	555 44.8	548 65.8
Other kinds of rolled products	-	-	35 2.8	41 4.9
In addition, steel ingots and billets	85 -	207 -	37 -	29 -

x/ 1951-1956 - calender years; since 1960/1961 - financial year.

xx/ The numerator - 1000 tons; the denominator - %

The demand of India for rolled products (in terms of inget steel) is estimated for 1970-1971 to be equal to about 9,400,000 tons; for 1976/1977 - up to 14,000,000 tons and for 1980/1981 - up to 20,000,000 tons /11/. The demand for the rolled products in the country is supposed to increase yearly in the period until 1970/1971 not more than by 3.1%; in 1971/1972 - 1975/1976, by about 4.2%, and in the following years, by about 5%. The deficit in alloy steel is expected to reach 33,000 tons by 1970/1971, 146,000 tons by 1975/1976 and 160,000 tons by 1980/1981.

To meet the expected deficit in ferrous metals until 1980/1981, it is planned: /11/

to complete the construction of a new fully-integrated iron and steel works at Bokaro;

to enlarge the capacity of the works of the Indian Iron and Steel Co by as much as

300,000 tons of steel a year;

to construct a new fully-integrated iron and steel works having the capacity of 4,000,000 tons of steel a year;

to enlarge alloy steel production capacity, including the capacity of the works belonging to the private companies.

The fourth large fully-integrated iron and steel works in Bokaro (state of Bihar), which will be specialised in manufacturing plates and sheets, is now being constructed with rendering the financial and technical assistance by the USSR. Its capacity will amount to about 4,000,000 tons of steel a year, including the first step thereof - 1,700,000 tons.

Upon putting into operation the first stage of the iron and steel works, various types of plates and sheets, which are now extremely deficient will be manufactured, such as cold-rolled, hot-rolled and galvanised sheets; at present, these types of rolled products are imported.

As to concerning production facilities, the iron and steel works at Bokaro (Table 10) could be compared with the most modern works in the world, having a high technical level. /6/ The first step of the Bokaro iron and steel works is expected to be put into operation in December of 1971.

A new non-integrated works at Arkanam (state of Madras) is being constructed with rendering the technical assistance by the Soviet institutions and enterprises. The first stage of the works includes an electric steelmaking shop having a 25-t electric arc furnace and a four-strand continuous casting plant having the capacity of 50,000 tons of steel a year.

The development of the iron and steel industry, which is being carried into effect and planned for the future, has resulted in creation of a large design office incorporated in the state-owned Hindustan steel company, and also in creating the private design and consulting Dastur company.

Table 10. Composition of main production shops of the Bokaro iron and steel works

Shops and products to be manufactured	Composition		Capacity in thousands of tons	
	Full development	1st stage	Full development	1st stage
Coke and by-products	7 batteries each comprising 69 coke ovens; blast-furnace coke plus 25 minus 80 mm	4 batteries	3,480	2,090
Sinter plant	3 sintering machines each having the area of 259 sq.m	2 machines	6,200	3,700
Blast-furnace	5 blast furnaces each having the working volume of 2000 cu.m	3 blast furnaces	4,585	2,735
Converter:				
No 1	5×100 t converters	4 converters		
No 2	2×250 t converters	-	4,000	1,700

Shops and products to be manufactured	Composition		Capacity in thousands of tons	
	Full development	1st stage	Full development	1st stage
1250 mm slabbing mill	12 groups of soaking pits	6 groups	3,450	1,465
2000 mm continuous plate mill	Having 3 heating furnaces	Having 2 heating furnaces	3,355	1,430
Cold-rolling shop	2000 mm and 1700 mm mills	2000 mill		
Cold-rolled coils	-	-	400	125
Cold-rolled sheets	-	-	700	300
Galvanized sheets	-	-	600	150

The Dastur design and consulting company participates in performing some design assignments for the Bokaro iron and steel works.

The share of national economy in the construction and enlargement of iron and steel works is steadily increasing.

Thus, the foreign purchases amounted over 50 per cent of the total cost of the first stages of the iron and steel works in Bhilai, Durgapur and Rourkela whereas the enlargement of these works required averagely about 38 per cent of the foreign currency expenses. /6,12/

For the first stage of the Bokaro iron and steel works it is planned to manufacture about 60 per cent of the required mechanical equipment in India at the enterprises of the state-owned Heavy Engineering, Bharat Heavy Electricals, Heavy Electricals of India, Mining and Machinery companies. /13/

Pakistan

Pakistan is an agricultural country, in which only the mining industry and the industry for processing agricultural materials are developed. Pakistan has no fully-integrated iron and steel works, and has a number of small semi-integrated works with steelmaking and rolling shops, and a great number of rolling mills processing imported billets.

The potential iron ore reserves in Pakistan are estimated at 400 m. tons, including the proved resources of 125 m. tons. Iron-ore deposits are explored in the Kalabagh district, the iron ore containing up to 40% Fe. Large deposits of iron ore containing about 40 to 65% Fe are discovered in the Chittral district. Iron ore deposits are also found in Langrial, Galdamin-Abbotabad, Kilat and Ziarat.

The reserves of each of the above-mentioned deposits vary from 10 m. to 40 m. tons.

The manganese-ore reserves of the country amount to approximately 500,000 tons (the manganese ore containing about 31 to 56% Mn). The manganese-ore deposits are found in the Kohat and Las Bela districts, a manganese-ore deposit in Sida-Dora, the reserves of which are not yet determined, was discovered not long ago. /14/

Chrome-ore reserves are estimated at 20 m. tons (the ore containing up to 47 per cent of chromium); a chrome-ore deposit is found in the Beluchistan region.

The potential reserves of coal amount to 190 m. tons.

At present, four principal coal fields are to be found in West Pakistan: in Makerwal, in the region east from Mianwali, in Sharing-Deghari (south from Kwetta), in the region north-

weetward from Karachi. Coal fields in the regione of Jimpir, Bog a and Radjshabi (East Pakistan) are also explored. /1/ In 1966, the coal was mined in an amount of 1.2 m. tone; in 1967 - 1.5m tons.

In 1967, the proved oil resources of Pak tan were estimated et 6.8 m. tons, and the annual output of oil wae equal to 500,000 tons.

In the period from 1961 to 1966 the Oil and Gas Co had found 14 oil fielde in East and Weet Pakietan with the aseistance of Soviet specialiets.

The potential reserves of natural gas are estimated at 575 bil. cu.m, the main deposits of natural gas are found in West Pakistan in the regione of Sui (170 bil. cu.m), Mari (99 bil.cu.m). The largeet depoeit of natural gas in Eaet Pakistan ie found in the Chattagh region. /15/

In 1966 the fixed rated power of electric power stations was equal to 1,222,000 kW, and the generation electric power - 3903 m. kWh.

About 130 rolling mills of the total capacity up to 275,000 tons of rolled steel are known to exist in Pakistan. There are aleo two works for manufacutring wire rode, the capacity of which amounts approximately to 15,000 tone a year, and a number of works for manufacturing tubes, the capacity of which equals to about 13,000 tone a year.

The total capacity of the works with steelmaking ehops producing mainly castinge and forgings, is estimated at 40,000 to 60,000 tons of eteel a year.

In 1955-1960 $ 21,000,000 were spent on modernizing the actuating worke, whereas $ 260,000,000 were spent on the construction of new works.

The state Steel Corporation of Pakistan, possessing the capital of 25 m. Pakistan rupees, has a works in Karachi, comprising two section mills of the total capacity of 35,000 tons of rolled products a year, and mille for rolling wire and flat hoop iron. /11/

The National Steel of Pakistan Company builds a worke near Karachi. On completing the first etage of the works, its capacity will be equal to 330,000 tons of rolled products a year. The range of rolled producte is suppoeed to be the following, in 1000 tons: rerolling feed - 100; hot-rolled sheets - 65; galvanized sheets - 55; sectione - 40; tube billets - 40; and railway materiale - 30.

The coet of construction of the works is estimated at $ 150-200,000,000. The works is planned to be further enlarged up to 500,000-575,000 tone of etsel a year.

The same company plans constructing a new worke in Karachi. According to negotiations conducted by the company in 1968, the conetruction of the iron and eteel works will be financed with participation of enterpriees of Czechoslovakia, German Democratic Republic, Japan, and France.

France has granted to the company a credit for $ 180,000,000. /16,17/

The Corporation for the Industrial Development of Weet Pakietan have worked out a project for constructing a fully-integrated iron and eteel worke in Kalabagh with a capacity of 500,000 tons of steel a year, based on local iron-ore depoeite. /18,19/

A eteel worke is being constructed in the Chittagong district (East Pakistan); this works comprises three 60 t open-hearth furnaces, a blooming mill, a plate mill, a two-high sheet mill, three eection mills, forging and foundry equipment, as well as three galvanized lines.

The construction of the first etage of the worke was completed in October of 1966. The coet of the first stage of the works is estimated at $ 80,000,000 /20/. The equipment for production of 150,000 tone of steel and 115,000 tons of sections and flate per year has been put in operation.

On putting in operation the fourth 60 t open-hearth furnace, the final capacity of the works (about 250,000 tons of steel ingots a year) is expected to be reached in 1970. /21/

The works production is supposed to meet about 20-25 per cant of the Eaet Pakistan demand for ferrous metals.

Projecte are also existing on a further enlargemsnt of the works capacity up to 1 m. tons of steel a year.

Rol[illegible] of a smaller capacity, mainly those having rolling mills, are now under construction or in the design stage in Pakistan.

The Pakistan government conducts negotiations with a number of countries for obtaining the financial and technical assistance in constructing those iron and steel works.

A tube-welding mill with the yearly capacity of 10,000 tons of welded tubes is planned to be constructed in Dacca. Tubs-rolling mills are also planned to be erected in Lachor and Karachi.

Preliminary projects have been worked out for construction of a works with steelmaking units of 50,000 tons of steel capacity a year in West Pakistan.

In 1966 an agreement was concluded with the Japansse companies about furnishing equipmsnt for a works with the annual capacity of 6,000 tons of stainless sheets, the cost of this project amounting to approximatsly $ 13,000,000. /22/

In the same year, an agreemsnt was signed on the construction in West Pakistan of a works for manufacturing 4-11" weld tubes, the annual capacity of this works amounting to 150,000 tons (two production linss) and on supplying sheets,as well.

A tube mill was planned to be erected at Chittagong Pipe Mills' works, the mill being ordered in the Federal Republic of Germany and intended for rolling 3/4 to 1/2'' tubes. /23-25/

In February of 1968 the Walibai Kamruddin Company placed an order with one of the Japanese companiss for furnishing the following equipment: two 12 t electric arc furnaces, one 4 t electric arc furnace, a blooming-slaobing mill,strip,shset and plate mills,forging and foundry equipment, intended for the works in Valika Nagar near Karachi, the capacity of this works being estimated at 20,000 tons of specialty steels a year. The cost of the equipment is estimated at $ 15,000,000. Its furnishing will be effected within 24 months, erection and testing within 36 months.

The following range of rolled products is planned for this works, in 1000 tons: billets - 11.4; stainless sheets - 3.0, stainless ingot steel - 2.0, steel castings - 2.0, platss - 1.0, forgings - 0.8.

On completing the construction of the works, its further expansion is planned to be effected in two stages with a view to increasing the works capacity first up to 30,000 and then up to 40,000 tons of steel a year. Imported scrap is planned to be used as charge materials. The works, which will be controlled by the Pakistan Special and Alloy Steel Plant Co, is planned to be put in operation in 1971. The personnel to operate the works (about 100 Pakistan citizens) should be trained in Japan. /26-28/

At present, the production of ferrous metals in the country meets less than 1/5 of all the demand of Pakistan. It is supposed that on completing the construction of the works in Karachi and Chittagong, the country's dsmand in ferrous metals will be met by as much as 70% by the local production. The demand of Pakistan in ferrous metals are estimated at 2 m. tons by 1970. /21/

In 1967 the imports of ferrous metals amounted to 654,700 tons, including: billets and semis - 283,000 tons, railway materials - 28,300 tons, heavy and light sections - 53,400 tons, wire rods - 4,500 tons, strips - 22,000 tons, plates - 33,100 tons, steel sheets - 158,100 tons, stsel pipes and fittings - 24,600 tons, wire - 10,600 tons, tin plate - 32,400 tons, axles, wheels and tyres- 4,700 tons. /29-30/

Thailand

Agriculture (mainly cultivation of soil) lies at the base of economics of Thailand. The country has one small fully-integrated iron and steel works and a number of non-integrated works.

The potential reserves of iron ore are estimated at 29 m. tons, including the proved resources of 10 m. tons of magnetite and hematite ores containing 66.4% Fe, 3.6% Mn, 1.8% SiO_2

0.62% Al_2O_3; 0.060 P, and 0.08% S.

The main iron ore deposit which has been mined since 1963, is located at a distance of 200 km northward from Bangkok. In the period of 1961-1964, three mines were put in operation at a newly discovered deposit of a high-quality iron ore, the resources of which are estimated at about 7 m. tons, the deposit being located at the Knao Tan Kuwai region of the Lonbury province situated at a distance of 160 km from Bangkok. In 1966, iron ore was mined in a quantity of 691,000 tons. The iron ore is exported in Japan. /15/

The manganese ore reserves are estimated at 300,000 tons; tungsten ore - 20 m. tons, including the proved resources thereof, 10 m. tons, containing about 1 to 2 per cent of tungsten. /15/

There are no reserves of coking coals in the country. In 1966, the quantity of a low-grade coal mined was approximately 100,000 tons a yesr.

In 1965, the fixed power of electric power stations was estimated at 559,200 kW; the quantity of generated electric power amounted to 1816 m. kWh. /31/

The Siam Iron and Steel Company owns a single fully-integreted iron and steel works of the country, the capacity of which equals 20,000 tons of iron and 120,000 tons of steel a year. This iron and steel works is located in the Ta Luang region and comprises three charcoal-fired blast furnaces, three electric-arc furnaces, six induction furnaces, an open-hearth furnace, a continuous casting plant, and a section mill with the capacity of 155,000 tons a year. Iron is made with the use of local iron ore. /10/

At present the works is being reconstructed and enlarged. The annual capacity on production of reinforcing rods and other sections are planned to be stepped up to 93,000 and 27,000 tons, respectively. A project has been worked out for a further increase the annual capacity of the works up to 120,000 tons of reinforcing rods and 30,000 tons of other sections (in 1970-1971).

The imports of scrap iron from abroad is planned to be increased because of lack of the local scrap.

The G.S.Steel Co of Thailand has a works near Bangkok, the annual capacity of which amounts to 90,000 tons of small sections, the works having been constructed with the financial and technical assistance of Japanese companies that own 60 per cent of the shares of this company. /32,33/. This works, having two electric arc furnaces and a rolling mill, was put in operation in 1968. The cost of the works construction is estimated at 165 m. bats (approximately £ 5,250,000). The final capacity of the works should amount to 120,000 tons of sections a year. /34,35/

In the period of 1962 to 1964, a number of rolling and tube mills were constructed in Thailand for production of welded and galvanized tubes (12,000 tons a year), helical welded tubes of large diameter (about 100,000 tons a year), section steel (10,000 tons a year), and galvanized sheets. Most of these mills operate on the sheets imported from Japan.

Projects for a further development of iron and steel industry envisage the construction of a number of non-integreted works.

Thus, a works of the capacity of 100,000 to 130,000 tons of sections a year, a works for production of galvanized and cast iron tubes (capacity of 14,000 tons a year), a tube works (capacity of 25,000 tons a year), and a works for production of galvanized sheets are either under construction or in the design stage.

In May of 1966, the Sintani Industry Co started constructing near Bangkok a works for production of wire. The capacity of this works amounts to 800 tons of finished products a month, including galvanized wire - 450 tons, annealed wire - 200 tons, and barbed wire - 150 tons. The works was put in operation in July of 1967. /36/

According to plans for development of the Thailand economics, the requirements of the country in ferrous metals will amount in 1970 to 857,000 tons, in 1975, to 1,124,000 tons, and in 1980, to

1,3[illegible],000 tons.

In the lest few yeers, Japan was the main supplier of ferrous metals to Thailand.

In 1962, the share of Japan in the imports of ferrous metals amounted to 64%, in 1964 - 75%, and in 1965 - 82%.

In 1967, the totel imports amounted to 551,400 tons, including: billets and semis - 12,900 tons, reilway materiale - 5,800 tons, heavy and light sections - 144,900 tons, wire rods - 43,500 tons, strips - 32,800 tone, platee - 39,900 tone, sheets - 172,800 tons, steel tubes and fittings 26,300 tons, wire - 42,000 tone, and tin plete - 31,600 tons. (29,30).

Malaysia

Melaysia is an agricultural country with e developing mining industry (mining of iron and tin ore). Melaysia has two iron and steel works, including a small fully-integreted one.

Ths potential reservee of iron ore ere estimeted at 150,000,000 tons, including the proved resources of 120 m. tons.

The main iron-ore deposits are found in the regions of Ulu-Rompin, Tashbun, Bukit Besi, Kota Tinggi, Sri Medan, and Luang Kep. The potentisl reserves of the Ulu-Rompin deposit amount to sbout 20,000,000 tons.

Chemical composition of iron ores of the lergest mines of Malaysis,%

Components	Deposits				
	Ulu-Rompin	Bukit Besi	Kota Tinggi	Sri Medan	Luang Kap
Fe	54-56	59.64	67.1	59.8-64.4	47.8
SiO_2	6.1	8.6	1.1	2.6-8.2	7.6
P	0.022-0.55	0.048	0.32	0.119-0.214	0.05
	0.03-0.046	0.009	1.01	0.006-0.320	2.04
Al_2O_3	-	-	1.02	-	10.84
TiO_2	-	-	1.05	-	0.12

The Ulu-Rompin deposit started to be mined in 1962. The cepacity of the mine amounts to 2,000,000 tons a year. The rich ore is mined by an open method, crushed, washed and screened, being then shipped to the port Kuala Rompin.

The eame procedure is adopted for benefication and shipping the rich iron ore to the port Suru et the deposit of Bukit Besi. The richest iron-ore deposits are found in the regions of Kota Tinggi and Sri Medan. It is supposed, however, that due to an intense mining of ore, as will be carried out in the period of 1970 to 1975, the quantity of iron ore mined in the country will decreese owing to exhaustion of the deposits.

The winning of ore et 2? mines amounted (in terms of iron content) to 3,300,000 tons in 1966, and to 3,100,000 tons in 1967.

Almost all the rich ore ie exported to Japan. In 1965, the exports of iron ore amounted to 6,700,000 tons, and in 1966, to 5,800,000 tons. /37/

The potentisl reservee of coal in the country are estimeted at 30,000,000-50,000,000 tone, the coal fields ere located in various regione of the country, yet the coals of ell the mines are non-coking.

The coal suitable for production of metsllurgical coke, is to be found only in the Bstu

Arang region.

In 1966, the mining of manganese ores amounted to 2,000 tons.

The proved reserves of oil in the country are estimated at 66,600,000 tons, the production of oil in 1967 was equal to 5,000,000 tons.

The fixed power of electric power stations in 1966 amounted to 26,000 kW, the generation of electric power - 2,390,000 kWh.

In 1962, the Federal Iron Works Co with the assistance of Japanese companies, put in operation a works intended for production of galvanized sheets, the capacity of which equalled 28,000 tons a year.

At present, the Malayawata Steel Co, founded in August of 1966 and having the capital of 31,000,000 Malayan dollars. 51% of which are owned by the Government and local companies, and the balance, by the group of Japanese companies headed by Yawata Seitetsu. are constructing an integrated works in the Prai city. The works comprises a sintering strand, a charcoal-fired blast furnace having the capacity of 170 tons of iron a day, a 12 t converter, and a combined section mill with the capacity of 150,000 tons a year. The blast furnace and converter were put in operation in 1967. The second blast furnace is planned to be put in operation in 1969. /38/

The cost of construction of an iron and steel works having the initial yearly capacity of 50,000 tons of steel (with the possibility of a further expansion up to the capacity of 100,000 tons in 1969) is estimated at $ 63,500,000. /39,40/

According to other sources, the initial annual capacity of the works will amount to 62,000tons of iron, 60,000 tons of steel, and 55,000 tons of rolled products. /41/

In the following decade, the works capacity is planned to be increased up to 800,000 tons of steel a year. Already in the process of construction of the combine, a discussion was started on projects of enlarging the range of finished products to be manufactured. In particular, in addition to sections, it is planned to set up the production of middle- and heavy gauge plates for ship-buildings, wire rods, tin plates, and steel tubes.

In March of 1966, the Suun Sang and Co (in Kuala Lumpur) had published a report on construction of a works intended for production of galvanized tubes, the works having the capacity of 1,000 tons a month.

The Malaysian Galvanized Iron Pipes Co plans putting in operation a works in Petaling Jaya, intended for production of galvanized steel pipes and fittings.

The initial capacity of the works is estimated at 2,400 tons of products a month, in the futher course, the works capacity will be doubled. Part of the finished products is planned to be exported in neighbouring countries.

In April of 1968, the Steel Pipe Industries of Malaysia Co started constructing a works with the capacity of 13,000 tons of welded pipes a year. The works is planned to be put in operation in 1969. /42,43/

The predominant part of the country's requirements in ferrous metals is met by imports. In 1967, the import amounted to 254,400 tons, including billets and semis - 11,700 tons, railway materials - 7,500 tons, heavy and light sections - 69,700 tons, wire rods - 5,700 tons, strips - 2,500 tons, plates 41,300, sheets - 61,800 tons, stesl tubes and fittings - 30,200 tons, wire - 5,700 tons, tin plate - 17,400 tons, axles, whesls and bandages - 900 tons. /29,30/

Philippines

Philippines are an agricultural country with a developing mining industry. At present, the country has a number of small-capacity non-integrated works, a fully-integrated iron and steel works is under construction.

The country possesses considerable resources of iron ore, the potential reserves thereof being estimated at 920,000,000 tons, including the provsd resources of 590,000,000 tons.

Iron ore is mined in deposits that are situated in the region of Lusong, on isles of Samar,

Marinduque, and Mindanao. The iron ore reserves of the Lusong deposit are estimated at 20,000,000 tons. The production and export of the iron ore mined at the Larap mine disposed in the Lusong region, amount to about 1,000,000 tons a year (the ore containing about 42 to 50% Fe). Reserves of the Bulakan deposit being mined, the ore of which contains 57 to 62% Fe and 1 to 4.6% S, are also estimated at 20,000,000 tons.

The iron ore is mined by an open and underground techniques, dressed, graded, and delivered to sea ports.

Due to the resources of rich iron ores diminishing, the number of ore-beneficating plants in the country steadily increases, as well as the number of plants producing iron-ore pellets.

In 1966, the production of iron ore amounted to 1,400,000 tons, in 1970, the production of iron ore is planned to be increased up to 1,800,000 tons and in 1975, up to 2,250,000 tons.

The rich Philippine iron ores are mainly exported to Japan which imports from Philippines about 1,000,000 tons a year.

Japan renders an assistance to Philippines in building and equipping mines, ore-beneficating and pelletizing plants.

The manganese ore reserves are estimated at 6,000,000 tons, including the available reserves of 1,500,000 tons. The main regions of mining these ores are situated in the northern part of Lusong, on isles of Sikutor and Busuanga. In 1966, the production of these ores amounted to 52,600 tons.

The chromium ore reserves are estimated at 20,000,000 tons, the reserves of nickel-containing ores amount to 1,300,000 tons.

The potential reserves of coal in Philippines are estimated at 35,000,000 tons, including the proved resources of 3 m. tons.

Coal fields are situated in Lusong, Mindanao, and in central Visayas. A deposit of coaking coals was recently discovered in the Malangas region, the reserves of which are estimated at 10,000,000 tons. In 1966, the production of coal amounted to 100,000 tons. /45/

In 1965, the fixed power of electric power stations was estimated to be 1,085,000 kW, the generation of electric power amounts to about 5 bil. kWh a year.

At the beginning of 1967, the Philippine Iron Mines Co had put into operation three processing lines at an iron-ore pelletizing plant built with the assistance of Japanese companies.

The total cost of the equipment installed at the plant and in mines of the Company was estimated at 84,600,000 Philippine pesos. The final capacity of the plant will amount to 880,000 tons a year.

At present, Philippines have four integrated iron and steel works of the total capacity of 180,000 tons of steel and 240,000 to 250,000 tons of rolled products a year, and about ten non-integrated works producing various types of rolled products and products of further processing. They include a non-integrated works with the capacity of 120,000 tons of cold-rolled sheets, five works for production of galvanized sheets with the total capacity of more than 180,000 tons a year, a works having the capacity of about 70,000 tons of tin plates and works having the total capacity of 45,000-50,000 tons of steel pipes and fittings a year.

All the works producing galvanized sheets, pipes and tin plates were built in post-war years with the technical and financial assistance of the Japanese companies. Since the annual demand of inner market in galvanized sheets does not exceed 100,000 tons, the capacities of the corresponding works are utilized by 50-60%.

In many cases, the galvanized sheets and tin plates are manufactured with the use of a cold-rolled sheets imported from Japan. /46,47/

The Elisald Iron and Steel Co has a works for production of tin plate, which was put into operation in 1962 in the Rizal province. The works is provided with four hot tinning lines having the capacity of 12,000 to 15,000 tons a year, and one electrolytic tinning line of the capacity of 48,000 tons a year. /48/.

Sheets for the works ie supplied by the Samar Mining Co, which obtains it from Japan in exchange for iron ore. In 1967, the works produced 46,000 tons of tin plates. In 1969, it ie planned to put in operetion im this works a cold-rolling mill having the capacity of 150,000 tons a ywar. /46/

In 1969, another Philippine Company also intends to install a cold-rolling mill with the capacity of 240,000 tons a year. /49/

In 1966, a project was worked out for building a works producing pipes in Manila. This works was plannad to be constructed by domestic companies in conjunction with s group of Holland and other foreign companies. /50/

The government of Philippines took a dacision for development of iron and steel indwetry by constructing fully-integrated works that could meet the inner market demand and utilize the available resourcas of iron ore.

In October of 1965, in the provinca of Lanao del Norte, Iligan city near Manila, the Iligan Integrated Steel Mills Co started constructing the first fully-integrated iron and steel works. The initial annual capacity of tha works is planned to reach 315,000-350,000 tons of steel and 275,000-290,000 tons of rollad products.

The works comprises electric iron smelting furneces each having the daily capacity of 150 tons, two 60 t oxygen convertars, six electric arc furnaces, a blooming-slabbing mill, a reversing hot strip mill, a medium-section mill, a cold-rolling mill, and a dressing rolling mill, as well as lines for production of tin plete and galvanizad sheets.

Electric power will be supplied to this works from a hydroelactrical power plant situated at e distance of 4 miles from the works.

The cost of construction of the works is estimated at 110,000,000-115,000,000 doll. The construction work was plannad to be completed at the end of 1968. The works output is supposad to meet up to 55 per cent of the inner market demand in ferrous matals. /46,47/

The second iron and steel works of the rated capacity of 250,000 tons of rolled products is planned to be constructed in Mindanao near Manile. The Santa Inss Stsel Company intsnded to carry into effect construction of this works. The project envisages constructing a blest furnace having tha capacity of 850 tons of iron a day, a coke-oven battery with the yearly capacity of 175,000 tons of coke, e 30 t oxygen converter, and a steel continuous casting plant. The construction cost is estimated at $ 60,000,000. /17/

Tha Philippine's demand in ferrous metals is covered by the domestic production only to 10-15 par cent.

In 1967, the quantity of imported ferrous metals amounted to 835,600 tons, including billets and semis - 182,800 tons, railway materials - 17,700 tons, hesvy and light sections - 90,800 tons, wire rods - 20,800 tons, strips-36,400 tons, plates-79,200 tons, sheets - 245,300 tons, steel pipes and fittings - 41,000 tons, wire - 10,300 tons, tin plate - 111,200 tons, axles, wheels and tyres - 100 tons. /29,30/

Ceylon

Ceylon is an agricultural country having a developing metalworking industry. The country has a small non-integrated steslworks with rolling mill shops.

The proved resources of iron ores in Ceylon are estimatad at 7,500,000 tons, including those of tha Dela deposit amounting to 2,500,000 tons, and those of Vilagedera-Panirendava deposit - 5,000,000 tons. A deposit of limonite ores was discovered in ths southeast Ceylon. The potential resarves of the deposit are estimated at 5,000,000-6,000,000 tons, the limonite containing about 50% Fe. Magnetita deposits were discovered in Chilaw, the reserves of which are estimatad at about 3,500,000 tons. /44/

Coal is imported in Ceylon.

In 1965, the fixed power of electric power stations amounted to 220,000 kW, in 1966, tha

gunsrstion of slectric power wss equal to 522,000,000 kWh.

In March of 1967, in Orwsll at a diatanca of 6 km northward from Khomagani, the first iron and steel worke, owned by the Ceylon Steel Company, wae put into operatiom with the USSR assistance, the initial aanual capscity of the works amounting to 30,000 toms of rolled products. A section aill and wire-producing equipment were installed st ths worke. Om completing the comstruction of the works, its annual capacity will amount to 60,000 tons of rolled produste.

The project snvisagea erecting the following units: an slectric-arc or blast furnacs for making iron with tha use of locally minad iron ore and charcoal, steelmaking furnacee, s light-section wire mill and galvanized sheat lines.

Sactions is first manufactured of imported billets. The second construction etage involves erection of stealmaking furnsces that sre intendsd for remelting imported pig iron and local scrap, the third stsga of construction invoies ersction of a blast furnace or an elsotric arc furnace. /51-53/

Tha construction costs of the works is estimatad at 116,000,000 Ceylon rupess.

The Ceylon Galvanizing Industries Co formad by two Japansse companies and the Csylon Development Finance of Ceylon Co, are constructing a works for production of galvanized shsets.

The works was planned to be constructed in 1968.

The initial capacity of the works is estimatad at 6,700 tons a yesr, with s further increase up to 8,400 tons a year, tha finsl capscity thereof is estimated at 12,000 tons of galvanized shaets a yesr. Cold-rolled sheat for thie worke is planned to be importsd. /51,54/

In 1966, a project was approved, envisaging the construction of another works for production of galvanized shaet, tha capacity of this works amounting to 10,000 tons s year and the construction costs, 1,150,000 Csylon rupaes. The Csylon Letscha Industries Co intended building this works with participation of Japanesa companies. /55/

A greater part of tha country's requirements in ferrous metals is met by imports, the volume of which amountad in 1967 to 86,800 tons. In 1967, the imports were the following (in 1000 tons): billets and semis - 28,400 tons, railway materials - 600 tons, heavy and light sections - 20,000 tons, wira rods - 300 tons, strips - 900 tons, plates - 6,200 tons, sheets - 15,800 tons, stsel pipes and fittings - 2,800 tons, wire - 9,800 tons, tin plste - 900 tons, axlee, wheels and tyres - 1,100 tons. /29,30/

Burma

Burma is an agricultursl country, in which light, foodstuff, and tsxtile industriee have just been started to develop. The ocuntry has s single small iron and stsel works at Iswama.

The potential resarves of iron ors in the country sra astimated at 45,000,000 tons, including ths proved rssources of 10,000,000 tons, of which 2,000,000 tons are to bs found in the northern part of the country, and 8,000,000 tons in the southsrn part of ths country. Limonitee contain about 40 to 60% Fe. Iron-ore deposite are practically not mined. In 1965, the quantity of iron ore mined was squal to 5,000 tons.

The raserves of brown coal and lignites are estimated st 6,000,000 tons, including the proved raserves of 3,000,000 tons. Deposite of coking cosl are found in the Kalewa region. In 1967, tha output of coal mined in this region amounted to 24,000 tons. In 1966, ths svailable resarves of oil ware equal to 4,800,000 tons, its production, 600,000 tons. In 1966, the output of natural gas was equal to 109,000,000 cu.m./1,12,15/

In 1966-1967, tha fixsd power of slectric power stations was estimated at 193,800 kW, including that of hydroelectrical power plants - 84,500 kW. In 1966, the generation of electric power was equal to 396,000,000 kWh. /31/

Since 1957, a state-ownsd iron and steel works is in operation in Iswama region (Insane situated at a distance of 19 km from Rangoon). The cost of its construction amounted to 37,000,000 kjatt.

The works comprises four shops. The steelmaking shop is provided with a 12-14 t electric arc furnace operating on imported scrap and ferroalloys, the annual capacity of which equals 20,000 tons of steel, the section mill shop has a light-section and wire mill, the annual capacity of which equals 40,000 tons; the plate mill shop (operating since 1958) has a sheet mill and equipment for production of 8,000 tons of galvanized corrugated sheet a year; the hardware shop (orepating since 1959) is intended for manufacturing nails. The rolling and hardware shops mainly operate on imported billets.

The works capacity is further planned to be stepped up to 150,000 tons of rolled products a year.

The demand of the country's economics in ferrous metals are mainly met by imports, the volume of which in 1967 amounted to 60,300 tons, including: billets and semis - 17,100 tons, railway materials - 900 tons, heavy and light sections - 4,300 tons, wire rods - 100 tons, strips - 100 tons, plates - 2,600 tons, sheets - 7,800 tons, steel pipes and fittings - 13,400 tons, wire 11,400 tons, tin plate - 2,000 tons, axles, wheels and tyres - 600 tons. /29,30/

Singapore

Singapore does not possess its own raw materials base for the development of iron and steel industry.

In 1965, the fixed power of electric power stations was estimated at 344,000 kW, and the generation of electric power was equal to 1,236,000 kWh in 1966.

A number of small iron and steel works producing steel pipes and sections were mainly constructed after 1955. Only some of these works have electric arc furnaces for remelting scrap. Sheets and billets for other works are imported.

At present eight actuating works manufacture the following products: two works (having the capacities of 30,000 and 24,000 tons a year, respectively) produce helical-weld pipes (steel and galvanized), s works put into operation in 1965 and having the capacity of 600 tons a month - pipes of 13 to 100 mm diameter, three works (each having the capacity of about 12,000 tons a year), - galvanized sheets, two works - sections.

In December of 1964, the National Iron and Steel Mills Co had put into operation an iron and steel works in the Jurong district having two electric arc furnaces and three section mills. The last furnace was put into operation in March of 1966. At present, the steelmaking capacity of the works amounts to 120,000 tons a month. /10/ The works capacity is further planned to be increased up to 180,000 tons a year, it is also planned to put into operation facilities for making iron and manufacturing rails, beams and channels. /56/

In 1965, a new tube-rolling works was started to be constructed, as well as a works for producing cold-rolled and galvanized sheets with the capacity of about 100,000 tons a year. Hot-rolled coiled steel was planned to be imported from Japan.

In 1966, a domestic campany was established (49% of the capital thereof owned by the Japanese Fudzi Seitetsu Co) which planned a works to be constructed for production of wire, the initial capacity of this works amounting to 600 tons a month. Wire rods for this works was to be imported. /40/

In January 1967, the Japanese companies Fuji Seitetsu and Mizui announced that they were going to construct a works for production of galvanized and bright wire in the state of Jurong, the capacity of which in both types of products being equal to 4,200 and 3,600 tons a year, respectively.

For this purpose the Eastern Wire Co had been established having the capital of 900,000 Singapore dollars, of which 54.6% are owned by the Japanese companies and 45.64%, by the domestic companies. Capital investments in the construction of the works are estimated at 412,000 Singapore dollars.

Information is available on the domestic companies of Singapore, Malaysia and Indonesia.

having established a joint company Oriental Metal Products possessing the capital of 500,000 Singapore dollars for construction of a works for production of light sections in Singapore. The equipment for the works, the cost of which is estimated at more than 500,000 dollars, was ordered in Japan.

Singapore is importing ferrous metals in an amount of 150,000 to 200,000 tons a year. From this quantity, sheets total up to 45%, sections - 30%, and pipes - 25%.

Until 1967, Japan imported to Singapore about 90% of the total of plates being imported, in 1966, its share was reduced to 73% on account of an increasing competition of West-European countries and Australia. Nevertheless, the main proportion of thin- and medium sheets, as well as about 80 per cent of strips are still supplied from Japan.

Singapore is exporting rolled products into neighbouring counries. In 1960, its export amounted to 40,200 tons, in 1964 - 48,500 tons, including galvanized sheets - 18,900 and 5,200 tons, sections - 16,900 and 36,400 tons, hot-rolled sheets - 4,400 and 6,900 tons, respectively. /56,57/

The domestic products are exported but to an insignificant extent.

Singapore is mainly re-exporting metal products that are purchased in other countries. The main importers are Malaysia and Hong Kong.

Indonesia

Indonesia is an agricultural country having developing processing and mining industries (production of oil and tin-containing ores). The country has a single non-integrated works of small capacity.

Deposits of iron ore containing nickel and chromium, are situated in the central part of Celebss and on Borneo (the reserves are estimated at 500 m. tons). The available reserves in the central part of Celebes in the Jaronda region are estimated approximately at 380 m. tons. These ores contain 49% Fe, 1.5-2% SiO_2, 5-7.5% Al_2O_3, 2.5-4.8% Cr, 0.4-0.9% Ni, 0.09-0.11% P.

Other iron ore deposits of Celebes are situated in the districts of Pamali, Lingga Kona, Karipsman and Bone-Putiye.

On the island of Celebes, the iron ors is not mined.

The actual resources of the island of Borneo amount to 96 m. tons of iron ore containing 47-51% Fe, 3-6,7% SiO_2, 8.6-11,8% Al_2O_3, 0.64-1.8% Cr, 0.47-1% Ni. The iron-ore deposits ars situated in the Duwa district at a distance of 15 km from the beach.

In the central part of the island of Jawa, the reserves of iron ore containing 60% Fe and and 10% SiO_2, amount to 35 m. tons.

In the Gunung Ratai deposits (island of Sumatra), the potential resources of iron ore are estimatsd at 10 m. tons. The iron ore is also situated in the regions of Gunung Besi, Bukit Raja, and Raja-Basa.

In Kuala-Boe and Tjotplui regions, magnetite sands are found, containing 54% Fe and 0.16% P. The iron ore is not mined here either.

On the island of Kalimantan, deposit of iron ore are found, the reserves of which amount to 2.6 m. tons, the iron ore containing 60-65% Fe./1/

No data are available, concerning the mining of iron ores in Indonesia.

The actual reserves of manganese ore containing 47% Mn, amount to 10 m. tons, those of nickel ore containing 1.2-1.5% Ni, 1.8 m. tons, those of cobalt ore, containing 0.14-0.16% Co, 180,000 tons. /1/

The country's coal reserves amount to 500 m. tons, including those in Ombilin of 200 m. tons, in Bukit Asame - 150 m. tons, in Mexakate, Palau and Prapatin (island of Kalimantan) - 100 m. tons. The main explored iron ore depoeits are situated on the island of Sumatra. The coal mined at the Ombilin deposit may be used for preparing metallurgical coke.

In 1966, the quality of coal minad amounted to 400,000 tons, 70 per cent of coal being mined at the Bukit Asame deposit.

In 1966, the available reeervee of oil were eetimated at 1,234 m. tons. Indonesia ie the first of the southeast Asia countries with regard to the oil resources. In 1967, the production of oil in Indoneeia amounted to 25.5 m. tons.

The available reserves of natural gas amount to 56.6 bil. m^3. The main natural gas deposite are found on the islands of Sumatra and Borneo.

In 1966, the mining of the natural gas amounted to 3.5 bil. cu.m. /31/

Water-power reeources of the country are eetimated at 2.86 m. kW. The fixed power of thermal electric power etations ie estimated at 343,000 kW, while the generation of eleotric power amounts to about 1.5 m. kWh.

A small non-integrated works is in the Jakarta region, the capacity of which amounts to 10,000-15,000 tons of rolled producte a year. The worke has a number of small-capacity sheet mills and the equipment for production of galvanized sheets. The works is capable of meeting only an insignificant part of the innsr market demand in ferrous metals.

The Tombgh Mas Co has a worke producing 500 tons of galvanized sheets a month. /58/

The Holland group Hoovens has proposed a project on the contruction of a worke intented for the production of pipes and wire.

Moreover, there is an information on the Japanese firms constructing a strip mill in the country; howavar, there ie not any detailed information on this subject. /59, 60/

The Indonesia demand for ferrous metals are almost oomplataly met by import, which amounted to 153,300 tons in 1957, including billets and semis - 100 tons, railway materials - 2,600 tons, heavy and light sactions - 31,300 tons, wire rods - 500 tons, strips - 3,700 tons, plates - 8,800 tons, sheets - 46,100 tons, pipes and fittings - 29,500 tons, wire - 20,500 tons, tin plate - 9,700 tons, axles, wheels and tyres - 500 tons. /29,30/

Nepal

Napal ie an agricultural country. This country has but a single small capacity non-intagrated steelworke producing rolled products.

The total reserves of a high-quality iron ore in the Hitaura region amount to 30 m. tons. In 1966, the fixed power of power plants was estimated at 11,750 kW, while the ganeration of electric power in the same year, amounted to 30 m. kWh. /15/

At present, a rolling mill is operating in Nepal, tha annual capacity of which amounts to about 20,000 tons. Billets for the mill are imported from India.

The quantity of imported ferrous metals equals 20,000-30,000 tons a year.

Afghanistan

Afghanistan is an agricultural country having developad animal breeding. This country has a single small capacity iron and steel works.

The country has considerable resources of the iron ore.

The potential reserves of hamatites of the Hajigak deposit amount to 2.5 bil. tons. /5/

The reeerves of the recently discovered deposits of haematites and magnetites, containing about 64 per cent of iron in Hakrez Kandagar, Jabal-us-Siraj, Herat and in other regione, amount to more than 20 m. tons. /44/

The potential resources of coal are eetimated at 80 m. tons. including the available reeerves of 20 m. tons. The main coal fields are disposed in the Karkar, Iehpushta and Dar-ee-Suf regione.

In 1966, the available reeerves of oil were estimated at 13.5 m. tons. The natural gas reserves in the Nibergan region amount to 2.8 bil. cu.m, tha production of the natural gas amounted to 109 m. cu.m.

In 1965, the fixed power of electric power stations amounted to 89,000 kW, while the generation of electric power in 1966, equalled 350 m. kWh. /61/

In 1968, the first non-integrated steelworks having the annual capacity of 3,000 tons of reinforcing rods, was put into operation near Kabul.

Until recent years, the country's demand for ferrous metals was fully met by imports, the quantity of which amounted to 12,000 tons in 1967 including heavy and light sections - 7,800 tons, sheets - 3,500 tons, wire rods - 600 tons, steel pipes and fittings - 100 tons. /29,30/

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CHAPTER VII

FOREIGN TRADE AND CONSUMPTION OF FERROUS METALS IN THE DEVELOPING COUNTRIES OF ASIA, AFRICA AND LATIN AMERICA

Before the World War II and in the first postwar years, most developing countries met their demand for ferrous metals mainly by importing them from developed countries. Owing to the creation in a number of developing countries of domestic iron and steel industry the share of import in the apparent consumption of steel is gradually decreasing. In the period of 1955-1967, the share of import in the apparent consumption of steel in all the developing countries decreased as a whole from 68 to 42 per cent (Table 1) /1-6/.

In 1967 the steelmaking capacity of the countries of Latin America was estimated at more than 12 m.tons per year, including, Brazil - about 4.6, Mexico-about 2.9, and Argentina-about 1.9./7/

A growth in the apparent consumption of ferrous metals in the Latin American countries is accompanied by a steady decrease in the share of import. Thus, in 1955 the imports were in excess of the production of ferrous metals, in 1960 the domestic production of ferrous metals was already greater than the imports by 1.2 m.tons; in 1965, by 4.6 m.tons; in 1966, by 5.8 m.tons, and in 1967, by 6.7 m.tons. In 1967, the Latin-American countries met about three-quarter of their demand for ferrous metals by the domestic production.

In various countries of Latin America, the domestic production meets the inner market demand for ferrous metals to different extents.

Table 1. Production and consumption of steel and foreign trade in steel[1/], 10^3 tons

	Total	Including regions			
		Latin America (without Cuba)	Africa (without South Africa and Rhodesia)	South-East Asia (without CPR and Japan)	Near and Middle East (without Israel)
1	2	3	4	5	6
1955					
Production	4,287	2,530	No data	1,757	No data
Import	9,023	3,918	1,626	2,689	790
Export	No data	No data	No data	No data	No data
Apparent consumption	13,310	6,448	1,626	4,446	790
1960					
Production	8,736	4,828	151[2/]	3,757	No data
Import	9,982	3,595	1,642	3,490	1,255
Export	212	147[4/]	No data	65[6/]	No data
Apparent consumption	18,506	8,276	1,793	7,182	1,255
1965					
Production	15,473	8,291	209[2/]	6,955	18[3/]
Import	11,754	3,722	1,988	4,350	1,704
Export	579	466[4/]	No data	113[6/]	No data
Apparent consumption	26,648	11,547	2,197	11,182	1,722

Table 1 (Continued)

1	2	3	4	5	6
1966					
Production	16,608	9,188	210[2/]	7,192	18[3/]
Import	11,450	3,365	2,595	3,532	1,958
Export	384	175[5/]	No data	209[6/]	No data
Apparent consumption	27,674	12,378	2,805	10,515	1,976
1967					
Production	17,315	9,687	220[2/]	7,390	18[3/]
Import	12,343	2,980	1,907	4,775	2,681
Export	363	No data	No data	363[6/]	No data
Apparent consumption	29,295	12,667	2,127	11,802	2,699

1. In terms of ingot steel
2. The United Arab Republic and Algeria
3. Lebanon
4. Brazil and Chile
5. Brazil
6. India

In separate countries (Brazil, Chile and others), the demand for ferrous metals is met by 80-100% by the domestic production (Table 2) /2-5/.

Table 2. Production and consumption of steel, and foreign trade in steel in a number of Latin-American countries[x/], 10^3 tons

	Brazil	Mexico	Argentina	Venezuela	Chile
1955					
Production	1,162	761	218	No data	312
Import	291	301	1,726	625	64
Export	No data	No data	No data	No data	No dat
Apparent consumption	1,453	1,062	1,944	625	376
1960					
Production	2,282	1,539	277	47	451
Import	390	263	1,315	476	85
Export	23	No data	No data	-	124
Apparent consumption	2,649	1,802	1,592	523	412
1965					
Production	3,017	2,455	1,368	625	476
Import	179	276	1,179	571	134
Export	453	No data	No data	No data	13
Apparent consumption	2,743	2,731	2,547	1,196	597

Table 2. (Continued)

	Brazil	Mexico	Argentina	Venezuela	Chile
1966					
Production	3,713	2,788	1,267	587	577
Import	382	275	628	507	87
Export	175	No data	No data	No data	No data
Apparent consumption	3,920	3,063	1,895	1,044	664
1967					
Production	3,665	3,023	1,326	690	631
Import	337	191	704	497	38
Export	No data	No data	No data	No data	No data
Apparent consumption	4,002	3,214	2,030	1,187	669

x/ In terms of ingot steel.

The above Table gives data on export and import, as published by the United Nations Organization, which are somewhat different from the data presented in Chapter III, that are taken from the annual statistical report.

The United Nations data should be used on account of the fact that they contain information on the imports of ferrous metals.

A reduction of the imports share in the apparent consumption of ferrous metals in the countries of Latin America was accompanied by a variation in the imports in terms of an increase in the proportion of plates, sheets, strips, especially sheets, and a decrease in the share of ingots and billets, as well as pipes and fittings (Table 3) /2/.

Table 3. Imports of ferrous metals by Latin America, %

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	24.0	18.1	25.3	15.8	14.2
Railway materials	8.8	10.6	4.9	6.2	4.5
Sections	17.3	16.3	16.9	16.8	15.4
Wire rods	0.2	0.5	2.3	2.4	1.7
Stripe	1.2	3.4	1.4	1.7	2.0
Plates	6.8	8.0	5.4	7.1	8.6
Sheets	12.5	15.7	22.5	27.2	27.7
Pipes and fittings	17.0	13.1	9.1	8.6	10.1
Wire	2.7	3.3	2.7	3.3	3.5
Tin plate	8.4	10.3	8.6	11.1	10.9
Axles, wheels, tyres	1.1	0.7	0.9	0.8	1.4
Total:	100.0	100.0	100.0	100.0	100.0

A considerable increase in the share of sheets and strips in the imports of rolled products is caused by a progressing industrialization of the Latin-American countries and by an increasing the importance of such industry branches as automobile, machine-building, and others, especially in such countries as Brazil, as well as Chile and Mexico /8/.

The demand for ferrous metals (in terms of steel ingots) in the countries of Latin America is supposed to increase in the foreseeable future at such a rate that, according to estimates of the Economic Commission for Latin America, it will amount to 17.3 m.tons in 1970, 25.8 m. tons in 1975 and 38.5 m.tons in 1980 /9/.

According to the estimates of the same Commission, the production of steel in the countries of Latin America will reach 16.25 m.tons in 1970 /10/.

The main producing Latin-American countries plan approaching the complete meeting of their demand for ferrous metals or even (Brazil) having a surplus thereof for exporting them within the region (Table 4) /9,10/.

Table 4. Estimates of the demand and production of steel in countries of Latin America in 1970., 10^6 tons

Country	Demand	Production	Difference
Total including:	17.3	16.3	-1.0
Brazil	5.6	6.3	+0.7
Mexico	3.9	3.4	-0.5
Argentina	3.4	3.2	-0.2
Venezuela	1.2	1.2	-
Columbia	0.8	0.8	-
Chile	0.9	0.7	-0.2
Peru	0.5	0.5	-
Uruguay	0.2	0.2	-
Other countries	0.8	-	-0.8

At present, the Latin-American countries are carrying into effect the reconstruction and enlargement of the existing iron and steel works, and the construction of new works of various capacities, including two fully-integrated iron and steel works (in Argentina - a works having the annual capacity of 5 m.tons of rolled products and in Mexico - a works having the annual capacity of 240,000 tons of rolled products).

In the nearest years, a number of new iron and steel works are planned to be constructed; projects are published on the construction of about 40 works, including eight fully-integrated ones having the total annual capacity of more than 5,000,000 tons of steel (in Brazil, Mexico, Columbia, Uruguay).

The countries of the South-East Asia and the Far East are almost not inferior to the Latin-American countries with regard to absolute values of ferrous metals consumption but they depend much more on imports in spite of the fact that the share of domestic production in the apparent consumption of steel in these countries is steadily increasing. Thus, in 1955 , import met about 60 per cent of demand for ferrous metals of the countries of the South-East Asia and the Far East, in 1967, this proportion dropped to about 40 per cent (Table 1).

The iron and steel industry of the countries of the South-East Asia began to develop only after the World War II (with the exception of India). Most countries of this region (with the exception of India) have small iron and steel works of a small capacity which produce mainly sections.

In the countries of the South-East Asia and the Far East (with the exception of India), the production of ferrous metals meets only a small share (about 1/5) of the demand of their domestic market. That is why the ferrous metals are imported into these countries in conside-

rable quantities. India meets its requirements in ferrous metals by the domestic production to an extent of 90 per cent (Table 5) /2-6/.

Table 5. Production and consumption of steel, and foreign trade in steel of the countries of the South-East Asia[x/], 10^3 tons

	Total	Including: India	Including: Other countries of the South-East Asia
1955			
Production	1757	1732	25
Import	2689	1129	1560
Export	No data	No data	No data
Apparent consumption	4446	2861	1585
1960			
Production	3757	3339	418
Import	3490	1518	1972
Export	65	65	No data
Apparent consumption	7182	4792	2390
1965			
Production	6955	6413	542
Import	4340	1113	3227
Export	113	113	No data
Apparent consumption	11182	7413	3769
1966			
Production	7192	6608	584
Import	3532	664	2868
Export	209	209	No data
Apparent consumption	10515	7063	3452
1967			
Production	7390	6630	760
Import	4775	802	3973
Export	363	363	No data
Apparent consumption	11802	7069	4733

x/ In terms of ingot steel.

As it appears from the data given in Table 5, the production and consumption of steel in the countries of the South-East Asia is determined by the corresponding data on India, the share of which amounted, according to data for 1967., in the production of steel to about 90% and in the apparent consumption, to about 60%.

At present, India has six fully-integrated iron and steel works with the total capacity exceeding 9 m.tons of steel per year, including, the Bhilai works -2.5, Durgapur works 1.6, Rourkela works-1.8, TISCO -2.0, IISCO -1.0, and Mysore Iron & Steel Co-0.5.

In additon to large iron and steel works, the country has many small-capacity non-integrated works, including those having only rolling shops operating on billets that are supplied from large state-owned enterprises.

Import of ferrous metals plays an insignificant role, since India is now capable of meeting its requirements in ferrous metals by domestic production to an extent of 90%.

In the import of the rolled products sheets and plates are prevailing, which is explained by an insufficient domestic production there of (Table 6)/2/. In the period of 1955-1967., share of sheets in the total import of ferrous metals into India increased from 13.0 to 26.8% i.e., more than two times.

Table 6. Imports of ferrous metals to India,%

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	5.3	5.2	3.6	4.1	4.3
Railway materials	12.5	16.4	0.1	-	-
Sections	21.7	13.5	19.0	20.3	16.8
Wire rods	1.9	2.1	6.4	6.2	8.2
Stripe	5.2	3.6	5.5	4.7	7.4
Plates	16.5	9.3	19.9	11.2	11.5
Sheets	13	26	29.4	29.3	26.8
Pipes and fittings	11.8	6.3	4.8	5.9	4.7
Wire	5.7	9.3	4.7	3.7	3.0
Tin plats	6.0	7.6	4.4	9.8	14.4
Axles, wheels, tyres	0.4	0.7	2.2	4.8	2.8
Total:	100.0	100.0	100.0	100.0	100.0

The rolled products range of ferrous metals import to the remaining countries of the South-East Asia and the Far East (with the exception of India) is characterised by a high proportion of sections and sheets owing to a great demand for them from such branches of industry as building industry, shipbuilding, light industry and canned food production.

In the last 10 to 12 years, trends became evident in the structure of ferrous metals import to the countries of the South-East Asia and the Far East (with the exception of India), concerning a decrease in the proportion of sections and an increase in the proportion of sheet and strips, as well of steel ingots and billets (Table 7) /2/.

Table 7. Imports of ferrous metals to the countries of the South-East Asia and the Far East (with the exception of India),%

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	7.4	10.4	12.0	13.5	18.5

Table 7 (Continued)

1	2	3	3	5	6
Railway matsrials	5.6	4.0	4.1	3.6	2.2
Seotions	25.6	19.3	30.0	20.1	16.3
Strips	2.9	3.7	2.8	4.0	4.0
Platss	6.9	7.9	6.3	7.5	8.7
Sheets	24.2	25.5	24.0	28.6	27.1
Pipes and fittings	10.2	8.3	7.1	6.2	6.3
Wire	6.4	7.4	6.0	5.7	4.4
Tin plats	9.8	11.2	5.3	4.9	8.8
Axlee, wheels and tyres	0.3	0.6	0.4	0.2	0.3
Total:	100.0	100.0	100.0	100.0	100.0

In ths period of 1955-1967, the share of sections decreased from 25.6 to 16.3% whereas that of sheets and strips increased from 34.0 to 39.8% and that of ingots and billets increased from 7.4 to 18.5% i.e., by as much as 2.5 times. This is explained by the fact that in a number of the countries of thie region many small-capacity non-integrated iron and steel works were constructed, having rolling mills (mainly for the production of sections), facilities for the production of tin plate and other products to be further processed, which are operating on imported materials (ingots, billets, sheets).

The rolled products range of the ferrous metal imports to the countries of the South-East Asia and the Far East is as a whole characterised by the data given in Table 8 /2/.

Table 8. Imports of ferrous metals to the countries of the South-East Asia and the Far East, %

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	6.5	8.1	9.9	11.8	16.2
Railway materials	8.5	9.4	3.1	3.0	1.8
Sections	23.9	16.8	27.2	20.1	16.4
Wire rods	1.2	1.9	3.1	5.8	4.2
Strips	3.9	3.7	3.5	4.1	4.6
Plates	11.0	8.5	9.7	8.2	9.1
Sheets	19.5	25.7	25.3	28.7	27.1
Pipes and fittings	10.9	7.5	6.5	6.1	6.1
Wire	6.1	8.2	5.7	5.3	4.1
Tin plats	8.2	9.6	5.1	5.8	9.7
Axles, wheels, and tyres	0.3	0.6	0.9	1.1	0.7
Total:	100.0	100.0	100.0	100.0	100.0

Among ths countries of ths South-East Asia and the Far East, with the exception of India, the largest importers of ferrous metals are the Philippines, Pakistan, and Thailand. In 1967, the share of these four countries amounted to 71% of the total imports of ferrous metals to

the countries of this region (Table 9) /2/.

Table 9

Table 9. Imports of ferrous metals to the countries of the South-East Asia and the Far East, %

Countries	Years				
	1955	1960	1965	1966	1967
Indie	42.0	43.5	25.2	18.6	16.5
Philippinee	9.6	10.5	15.5	20.4	22.3
Pakistan	11.4	13.7	19.9	15.0	17.5
Thailand	5.9	6.2	10.3	19.4	14.7
Hong Kong	5.6	6.7	10.7	10.2	6.8
Malaysie	9.5	4.4	6.1	8.0	6.8
Indoneeia	11.3	9.0	7.3	3.4	4.1
Ceylon	1.9	2.8	1.9	2.5	2.3
Burme	2.4	2.8	2.7	1.9	1.6
Other countries	0.4	0.4	0.4	0.6	7.4
Total:	100.0	100.0	100.0	100.0	100.0

These countries (Philippines, India, Thailand) alec import the main share of sheets, as well as ingote and billets (Philippines and Pakietan).

In the neareet future, the demand for ferroue metale (in terms of ingot steel) in the countries of the South-East Asia and the Far Eaet is expected to be increased.

In India, a fully-integrated iron and eteel works with the annual capacity of 4 m.tone of steel ie under conetruction at Bokaro, this works is intended for the production of sheete which are now imported in largs quantities. The first etage of the works having the annual capacity of 1.7 m.tons of steel is planned to be put into opsretiom in 1971.

In conformity with the project on enlargement of the capacity of the Bhilai iron and steel works which is intendsd for production of rails, hsavy and medium sections, India will get the possibility not only to cut down ite import of sections but aleo to sxport eome typee of the latter (rails,for instance)/18/.

A number of new iron and steel worke are plannsd to be oonetructed in the nearest future. Projects are available for the construction of about 30 iron and steel works, including three fully-integrated works of the total annual capacity of about 5,000,000 tons (in India, Pakistan, and the Philippines).

The Near and Middle East is one of the regions where the production of steel started comparatively not long ago. At present, steel is being made only in one country of thie regiom (Lebanon), five countries (Lebanon, Saudi Arabia, Kuwait, Iraq, Iran) have rolling mills for the production of rolled products, mainly sections and pipes.

As in moet developing countries, in the countriee of the Near and Middle East ferrous metals are mainly used in building, mining industry, and agriculture. That is why mainly sections, pipes and fittings are imported ths proportion of which amounting to 67,8% in 1967 (Table 10) /2/.

A great part of imported ferrous metals are directed into the countries having the devsloped or rapidly developing oil-gas industry; thus, about two-thirds of the entire imports of ferrous metals in 1967 were directed to Iran, Iraq and Saudi Arabia (Table 11)/2/.

According to varicus sstimates, no substantial variations in the structure and quantity of ferrous metals imports to the countries of the Near and Middle East are sxpscted

Table 10. Imports of ferrous metals to the countries of the Near and Middle East, %

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	-	-	1.1	3.3	4.5
Railway materials	21.0	5.4	0.6	1.1	1.4
Sections	40.6	58.4	45.6	42.1	42.6
Wire rods	0.4	0.3	0.5	7.5	0.6
Strips	0.2	2.1	1.6	1.3	1.1
Plates	5.7	3.7	4.0	5.2	6.5
Sheets	9.7	8.3	11.7	11.6	12.1
Pipes and fittings	15.6	18.3	30.4	22.8	25.2
Wire	2.5	1.5	1.8	1.9	4.0
Tin plate	3.8	1.9	2.6	3.0	1.9
Axles, wheels, and tyres	0.5	0.1	0.1	0.2	0.1
Total:	100.0	100.0	100.0	100.0	100.0

Table 11. Imports of ferrous metals to the countries of the Near and Middle East, %

Countries	Years				
	1955	1960	1965	1966	1967
Iran	41.4	42.2	41.1	37.2	52.1
Iraq	12.8	20.6	12.2	16.7	8.3
Kuwait	3.3	9.5	9.2	7.8	8.9
Saudi Arabia	9.3	5.0	18.1	11.6	5.7
Syria	30.8	9.2	5.0	10.5	6.1
Lebanon		11.2	13.4	15.5	7.8
Other countries	2.4	2.3	1.0	0.7	11.1
Total:	100.0	100.0	100.0	100.0	100.0

to take place up to 1970-1975. The production of ferrous metals will slightly increase /6/. At present, a number of iron and steel works are under construction, including one fully-integrated works in Iran, Isfahan, the intial annual capacity of which will equal to 500,000-600,000 tons of steel.

In a number of countries, projects are planned to be worked out for construction of new iron and steel works, mainly non-integrated ones.

The developing countries of Africa (with the exception of few ones) are countries having a weakly developed iron and steel industry . Only two fully-integrated iron and steel works are existing (in the United Arab Republic and Tunisia) having the total annual capacity of about 400,000 tons of steel and approximately 40 small-capacity works, the greater part of

which are intended for production of sections and sheets, mainly galvanised ones.

Iron and steel works do not play any important role in meeting the demand of African countries for ferrous metals (with the exception of the United Arab Republic); this is why the requirements of metal-consuming branches of industry in these countries are met by import. The United Arab Republic meets the requirements in ferrous metals by domestic production to an extent of 1/3 (Table 12)/2-5/.

In conformity with the data given in Table 12, the share of the United Arab Republic in the production of ferrous metals by the African countries in 1967., amounted to 90%, being equal to a quarter of the apparent consumption of ferrous metals.

At present, the iron and steel industry of the United Arab Republic has a number of iron and steel works of the total capacity of 400,000 to 500,000 tons of steel per year, including one fully-integrated works at Helwan, three non-integrated works having steelmaking and rolling mill shops, as well as a number of small-capacity works intended for the production of ferroalloys, pipes, and hardware.

Table 12. Production and consumption of steel, and foreign trade in steel in African countries[x/] 10^3 tons

	Total:	Including: UAR	Including: Other African countries
1955			
Production	No data	No data	No data
Import	1626	320	1306
Apparent consumption	1626	320	1306
1960			
Production	151	136	15
Import	1642	222	1420
Apparent consumption	1793	358	1435
1965			
Production	209	179	30
Import	1988	328	1660
Apparent consumption	2197	507	1690
1966			
Production	210	180	30
Import	2595	359	2236
Apparent consumption	2805	539	2266
1967			
Production	220	200	20
Import	1907	348	1559
Apparent consumption	2127	548	1579

x/ In terms of ingot steel.

In the rolled-product range of imports to the United Arab Republic in 1967., the greater part were sections, wire rods, as well as ingots and billets (Table 13)/2/.

Table 13. Ferrous metal imports to the United Arab Republic, %

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	0,5	2.7	0.1	-	17.8
Railway materials	13.5	7.6	10.3	11.7	3.0
Sections	46.0	27.5	24.1	22.1	29.3
Wire rods	0.8	0.6	0.1	16.1	13.4
Strips	3.2	4.9	14.1	9.8	8.4
Plates	6.5	12.6	14.8	12.9	6.4
Sheets	8.2	6.4	13.5	8.6	5.4
Pipes and fittings	13.3	28.8	7.9	8.6	9.1
Wire	3.8	3.8	3.7	3.0	1.4
Tin plate	3.5	4.1	10.7	4.9	5.0
Axles, wheels, and bandages	0.7	1.0	0.7	2.3	0.8
Total	100.0	100.0	100.0	100.0	100.0

In the rolled-products range of the imports to the African countries (with the exception of the United Arab Republic), sections, pipes and fittings prevail, the proportion of which amounted to more than half of the entire quantity of ferrous metals imported to these countries in 1967 (Table 14) /2/. This is explained by the fact that in the African countries the rolled products are mainly consumed in building, manufacturing tare, packing agricultural products, as well as in the oil-gas industry and agriculture for irrigation and watering purposes.

Variations in the ferrous metals imports to the African countries (with the exception of the United Arab Republic), which have taken place during the last 10 to 12 years, are characterized by a drastic increase in the proportion of pipes and fittings, which is connected with the starting exploitation of new deposits of oil and natural gas in a number of African countries /7/. In 1955-1967, the proportion of pipes and fittings in the total import of ferrous metals to the countries of this region increased from 7,9 to 27.6%, i.e. by more than 3 times. In 1967, the proportion of pipes and fittings amounted to about 70% in Libya, about 30% in Algeria and Nigeria.

The rolled-products range of the imports to the African countries is as a whole characterized by the data given in Table 15 /2/.

Table 14. Imports of ferrous metals to Africa (with the exception of the United Arab Republic), %

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	2.1	1.9	1.4	2.4	2.3
Railway materials	10.9	7.1	3.5	5.2	6.7
Sections	38.7	34.3	30.4	28.9	26.6
Wire rods	2.2	2.2	5.3	3.3	3.6
Strips	1.5	1.5	2.5	1.8	1.3
Plates	4.8	4.5	4.6	5.2	6.7

Table 14 (Continued)

1	2	3	4	5	6
Sheets	25.2	14.7	16.5	17.5	16.4
Pipes and fittings	7.9	26.5	28.0	21.6	27.6
Wire	2.9	4.0	2.8	4.0	3.1
Tin plate	3.1	2.6	5.0	8.3	4.9
Axles, wheels, and tyres	0.7	0.7	1.0	1.8	0.8
Total:	100.0	100.0	100.0	100.0	100.0

Table 15. Imports of ferrous metals to Africa (in total),%

Rolled products	Years				
	1955	1960	1965	1966	1967
Ingots and billets	1.8	2.0	1.2	2.1	5.2
Railway materials	11.4	7.2	4.6	6.1	6.0
Sections	40.2	33.4	29.5	28.0	27.1
Wire rods	1.9	2.0	4.5	5.1	5.4
Strips	1.9	1.9	3.5	2.9	2.6
Plates	5.2	5.5	6.3	6.3	6.6
Sheets	21.8	13.6	16.0	16.2	14.4
Pipes and fittings	9.0	26.8	24.7	19.7	24.2
Wire	3.0	4.0	2.9	3.9	24.2
Tin plate	3.1	2.8	5.9	7.8	4.9
Axles, wheels, and tyres	0.7	0.8	0.9	1.9	0.8
Total:	100.0	100.0	100.0	100.0	100.0

The African continent is supposed to require about 10.5 m.tons of steel in 1972-1975 (11), and in 1980,- about 12 m.tons of steel /12/.

At present, the African countries carry into effect the reconstruction and enlargement of the existing iron and steel works, including fully-integrated works (in Algeria and Morocco). The initial annual capacity of the iron and steel works at Annaba (Algeria) equals to 350,000-450,000 tons of steel and that of the iron and steel works at Nador (Morocco)- 180,000 tons of steel.

In the nearest future, most African countries are expected to start constructing new iron and steel works, including eight fully-integrated works of the total annual capacity of about 2,5 m.tons of steel (in Nigeria, Uganda, Zambia, Congo (Kinshassa), Mauritania, Ivory Coast, Liberia).

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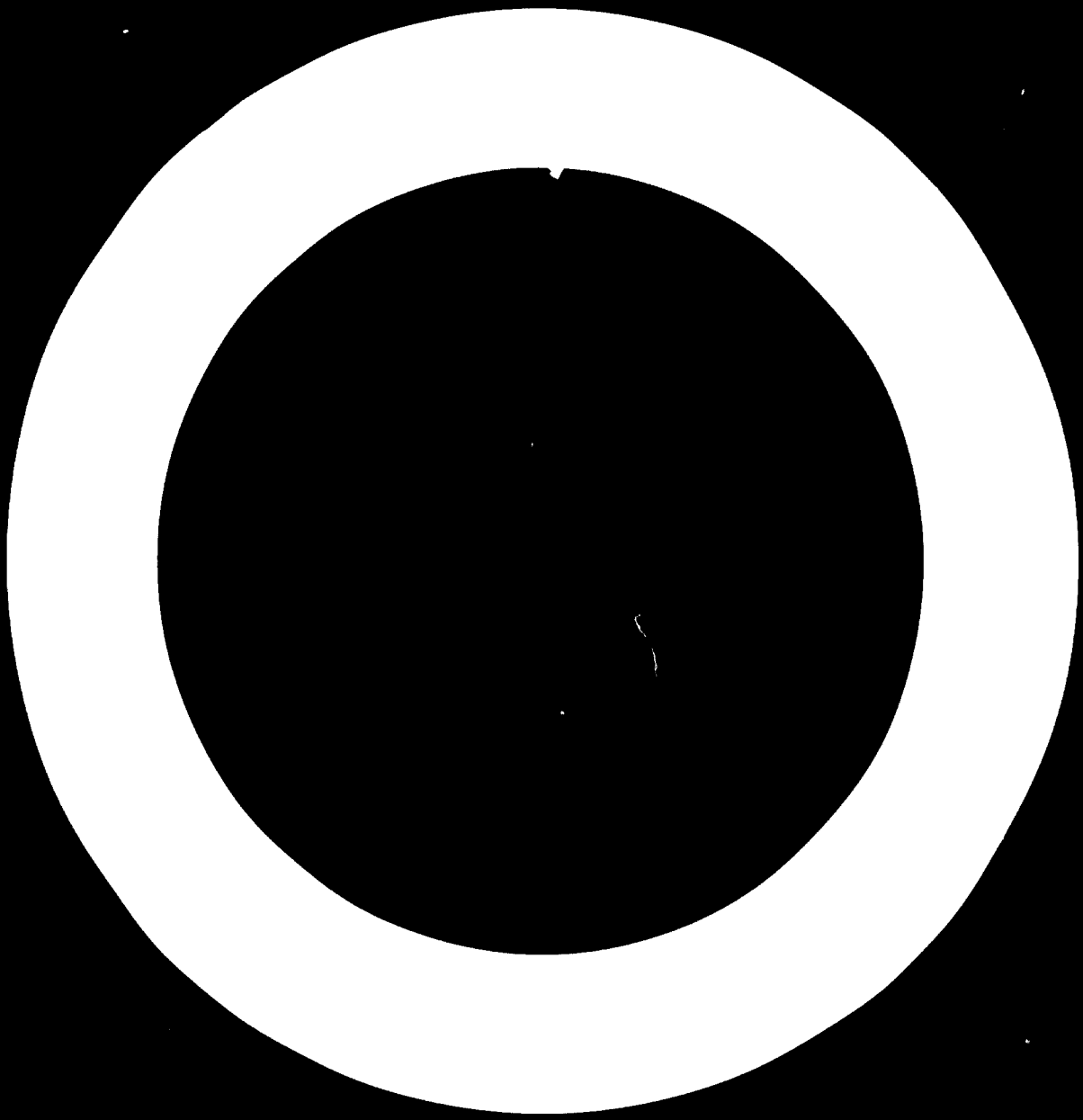

CONCLUSIONS

1. The industrialization of the developing countriee is one of the paramount problems confronting those countries. As a result many developing countries place strong emphasis on creating and developing domestic iron and steel industry, considering thie to be essential for the industrielization of the country. The initiative in creating iron and steel industry belongs in most cases to the governments of these countries, but the conetruction of iron and steel works is carried out with financial and technical assistance of the developed countries.

2. The majority of the developing countries are faced with considerable difficulties in creating and developing the domestic iron and steel industry. Those difficultiee include shortage of sources for financing the construction of iron and steel works, especially the lack of foreign currency, the low competitivity of the metal products of the domeetic production in comparison with cheaper imported metals, the limited oapacity of the domestic markets of ferrous metals, the shortage of skilled workers and specialists.

3. Iron and steel enterprises are now in operation or under construction in approximately 45 countries. Among them small-capacity non-integrated works with rolling mills are in operation or under construction in the majority of the countries (over 30 countries). These rolling mills are mainly supplied with purchased billets. Besides, works producing galvanized sheets from imported steel coils es well as pipe works are in operation or under construction in thoee countries, the pipe works being built mostly in the countries with developing oil-gas industry.

In thie group of the countries, in e number of non-integrated works with rolling mills there are electric arc furnaces for remelting domestic or imported scrap and producing steel ingots of low weight. Light sections or wire rode are then rolled from those ingots. Burme, Ghana, Guatemala, Iran, Ireq, Quwait, Lebanon, Saudi Arabia, Singapore, Thailand, Uganda, Uruguay, Philippines, Ethiopia and others enter into this group of the countries.

Argentina, Brazil, Venezuela, India, Mexico, the UAR, Peru, Chile and other countries constitute another, smaller group of countries having relatively high level of industrial development. About 30 fully-integrated works constructed mainly during the last decade are in operation in the countries of the group. These works meet about 80% of the countriee' demand for ferrous metals.

4. The rest developing countries have no neccessary economic conditions for creating a domestic iron and steel industry, especially many countries of the African continent and some countries of the South East Asia, the Near and Middle East, the Far East, that are lagging behind the other developing countries in the level of industrial development. They are likely to be fully dependent on ferrous metal imports for at least the next decade.

5. As a whole, all the developing countries meet approximately 65% of their demand for ferrous metals by the domestic production as a result of steel output growth. Accordingly, the ratee of the ferrous metal production growth exceeded in 1960-1967 the rates of the coneumption rise. If these rates are retained for the next years, it ehould be expected that the difference between the production and consumption of ferrous metals will be gradually decreased. The realization of all the planned projects of constructing new iron and steel worke and expanding existing ones will be beneficial for speeding up the process of belancing the production and consumption of ferrous metals.

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