CHAPTER V

INDUSTRIES

OLD TIME INDUSTRIES

The present district of Sundargarh comprises the two ex-States of Gangpur and Bonai. These ex-States had no special manufactures in the past. Villages were self contained with their own black-smiths, potters, carpenters, and weavers, etc. Iron smelting, gold washing and the making of vessels of soap-stone for domestic use were some of the important old time industries of the district. Gold washing has been discontinued due to economic reasons, and iron smelting is now confined to a few villages in Bonai subdivision and the other industries are still continuing in a cottage stage. Cobden Ramsay in his Gazetteer * has given the following account of the gold washing in Bonai. "Gold washing is done by the Jhora caste, men and women alike sharing in the work. The gold is obtained from the sands in the bed of the Brahmani river and its tributary streams. The earnings of a Jhora washer will average about 3 annas (20 paise) a day. Though the quantities of gold obtained in this way are small, probably most of the gold ornaments worn by people in Bonai are made of gold obtained locally from the Jhoras".

Large quantities of wild tassar cocoons were being exported from Bonai at the beginning of the present century (20th). Artificial culture of the tassar worm did not flourish as the local people considered it an impure occupation. Tassar cocoons and stick lac were the most valuable of the forest products.

Prior to Independence the industrial activities in Sundargarh were confined only to Birmitrapur, the site of the limestone quarry. The establishment of the coment factory at Rajgangpur in 1951 and the steel plant at Rourkela in 1955 were mainly responsible for rapid industrial development in the district. During the past decade large, medium, and a number of small-scale and ancillary industries in and around Rourkela began to concentrate and created an industrial complex. All the large-scale industries of the district viz., (*i*) the Steel Plant at Rourkela, (*ii*) the Fertiliser Plant, Rourkela, (*iii*) Cement Factory at Rajgangpur, (*iv*) Messrs. Utkal Machinery Ltd., at Kansbahal, and (*v*) the Limestone Quarry, Bisra, are in the complex.

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* Feudatory States of Orissa-L.E.B. Cobden-Ramsay P-13

Sundargarh has emerged as one of the industrially advanced districts of Orissa. Industrial activities including mining and quarrying engaged 56,044 persons (17·29 per cent of the total working population) in 1971.

POWER

The first Electrical Power House (diesel engine) was installed in the district in the early forties. It was of 130 K. W. capacity and was meant to electrify the streets of Sundargarh town and supply electricity to a limited number of consumers.

In 1950, a thermal power station of 3,000 K. W. was installed at Rajgangpur for the exclusive use of the newly installed cement factory. In 1955, the Rajgangpur town was electrified and power was supplied from the above thermal station. After the completion of the Hirakud Project the thermal power station was closed. Since 1957 Sundargarh is getting electricity from Hirakud Hydro-electricity Project situated in the district of Sambalpur and the Talcher Thermal Station in Dhenkanal district. The total power consumption in the district (including seven police station areas of Sambalpur district) during 1971-72 was 52,51,20,476 K. W. H. Out of which 47,04,95,816 units were consumed by industrial establishments. While the consumption of electricity for agricultural purposes is negligible that for industrial purposes is very high which accounts for more than 90 per cent of the total power consumption. This is because of the location of a numbet of large-scale industries in the district.

All the five towns (Sundargarh, Rajgangpur, Birmitrapur, Rourkela civil township, and Rourkela steel township) and 182 villages out of 1,588 inhabited villages (1961 Census) have been electrified.

MINING

Sundargarh occupies a prominent position in the mineral map of the country. The important minerals occuring in the district are iron-ore, limestone, manganese, dolomite and fire-clay. Besides, a few other minerals like mica, bauxite, quartz, lead, copper and zinc etc., are also found.

Except dolomite and fire-clay which are exploited only by private agencies at present, the other minerals are exploited both by the government and by private agencies.

Limestone and Dolomite

Commercial exploitation of limestone and dolomite was started by E. G. Barton in 1898. He was granted a lease over an area of 12 acres (4·85 hectares) near Panposh. He took lease of another 23 acres (9·30 hectares) at Jhirpani in 1902. Barton transferred

these two leases to Josef Zobel and the latter took another lease over 2,317 acres (937.45 hectares) in 1910. The next year Zobel again transferred a major portion of the lease area to Messrs Bisra Stone Lime Company and the rest to the Tata Iron and Steel Company. In course of time many lease-holders were attracted to exploit limestone deposits in the district. During 1971 there were 7 limestone and 6 dolomite mines in operation.

Production and export of limestone and lime from Sundargarh is continuing since 1900. During 1969-70, 19·2 lakh tonnes of limestone and 5·66 lakh tonnes of dolomite were produced in the district.

Manganese

Manganese-ore deposits first came to light in 1907. In that year a prospecting licence over an area of 96 square miles (248 square kms.) was granted to Madhulal Deogar. In 1909 two other persons, Isaac Shrager and B. N. Basu joined Deogar as partners. A light tram-way was constructed from Dharuadihi railway station to Ghariajor in 1908 for haulage of ore and it was completed in 1909. A mining lease was granted to the firm over 7·25 square miles (18·77 sq. kms.) in 1912. But the lease lapsed in 1914 due to improper mining operation. A second lease was granted in 1917 to the New Gangpur Mining Syndicate. The lease was surrendered in 1927 since the working became uneconomic due to the fall in the market price of manganese.

Many agencies took lease of manganese mines in the district at different periods. During 1960 there were 43 working mines in the district and 52,432 tonnes of ore were raised. In 1969–70 the number of mines was reduced to 20 , but the production increased to 1,17,967 tonnes. Generally ores of second grade (35 to 44 per cent) and third grade (below 35 per cent) are produced. Ore of first grade (45 per cent and above) and chemical grades are very limited. The proportion of high grade ore is about 15 per cent of the total production.

Iron Ore

The exploitation of iron-ore in the district is very recent. The first lease was granted in 1955 to a private party over an area of 153·32 acres (62 hectares) at Bandhabahal in Sundargarh subdivision. The huge deposit of iron-ore in Bonai area was not tapped in the past, probably due to the absence of proper communication facilities. A lease was granted in 1959 over 300 acres (121 hectares) at Nadikasira. During 1960, two mining leases over 6,144 acres (2485·86 hectares) in Barsuan and 192·64 acres (77·84 hectares) in Joda were granted to M/s. Hindustan Steel Limited. Production started in the same year in both the mines. The Barsuan mine is fully mecha-

nised. Mining is carried out by top slicing method with benches of 10 metres height each. Blast holes are drilled in the ore body, which are blasted by liquid oxygen and high explosives. Then the ore is loaded by electric shovels into dumpers, which carry it to the crusher plant to be crushed down to minus (less than) 3" size and then conveyed down hill by coveyers. The ore is also screened and loaded mechanically into wagons for despatch to the Rourkela Steel Plant. A special broad-gauge Railway line has been built over a distance of about 50 miles (80km.) from Barsuan mines to Rourkela for haulage of iron ore.

At present there are 10 working mines in the district with an annual production capacity of 1,201,969 tonnes of ore (1959).

Fire Clay

Messrs Orissa Cement Ltd. was granted a lease for fire-clay at Khunti Jharia. Mining started in 1960 and 1,195 tonnes of clay was raised in that year. In 1961 another lease was granted at Dabunga area. But both the mines were closed as the clay was found unsuitable. The firm was then permitted to exploit the Kiripsira deposits in Hemgir Tahsil. There are 3 working mines in the district at present and they produced 19,800 tonnes of fira-clay in 1969.

Other mines

There are 3 quartz, a quartzite, a china-clay and a bauxite mine in the district at present. During 1969, 71,807 tonnes of quartz was produced.

Mineral-based Industries

The important mineral-based industries of Sundargarh are the Steel Plant of M/s. Hindustan Steel Limited at Rourkela, Cement and Refractory Plants of M/s. Orissa Cement Limited at Rajgangpur and the Refractory Plant of M/s. Orissa Industries Limited at Lathikata. All these industries draw on the mineral resources of the district. The extensive lime-stone and dolomite reserves of the district cater to the needs of all the steel plants in the eastern region of the country besides meeting the growing requirements of other industries in the State and outside.

The tremendous iron-ore potential of Sundargarh (Bonai subdivision) and Keonjhar districts can sustain several integrated Iron and Steel Plants. M/s. Dastur and Co., who had been appointed to prepare feasibility reports for additional steel plants, have recommended the establishment of a second steel plant in Orissa either at Nayagarh or Bonai or at Paradeep with an initial producation capacity of 2 million tonnes depending upon the iron-ore resources of the Bonai-Keonjhar belt, and the limestone potential of the Sundargarh district. Plans for the establishment of a lead-smelter

based on the lead deposits near Sargipali, in clollaboration with the Central Government, have been finalised. This smelter would produce about 10,000 tonnes of lead metal per annum besides 3,00,000 kgs. of silver as by-product. With the progressive advancement achieved in the field of industry and technology, Sundargarh holds promise for the establishment of a wide range of mineral-based industries in future. Those which merit mention are :— (1) palletisation/agglomeration plant based on iron-ore mines, (2) electrolytic manganese based on the manganese ore potential of the Koira region (3) beneficiation plant for low grade manganese ores, (4) precipitated chalk and calcium carbide, based on the high grade limestone deposits, and (5) magnesium metal and magnesium corbonate, etc. based on the dolomite resources of the district.

Mining Revenue

There was no uniformity in the rate of royalty during Durbar administration and the individual lease-holders were paying royalty as per the condition laid down in their respective lease deeds. After the formation of the present district in 1948 grant of lease was regulated and the rate of royalty was fixed according to Central laws. There was a remarkable rise of the revenue. The collection rose from Rs. 15,47,486 in 1960-61 to Rs. 32,06,178 in 1966-67. Dvring 1971-72 collection figure reached Rs. 59,10,852. A statement showing mineral wise collection of revenue from 1966-67 to 1971-72 is given as Appendix I.

LARGE-SCALE INDUSTRIES

The following large-scale industries are established in this district.

(*i*) Hindustan Steel Limited, Rourkela, which produces steel plates, strips, steel sheets, tin plates, etc.

(*ii*) Hindustan Steel Limited, Fertiliser Plant, Rourkela.

(*iii*) Orissa Cement Limited, Rajgangpur, which produces cement, cement products and refractories.

(*iv*) Utkal Mechinery Limited, Kansbahal, which manufactures machinery and equipment for sugar mills, paper mills, steel plants, etc.

(*v*) Orissa Fertilisers and Chemicals Limited, Kalunga, which produces phosphatic fertilizer.

(*vi*) Indian Detonators Limited, Rourkela, producing high explosives.

(*vii*) Orissa Industries Limited, Lathikata, producing refractories.

These industries are more or less based on the minerals available in Sundargarh and its neighbouring districts. Details about the Steel Plant and the Fertiliser Plant have been given as Appendix II (Rourkela, where steel is tempered). The rest are discussed below.

Orissa Cement Limited, Rajgangpur

The Orissa Cement Ltd. was established at Rajgangpur in pursuance of an agreement in December, 1948, between the State of Orissa and M/s. Dalmia Jain Agencies Limited (now M/s. Dalmia Agencies Private Limited originally Managing Agents of the Company). The company have invested a capital of Rs. 8,10,00,000 including the State Government's share of Rs. 40 lakhs and provide employment to 3,500 persons at present. The factory was established in a period of $1\frac{1}{2}$ years and it was put well in time to cater to the entire requirements of the construction of the Hirakud Dam Project. Limestone, the principal raw material for manufacturing cement, is obtained from the company's own quarries at Lanjiberna situated at a distance of about 10 km. from the factory site. Beginning with a modest start of an annual capacity of 1,67,648 tonnes in 1951, it has grown into a big industrial complex since 1957 onwards increasing its annual installed capacity to 4,01,000 tonnes of Portland and Pozzolana cement; 1,20,909 tonnes of high quality fire clay, silica, burnt basic and chemically bonded refractories; and 35,268 tonnes of spun R. C. C. pipes, prestressed concrete products, etc.

The refractory plant was put up in technical collaboration with a West German Firm and it was planned to meet the needs of special refractories by the three Public Sector Steel Plants located at Rourkela, Bhilai and Durgapur. The erection work commenced in 1956. Fire bricks and silica plants started production in 1958, and the plant for burnt basic bricks was put into commission in 1959. Manufacture of chemically bonded steel clad basic bricks was started in 1962.

The finished products, their quantity and value for the period 1969 to 1971 is given below:—

Articles	1969		1970		1971	
	Quantity (in tonnes)	Value (in Rs. lakhs)	Quantity (in tonnes)	Value (in Rs. lakhs)	Quantity (in tonnes)	Value (in Rs. lakhs)
1	2	3	4	5	6	7
Cement ..	4,53,670	433·03	3,83,554	377·07	3,97,655	390·93
Cement products.	10,058	18·86	8,881	12·93	10,750	19·68
Refractories.	72,163	436·09	92,942	622·42	1,08,486	738·56

Marketing of the products

Distribution of cement is regulated by the Government of India and the marketing zone of the factory includes the States of Orissa, West Bengal, Assam, and Bihar. R. C. C. poles and pipes are generally supplied to the Railways, the Electricity Boards of Orissa, West Bengal, Bihar and Uttar Pradesh, and to big public undertakings viz., the Bokaro Steel Plant, the Bharat Aluminium Company and the Hindustan Steel Limited, etc. The steel factories and also some chemical, textile, cement, copper, and other non-ferrous industries are the main consumers of refractories. Besides, some portions of the products are exported to foreign countries.

Utkal Machinery (P) Limited, Kansbahal

Established in 1960 at Kansbahal, about 20 km. from Rourkela, the Utkal Machinery Ltd. manufactures equipments for steel plants, pulp and paper plants, chemical plants, crushing and screening machinery, and hydraulic equipments. The firm also undertakes special machining works and site erection of the machinery supplied by it.

The company have invested Rs. 3·35 crore and provides employment to 1,230 persons.

Orissa Fertilizer and Chemical Limited, Rourkela

The Orrissa Fertilizer and Chemical Ltd. has been established near Kalunga with a capital investment of Rs. 73 lakhs. The plant produces phosphatic fertilizer, having an installed capacity of 45,000 tonnes per year. The raw materials consist of imported rock phosphate, basic slag and sulphuric acid. The factory which employs about 250 persons has started production since May 1973.

Indian Detonator Limited, Rourkela

Established in 1969 at Rourkela, the Indian Detonator Ltd. produces high explosives. It has an annual installed capacity of 10,000 tonnes. The basic raw materials required by the plant are ammonium nitrate, sodium nitrate, aluminium powder and gums. The factory built with a capital investment of Rs. 150 lakhs provides employment to 234 persons.

Orissa Industries Limited, Lathikata

The Orissa Iudustries Ltd. was established at Lathikata neat Rourkela in 1963 with a capital investment of Rs. 52 lakhs. The plant has an annual installed capacity of 34,000 tonnes of refractories. The important raw materials required are fire clay and bauxite. It produces all types of refractories and has provided employment to 650 persons.

SMALL-SCALE INDUSTRIES

The establishment of the Steel Plant at Rourkela and the Cement Factory at Rajgangpur was responsible for many small-scale industries to grow in the district during the last decade. These industries are largely concentrated in the areas around Rourkela and Rajgangpur.

During 1955-56 there were about 15 small-scale industries in the district including two saw-mills located at Hemgir and Jaraikela. In 1972 the number went up to 222 factories registered with the Directorate of Industries. Besides, there were many unregistered factories.

These 222 small-scale industries provided employment to 2,240 workers.

Some details about these units are given below.

Basic Metal Industries

The Basic Metal industries which are mainly located at Rourkela and Rajgangpur are ancillary in nature. They manufacture engineering articles like gears, slotted shafts, couplings, liners, bushes etc., to be supplied to the large scale engineering industries. Some of these industries manufacture steel furniture, stainless-steel utensils, aluminium grills, agricultural equipments, wire ropes, chains, and bolts and nuts. There are 50 engineering industries employing 1,256 persons.

Sheet Metal Industries

The Sheet Metal industries mainly manufacture sheet metal products like tin containers, trunks and automobile spares etc. These industries are 9 in number and employ 64 persons.

Food Processing and manufacturing Units

The large factory population has naturally led to the establishment of a number of concerns engaged in food processing industries. These include rice and oil mills, flour mills, ice and ice-cream units, toffee and confectionary, bread and bakery units. There are 57 such units which employ 364 workers.

Forest-based Industries

The rich forests of Sundargarh with its useful timber have led to the growth of the forest based industries. There are 10 saw mills and carpentry units employing 60 persons. The Forest Corporation of Orissa have got 3 saw mills in the district located at Rourkela, Kalunga and Chandiposh. The saw mills are fed from the timbers obtained from the forests and the furniture produced get good market in the urban areas of the district.

Chemical Industries

Insecticides, acids, fine chemicals, phenyle, candles, soaps etc., are manufactured by the chemical industries. These units are mostly concentrated at Rourkela and Rajgangpur. Their number was 17 in 1972 and they employed 105 workers. Some important chemical industries producing sodium silicate, aluminium shots, knotched bars, and bentonite powder, etc., are ancillary to the Rourkela Steel Plant and other large-scale industries.

Electrical appliances

The Electrical appliances industries are ancillary to the Rourkela Steel Plant and are located at Rourkela. They produce storage batterief, carbon brushes, electric coils etc. There are 5 units at present employing 25 persons.

Miscllaneous Industries

Various types of demand based industries engaged in manufacturing of brick and tile, tyre retreading, polythene and hessian bags, motor repairing, rope-making, shoe-making, tailoring etc., are included in this category. These industries are 64 in number and they employ about 330 workers. A shoe factory established in 1970 at the Rourkela Industrial Estate is ancillary to the Bata Shoe Company. Besides, there are 8 printing press units in the district employing 60 persons.

COTTAGE INDUSTRIES

The important household industries in the district are hand-loom weaving, carpentry, black-smithy, pottery, hand-pounding, shoe-making, oil pressing, stone-carving, basket making, and limestone processing etc. These activities are mostly hereditary in nature. The number of artisans engaged in each category of these industries according to 1961 Census is given below.

Category of artisans		
Spinners, weavers, knitters, dyers and related workers	..	4,815
Black-smiths, hammersmiths and forgeman	..	3,294
Basket weavers and related workers	..	2,912
Pottery and related clay formers	..	2,503
Leather-cutters, lesters and sewers	..	1,650
Carpenters, joiners, cabinet makers and related workers.	..	466

Weaving

Hand-spinning and weaving of cotton is one of the oldest industries of the district. In almost all the villages are found the local cotton weavers, who are Panas or Gandas and Hansis. The cloth woven is very coarse, but durable. The looms used by both castes are the same, but clothes turned out by the Hansis are somewhat finer than those woven by the Panas. The weavers eke out a precarious existence from the proceeds of their sale. In the past the entire local requirement of linen was met by the local weavers and spinners. Cotton was grown extensively in the district, specially in Bonai subdivision. This local trade had to face a challenge when mill-made yarn from Calcutta began to find its way during the beginning of the present century and ousted the locally produced articles. Gradually cheap mill-made clothes were imported and the hand-loom weaving lost its former position. Cotton cultivation was almost discontinued and the weavers were reduced to mere wage-earners or petty cultivators. To preserve the traditional skill of these artisans some Co-operative Societies have been organised during the recent years and they get financial and technical help from the Government.

In 1966-67 there were 24 societies having 1903 members. The number of looms in the district was 11,863. During the same year only 4 societies made some profits, 13 sustained loss and the rest 7 worked on no profit no loss basis. There were only 59 working looms and the rest 1,804 looms remained idle. Products worth Rs. 13,945 were sold during 1966–67.

Basket-making

Bamboo mat and wicker work is done by the Turi, Dom and Khond castes. The Turis do by far the finest work. The Doms make the bamboo wicker trunks, called *petras* and bamboo and palm-leaf mats and fans, while cheap and rough mats and baskets are made by the Khonds. At present there are 4 bamboo workers Co-operative Societies in the district located at Khuntgaon, Gopalpur, Birtola, and Bargaon.

Brass and bell-metal

Brass and bell-metal utensils for domestic use are being made by Kansari caste. They make also the brass ornaments, anklets, bracelet rings, etc., worn by women of the poorer classes. Tangarpali is one of the important centres of brass and bell-metal production in the district. At present the cheap aluminium and plastic products have almost replaced the use of bell-metal utensils by the common men. Use of stainless steel utensils is gradually becoming popular among the richer section of the society.

Soap-stone

Another unique old time industry which is still continuing is the manufacture of vessels of soap-stone or *khadi* for culinary and other domestic use. This industry is run by the men of the Bhumij or Bhandwal caste. Two varieties of stone are found in Bonai subdivision. One is an opaque variety of a greyish-white colour known as *dudh-khadi*, the other variety is of a greenish tinge and of a hyalescent or semi-crystalline character and is highly prized of the two. The stone vessels find good market in the neighbouring areas.

Iron Implements

The local black-smiths (*kamar*) were smelting iron-ore picked up from the surface and producing excellent iron. All the doemstic and agricultural implements used throughout the district were made from that iron. At present they depend upon factory made iron and steel for their living. A black-smithy co-operative society has also been organised in the district having 14 members.

Co-operative Industries

There are 22 Industrial Co-operative Societies excluding the Panchayat Industries. Out of these, 19 societies have been financed either by the Government or by the Orissa Khadi and Village Industries Board. These societies have provided employment to about 374 village artisans either fully or partly. The extent of assistance towards capital is Rs. 2,14,757. They deal in hand-pound rice, edible and non-edible oil,

pottery, leather, carpentry, black-smithy and lime products. They are very small-sized units operating in the villages.

Panchayat Samiti industries have been established in 13 Grama Panchayats of the district, out of which 9 carpentry units, a tile making unit, and a black-smithy unit are located in the areas around Birmitrapur, Rajgangpur and Bonai. Besides, there is a rice huller at Raidihi; and a rice huller-*cum*-oil mill at Kinjirma. Therse societies have received assistance towards capital to an extent of Rs. 3,85,708 and they employ 66 persons.

State Assistance to Industries

The State Government have provided many facilities for the development of existing industries as well as for the establishment of new industries (both small-scale and cottage). Suitable plots of land with all sorts of infrastructural facilities are being provided to the entrepreneures at concessional rate. Under the State-aid to Industries Act, these industries are allowed financial assistance, supply of controlled raw materials, and assistance to obtain raw materials from out side India, on liberal terms. They are assisted to obtain machinery on hire purchase basis. Electricity is made available at subsidised rate and steps are being taken for proper marketing of their products. The industries avail free technical advice and the State Government awards stipends to technical students in view of getting technical hands for different industries. A Training School has been established at Rourkela to train students in different technical trades.

Industrial Estates

There is an industrial estate in the district at Rourkela with 64 sheds. It provides modern type of factory accommodation and 52 factories have been established in the completed factory sheds of the estate. The rest 12 sheds are under construction. Besides, many industrial units in the district are housed either in residential buildings or in factory sheds owned or rented which in many cases do not conform to modern standards.

The State Government have acquired about 360 hectares of land at Kalunga (about 10 km. from Rourkela) for accommodation of various ancillary industries. The area is being developed by the Industrial Development Corporation of Orissa for allotment to entrepreneures or setting up of industries.

Another area under Commercial Industrial Estate is being developed at Rourkela with financial assistance from the Central Government. An area of 2 hectares (5·2 acres) has been acquired for this purpose. Construction of 2 blocks having 10 units each has already been started at a cost of Rs. 8 lakhs. It has been envisaged to provide small industrial accommodations to unemployed educated persons.

Industrial Potential and Plan for Future Development

Sundargarh is very rich in both mineral and forest wealth. These resources can feed many industries in future. Besides, the Rourkela Industrial Complex has built up the necessary infrastructure for the industries to grow. Recently discovered minerals like lead, zinc, and copper in Sargipali area near Sundargarh have created vast scope for establishment of industries. A 32 crore mineral development project is coming up in Sargipali area which will be a joint venture of the State and the Central Government.*

The small Industries Service Institute, Cuttack, and the Ancillary Industries Advisory Committee constituted by the State Government have recommended that there is scope for establishment of a number of industries in the district (Given as appendices III and IV). In the meantime some of these industries have already been established as an inspiration to the entrepreneurs of the future.

LABOUR AND EMPLOYEES ORGANISATION

There were 27 Labour Unions in the district in 1971. Generally the workers of registered factories and mines have formed trade unions to safeguard their interest. Almost all the major factories and mines of the district have provided amenities to their employees. The welfare measures include recreation clubs, subsidised canteens, housing accommodation, facilities for schools, hospitals, and sports. Besides, the Labour Department takes necessary steps for proper implementation of various labour laws in force in the district through their district level office located at Rourkela. Details about the industrial labours of the district have been given in Chapter XVII—Other Social Services.

Labour Contract Co-operative Societies

These co-operative societies accept orders from different concerns and execute the works. There were 17 such societies in 1968-69. They had a total membership of 3,599 and working capital of Rs. 1,40,000. Out of these 17 societies, 6 societies made profit to the extent of Rs. 1,68,000, 8 societies incurred a loss amounting to Rs. 6,107, and 3 worked on no profit no loss basis during 1969-70. There is a Mining Labour Contract Co-operative Society at Sundargarh having 586 members. In 1971-72 the society executed work orders amounting to Rs. 97,439. Its total assets exceeded Rs. 17 lakhs.

Labour Contract Union

To keep co-ordination among various Labour Contract Co-operative Societies in the district a Labour Contract Union has been organised in Sundargarh. During 1968-69, 15 out of 17 co-operative societies were members of the Union.

* State Bank of India—Survey Report on Sundargarh District (1972).

APPENDIX I

COLLECTION OF MINING REVENUE IN SUNDARGARH DISTRICT

(figures in rupees)

Sl. No.	Minerals	1966–67	1967–68	1968–69	1969–70	1970–71	1971–72
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Iron Ore ..	12,62,580·82	10,18,587·15	8,61,712·32	14,67,821·49	9,19,281·62	13,20,301·03
2	Manganese ..	5,43,090·69	3,03,283·75	6,69,087·61	4,05,287·92	7,48,238·61	5,88,717·05
3	Limestone & Dolomite ..	13,25,333·02	30,19,998·21	32,41,860·69	37,20,951·10	40,34,080·55	35,33,177·08
4	China-clay ..	..	391·22	..	..	..	354·38
5	Fire-clay ..	35,420·02	22,610·25	6,004·27	33,585·53	28,392·57	34,190·74
6	Asbestos ..	5,850·00	5,850·00	13,431·57	..	2,471·93	..
7	Kaolin ..	21,697·87	..	..	..	..	..
8	Crush Conglomerate ..	1,388·50	986·37	..	..	..	..
9	Quartzite ..	..	..	..	..	..	3,662.64
10	Quartz ..	..	..	38,497·38	72,641·34	56,172·32	62,010·94
11	Bauxite ..	..	..	..	..	..	2,302·79
12	Miscellaneous (Application fees, etc.) ..	10,817·71	1,91,031·07	2,40,417·57	7,755·28	3,10,879·98	3,66,155·91
	Total ..	32,06,178·63	45,62,738·02	50,71,011·41	57,08,042·66	60,99,517·58	59,10,852·56

APPENDIX II

ROURKELA, WHERE STEEL IS TEMPERED

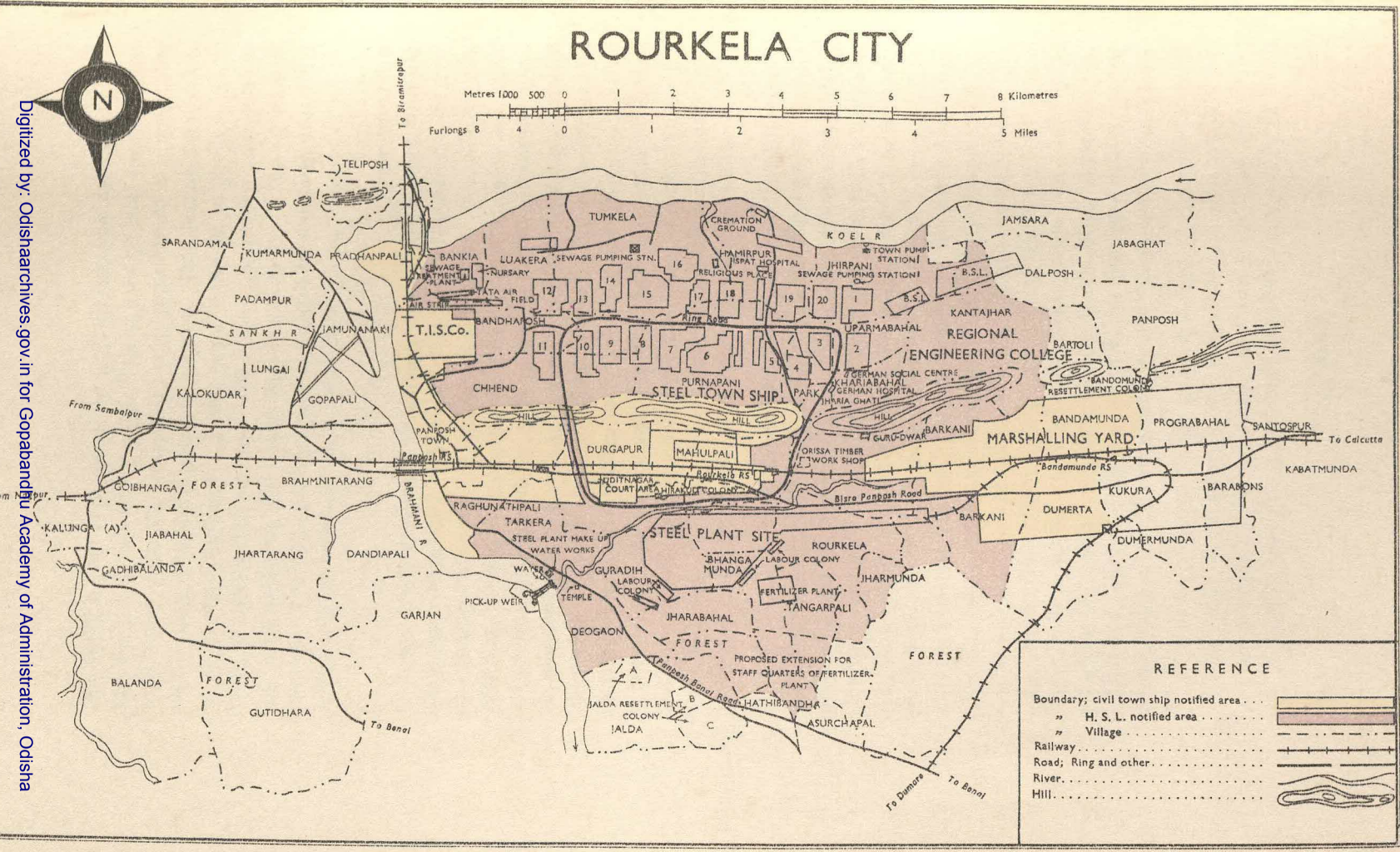
GROWTH OF IRON AND STEEL INDUSTRIES IN INDIA

The art of smelting iron was known in ancient India. Reference to iron has been made in the Rig Veda (2000 B. C.) and it is said that India is the first producer of carbon steel. The most celebrated mass of ancient Indian iron is the Iron Pillar standing near the Kutab Minar at Delhi which shows no sign of rust and provides complete testimony of the skill and art of the Indian iron-making 1,500 years ago. The iron pillar at Dhar, the ancient capital of Malwa, 33 miles west of Indore has a length of about 50 feet and its lower portion is square in section, $16\frac{1}{2}''X16\frac{1}{2}''$ and the upper is octagonal and 10" to 11" across. The weight of this pillar is about 7 tonnes more than that of the Iron Pillar at Delhi. This pillar was probably made and erected about the year 321 A. D. Besides, there are numerous beams and smaller pieces at the Sun Temple at Konarka in Orissa built in the earlier part of 13th century A. D. The beams were constructed by welding short blooms together. The blacksmiths of Orissa produced various types of weapons and also smooth barrelled guns known as Oriya Nali or Oriya barrel. Weapons and articles made of Indian steel and wrought iron were available all over the country even after it came under British occupation.

In early days the smelting of iron took place in small charcoal fired furnaces, which consisted merely of pits on the ground. Air was blown by the only process in vogue at that time i. e., the foot-bellows. It was not possible to separate the iron from the slag by this method and wrought iron was made by further working the furnace product. Each furnace was worked with two goat-skin bellows so that a continuous blast of air could be produced. The charcoal fuel was made from various hard woods such as Teak, Babul and Sal. Some of the smelters of this type can still be seen near Manoharpur, hardly 50 km. from Rourkela. Piles of metallic modules found at different places in North Orissa indicate the existence of a smelter not long ago.

The first smelter for smelting iron ore in India was started by J. M. Heath, a civil servant of the East India Company at Porto Novo, Madras, in 1830. In 1833, furnaces, forges and rolling mills were established at Porto Novo. After the liquidation of this company in 1874, the Napier Foundry Company was set up for manufacture of iron in 1875 which lasted only up to 1877. In West Bengal the indigenous industry was highly developed in the Birbhum district. The furnaces were comparatively large. In 1852, there were about 70 furnaces in different parts of West Bengal. The annual out-put of each furnace was about 34

ROURKELA CITY



REFERENCE

- Boundary; civil town ship notified area . . .
- " H. S. L. notified area . . . . . .
- " Village . . . . . .
- Railway . . . . . .
- Road; Ring and other . . . . . .
- River . . . . . .
- Hill . . . . . .

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tonnes of iron. About the year 1874, the Bengal Iron Company was formed and in 1878 the works consisted of 2 blast furnaces yielding 40 tonnes of pig iron per day. Attempts for smelting the local iron ores were also made in Kumaon region of Uttar Pradesh.

The foundation of the iron and steel industry on a stable footing was only laid in 1907 when the Tata Iron & Steel Company was formed and it started building the factory at Sakchi, a village in the district of Singhbhum. Production of pig iron by TISCO started in 1911 and of steel in 1913. The Government of Mysore started the Mysore State Iron & Steel Works in 1923 at Benkipur (now called Bhadravati) and the first blast furnace of the Company was blown in January 1923. In March 1930 a steel plant was set up and in April 1930 steel rolling mills were started. The Indian Iron & Steel Company was formed in March 1918. These plants were expanded under the first Five Year Plan (April 1951 to March 1956) and during the second Five Year Plan (April 1956 to March 1961) three new integrated steel plants at Rourkela (Orissa), Bhilai (Madhya Pradesh) and Durgapur (West Bengal) under the Hindustan Steel Limited started production.

Iron Making

Iron occurs in nature in the form of iron oxide mixed with other oxides such as aluminium oxide and silicon dioxide. The important iron bearing minerals are magnetite, hematite and limonite. In pure form of magnetite the iron content is 72·4 per cent and 27·6 per cent is oxygen. Generally, the iron content of magnetite ores varies from 65 per cent to 68 per cent due to presence of other oxides as impurities. In pure hematite the iron content can be 70 per cent maximum and the rest is oxygen. But, in commercial hematite ore, the iron varies from 60 per cent to 65 per cent due to the presence of impurities. This type (hematite) of ore is present in large deposits in Orissa and practically all the iron ore deposits of India are of this type. Limonite is nothing but hematite with varied amount of moisture content, present as water of crystallization.

As mentioned above, iron is present in iron ores as iron oxides. To get iron from iron ore (oxide) we need to get rid of oxygen. This can be done by any reducing agent like carbon and hydrogen which can combine with oxygen to form a gas. But, for commercial purposes carbon is found to be more suitable as it is available abundantly in nature in the form of coal. Coal can be burnt in absence of air to form coke which is a concentrated form of carbon. The other oxides (aluminium oxide and silicon dioxide) which are present in iron ore are made to combine with lime (present in limestone) to form a liquid slag

which separates out from iron at higher temperature due to its lightness. Therefore, iron is reduced at a very high temperature in a blast furnace. The heat in the blast furnace is supplied by burning of carbon (available from coke) in presence of air which is blown into the furnace. Thus to manufacture one ton of pig iron the following raw materials are needed:

Iron Ore (hematite)	.. 1500–1600 kg/ton Pig	Iron
Lime Stone (to form slag)	.. 300	Ditto
Dolomite (to form slag)	.. 100	Ditto
Coke (to supply reduction carbon and heating carbon)	.. 900	Ditto
Air (to supply oxygen for Coke—burning)	3500 to 4000	Ditto

The iron produced in a blast furnace has the following chemical compositions:

Carbon	.. 4·0 to 4.1	per cent
Silicon	.. 1·0 to 1.30	per cent
Manganese	.. 1·8 to 2.00	per cent
Sulphur	.. 0·04 to 0.06	per cent
Phosphorous	.. 0.20 to 0.24	per cent

When this iron is cast into small moulds it is called pig iron.

Wrought Iron This is a mixture of almost pure iron with slag and was produced in olden times when separation of slag and metal was not possible due to inability to attain high temperature. It was produced from iron ores in smaller hearths using charcoal as reducing and heat supplying source. The product of this type of smelting was spongy mass of pure iron intermixed with considerable amount of slag. Usable articles were produced by hammering the hot spongy mass to expel most of the slag. However, with the development of modern technique of producing higher temperature, wrought iron production from iron ore is replaced by production of pig iron by blast furnaces which is subsequently converted to steel.

Steel Making Most of the iron produced in blast furnaces is converted to steel either by Open Hearth or by L. D. process. Bessemer process which was used for steel making in the past, has now become more or less obsolete. In steel making the carbon, silicon, and manganese, present in molten iron is removed to the desired levels by oxygen. In Open Hearth process oxygen is supplied by air and in L. D. process pure oxygen is blown through the molten metal. In both the processes carbon is removed by the formation of carbon dioxide, which is a gas and thus escapes out. The silicon and managanese are removed as their oxides which being lighter floats on the metal bath. After the removal of these

elements, the molten metal consists of almost pure iron. This is very soft and its strength is less. But, the actual steel has to contain some amount of carbon, manganese, silicon, chromium, etc. to have proper strength. This is done by calculated addition of carbon (when carbon falls below the desired level during blowing), ferro-silicon, ferro-manganese, ferro-chromium, etc. Another use of ferro-manganese and ferro-silicon is to remove disolved oxygen from the molten metal which otherwise have harmful effects. The additions are done mostly during the time when the molten metal is poured into ladles. Thus, a typical low carbon steel which had undergone all the above processes as will contain:

Carbon	..	0·15 to 0·25 per cent
Silicon	..	0·02 to 0·35 per cent
Manganese	..	0·30 to 0·80 per cent
Sulpher	..	0·03 to 0·05 per cent
Phosphorous	..	0·03 to 0·05 per cent

The unique feature of the Rourkela Steel Plant is the adoption of L. D. process of steel making for the first time in India.

Although the L. D. process is the newest method of making steel, it is basically a delayed fulfilment of the dream of Henry Bessemer, who invented the familiar Bessemer Converter about a century ago. In devising the Converter, named after him, Bessemer blew air through molten iron and realised only half of his plan of making steel in large quantities at a low cost and in a short time. He could not go the whole way and lower the nitrogen content of steel and improve its quality by replacing the air blast by oxygen. Bessemer failed because it was exceedingly difficult in his time to get a regular supply of oxygen in bulk points. As a consequence, the steel industry developed the basic open hearth method of making high quality steel.

Today, with the improved techniques of producing pure oxygen in large quantities Bessemer's original dream of an oxygen-blown steel-making process has become a reality. As the Indian steel industry is launched upon its greatest expansion programme in history, the development of the L. D. process could not have come at a more auspicious time.

The L. D. process is named after the two steel towns in Austria, Linz and Donaowitz where it was developed by the Austrian steel manufacturing company, the VOEST. In L. D. process 99·5 per cent pure oxygen is blown through the molten iron kept in the L. D. vessel by water-cooled lance.

The L. D. process is eminently suitable for the production of low-carbon steel which is used for cold and hot rolled sheets, strips and tinplates. The investment costs of an L. D. plant, including the oxygen plant and the gas-cleaning equipment are considerably lower and works out to 60 to 70 per cent of those of an open hearth steel plant of the same annual capacity. The building site required by an L. D. plant is much smaller than that required by an open hearth plant of the same capacity. The processing costs of L. D. steel are much lower too. Including capital costs, they are, per ton, about 30 to 50 per cent lower than those of open hearth steel. The oxygen plant, in the process of making oxygen releases nitrogen which is used for manufacturing nitro-limestone fertilizer as a by-product. The operational methods of an L. D. plant are simple and the maintenance of the converters is easy. The entire process of cooling the converter, removal of damaged brick linings, relining with fresh bricks and preheating the lining can be done in about three to four days.

Alloy steel

According to composition the steel can be broadly divided into two types (*i*) plain carbon steels, (*ii*) alloy steels. The plain carbon steels contain the usual five elements up to the following percentage —

Carbon	up to	1·82 per cent
Silicon	up to	0·5 per cent
Manganese	up to	0·8 per cent
Sulphur	up to	0·06 per cent
Phosphorus	up to	0·06 per cent

Alloy Steels contain beside the above elements other alloying elements like chromium, nickel, molybdenum, and vanadium. When the contents of silicon and manganese are higher than the above mentioned level, it is also taken as alloying elements. Steel containing alloying elements totalling up to 5 per cent, are called low alloy steel. When the alloying elements exceed 5 per cent in total they are called high alloy steels. The typical example of a high alloy steel is 18/8 stainless steel used for household utensils. This contains 18 per cent chromium and 8 per cent nickel in addition to its usual carbon, silicon and manganese content. Low alloy steels are used for making various types of tools and are, therefore, commonly known as tool steels.

ROURKELA STEEL PLANT

A new era in the Indian steel industry was heralded when construction work on India's first of the three public sector steel plants at Rourkela started in October 1956, in collaboration with the Federal

Republic of Germany. This Plant is being managed by the Hindustan Steel Limited, a Government of India undertaking. A capital of Rs. 330,53,3/,426 has been invested in this undertaking.

Rourkela was chosen as the site for a steel plant owing to its naturally advantageous situation. Situated in the minerally rich State of Orissa, Rourkela has the advantage of being barely 80 km. away from rich iron-ore deposits. Manganese ore and limestone deposits are even closer. Water is obtained from the river Brahmani which is hardly 2 km. away from the plant. The requirements of raw materials are met mainly from its own captive mines. The completely mechanised iron-ore mines at Barsuan have a capacity to handle 800 tonnes of iron-ore per hour. A beneficiation plant has also been set up to improve the quality of the ore. Washed coal for Rourkela comes from Hindustan Steel's modern washeries situated at Dugda, Bhojudih, Patherdih and also from Kargal Washery of the National Coal Development Corporation. Limestone is obtained from the Plants' quarries at Purnapani and Satna. Manganese ore is brought from nearby mines in Orissa while dolomite is obtained from Birmitrapur and Baradwar.

A detailed project report for this plant prepared by Messrs Indian Gemeinschaft Krupp-Demag GmBh was finalised in November 1955 and was accepted by the Government of India in February, 1956. The work started soon after that and its various units went into production on different dates during 1958 and 1960. The first battery of Coke Ovens was commissioned on December 1, 1958 ; the first Blast Furnace on February 3, 1959 ; the first Open Hearth on April 28, 1959 ; the first L. D. Converter on December 27, 1959 ; the Blooming Mill started production on December 15, 1959, and the Plate Mill on September, 12, 1960.

The plant was originally designed to produce 1 million tonnes of steel ingots per year. To meet the growing demand of flat steel in the country the plant has been expanded to 1.8 million tonne ingot steel capacity per year. At the 1 million tonne stage the technical know-how and most of the equipments had to be imported from W. Germany. A remarkable feature of the present expansion is that considerable amount of material of indigenous manufacture has been utilised in various units.

Power Supply

The plant consumes as much electricity as a fairly large city needs and the bulk of its power requirements is met from two sources, its own 100 m. w. thermal power station, and the Orissa State Electricity Board Grid consisting of the Hirakud system and the Talcher Thermal Power Station.

Finished Products

The plant produces a large variety of products meeting the demands of some of the most important industries like ship building, wagaon building, automobile and barrel manufacturing, tube making, manufacturing of domestic appliances, canning, packing, etc. Some of these industries have to depend entirely on Rourkela.

Main Units

The main units of the plant are Coke Ovens and By-products Plant, Blast Furnaces, Steel Melting Shop and Rolling Mills.

Coke ovens and by-products

The Coke Ovens at Rourkela comprise 3 batteries of 70 ovens each, and one battery of 80 ovens which has been added under the expansion scheme. In the Coke Ovens blended coal is heated to about 1,250° C out of contact with air for about 18 hours. The volatile matter is expelled and the coal is converted to a hard porous mass called coke. From the gas obtained during this process crude tar, crude benzol, and ammonia are recovered in the By-products Plant. The remaining gas is supplied to the Fertilizer Plant where hydrogen is removed by fractionation for making calcium ammonium nitrate.

The By-products Plant, one of the largest in India, treats 1,05,000 cubic metres of gas per hour. Here crude tar is refined to produce extra hard pitch, heavy oil, creosote oil, wash oil, tar fuel, road tar, dolomite tar, neutral oil, hot pressed naphthalene, phenol, cresol, and xylenol. Crude benzol is refined to produce benzene, toluene, xylene and solvent naphtha. This is the only plant in India where extra hard pitch is produced. Valuable products like phenol, cresol and xylenol are produced in the Carbolic Acid Unit of the plant.

Sintering Plant

Mechanised mining produces large quantities of iron ore fines which previously used to go waste. To gainfully utilise these fines with other plant wastes like mill scale, coke breeze and limestone fines, and to economise on the Blast Furnace operations a Sintering Plant with a capacity to produce 4,000 tonnes of self-fluxing sinter per day has been set up. Use of sinter in Blast Furnace reduces coke rate and flux rate ensuring higher iron production with better and uniform quality of hot metal.

Blast Furnaces

The Plant has four Blast Furnances. Three having a capacity of producing 1,000 tonnes of hot metal each existed in the 1 million tonne stage. Under the expansion scheme one blast furnance having a capacity of 1,500 tonnes of molten iron per day has been added. Iron ore in lump form, sinter, coke, limestone and dolomite are charged from the top in measured quantities. Preheated air is blown from the bottom through tuyeres. Coke provides the heat and energy for

reaction and reduces the iron oxide in the ore to molten iron. Limestone and dolomite help in the removal of impurities by combining with them to form slag which is removed through the slag holes in the furnaces.

The molten iron is tapped every four hours into ladles and taken to the mixers at the Steel Melting Shop. A part of iron is also cast into pigs at the two pig casting machines.

Oxygen Plant

The Oxygen Generating Plant has been erected to supply 99·5 per cent pure Oxygen to the L. D. converters. It is the largest oxygen plant in India and has a total capacity to produce 500 tonnes of oxygen per day. The pure nitrogen, obtained as a by-product from the Oxygen Plant is being utilised in the Fertiliser Plant.

Steel Making

At this Plant, bulk of steel is made by L. D. process. The first L. D. plant went into production in 1959. From then onwards, the development of the L. D. process has been a story of steady progress. Two more L. D. converters of 60 tonnes capacity each have been added recently to the existing three of 50 tonnes capacity each. There are four Open Hearth furnances of 80 tonnes capacity each. The capacity of production of ingot steel from L. D. converters constitutes 86 per cent of the total steel making capacity of the Plant.

The molten steel produced is tapped into ladles and then teemed into moulds and transferred to the stripper bay where ingots are stripped from these moulds and sent to soaking pits for reheating before rolling.

The accident of 1971 in the Steel Melting shop

A serious accident took place in the Steel Plant when the roof of the Steel Melting shop collapsed in July 1971. A brief account of the accident is given below.

The gas coming out from the L. D. converters during the blowing is directed through the uptakes and the horizontal connecting duct to the associated gas conditioning tower. The object of this gas conditioning tower is primarily to cool the gas from a temperature of about 1200° C to about 250° C which is achieved by spraying atomized water through several nozzles supplied with high pressure water and secondarily to arrest the coarser particles of dust and collect it at the bottom through a controlled gate valve. The gas further is directed through two horizontal type dry electrode precipitator units with connected power packs for cleaning a total gas volume of about 2,38,400 cubic metres at N. T. P. per hour. An induced draft fan assists to draw out the entire gas creating a suction and letting out through chimney at the end. The precipitators accommodate horizontal rows of dis-

charge electrodes and collecting electrodes which form the main components of the entire system of dust extraction. The dust that is collected at the bottom is conveyed through individual chain conveyors to a main system leading to a central storage whereby periodically it is cleared away. As the dust is rich in iron content, efforts are being made to utilise it usefully in iron and steel making. Each converter has its own gas conditioning tower but the induced draft fan and the precipitators remain common to all. The equipment is highly sophisticated with electronic controlling device and high voltage power supply. According to the present blowing practice in L. D. converters, the dust collection amounts to 2 per cent of L. D. production as against 1·2 per cent envisaged by the supplier.

However, the dust escaping from the L. D. converters contains fine particles of iron-oxide which unless arrested, deposit themselves on the roof of the Steel Melting Shop. This deposit is fairly heavy, and as per the Technical Enquiry Committee which enquired into the roof collapse in July, 1971 was the primary cause for the disasterous roof collapse in that year. In fact, following the roof collapse, the column and roof of the Steel Melting Shop have been strengthened during the rebuilding and also following the rebuilding. Apart from the overbearing weight of such a deposit, the atmospheric pollution caused by such dust is also a potential health hazard. In fact, in the foreign countries the atmospheric pollution that would be caused by the L. D. dust forms the major consideration for installation of the Dust Catcher Plants. This plant has been working very satisfactorily since February, 1972.

Rolling of Steel

The Rolling Mills at Rourkela have two main sections viz., Hot Rolling Mills and Cold Rolling Mills. Hot Rolling Mills comprise of a Blooming and Slabbing Mill, Hot Strip Mill, Plate Mill and Electrical Sheet Mill.

Hot Rolling Mills

Blooming and Slabbing Mill

The Blooming and Slabbing Mill may be called the mother product mill for all other units. It is the main unit through which all the steel ingots pass before being rolled into finished products. The Blooming and Slabbing Mill is designed to produce slabs and blooms. Since the Rourkela Steel Plant produces flat products, this mill rolls slabs mainly. Though the mill had an inherent capacity to roll 1·8 million tonnes of steel ingots annually, to cope with increased production four batteries of Soaking Pits, one Ingot Bogie, a Hot Scarfing Machine and a Water Wheel have been provided under expansion scheme.

Plate Mill

About 25 per cent of the slabs produced at the Slabbing Mill are rolled into plates ranging in thickness from 5 mm to 63 mm The plates are used for making locomotives, wagons, bridge-girders, ships, boilers, trucks, cranes, penstock, railway coaches and many heavy equipments including electrical equipment.

Hot Strip Mill

The modern semi-cotinuous wide Hot Strip Mill, the first of its kind in India, converts slabs into strips ranging from 1·6 mm to 10 mm in thickness. Hot rolled strips are further processed in Cold Rolling mills, Pipe Plant, Electrical Sheet Mill at mill's own Dividing lines. Strips are also sold as such. The plates and sheets produced at the mill's own Dividing lines are used for making wagons, coaches, ships, boilers, bridges, telephone posts, etc. Chequered plates are used for flooring. Hot rolled strips are mainly used for making tubes and liquid-petroleum-gas cylinders.

Cold Rolling Mill

Before cold reduction in this Mill, coils from Hot Strip Mill have to be pickled where scale formed during hot rolling is removed. This is done in two pickling lines, the new one having a capacity of 450,000 tonnes per year and the earlier one having a capacity of 318,000 tonnes per year. Hot rolled pickled coils, 2 mm to 4 mm in thickness are cold reduced to 0·15 to 1·6 mm in thickness in three Cold Rolling units:

The newly installed 1420 mm 4—High 5—Stand Tandem Mill,
The earlier existing 1700 mm 4—High Reversing Mill and 1200 mm 4—High Reversing Mill.

The 1420 mm 4—High 5—Stand Tandem Mill is one of the most sophisticated units of the Rourkela steel plant. It has a delivery speed of 1,800 metres per minute. It rolls material for autobody sheets, galvanised sheets and tin plates. To ensure quality, provision of an X-Ray gauge to measure the thickness of the strip and data logging equipment to record the thickness along the entire length of the strip has been made. Capacity of this Mill is 600,000 tonnes per year.

After cold reduction the steel becomes hard and needs relieving of stress before further processing. To restore the requisite workability it has to be annealed. Annealing is done either in stack annealing furnances or in a continuous annealing line with built-in degreasing facilities. Both types of annealing furnances have been installed at this Plant. The average output of the continuous annealing line is 11 tonnes per hour. The nominal speed of the line is 120 metres per minute. To avoid oxidation of the strip, inert atmosphere of 4 to 6 per cent hydrogen and 94 to 96 per cent nitrogen is maintained inside the furnance.

Cold Rolled strips must be tempered after annealing. This is done in Skin Pass Mills where necessary physical properties, surface finish, and flatness are obtained. Cars, railway passenger coaches, panel boards of electrical and mechanical equipment, refrigerators, air conditioners, steel furniture and office equipment, oil drums and many more things are made out of cold rolled sheets.

Galvanising

Production of galvanised sheets in continuous hot dip galvanising lines by Armco–Sendzimir process has been introduced in the country for the first time at Rourkela Steel Plant. In this process, cleaning, annealing and coating of the strip are done in a continuous process in the same line. There are two lines of 80,000 tonnes per year capacity each. The cold rolled strip is uncoiled, trimmed and passed through open flame oxidising furnace which also serves as a flame degreaser. The strip is annealed under a reducing atmosphere. The strip is cooled in the next zone of the reducing furnance to a temperature slightly higher than the galvanising temperature. It is then passed through the molten zinc bath. As the molten zinc solidifies, the spangles come out on the galvanised strip surface. The hot galvanised strip is cooled by passing through a long cooling zone. It finally passes through finishing section for cutting to the required sizes. The galvanised sheets are also given a passivation treatment for increasing the resistance against corrosion. These sheets are supplied both in plain and corrugated condition. Corrugation is done in two tandem corrugating lines.

Galvanised sheets are widely used for roofing and panelling purposes. They are also used in refrigeration and air conditioning. Agriculture sector is a major user of galvanised sheets. These can also be used in the automobile industry.

Tinning

The Tinning Plant has a capacity to produce 2,00,000 tonnes of tin plates annually—1,50,000 tonnes per year from the new electrolytic tinning line and 50,000 tonnes per year from the hot dip process.

At the Electrolytic Tinning Line, Acid Ferrostan process is employed. Long bars of tin constitute the anode and the cold rolled strip acts as cathode. Solution of stannous sulphate in phenol sulphonic acid is used as the electrolyte.

Electrolytic tin plates produced at Rourkela have uniform coating which ensures perfect protection against corrosion. These are widely used in the manufacture of containers for packing of various products like processed and unprocessed food, cosmetics, etc. They are also used in electronic and automobile industry.

Electrical Sheet Mill

The Electrical steel sheets which must have low electrical losses, high magnetic permeability and high electrical resistance are used for making magnetic cores of generators and other electrical equipments.

Very low carbon steel with high silicon content and low sulphur is rolled in Hot Strip Mill to strips of 4 mm. to 6 mm. thickness. These are further pack-rolled with unidirectional grain deformation in the Electrical Sheet Mill. Heating is done in intermediate stages in walking beam furnaces. The sheets, after finishing to the required size, are skin passed to obtain dead-flat surface. They are then heat treated in Walzwerk-Neviges patented annealing furnaces or Roller Hearth furnace for grain orientation and for lower watt-loss.

Pipe Plant

The Pipe Plant at Rourkela is designed for production of large diameter Electric Resistance Welded (ERW) pipes suitable for gas and oil transmission, water well casings, irrigation, drainage, structural and mechanical uses and also for piling, prospecting, mine shafting, etc.

This Plant is among the few in the world entitled to use the quality stamp of the American Petroleum Institute. Besides supplying API pipes to several pipe lines in India, viz., Naharkatuya-Noonmati-Barauni pipe line ; Gauhati-Silliguri pipe line ; Haldia-Barauni-Kanpur pipe line ; and Gujarat pipe line, this plant has the distinction of exporting pipe to several countries against stiff international competition.

Hot rolled steel strips are fed into the forming mill where they are progressively formed into a tubular shape. Continuous resistance welding machine welds the butting edges. The pipes are finished and thoroughly tested to maintain high standards of quality.

Other Units

To keep a steel plant of the size of Rourkela operating smoothly a number of service departments and auxiliary units perform vital functions. The important among them are discussed below.

Foundries

The plant's requirements of casting of various sizes are met by the Foundries. Bulk of these are supplied by the Grey Iron Foundry which has an annual capacity to make 64,000 tonnes of grey iron castings. Main requirements are in the form of ingot moulds and base plates required by the Steel Melting Shop and slag pots required by the

Blast Furnace as well as by the Steel Melting Shop. The steel foundry and the non-ferreous foundry have an annual capacity of 5,000 tonnes and 300 tonnes respectively.

Research and Control Laboratory

A well-equipped Metallurgical Research and Control Laboratory has been set-up in the Plant. Its function is to check the quality at every stage through highly qualified staff of Metallurgists, Physicists and Chemists.

Training

The dearth of skilled personnel to man industrial units posed serious problems in India. A modern technical Institute has been established at Rourkela to train its own technicians and engineers. It also trains personnel for other steel plants.

The modern Technical Institute at Rourkela has training facilities for 18 different trades and maintains different shops for these trades. The institute has so far trained over 6,300 trainees under its regular training schemes. The institute has facilities to train nearly 2,000 trainees every year. Training facilities at Rourkela have been appreciated even by the more industrially advanced cuontries. Trainees from Australia, Germany, Burma, Ceylon, Phillipines, Spain and South Vietnam have been trained at this institute.

Besides organising technical training courses the institute also conducts Employees Training Schemes and Management Development Schemes.

Fertilizer

The Fertilizer Plant is a Public Sector undertaking and has been constructed at a cost of Rs. 268·7 millions. It is the only fertilizer plant in the country based on the utilisation of surplus gas from a steel plant.

The Plant is designed to gainfully utilise the by-products like hydrogen from Coke Oven gas, nitrogen from the Oxygen Plant and limestone fines from Purnapani. Designed to fix 1,15,000 tonnes of nitrogen per year in the form of calcium ammonium nitrate (CAN), the Plant has a gas fractionation section, a naphtha steam reforming unit, an ammonia synthesis unit, a nitric acid plant and a nitrolime plant. A naphtha reformation unit has been set up recently to augment the supply of hydrogen.

In terms of CAN the plant has a rated capacity to produce 5,60,000 tonnes of calcium ammonium nitrate per year. This product is conventionally marketed with 20·5 per cent nitrogen content. With technological improvements at Rourkela the product has been enriched to 25 per cent nitrogen content which is marketed under the trade name 'SONA'.

A further quantity of fertilizer is produced in the By-Products Plant. Ammonia recovered from the Coke Oven gas is absorbed in Sulphuric acid to obtain ammonium sulphate. This Plant produces about 20,000 tonnes of ammonium sulphate annually.

APPENDIX

NEW SMALL-SCALE INDUSTRIES RECOMMENDED BY SMALL

Type of Industry	No. of Units	Location	Capacity
(1)	(2)	(3)	(4)
Resource based			
Doors and Windows ..	2	Rourkela/Rajgangpur ..	Rs. 2.1 lakhs per annum.
Tannery ..	1	Rourkela ..	25 pieces of hides for sole leather, 25 pieces of hides for chrome upper leather.
By-product based			
Coke briquets ..	1	Rourkela ..	600 mt.
Nitro benzene ..	1	Rourkela ..	150 mt.
Calero benzene ..	1	Rourkela ..	120 mt.
Demand based			
Baby walkers, tricycles and perambulators.	1	Rourkela ..	Rs. 1.50 lakhs per annum.
Carriers, Crash guards, side boxes, etc., for motorcycles and scooters.	1	Rourkela ..	
Garden tools like forks, knives, rakes, etc.	1	Rourkela ..	Rs. 5 lakhs per annum.
Agricultural implements and tools.	1	Rourkela ..	Rs. 6 lakhs per annum.
Aluminium builders hardware.	1	Rourkela ..	Rs. 3 lakhs per annum.
Anodised aluminium articles.	1	Rourkela ..	Rs. 1 lakh per annum.
Cement products ..	3	Rourkela/Rajgangpur Birmitrapur.	Ditto
Fertiliser mixtures ..	2	Rourkela/Sundargarh	10 tonnes per day.
Plastic toys, and novelty goods.	1	Rourkela ..	Rs. 1 lakh per annum.
Paper bags ..	1	Rourkela ..	Rs. 5 lakhs per annum.
Waxed paper ..	2	Rourkela ..	
Exercise note books, ledgers, file covers, letter pads, etc.	3	Rourkela/Rajgangpur/ Sundargarh.	
Holdalls, travel bags and school bags.	2	Rourkela/Rajgangpur	Rs. 0.60 lakh.
Readymade garments..	2	Rourkela ..	Rs. 2 lakhs.
Cold Storage ..	1	Sindargarh ..	5,000 mds.
Phenyle ..	1	Rourkela ..	40 mt. per annum.
Printing Ink ..	1	Rourkela ..	48 mt. per annum.
Re-rolling mills ..	1	Rourkela ..	3,000 mt. per annum.
Gas Cylinders	1	Rourkela ..	6,000 pieces per annum.

SOURCE :—Report on the Industrial Development Potentialities of Sundargarh.

III

INDUSTRIES SERVICES INSTITUTE, CUTTACK

Estimated capital investment per unit		Total (Rs. in lakhs)	No. of workers per unit
fixed	working		
(5)	(6)	(7)	(8)
Rs.	Rs.		
52,000	40,000	0·92	35
1,60,000	2,80,000	4·40	38
..	Not mentioned	0·80	8
..	Ditto	2·25	15
..	Ditto	5·00	20
..	Ditto	1.00	25
..	Ditto	0.25	10
..	Ditto	4.00	25
..	Ditto	5.00	30
..	Ditto	1.95	30
..	Ditto	0.40	15
..	Ditto	0.25	8
..	Ditto	0.70	14
..	Ditto	0.50	15
..	Ditto	0.75	10
2,500	2,500	0.05	5
..	Not mentioned	0.36	30
..	Ditto	0.25	10
..	Ditto	0.30	15
..	Ditto	1.00	12
..	Ditto	0.50	8
..	Ditto	3.50	16
..	Ditto	6.70	31
..	Ditto	3.50	15

District (Orissa)—Small Industries Service Institute, Cuttack.

APPENDIX

POSSIBILITY OF ANCILLARY INDUSTRIES IN

Name of Industry	Items to be manufactured	Annual capacity (quantity & value)
(1)	(2)	(3)
1. Grey Iron Foundry ..	General castings ..	200 tons Rs. 10 lakhs
2. Silicate Factory ..	(*i*) Sodium silicate ..	250 tons
	(*ii*) Sodium orthesilicate ..	150 tons
	(*iii*) Exothermic cover powder	300 tons Rs. 4.5 lakhs
3. Alluminium Knotched Bars and Shots.	Alluminium knotched bars and shots.	200 tons Rs. 10 lakhs.
4. Polythene lined Bitumenised hessain bags.	Rolls of polythene lined bitumenised hessain bags.	45 lakhs bags Rs. 65 lakhs
5. Pipe Plant ..	Conduit pipes of different diameters.	10 lakhs metres Rs. 15 lakhs
6. Structural Factory ..	Structurals like plate and sheet metal work.	1,000 tons Rs. 15 lakhs
7. Saw Mill-*cum*-Wood working unit.	Sawn timber ..	50, 000 cft. Rs. 3·5 lakhs
8. Bolts and Nuts ..	Metric size bolts and nuts ..	300 tons Rs. 6 lakhs
9. Rubber Moulded Hoods ..	Oil seals bushes, rubberising rolls.	Rs. 10 lakhs
10. Safety Boots and Shoes ..	Safety boots, other shoes, including children shoes.	15,000 pairs 10,000 pairs. Rs. 5 lakhs.
11. Safety Gloves ..	Weather-canvas and all type of hand gloves.	15,000 pairs Rs. 1·5 lakhs.
12. Electrical Accessories. ..	Parts of electric motors. etc.	Rs. 5 lakhs
13. Small Hand-Tools Unit ..	Hammers, chiesels, wrenches etc., for steel plant.	Rs. 10 lakhs
14. Printing Press ..	Printing and stationery including special job.	Rs. 5 lakhs
15. Manufacture of stopper rods	Stopper rods ..	1,000 rods Rs. 5 lakhs.
16. Chains, wire rope slings, pulley blocks.	Chains, ropes, pulleys, etc. ..	Rs. 10 lakhs

IV

SUNDARGARH DISTRICT

Employment potential	Capital outlay (Rs. in lakhs)	
	Fixed Capital	Working Capital
(4)	(5)	(6)
50	1·5	2·0
20	0·8	1·5
20	0·5	2·0
20	1·2	10·0
20	0·9	3·0
40	2·0	3·0
40	0·4	1·0
20	2·8	1·5
20	1·2	2·0
30	0·8	1·2
15	0·4	0·3
15	0·8	1·5
20	2·0	2·0
30	2·0	1·2
10	1·0	1·5
20	5·0	2·5

Name of Industry	Items to be manufactured	Annual capacity (quantity & value)
(1)	(2)	(3)
17. Instruments Repair Shop	Repair and manufacture of metering and indicating instruments like water meters, ammeters, dial indicators, pressure gauges, etc.	2,000 nos. of different types. Rs. 4 lakhs
18. Machine Shop (Small spares).	Small spares like collars, sleeves, pins, special head bolts, flanges.	Rs. 10 lakhs
19. Machine Shop (medium and heavy parts).	Medium and heavy parts like shafts, rolls, and plates, sleeper pads, heavy head bolts, scrapars, etc.	Rs. 15 lakhs
20. Machine Shop (precision repeat job).	Precision repeat jobs like gears, sprockets, circlips, precision rings, conveyor rollers, precision bearing-sleeves and such other jobs.	Rs. 10 lakhs
21. Machine Shop (non-ferrous spares).	Various non-ferrous spares.	Rs. 10 lakhs
22. Machine Shop (forge shop and boring jobs).	Forging jobs and boring items.	Rs. 4 lakhs
23. High Pressure Valves ..	Hydraulic valves for replacement, repairs valves and fittings.	2,000 nos. Rs. 3 lakhs.
24. Steel Foundry ..	Steel castings ..	75,000 tons Rs. 70 lakhs
25. Non-ferreous Foundry ..	Non-ferreous blanks and castings.	Rs. 6 lakhs
26. Wood working joinery Shop.	Furniture of different types..	Rs. 3 lakhs
27 Magnesite Nozzles, and Fireclay Sleeves.	Nozzles and sleeves ..	2 lakhs nos. 1 lakh nos.
28. Automobile Spares ..	Fast-wearing spares for the heavy vehicles.	Rs. 5 lakhs
29. Manufacture of bearings...	Bush, ball and rollr bearings	Rs. 20 lakhs
30. Asbestos Packings ..	Asbestos ropes, steamline packings, etc.	Rs. 4·5 lakhs
Total ..	..	352.0

SOURCE :—Report on Ancillary Industries, Rourkela, 1969, published by the

Employment potential	Capital outlay (Rs. in lakhs)	
	Fixed Capital	Working Capital
(4)	(5)	(6)
20	1·8	8·0
20	1·0	1·5
20	3·5	2·5
20	3·0	1·5
15	1·5	2·5
20	3·0	1·0
15	1·8	0·8
150	35·0	15·0
20	1·5	2·0
30	0·8	0·5
20	1·5	1·5
15	2·2	1·5
50	10·0	6·0
15	0·8	1·0
820	90.7	74.3

Directorate of Industries, Government of Orissa, Cuttack.