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THE
AGRICULTURAL LEDGER.

1898—No. 17.

IRON.

[*Dictionary of Economic Products, Vol. IV., I. 440-71.*]

THE IRON INDUSTRY IN THE CENTRAL PROVINCES.

A memorandum containing extracts from the Reports furnished on the subject by Deputy Commissioners and Forest Officers.

The following reports on the Iron Industry of the Central Provinces were received by the Reporter on Economic Products to the Government of India in response to a circular letter soliciting fresh information on the chief minerals of the provinces. The accompanying reports were considered too lengthy for publication in the *Review of Mineral Production in India* for 1897, and are accordingly brought together in the form of an *Agricultural Ledger* since the accounts are not contained in the *Dictionary of Economic Products*:—

1. **Saugor.**—There are six iron mines in Mauzas Tigoda, Hirapur and Baretha in the Banda tahsil. These mines are not leased out but are open to all paying annas 8 for each furnace. The total number of persons employed was 1,844, the total earnings R604 and the total wages paid R211. The details of furnaces are given below:—

Name of Village.	No. of furnaces.	Annual duty.
		R a. p.
Tigoda	12	6 0 0
Hirapur	15	7 8 0
Baretha	8	4 0 0
	—	—
	35	17 8 0
	—	—

2. **Damoh.**—There are certain blacksmiths, two in number, in Mauza Koopi in the Hatta tahsil, who purchase iron ore at the rate of

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IRON ORES.

Deputy Commissioner.
Saugor.

Deputy Commissioner.
Damoh.

IRON.	The Iron Industry														
IRON ORES.	24 maunds per rupee from Mauza Deora in the Chhattarpur State ;														
Damoh.	they smelt it and extract refined iron and make therefrom utensils, such as pans, <i>tawas</i> , etc. Retail purchasers take these to the North-West Provinces for purposes of trade and sell the pans at 3 or 4 seers per rupee and <i>tawas</i> at 4 to 6 seers per rupee. The blacksmiths prepare a kiln in the earth, put the iron ore into it and obtain the metal in a superior form. They purchase coal for smelting purposes from villages. They do not pay any Government dues, but the <i>Malguzar</i> (landlord) levies a duty of R16 per kiln per annum in lieu of the fuel obtained by them from the Malguzari forest.														
Deputy Com- missioner. Jabalpur. Conf. p. 8 et seq.	3. <i>Jabalpur</i> .—The number of furnaces at work generally in this district on smelting iron ore is 28 for the current year. In previous years the number was fluctuating.														
Trade in native iron affected by the European articles.	As a matter of fact the industry is one which is considerably influenced by the European iron which is fashioned to meet all requirements of the market, whereas the native iron produced in the district is sold in lumps as locally prepared, and is very costly to work into shape. The number of persons employed daily from 1st November to 31st May per furnace from the time the furnace is made, to that when the crude iron is turned out, is as follows :—														
Labour engaged per furnace.	<table border="0"> <tr> <td>For cutting wood and converting it into charcoal</td> <td>7 men.</td> </tr> <tr> <td>For extracting the iron ore</td> <td>2 „</td> </tr> <tr> <td>To attend to the furnace</td> <td>2 „</td> </tr> <tr> <td>For refining the iron, Bellows and Hammermen</td> <td>4 „</td> </tr> <tr> <td>Refiner</td> <td>1 man.</td> </tr> <tr> <td>For making separate charcoal of dry bamboos for refining purpose</td> <td>5 men,</td> </tr> <tr> <td style="text-align: right;">TOTAL</td> <td>21 „</td> </tr> </table>	For cutting wood and converting it into charcoal	7 men.	For extracting the iron ore	2 „	To attend to the furnace	2 „	For refining the iron, Bellows and Hammermen	4 „	Refiner	1 man.	For making separate charcoal of dry bamboos for refining purpose	5 men,	TOTAL	21 „
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For making separate charcoal of dry bamboos for refining purpose	5 men,														
TOTAL	21 „														
Cost of furnace.	Furnaces are annually worked for about seven months, <i>i.e.</i> , from November to May. During the rains no work is done. (a) The cost of making and maintaining a furnace is estimated at R261.														
Outturn of crude iron.	Each furnace when in work consumes daily 3½ maunds of iron ore and 4 maunds of charcoal. The outturn, at the end of the day's work, of crude iron varies from 33 to 50 seers. The estimated outturn of crude iron, called locally "Tickole" or "Bloom," in the seven months' season would be about 275 maunds,														

in the Central Provinces.

which sells at about R4 per gon = 3 maunds = R366-10-8, leaving a profit of R105-10-8. This bloom is then re-smelted into pig iron locally called "Chaudia." For this refining purpose 10 men are engaged, these men can refine in one day the crude iron obtained from the furnaces, or about 220 maunds. The cost of the last operation is estimated as follows :—

	R
Labour at R14 per mensem and 1 blacksmith at R8 per mensem, converting 275 maunds bloom iron into pig iron for 2½ months	51
Cost of preparing bamboo charcoal	35
Forest dues on bamboo charcoal	9
	—
TOTAL	95
Add cost of making bloom	261
	—
TOTAL	<u>356</u>

The outturn of pig iron from 275 maunds bloom is equal to 220 maunds, which, at the average market rate, *viz.*, R2-8-0 per maund, yields R550, or a profit on the whole operation of R194.

The above details refer to the cost of working one furnace. Multiplying them by the number of furnaces working some idea of the extent of the industry may be formed.

Roughly estimated, it comes to about R16,000, of which 64·73 per cent. is spent on labour.

The area required to supply the quantity of charcoal noted above is about 30 acres per furnace, *i.e.*, 840 acres in all.

The pig iron so produced finds its way into all the local markets for all agricultural and domestic requirements, and it is even exported for similar purposes to Mirzapur, Ghazipur, Agra, Cawnpur, Lucknow, Benares, Dinapur, Nagpur, Bhusawal, and Khandwa. The famous Olphert's oxide of iron paint is also manufactured in Murwara tahsil, being ground in mills worked by water power. It appears they engage about 50 women and children, and the annual outturn is about 1,500 maunds, which is exported all over India, at a cost here of R5-8 per maund of 82lb.

Mandla.—There are altogether 51 furnaces. The quantity produced during 1897 amounted to 9 tons. The owners of 18 furnaces in the Dindori tahsil obtain the ore from the Rewab

IRON.

IRON ORES.

Jabalpur.

Cost of refining crude iron.

Outturn of pig iron.

Computed extent of the industry.

Trade in pig iron. Distribution.

Conf. p. 22. Olphert's paint. Labour and outturn.

Divisional Forest Officer. Mandla. Outturn.

IRON.	The Iron Industry
IRON ORES. Mandla.	State or other parts of the district. The earnings in 1897 are stated by the people themselves to have been from Rs. 25. to Rs. 30 per furnace. The people do not depend entirely on iron smelting for their livelihood, but supplement it by agriculture. The famine had a prejudicial effect upon this industry as several iron smelters abandoned their special occupation and took employment as common labourers.
Iron smelters also agriculturists Famine.	<i>Seoni.</i> —The industry of iron smelting entirely stopped last year on the outbreak of the famine, the people left their houses and went to labour on relief works or elsewhere.
Deputy Com- missioner. Seoni. Famine.	<i>Narsinghpur.</i> —The district of Narsinghpur is not very rich in iron ore, though ore is found in several places, but in small quantities. Tendukhera is the only noteworthy place in the district where the ore is found abundantly, but the mines are on altogether too small a scale to make it worth the while of a company to put any capital into the business.
Divisional Forest Officers. Narsinghpur.	Formerly there were 50 furnaces worked by some 40 smelters, now there are only 25 worked by 16 smelters. Some of the men have died and some left this work during the famine, which diminished the demand for iron.
Ore not abundant.	Since English manufactured articles have found their way into the local markets, the trade of Tendukhera iron has fallen off.
Decline of the industry.	In the two mines which are regularly worked, each person employed for digging ore gets six pies for a basketful of ore dug. In this way each labourer earns three to five annas.
Deputy Com- missioner. Rate of wages.	7. <i>Chanda.</i> —The iron ore crystalline hæmatite was quarried from the following localities. During the year 1897 (1) Lohara hill, about 6 miles east of Talodi, on the main road from Mul to Brahmapuri, (2) near Gaujewahi, about 2 miles south-east of the village from hill called "Aswal Dongri," (3) a small hill in the Dewalgaon village lands, about 6 miles of Armori, (4) a hill called Sattighat, about 8 miles east of Wairagarh, (5) hills near Pariswada (Sironcha tahsil).
Divisional Forest Officer. Chanda.	The ore was for the most part dug out in big lumps and then broken into convenient sized pieces and stacked in heaps. It was then carted by the <i>Kotwars</i> or smelters to their furnaces or <i>kothees</i> . The cost of carting the ore varying according to the distance of the village from the quarry.
Localities from whence obtained.	
Collection and carriage of ore.	

in the Central Provinces.	IRON.
<p>3. It will not be amiss to here explain the kind of furnace used and the method of smelting. No doubt the system employed does not give anything like the outturn that should be obtained from the iron put into the furnaces. There is also a greater waste of fuel than need be. Worked under different principles, the iron industry of the district should be made to pay a good profit instead of the hand-to-mouth business it now is.</p>	<p>IRON ORES. Chanda. Description of furnaces.</p>
<p>The furnaces, locally called <i>kothees</i>, are built up chiefly of clay and small stones 6 feet in height, of an irregular conical shape with a projection in front. The flue does not run straight down the centre, but slopes down from the top to the opening for the nozzle of the bellows at the bottom.</p>	<p>Process of smelting.</p>
<p>The flue of the furnace is from 12" to 13" across at the top to 6" at the bottom. The entire furnace on the outside, with the exception of the fire hole, is closed. On the furnace being charged with alternate layers of ore and charcoal and the fire put in, the fire hole is closed with bricks and plastered over with wet earth, leaving only a small passage for the nozzle of the bellows to fit into. As the charcoal and iron ore burn, more layers of ore and charcoal are put in. After four hours a small hole is made at the bottom of the furnace for taking out the slag; the hole is then closed. After another four hours the furnace is opened, and the iron which has by this time formed a lump at the bottom is taken out, and in some cases subjected to a second process of smelting in a smaller furnace, whose height is only about 1½ feet. This furnace, besides having the nozzle hole for the bellows, has a hole in front kept open for any slag remaining to run out. This second smelting was not, however, used by all <i>Kotkars</i>, and consequently the prices obtained for one smelting were much lower than if a second smelting had been done.</p>	<p>A second smelting occasionally resorted to.</p>
<p>During the year 1897 there were 23 furnaces working. These furnaces were worked from January to the end of May, five months in all. No working was carried out during the rains.</p>	<p>Numbers of furnaces employed during the year.</p>
<p>The average amount of ore used in the furnaces monthly was about 182 tons to give a yield of 40 tons of rough iron. This would give the total quantity of iron ore quarried at about 910 tons in the district and the yield to smelters after one smelting of 200 tons of iron.</p>	<p>Royalty paid to the Forest Department.</p>
<p>For the working of each furnace monthly the <i>Kotkars</i> paid a royalty of from R3 to R5. This royalty enabled the <i>Kotkars</i> to remove</p>	

IRON.	The Iron Industry
<p>IRON ORES. Chanda.</p>	<p>the ore free, and to cut wood and manufacture charcoal from the Government forests. To smelt one ton of ore about $1\frac{1}{2}$ tons of charcoal were required, which gives the total amount of charcoal consumed at about 734 tons during the year.</p>
<p>Other expenses incurred by "Kotkars."</p>	<p>For the working of each furnace when home labour was not available, an establishment was maintained of three coolies to blow the bellows and charge the furnace at R4 each monthly, two coolies to burn and supply the charcoal at R5-8 each, and to break the ore into small pieces fit for the furnace, three women at R1-14-0 each. This gives a total of R28-10-0 for establishment per furnace. Besides the above, a charge of R14 per furnace was incurred for digging and collecting the ore into heaps and then carting to the furnace.</p>
<p>Selling prices and profits to smelters.</p>	<p>Lastly, each furnace requires monthly a new pair of bellows at a cost of about R4.</p> <p>Thus the total expenditure including royalty for the up-keep of each furnace monthly was during the year from R49-10-0 to R51-10-0.</p>
<p>Absence of inter-provincial trade.</p>	<p>The selling price of the impure iron of one smelting per furnace was 15 seers for the rupee, or R56 for the 840 seers turned out.</p> <p>The monthly profit was then calculated to be R4-6-0 on each furnace. This, of course, was the case where no home labour had been employed, but such cases are very exceptional, so that a profit of R15 to R20 may safely be put down for each furnace, and as each furnace has nearly always two men as partners, a safe average of R7-8 per <i>Kotkar's</i> house may be taken.</p>
<p>Deputy Commissioner.</p>	<p>Notwithstanding this fair profit per house the <i>Kotkars</i> are exceedingly poor, for like their village brethren, whether in trade or agriculture, they are deeply in the hands of the Sowkar, who at the prevailing high rate of interest swallows all the profits and barely keep the <i>Kotkar's</i> household going in food.</p> <p>The entire quantity of iron turned out is bought and consumed locally, little or nothing going out of the district. The iron is used in the manufacture of wheel tyres, plough pins, axes, etc.</p>
<p>Bhandara. Number of furnaces at work in 1897.</p>	<p>8. <i>Bhandara</i>.—There were 14 furnaces in operation in Tirora tahsil for smelting iron from iron ore during the year 1897. They worked during the eight dry months of the year. Six persons were at work at each furnace, of whom four were men and two women. Thus 56 men and 28 women were employed during the year for</p> <p>I. 440-71.</p>

in the Central Provinces.

IRON.

production of iron. The total output of iron smelted at 14 furnaces was 45,696 seers, each furnace giving about 3,264 seers in eight months. This quantity was worth Rs 2,150 at a price of one rupee for 2½ pieces weighing 21¼ seers. Accordingly the gross earnings of each furnace were Rs 154. The cost of wages paid to labourers employed was Rs 1,792, each male labourer being paid two pieces of iron worth about Rs 12-9, and each female getting one piece worth Rs 6-4 per week. In addition to the above amount a sum of Rs 112 at the rate of Rs 14 a month (Rs 1 for each furnace) had to be paid to the zamindar within whose local limits iron ore is produced, for coal, fuel and bamboos removed from the forest for use at the furnace. Thus the total expenditure on the business amounted to Rs 1,904 or Rs 136 for each furnace, and the net earnings of the workers were Rs 246 or about Rs 17-9-0 from each furnace.

9. *Balaghat*.—Iron ore is found in the zamindaris of Bhanpur, Kinhi and Bahela. Formerly there were about 50 families engaged in smelting iron in this district, but at present the industry has almost ceased to exist. Owing to the agricultural distress prevailing in this district for the last four or five years, many of the workers have left the district in search of some other employment. It is said that a family (one man, his wife and two or three children) when employed in smelting iron can earn about Rs 3 to Rs 5 per month. Five furnaces were at work during the year.

10. *Sambalpur*.—There are 23 furnaces in the Sambalpur tahsil; of these 14 are in Rampur and 9 in Laira zamindaris. The former levies royalty from the workers of iron ore at Rs 12-0 per furnace, while the latter realizes Rs 8-0 for the working of all the 9 furnaces in the zamindari. These furnaces are worked by 69 men, and their annual earnings from each furnace may be estimated at Rs 100 or Rs 2,300 for all the 23 furnaces. Excluding the charges, namely, Rs 59 royalty and Rs 355 cost of quarrying, their profit amounts to Rs 1,886. In the Bargarh tahsil there are eight furnaces worked by 16 men. They work for five months from January to May. Their earnings amount to Rs 266 in all, and excluding Rs 149, the cost of quarrying, their profit amounts to Rs 117.

11. *Raipur*.—There are in all 33 furnaces working in the district. The workers pay Rs 11 per furnace as royalty to the zamindar. The cost of quarrying and charcoal used is estimated at Rs 350

IRON ORES.

Bhandara.
Output.

Price of labour and profits to smelters.

Deputy Commissioner.
Balaghat, Moribund state of the industry.

Deputy Commissioner.
Sambalpur.

Number of furnaces.

Royalty.

Labour.

Profits to smelters.

Deputy Commissioner.
Raipur.

IRON.	The Iron Industry
<p>IRON ORES.</p> <p>Raipur.</p> <p>Number of furnaces at work.</p> <p>Difficulty of ascertaining quantity of ore treated.</p> <p>Profits.</p>	<p>per furnace. Thus the total estimated expenditure per furnace is about R361. They use as much iron ore as they can take out from the quarries throughout the year and there are no data to find out exactly what quantity is used in each furnace during a year. The approximate quantity as far as could be ascertained is in round figures 8½ tons. Each furnace produces about 2½ tons of smelted iron, which is wrought and sold at the rate of four seers per rupee. Thus the gross income from each furnace is nearly R550 per year. The net income after deducting the cost of quarrying, charcoal and royalty is consequently R189 per furnace per year.</p>
<p>Jabalpur.</p> <p>Conf. pp. 2, 3.</p>	<p style="text-align: center;">IRON INDUSTRY IN THE JABALPUR DISTRICT.</p> <p><i>Copy of letter, dated the 14th February 1898, from R. S. Hole, Esq., Assistant Conservator of Forests, to the Conservator of Forests, Northern Circle, Central Provinces.</i></p>
<p>Iron smelting distinguished from iron manufacture.</p>	<p>Under the general term of iron industry two main branches of employment are included, the object of one being the smelting of the iron and the production of workable metal from the crude ore, and of the other the production of articles manufactured from the metal. It is necessary to draw a distinction between them as the class of people engaged in the two cases is quite different.</p>
<p>Iron smelters.</p>	<p>2. The actual smelters or <i>bhatti-wallas</i>, as they are generally called, are invariably poor, low caste individuals, such as Dhimars, Lohdis, Kachchis, Patharis, Chamars, Gondes, etc., and are very rarely Lohars, <i>i.e.</i>, workers in iron, or blacksmiths by caste. A good experienced smith can easily earn from R15 to R20 a month and sometimes more, so that there is obviously very little inducement for him to take up iron smelting at a maximum wage of R8 per month. The present smelters are, without exception, an ignorant class of people, very poor, absolutely unambitious and blind to their own interests. They seem to be quite content as long as they can manage to exist and any course of action, however advantageous in the long run, which involves a little present trouble and exertion is not contemplated by them. Like most natives they are strongly imbued with conservative ideas, and as long as possible they stay in the old groove in which their fathers ran, and when that becomes absolutely impossible and not before, they make shift, as best they can, to live with the least possible exertion. Such men are eminently unsuited to be leaders of industrial progress and they, to</p>
<p>Their want of enterprise.</p>	
<p>And hence gloomy prospect of the industry.</p>	

in the Central Provinces.

whom one would naturally look to develop the industry, are most to be blamed for its moribund condition. It is true that they have for many years been subjected to the tyranny of the middlemen, as well as confronted by other difficulties, but, at the same time, they have generally only had themselves to blame for this. The poverty of the smelters makes a middleman a necessity, and as the smelters seem to regard their poverty as inevitable, as, with their present character, it certainly is, they look on a lessee as the only person who can give them employment and therefore a blessing. At the same time, the lessee who is generally a Malguzar or other non-resident proprietor, not being a Lohar, does not see his way to increase his gains by developing the industry and improving the furnace and plant, but confines himself to working the smelters as hard as possible with minimum pay, thus making it their interest to do as little as they possibly can for the money. The Lohars or blacksmiths, *i.e.*, men who usually confine themselves to manufacturing articles from the iron prepared by the smelters, are generally much more intelligent. They prefer to be quite independent so that they can mend tools and pick up other odd jobs when not engaged on carrying out orders. They can, moreover, turn out articles of good workmanship, many of them requiring considerable skill. I have seen a rifle barrel made some 15 years ago at Barela from Bagharaji iron which is wonderfully true and symmetrical. Inside it is octagonal in shape which probably gives a spin to the bullet similar to straight rifling. The whole rifle was of native make and sold for Rs 35. Most of these smiths know nothing of the process of iron-smelting or of the construction of the furnace and, as a rule, only those Lohars who are not clever enough to make their living as smiths become *bhatti-wallas*. There can, however, be very little doubt that the shape and size of the furnace and general methods employed by the smelters are probably the very best that, with the simple appliances at their disposal, they could possibly adopt, but it is very doubtful whether people of the present class of smelters could have originated or have improved any such method. That the early smelters and smiths of India were skilful men seems well established, inasmuch as they were able to produce a mass of wrought iron in the fourth century which would have been no easy operation at the present day with our largest rolls and steam hammers, and how it is that "this

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Jabalpur.

Lessees.

Lohars or
blacksmiths.

IRON.**The Iron Industry****IRON ORES.**

Jabalpur.
Lohars or
blacksmiths.

remnant of a people possessing special knowledge" have fallen so low as they have seems impossible to explain. After all, a skilled and experienced smith who knows exactly the qualities which the best iron for his purposes must possess and who also understands the methods employed in producing the iron and who would, occasionally, also be a man of capital is the only person who can be expected to improve the industry, but whether or not the smiths in the old days were also themselves smelters or proprietors of furnaces would take too long to discuss now. Very few of the Lohars, except the less prosperous individuals in the small country villages, in the immediate neighbourhood of mines, **work only with native iron**, the majority of them having removed their shops to the larger towns and turned their attention chiefly to the manufacture of articles from the cheap English iron. At all events, whether the smelters are or are not to blame for the backward state of the industry, it is almost certainly due to them, to their ignorance, poverty and bigoted conservatism that the industry, such as it is, has survived at all in face of the numerous difficulties which have beset it.

Migration
of black-
smiths to
larger towns

Smelters.

In the neighbourhood of every well-known mine, where smelting has at any time been carried on to any extent there are two or three families who know how to make a furnace and understand the smelting business, knowledge inherited from their forefathers and which they, in turn, will transmit to their descendants. Owing to the primitive nature of the furnace, which is built entirely of sun-dried clay and cannot therefore withstand the action of heavy rain for more than three or four days, no work can be carried on during the monsoon and the smelters have to earn their livelihood as best they can by practising their usual vocations. Occasionally, the lessee of a number of furnaces who desires to keep an exceptionally skilful smelter in his employ will engage him to cut wood and make charcoal during this period. At present, owing to the very limited sale which their wares now command, many smelters have to maintain themselves all the year round by practising some industry other than iron smelting, but when they get an opportunity of again taking up the work they certainly seem to prefer it to their usual employments. This, however, it must be acknowledged after reviewing their past history, seems to be due to the fact that the work is easier and brings a more certain, if not actually larger, remuneration with

Smelting
usually
preferred
to other
callings
possibly more
lucrative.

in the Central Provinces.

IRON.

less trouble and worry than their ordinary vocations, rather than to any real interest taken in their trade and its development.

3. As no smelting can be carried on during the rains, the working season practically consists of seven months from November to May inclusive, and so any report reviewing the progress of the industry during the past year must consider portions of two working seasons. From January to May of last year there were altogether 29 furnaces, which derived their supply of fuel from Government forests situated as follows :—

At Khaireni	4
„ Borha	5
„ Bagharaji	3
„ Sonti	5
„ Tonri	3
„ Kundwara	2
„ Hargarh	7
	<u>29</u>

And from October to December there were altogether 12.

At Bagharaji	3
„ Sonti	3
„ Tonri	4
„ Kundwara	1
„ Sunawal	1
	<u>12</u>

Besides these there were a few which obtained their fuel from Malguzari jungles chiefly in the Murwara tahsil. In the beginning of 1895 there were 43 furnaces which derived their supply of ore from the Jauli and Pertabpur mines alone, besides several others situated near the Gangai and Dhanwahi mines and also in the Murwara tahsil, so it will be seen that the number of furnaces has considerably decreased in the last year or two. This cannot be ascribed to the famine, for, owing to the generosity of Government in giving money advances, numbers of the smelters were kept at work and considerable quantities of iron made during the period, while several blacksmiths have informed me that, at the time, there was an unusually large demand for Indian iron for tools for relief works, etc. The fact is that the industry as now carried on by the natives is absolutely stagnant, and bare statistics giving the number of

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Jabalpur.

Smelters.

State of the industry in 1897.

Conf. p. 24.

Number of furnaces in 1895.

Decline of the industry.

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IRON ORES.

Jabalpur.

Smelters.

History of
the industry.Government
assists the
smelters.Did not
result in
improvement
of furnaces
or plant.

furnaces in work during any year do not in any way indicate the true state of the industry at the time, and conclusions drawn from them as to the relative prosperity of the industry at various times are erroneous. To make this quite clear, a very brief sketch of the history of the industry here during the last few years may be given.

4. In 1885, when the first effort was made to revive the industry, it was believed that the baneful influence of the middleman was the principal cause of the miserable state of the smelters, and, in consequence, it was decided (in the words used at the time by the Commissioner) "to let native iron smelters take out a license from Government direct at a fair rate, while licenses should be renewable annually at the same rate for a period of say 10 years or longer if thought necessary." "This would give these men the security which at present, it is said, they have not and would encourage them, if anything is likely to, to improve their furnaces and plant." At the same time the high octroi duty and excessive taxation to which they had been subjected were reduced. Whether these measures resulted in the construction and working of a larger number of furnaces is not evident, but certainly no improvements were made in the furnaces or plant. In a report made by Mr. Bose (of the Geological Survey of India) on the subject in 1888, the following remark occurs:—"These men are too ignorant to properly understand their own interests," and he gives as an example of their stupidity that when one year Mr. Olpherts gave a large order for all the refined iron smelted in the furnaces on the Lora Range, they were very pleased at having cheated his agent by giving him the rough bloomery iron with about 30 per cent. of slag instead of the refined iron. At the same time, the smelters complained of the trouble necessary to get a license direct from Government, and said they preferred getting it from a lessee, who, three years before, had been cited by the Deputy Commissioner as the greatest curse of the industry, inasmuch as he was able by refusing a license "to throw out of employment the resident Lohars (*i.e.*, smelters) or to compel them to betake themselves to other localities."

These remarks may seem to be unnecessary, but I have considered them worthy of mention since they show that what has happened again in the last few years is practically a repetition of what took place several years ago. In 1894 the industry had apparently

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<p>once more sunk to its own level, and from 1894 to 1896 efforts were again made to revive it. This time the course of action was to hand over all the more important mines to the Forest Department to prevent "the Lohars (smelters presumably) being crushed by the heavy royalties imposed by middlemen," and a royalty of ₹50 for wood and ₹10 for ore for one furnace, for a whole season, was fixed for all the furnaces which obtained their wood from Government forests. For the first year only ₹50 was charged, the royalty on the ore being remitted. Arrangements were also made that coupés should always be open within easy distance of the furnaces. At first the number of furnaces rapidly increased, and in 1895 there were probably more than 60 furnaces in work. Then came the famine, and the demand for the articles usually made from the Indian iron decreased, the iron could not be sold and the smelters had to stop work. Then help came in the shape of money advances from Government, and a number of smelters again started work with the result that a considerable quantity of iron was manufactured which could not be sold. A certain amount of it was eventually disposed of by manufacturing tools for the relief works, but a great deal was still left on the market. Consequently, the number of furnaces is now again decreasing, and the industry returning to its normal state of stagnation. It is true that the advances were generally given to the lessee or middleman (notably to the Malguzar of Sunawal who had 15 furnaces under him), but it is very probable that, if the money had been given direct to the smelters, such as they now are, the final results would have been much the same. As a relief work, the money advances no doubt did a great deal of good in keeping the smelters at their customary congenial occupation, instead of allowing them to burden the Government works, but, as far as improving or reviving the industry went, this policy was absolutely useless. To deal primarily with the middleman who naturally puts his own interest in the fore-ground and on whom the smelters are more or less dependent is an obvious mistake, and to increase the outturn of iron, without reducing the labour or improving the methods by which it is produced and so reducing its market price, can only end in drugging the market and in throwing the smelters eventually out of work.</p> <p>5. At its present prices, there is a very limited demand for the Indian iron, but, such as it is, it seems fairly constant, so that,</p>	<p>IRON ORES. Jabalpur. Smelters. Position of the industry in 1894. Forest Department. Royalty.</p> <p>Number of furnaces working in 1895.</p> <p>Famine.</p> <p>Present decline of the industry.</p>
	<p>Limited but steady demand for Indian Iron.</p>

IRON.		The Iron Industry			
IRON ORES.		although there is no chance of the industry developing on the present lines, it is equally certain that it will not absolutely die out, at all events for many years. Seven blacksmiths, chosen at random in Jabalpur, gave the following figures as the quantity of iron purchased by them last year, <i>i.e.</i> , 1896-97 :—			
Jabalpur.					
Quantity of iron purchased by certain blacksmiths, 1896-97.	Serial Number.	English iron.		Indian iron.	
		Maunds.			
	1	.	.	.	50
	2	.	.	.	55
	3	.	.	.	30 to 35
	4	.	.	.	65
	5	.	.	.	15
	6	.	.	.	30
7	.	.	.	40 to 45	
Why native iron is preferred by blacksmiths to the English article.		<p>The reason of this demand for the native iron is that, on account of its great malleability, certain articles in universal use can only be made from it with the rude appliances of the common smiths. Thus in making the <i>kulhari</i>, or small axe in general use, the hole in the iron head which holds the wooden handle is made by hammering it out with a large nail when the iron is hot, which cannot be done with English iron. The <i>karrahi</i>, too, like a large plate with handles, is formed by subjecting the cold iron to continual hammering which also has the effect of giving the metal a fine polish. This could not be done with the more brittle English iron. Local prejudice in favour of the native iron is very strong, and it is entirely owing to its high price that it is when possible replaced by the cheaper English iron. It is said to be more durable and to corrode less than the latter, and, on account of its malleability, a tool made of it is easier to mend when broken. The so-called steel, or <i>kheri</i>, which is made at Gogra, Dhanwahi and Mangeli is manufactured in precisely the same way as the ordinary iron in the common native furnace, its peculiar character being due to the ore from which it is directly derived. This has been analysed and contains on an average 12 per cent. of manganese, some of it containing very much more. The iron obtained from it is white, glittering and very hard, and appears somewhat to resemble specular iron. It is brittle and consequently the large number of articles for which the common malleable iron is so admirably adapted cannot be made from this. There is a small demand for it for edging axes and</p>			
Steel. (So-called.)					

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<p>facing tools. The Indian iron is sold in round cakes, about 6" in diameter, 1" thick and weighing $4\frac{1}{2}$ seers, at about R3 per maund. The <i>kheri</i> is, as a rule, more expensive and sometimes fetches as much as R$3\frac{1}{2}$ per maund. Most of the English iron used is old iron generally bought from the railway at R2 to R2-8 a maund, consisting of old rails, screws, nuts, broken wheels, axes, etc., out of which the ordinary heavy hammers and other common articles not requiring much shaping are made. English iron is bought in flat bars at R5, in wires or small square bars at R6, as steel at R6 to R8 or as best steel at R10 a maund. The latter is largely used for the sides of tongas.</p>	<p>IRON ORES. Jabalpur. Steel. (So-called.) English scrap iron.</p>
<p>6. The ores which have been most largely worked during the past year are of three principal types :—</p>	<p>Kinds of ore worked.</p>
<p>(a) That used by the furnaces at Borha, Sonti, Tonri, Bagharaji, Kundwara and Sunawal which is chiefly obtained from the mine at Partabpur, but also from shallow excavations at many other places in the neighbourhood, especially at Agaria. The ore is "a soft, crumbly, fine laminated micaceous iron, with some interbanded argillaceous layers." "The rock is so soft that it can be powdered between the fingers, and is simply dug out with ordinary <i>kodalis</i>." Below this there is generally "a schistose hæmatite, which is harder than the micaceous iron, although easily worked on account of its fissile character."</p>	<p>Result of analysis.</p>
<p>The schistose hæmatite yielded on analysis 68 per cent. of iron, and the soft ore from Partabpur gave 65 per cent., both containing a little phosphorus and sulphur. The soft, crumbly ore is very splendent, dark grey to black in colour, with a distinct cherry-red streak.</p>	
<p>(b) That found near Dhanwahi, Mangeli and Gogra on the Lora hills, used last year in the furnaces at Hargarh and from which the <i>kheri</i> is made. This ore is a "manganiferous micaceous hæmatite containing a varying proportion of interbanded jaspery quartz." "It is a siliceous ore, although not very highly so." An average sample of this gave 46 per cent. of iron and 12 per cent. manganese with traces of cobalt. "The manganese exists, in large part at least, in the form of psilomelane, occurring in irregular segregations, or more minutely disseminated through the rock." The</p>	

IRON.	The Iron Industry
<p>IRON ORES. Jabalpur. Kinds of ore worked.</p>	<p>present pits "are only in talus not in the rock <i>in situ</i>," the lumps of ore being embedded in reddish clay. The colour of the ore varies according to the proportion of manganese, but it is less lustrous and more bluish-grey in colour than the Partabpur ore also with a less distinct red streak.</p> <p>(c) The lateritic ores which prevail in the north of the district and were used last year in a few furnaces in the Murwara tahsil, <i>e.g.</i>, the four furnaces at Khaireni. The principal ores are two varieties of pisolitic limonite, "one of which breaks with a smooth conchoidal fracture and shining surface; the other with a rough uneven fracture and dull lustreless surface." "In the former the hardness and tenacity of the spherules, and of the cement in which they are embedded, are about equal, so that fracture takes indifferently through both parts of the rock." "The difference of fracture in the other variety is due partly to the cement, and also the spherules, breaking with a dull uneven surface; partly to some of the spherules being dragged out of their sockets unbroken, so that the surface of the rock shows a number of rounded prominences and depressions." "The conchoidal-fractured limonite is hard and brittle, the other much softer and sometimes quite friable." These varieties, however, seem to pass insensibly the one into the other, the hardness and tenacity of the spherules and of the cement often varying in the same piece of rock, so that the fracture in one place is smooth and conchoidal, while in another it is dull and uneven, many of the spherules having been dragged out of their sockets unbroken. These ores contain from 50 to 57 per cent. of iron and "a much higher percentage of phosphorus than the hæmatites, the phosphoric acid in the latter ranging from '10 to '27 per cent., and in the former from '76 to 1'41 per cent.</p>
<p>Percentage of iron.</p>	<p>7. The primitive methods and simple appliances, now used by the natives to smelt the iron here, are probably the same as have been employed by them from time immemorial and are shortly as follows:—</p>
<p>Description of furnace.</p>	<p>The furnace employed is probably the simplest form of the iron furnace now to be found in the world. It is built entirely of clay and sun-dried bricks. From behind, the furnace appears as a semi-circular erection rising 3' above the level of the ground. In front a trench is dug to a depth of 3', 3' 6" wide at the bottom, 4' wide at the</p>

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top and about 11' long. From the bottom of this trench to the front of the hearth of the furnace is 1' and the hearth which slopes up towards the back of the furnace is about 2' × 1' 10". From the front of the hearth (the back of the hearth being 5" higher) to the throat of the furnace is 4' 10" and at the throat the shaft is 10" square. The side walls are 10" to 12" thick and the hind wall 16" to 18", these being constructed of sun-dried bricks overlaid with a mixture of two parts of clay and one part *kodo* straw. These slope slightly outwards from the top of the furnace towards the ground. The front wall is only 2" thick, and in this there are no bricks. The bottom of this front wall is 1' 1" above the front of the hearth and slopes slightly outwards towards the top of the furnace. This front wall has to bear most of the pressure of the burden, and as it is only supported by its adhesion to the thick side walls, it must, at the same time, be kept thin. As a general rule, therefore, it only lasts about eight days and then has to be replaced. The top of the furnace is covered in by a light clay roof about 1½" thick, the large hole about 6" square being left open.

The man who plies the bellows sits in the trench in front of the furnace and, to prevent the smoke and ashes blowing from the charge-hole (which also acts as the chimney) into his face, a thin screen of clay 1" to 1½" thick is erected on the top of the furnace, 3" high in front and 2' 6" at the sides. In front of the furnace a roof of branches and leaves, supported on four posts, is placed as a shade from the sun. The whole furnace takes from 10 to 20 days and sometimes longer to prepare, costing about R8. As it is built of clay, it has to be constructed in sections, each of which must be left to get thoroughly dry, to allow the clay to consolidate, before the work is continued and so the construction of the furnace is necessarily a matter of some time. The usual arrangement is that nothing is paid for actually making the furnace. A lessee having engaged a *bhatti-walla* for the season at R7 to R8 per month, the latter sets to work to construct the furnace, he and his family devoting three or four hours to the work every three or four days, letting it get dry in the interval. As their usual occupations, therefore, are very slightly interrupted, the smelter gets nothing for this and is only paid after the furnace is finished and in work. On the front of the hearth a *gaderi* is placed which looks like a long, curved brick made of

IRON ORES.
Jabalpur.
Description
of furnace.

Cost of
constructing
furnace.

Methods
followed and
appliances
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IRON.	The Iron Industry
IRON ORES. Jabalpur, Methods followed and appliances used.	<p>sun-dried clay, about 2' long, 2" thick and 5" broad. In this about 20 holes are bored, the centre upper one not being perforated. In the latter a stick is placed which, resting on the bottom of the trench, supports the <i>gaderi</i> in its place. The bottom of the furnace is then filled with a mixture of charcoal and cow-dung, about 7 seers of the former and 5 of the latter, to the level of the top of the <i>gaderi</i>. On the top of the <i>gaderi</i>, equidistant from the sides of the furnace and from each other, kept pressed against the bottom of the front wall of the furnace by two stones resting on the <i>gaderi</i>, are two tuyères or <i>badlais</i>. These are directed so as to converge at the back of the furnace. They are made of sun-dried clay, about 1' 9" long, the diameter of the aperture at the large end being 2" and at the small end $\frac{3}{4}$", the outside diameter being 4" and 2" respectively. The whole of the front of the furnace from the front of the hearth to the bottom of the front wall, is then closed up with clay, leaving the apertures of the two tuyères of course uncovered. On the side of the trench opposite the furnace a step is cut, and resting on this and on a pole placed in two forked sticks leaning against the side of the furnace, are two or three flat boards, the end of the boards coming just below the apertures of the tuyères, so that the blower who sits here can comfortably ply the bellows. The bellows are made of goats' skins, about 1' in diameter and from 2' to 2½' high when stretched. They cost about ₹12 and last a whole season. The whole furnace is then filled with charcoal from the charge-hole, about six large baskets being necessary, or about 42 seers. The furnace is then fired by blowing-live charcoal through the tuyères and the whole is speedily in blast. When the furnace is thoroughly heated and the charcoal sufficiently sunk for the purpose, a basket of ore (this is circular, 9" in diameter and 6" high, holding about 9 seers of ore), and a basket of charcoal (this basket is also circular, 1'6" in diameter and 11" high, holding about 7 seers of charcoal) are added through the charge-hole. This is then done at regular intervals of 40 minutes, during the 12 to 14 hours that the furnace is in blast, in all 20 baskets of ore and 20 baskets of charcoal being used. Thus, altogether, 189 seers of charcoal (4 maunds 29 seers) and 180 seers of ore (4½ maunds) are used. Periodically at intervals of 30 or 40 minutes, a hole in the <i>gaderi</i> is opened with an iron poker and the slag allowed to run out, while the iron remains behind as a</p>
Tuyeres.	
Bellows.	

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<p>pasty mass. As the work continues the tuyères are gradually burnt away until, at last, only about 3" to 4" are left. No flux is used, so that the slag is highly ferruginous, the silicon in the iron being oxidised and forming with a portion of the iron a fusible ferrous silicate. Not only, therefore, is a portion of the metal wasted in the slag, but it also seems certain that the removal of the silica cannot be so complete, as it would be with the adoption of a suitable flux, and so extra labour is required to refine the resulting iron from the impurities still contained in it. After continuous working for 12 to 14 hours a porous bloom of iron is obtained weighing 30 to 35 seers, about 1' 9" × 1' 4" × 5" in size. The <i>gaderi</i> is then dug out with a pick, the iron pulled out while hot into the trench and left there during the night to cool until the next morning. If this rough bloom of iron is then sold, as it is, it fetches from R1-2-0 to R2, but it is generally first refined.</p>	<p>IRON ORES.</p> <p>Jabalpur. Methods followed and appliances used. No flux employed.</p> <p>Consequent waste of metal.</p>
<p>8. The iron is refined as follows ;—</p>	<p>Refining process.</p>
<p>The rough bloom having been broken into two pieces, these are taken away to an ordinary blacksmith's forge and heated to a red heat in a small furnace about 1' 6" high and 10" to 12" square. It is then beaten by heavy hammers on an anvil and formed into round cakes, in which form it is usually sold at R2-8 to R3 per maund. From 20 to 30 per cent. of slag separates out from the iron in this process. An experiment made by Mr. Bose, with the <i>kheri</i> obtained from the manganiferous ore of Dhanwahi, showed that the rough iron lost as much as 38 per cent. of slag in the refining, while a later experiment with the Partabpur ore gave a loss of only 24 per cent. From 45 to 55 seers of charcoal are used daily in the refining furnace and it is worthy of remark that, whereas any wood is used indiscriminately for the charcoal employed in the smelting furnace, charcoal made from dead bamboos is exclusively used for the refining furnace. The bellows, also, in this case are smaller, being about 1½' high when stretched and costing about R5.</p>	<p>Labour employed.</p>
<p>9. With regard to the number of persons employed in the industry, the following remarks are given :—</p>	
<p>(a) <i>For preparing charcoal.</i>—The usual charge for the supply of charcoal for one smelting furnace is from 8 to 12 annas a day.</p>	<p>I. 440-71.</p>

IRON.	The Iron Industry											
IRON ORES.	eight people being usually employed in cutting the wood and preparing the charcoal at the following rates per day :—											
Jabalpur.	<table border="0"> <tr> <td data-bbox="362 387 506 411">A skilled man</td> <td data-bbox="577 387 836 411">.</td> <td data-bbox="856 387 950 411">2 annas.</td> </tr> <tr> <td data-bbox="362 414 538 438">An ordinary man</td> <td data-bbox="577 414 836 438">.</td> <td data-bbox="856 414 918 438">1½ "</td> </tr> <tr> <td data-bbox="362 442 448 465">A woman</td> <td data-bbox="577 442 836 465">}</td> <td data-bbox="856 442 950 465" rowspan="2">1 anna.</td> </tr> <tr> <td data-bbox="362 469 436 493">A child</td> <td data-bbox="577 469 836 493">}</td> </tr> </table>	A skilled man	2 annas.	An ordinary man	1½ "	A woman	}	1 anna.	A child	}
A skilled man	2 annas.										
An ordinary man	1½ "										
A woman	}	1 anna.										
A child	}											
Charcoal burners.												
Miners.	<p>The people employed in this work are usually Kols, and it is found necessary to give advances to those people or else they cannot be depended on to perform the work, or prevented from working for other people. From six to eight people are, on an average, employed in preparing the charcoal for the refining furnace.</p>											
Charges for collecting the ore.	<p>(b) <i>For digging out and bringing the ore to the furnace.</i>—As a rule one man and his family, or from two to three individuals are employed on this work and the amount paid varies, according to the difficulty of getting the ore, the distance to which it has to be transported and the state of the road. Six rupees is paid at Tonri for the ore required for one furnace during a month, the ore being the soft, powdery, micaceous iron very easily extracted from the Partabpur mine about 5 miles off, whereas at Sunawal ₹7 is paid for the same ore, although the distance is nearly the same. At Dhanwahi and Gogra the charge is two annas a day for the ore extracted from the mines close by, whereas it is ₹0-2-9 for the furnaces at Korai and Hutwar, respectively 5 and 7 miles from the mines. This charge also includes <i>dressing</i>, i.e., breaking up the ore into small bits and roughly separating it from the quartzite matrix, which operation is unnecessary in the case of the Partabpur ore. The ore is carried on pack buffaloes.</p>											
Smelters.	<p>(c) <i>For managing the furnace.</i>—Two men are employed. One is the overseer who builds the furnace and understands the business of smelting thoroughly, getting from ₹7 to ₹8 a month. The other man, who simply acts as blower, gets ₹4 a month. These two men ply the bellows alternately, the one not engaged on the bellows seeing that the furnace is kept properly charged. A non-resident proprietor has to employ a munshi to supervise the smelters, the Malguzar of Sunawal employing three munshis, each on ₹10 a month, to supervise twelve furnaces and to keep the accounts.</p>											
	<p>(d) <i>For refining the iron.</i>—As a rule eight persons are required: the Lohar who superintends the work and holds the iron on the</p>											

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<p>anvil and directs the beaters or hammermen, getting from R10 to R15 per month, five hammermen and two men to work the bellows, on daily labour at 1½ to 2 annas a day. These people usually work from 5 A.M. to 1 P.M., the blower working 3½ hours on end and then changing. They can refine in one day from 90 to 105 seers of rough iron, or the produce of three furnaces, making from 60 to 70 seers of refined iron.</p>	<p>IRON ORES. Jabalpur. Labour necessary for refining. Wages.</p>
<p>(e) <i>For manufacturing articles from the iron made.</i>—As a rule, one Lohar or experienced smith is required, three to four beaters or hammermen, and one woman for the bellows. The beaters and woman who works the bellows are employed at 1½ to 2 annas a day and the usual arrangement is that, when any person desires certain articles, he gives the refined iron to the smith who then makes the articles required at the regular rate of R4 per maund, in other words, a maund of manufactured articles is made at a cost of R4. The working hours are usually from 6 A.M. to 6 P.M. with a break from 12 A.M. to 2 P.M.</p>	<p>Blacksmith and assistants.</p>
<p>For making certain articles more hammermen are required than for others, thus for <i>gantis</i>, <i>kulharis</i>, <i>kodalis</i>, and <i>phaoras</i> four hammermen are required and otherwise only three are employed. For some articles which require a good deal of finishing such as <i>karahis</i>, an extra man is employed who gets 4 to 5 annas a day, being able to make four or five finished <i>karahis</i> in one day from the rough plates prepared by the beaters.</p>	
<p>As I have before remarked, most of the smiths have now betaken themselves to the larger towns and carry on their trade chiefly with English iron, only taking small quantities of Indian iron now and then, according to the demand.</p>	<p>Conf. p. 10.</p>
<p>10. The commonest articles made from the native iron are the following :—</p>	<p>Manufactures from native iron.</p>
<p><i>Gantis</i>, pickaxes. <i>Hansiyas</i>, sickles. <i>Kulharis</i>, axes. <i>Pans</i>, plough share. <i>Kodali</i>, a pickaxe with one tooth. <i>Phaora</i>, a kind of spade. <i>Karrahi</i>, large plate with handles.</p>	<p>Conf. p. 23, et seq.</p>

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also Dict.
Econ. Pro-
ducts, Vol.
IV. p. 521.

Nails and hammers of various kinds are also made and occasionally gun-barrels (especially at Barela). I have also heard that small swords are still made in places, but I have as yet seen none.

11. Before closing this report on the iron industry of the district, it is worthy of notice that Mr. W. G. Olpherts has found a subsidiary use for the local iron ores which he has now practised for many years, *vis.*, the manufacture of his well known metallic paint. This gentleman held a lease of the iron mines at and near Jauli and Sarroli from 1875 to 1890, the principal ore which he used being that from the Jauli mine. This is described as "a semi-ochreous hæmatite in which a slightly schistose structure is often apparent. Hæmatite with metallic lustre also occurs, but is quite subordinate to the more ochrey kind. The ore is interbanded with quartzose layers which in some places greatly exceed the ferruginous part of the rock." Picked samples of the ochrey hæmatite are used by Mr. Olpherts, an analysis of which gave as much as 69 per cent. of iron while an average sample gave 53 per cent. of iron. The ore is first pounded with crushers, sifted and then ground to an impalpable powder with heavy millstones. In the neighbourhood of the works, the river Kutna has been dammed up by a weir, and arranged along this, there are eight millstones, four of which are larger than the rest. Each stone is fixed to a vertical iron shaft, in the lower part of which stout pieces of wood are fixed which radiate from the shaft like the spokes of a wheel. When the water is turned on to those spokes, the shaft revolves and the stone fixed to it turns upon another flat, horizontal stone below it, thus grinding up the ore which, when mixed with water, is poured into a hole in the centre of the upper stone, finally running out into a trough below it. After the ore has been ground up under the light stones, it is passed under the heavy ones; it is then collected and spread out in a layer about 3" thick on smooth flags or a concrete floor where it is left to dry. When quite dry it is powdered up, placed in bags of 1 cwt. and $\frac{1}{2}$ cwt. and sold at R7 per cwt. By mixing the ore with "varying proportions of red lead a series of bright crimson lakes may be prepared, with white lead a variety of lilac colours, with lamp-black and small quantities of the oxide warm chocolate browns may be obtained."

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To prepare the paint the following constituents are used in the given proportion :—

Of Olpherts' paint (<i>i.e.</i> , dry powdered ore)	14 lbs.
Resin finely ground	4 "
Raw linseed oil pure	20 "
Turpentine oil	$\frac{3}{4}$ "
Verdigris finely ground	$\frac{1}{4}$ "

and the following directions are given :—

"First take of linseed oil and paint sufficient quantities so as to macerate in a mortar to a fine paste free from granules. Boil remaining quantity of the linseed oil, in a separate iron pot, to boiling heat; add the quantity of resin to it and boil both over till the mixture nearly attains to a flaming heat, and add the verdigris and the macerated paint and stir the whole briskly until well assimilated and strain all into another clean vessel. The paint is then ready for use—the turpentine oil only being added when the paint is required to be applied at once to anything." Mr. Olpherts now holds a lease of the Gosulpur manganese mine at R1,000 per year, for five years from January 1895, and the pyrolusite from this mine is exported in the form of an impalpable powder, being ground up precisely like the hæmatite, as above described.

Copy of letter dated the 28th February 1898, from R. S. Hole, Esq., Assistant Conservator of Forests, to the Conservator of Forests, Northern Circle, Central Provinces.

With regard to the number and value of tools manufactured from native-made iron in the Jabalpur District last year and supplied to famine relief works, as well as with reference to the approximate number of individuals relieved by the money advances given by Government, I have the honour to submit the following :—

1. Towards the end of 1896, owing to the famine and the consequent decrease in the demand for articles usually manufactured from the native-made iron, there was a large quantity of the latter upon the market which could not be sold. It was found impossible to get rid of this until the idea was started of making tools for the famine works from this iron. Advances were then given by Government to enable the poorer smiths in the neighbourhood of the principal mines and smelting centres in the district, at Bagharaji and Sunawal, to set up their plant and start work. As these smiths, also,

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IRON ORES. Jabalpur. Native-made iron manu- factures.	<p>were not able to make certain articles that were required, two skilled Lohars were sent from Jabalpur to teach them. Altogether, Rs. 2,188 were advanced during the year, and this sufficed to work off the stock of old iron and also to start and keep in work several new <i>bhattis</i> or smelting furnaces. Up to the end of June, the following tools, which had been made from the local iron, had been disposed of to Famine Relief Works:—</p> <table data-bbox="373 543 965 748"> <thead> <tr> <th></th> <th style="text-align: right;">₹</th> <th style="text-align: right;">a.</th> <th style="text-align: right;">p.</th> </tr> </thead> <tbody> <tr> <td>3,974 Pickaxes, at 11 annas each</td> <td style="text-align: right;">2,732</td> <td style="text-align: right;">2</td> <td style="text-align: right;">0</td> </tr> <tr> <td>1,021 Kodalis " 5 "</td> <td style="text-align: right;">319</td> <td style="text-align: right;">1</td> <td style="text-align: right;">0</td> </tr> <tr> <td>1,703 Phaoras " 10 "</td> <td style="text-align: right;">1,064</td> <td style="text-align: right;">6</td> <td style="text-align: right;">0</td> </tr> <tr> <td>1,224 Hammers }</td> <td rowspan="2" style="text-align: right;">503</td> <td rowspan="2" style="text-align: right;">5</td> <td rowspan="2" style="text-align: right;">9</td> </tr> <tr> <td>101 Crow-bars }</td> </tr> <tr> <td style="text-align: right;">Total value</td> <td style="text-align: right;"><u>4,618</u></td> <td style="text-align: right;"><u>14</u></td> <td style="text-align: right;"><u>9</u></td> </tr> </tbody> </table>		₹	a.	p.	3,974 Pickaxes, at 11 annas each	2,732	2	0	1,021 Kodalis " 5 "	319	1	0	1,703 Phaoras " 10 "	1,064	6	0	1,224 Hammers }	503	5	9	101 Crow-bars }	Total value	<u>4,618</u>	<u>14</u>	<u>9</u>
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The value of the hammers and crow-bars cannot be given separately as they were sold by weight, they being made of several sizes. The crow-bars were sold at Rs 6 a maund and the hammers at Rs 10 and Rs 6 a maund, respectively, according as they were, or were not, faced with steel. Besides the above, from January to the end of August, about 5,000 more tools (chiefly gantis, phaoras, kodalis and hammers) were made which, although they were not directly disposed of to famine works, were, in large part at least, afterwards sold to other purchasers and the manufacture of which afforded employment to many poor people during the famine. This gives the approximate number of tools whose manufacture was directly the consequence of the money advances made by Government, but, before they were prepared, considerable quantities of tools had been purchased from the Jabalpur smiths for Relief Works, many of which were doubtless manufactured from the locally made iron.

2. With regard to the number of individuals relieved by Government advances, it is necessary to consider (a) the number of furnaces which were kept in work, and the number of people to whom these afforded employment, and (b) the number of people occupied in refining and making articles from the rough iron who, but for the money advances, would have been unable to continue work.

(a) As stated in the previous report, there were altogether 29 furnaces which were working, some time or other, between January

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and June of last year (1897) which derived their supply of fuel from the Government Forests. Besides these there was one which got its fuel from malguzari jungles, thus making 30 in all.

It is possible that there were a few more furnaces which got their supplies of fuel from malguzari jungles, but if any they must have been few in number, as the demand for the native-made iron, at the time, was almost entirely for tools for the relief works and these were principally supplied by the Forest Department and made from the iron manufactured in the above mentioned 30 furnaces. Of these 30 furnaces, three were already under a lessee before advances were made and would have continued working any way, so that we may take 27 furnaces as the number relieved. (The advances which were made to four of these furnaces are not included in the Rs. 1,88 mentioned above, as they were given by the Deputy Commissioner.) These 27 furnaces, however, were never all working at the same time.

In November and December there were 12 furnaces in work.

Now each furnace, on an average, gives employment to twelve individuals, eight being occupied in making the charcoal and cutting the wood, two in getting the ore and two for managing the furnace, so that the number of persons relieved is as under:—

Months.	No of furnaces in work.	No. of persons relieved.
January . . .	17	204
February . . .	18 (a)	216
March . . .	18	216
April . . .	26 (b)	312
May . . .	23 (c)	276
June . . .	4 (d)	48
July . . .	...	...
August . . .	...	...
September . . .	...	...
October . . .	...	...
November . . .	12	144
December . . .	12	144

Thus the largest number of persons relieved in any one month was 312, probably about 78 families, and of these 36 persons were employed for two weeks only.

(a) Of these 18 furnaces, one worked for three weeks only.

(b) " " 26 " three " " two " "

(c) " " 23 " one " " " " "

(d) These four furnaces only worked for one week. Still as the results can be only approximate fractions of a month are neglected in the above calculations.

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(b) Now with regard to refining the iron and making articles from it. We may first of all assume that all the iron made in the above-mentioned furnaces was refined and rendered marketable, so that the number of persons employed on this refining will be approximately as follows, since eight persons (one Lohar, five beaters, and two blowers) can refine the produce of three furnaces in one day and, on an average, seven persons can supply them with charcoal:—

In January	. 17	furnaces employed	45 + 39 = 84	persons.
„ February	. 18	„ „	48 + 42 = 90	„
„ March	. 18	„ „	48 + 42 = 90	„
„ April	. 26	„ „	69 + 60 = 129	„
„ May	. 23	„ „	61 + 53 = 114	„
„ June	. 4	„ „	11 + 10 = 21	„
„ July				
„ August				
„ September				
„ October				
„ November	. 12	„ „	32 + 28 = 60	„
„ December	. 12	„ „	32 + 28 = 60	„

Now from January to June, altogether 833 maunds of tools had been manufactured, and as, on an average, it takes one Lohar, four beaters, and one blower, one day, to produce 19 seers of these ordinary rough tools and seven persons to make the charcoal, it follows that, during these six months, about $\frac{833 \times 40}{180 \times 19} \times 6 = 58$ persons were employed, or more probably, every month 10 Lohars, 40 beaters and 10 blowers, or, altogether 60 persons were occupied and to supply them with charcoal 70 more persons. Finally, at the end of June, altogether about 15,177 seers of refined iron were in stock, and the 12 furnaces, working during November and December, probably produced $12 \times 33 \times 26^* \times 2$ seers of rough iron, *i.e.*, 20,592 seers, which would give about 14,414 seers of refined iron, allowing for the slag and other impurities. Thus $15,177 + 14,414 = 29,591$ seers of refined iron remain to be accounted for. Now, assuming that this is worked up, which would, if so, be mostly made into karrahis, tawas, kulharis, and other articles most commonly used, some of which, especially the karrahi, require more finish than the rough tools made for the relief works, we should have the following additional number of Lohars and assistants employed. On an average one Lohar, four beaters and one blower can produce 17 seers of these

* It is assumed that each furnace is working 26 days in each month to allow for repairs to furnace and other interruptions.

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articles in one day. The refined iron, also, when made up into articles, loses about 38 per cent. of its original volume and weight, so that between July and October, about 9,410 seers of articles and, from November to December, about 8,937 seers of articles were made. During July to October, therefore, $\frac{9410}{17 \times 120} \times 6 = 28$ persons were employed. We may, with more probability, put this at 30, *vis.*, 5 smiths, 20 beaters and 5 blowers and 35 persons for charcoal. During November to December about $\frac{8937}{17 \times 60} \times 6 = 53$ persons were employed. We may, with more probability, put this at 54, *i.e.*, 9 smiths, 36 beaters and 9 blowers and 63 persons for charcoal. It must be observed, however, that a good deal of this refined iron was probably sold and sent to Jabalpur as such and was there worked up into articles and, as the Jabalpur smiths are generally carrying on a flourishing industry just now and by no means entirely depend on the native-made iron for the success of their industry, being able to generally replace it with cheaper English iron, they cannot be said to have depended on the advances and thus to have been relieved. For the present this consideration may be disregarded, and we then have the following figures as the total number of persons relieved last year :—

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Month.	PERSONS EMPLOYED IN			TOTAL.	Approximate number of families.
	Smelting.	Refining.	Making articles.		
January . . .	204	84	130	418	105
February . . .	216	90	130	436	109
March . . .	216	90	130	436	109
April . . .	312	129	130	571	143
May . . .	276	114	130	520	130
June . . .	48	21	130	199	50
July . . .	...	...	65	65	16
August . . .	...	...	65	65	16
September . . .	...	...	65	65	16
October . . .	...	...	65	65	16
November . . .	144	60	117	321	80
December . . .	144	60	117	321	80
TOTAL	...	...	...	3,482	870

Thus an average number of about 290 persons, corresponding to about 73 families, were relieved each month throughout the year.

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