Indian Journal of History of Science, 17 (2) : 205—222 (1982)

DEVELOPMENT OF MINING TECHNOLOGY DURING THE NINETEENTH CENTURY IN INDIA

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1. INTRODUCTION

The present day civilization and the cultural progress of mankind has been influenced to a large extent by mining and metals. From the stone age to the present day, mining has made a vital contribution to engineering and the growth of civilization, which began with the making of tools and ornaments, and the smelting of ores 'probably some 9000 years ago'.[1]

The French mining historian Simonin[2] in his classic book *Underground Life or Mines and Miners* writes:

> "the intrepid coal miner, whose advent is of but recent date; the veteran of the mineral world—the metal miner—whose origin dates from the dawn of the history; and the patient seeker after gems"

and then comments :

> "everybody has thought, at some time or other, of the important part played by metals in the life of the nations. From the most precious to the basest, from the rarest to the commonest, they all play a special part; and material progress is only effected by their means. The history of metal constitutes the true history of inventions and labour."

In India, evidences exist of the use of gold, silver and copper in the Indus Valley Civilization (2500 B.C.-1800 B.C.). In *Ṛgveda*, the oldest composition of Aryans (1500 B.C.-1200 B.C.) mention has been made of the uses of copper, bronze, gold and silver and in *Yajurveda* (1100 B.C—1000 B.C.) mention has been made of the use of gold, silver, copper, lead, tin and iron[3].

The earliest and the most authentic record of information relating to minerals in India is found in '*Arthaśāstra*', a treatise composed by Kauṭilya famously known as Cāṇakya, between 321 and 296 B.C. This treatise gives a comprehensive account of the properties of ores of minerals and metals with the methods of their large scale production and treatment as well as the manufacture of alloys like brass, bronze and also gold and silver alloys with base metals (Sec ref. 3). In this treatise Kauṭilya gives the qualifications of the officers-in-charge of the mine and manufacture as below:

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> "The Superintendent of Mine should possess knowledge of the Science dealing with copper and other minerals; he should have experience in the art of distillation and condensation of mercury and of testing gems. Aided by experts in mineralogy and provided with mining labourers and necessary instruments he shall examine mines which, on account of their containing mineral excrements, crucibles, charcoal and ashes may appear to have been well exploited, or which may be newly discovered, on plains or mountain slopes possessing mineral ores, the richness of which can be ascertained by weight, depth of colour, piercing smell and taste."

The writings of travellers like Travernier, Pliny, Alberuni, Verthema, Barbusa, Hamilton, etc. also give glimpses of the old history of mining in India.[4]

The miners of ancient times mined the surface alluvial deposits or shallow vein deposits occurring at or near the surface and could not go down deep below ground due to the limited knowledge of mining techniques, ventilation methods and due to non-availability of better mining appliances. Copper was mined near Rakha (Bihar), Khetri (Rajasthan) and in Sikkim. Gold was worked at Kolar and Hutti and lead and zinc at Zawar in Rajasthan. The mines were opened by adits 0.9m×0.9m to 1.8m×1.2m or by shallow shafts 1.5m×1.2m or 1.2m×0.9m. In one case depth of 150m was reached. Fire setting was used to break the rock. Timbering was rarely resorted to. Small pillars of ore were left to support the ground and in some cases timbers 15-18 cm in diameter were used to support the stoped out areas.

> "The labourer while at work sat upon his heels with the lamp upon his head, holding a chisel in his left hand, struck with a hammer held in the right hand and collected the chipped fargments in the basket held upon his knees. The bamboo baskets of ore were passed along a chain of persons, usually 4 to 12 in number, who sat upon their haunches in the galleries or stood on the niches cut in the shafts; when the whole reached the foremost man, they moved upwards, and again ranged themselves, and this was continued until the mouth of the mine was reached. The age of these mines is reckoned to be 1500—1000 B.C.".[4]

There are evidences to show that at Hutti windlass was also used and broken earthen pots have been found at the bottom of workings at Hutti and elsewhere in South India which were used for boiling out water. Arabia Acasia was used for support. Pillars have also been left to support the excavations. Previous workings have also been filled with boulders, rocks and debris.

Mining of diamond has been done at Golcunda and Panna from time immemorial. In olden times wide shafts up to a depth of 15m were sunk to reach the conglomerate which was cracked by heating with fire for easy extraction. In the alluvial deposits pits up to 9m deep were sunk. The workings were haphazard in nature and the mining was done during the dry season only.

In the medieval ages, India had a fairly well developed metallurgical industry. The slags of iron and steel and metals like copper, zinc, lead and gold and to a smaller extent silver and cobalt in parts of Rajasthan and Bihar and at several places in Deccan bear testimony to the occurrence of vigorous and flourishing industry in the past. But this industry was run almost like a cottage industry and by the beginning of the nineteenth century was almost dead. It was, however, revived again with the consolida-

tion of British Raj by the middle of the nineteenth century. Mining of gold, manganese, copper, iron ore, mica and coal was taken up with enthusiasm and attempts were made to put mining on scientific and systematic basis.

2. Growth of the Mining Industry in the Nineteenth Century

Coal Mining

The first published reference to the mining of coal dates back to the year 1774 when shallow mines are reported to have been developed in the Raniganj coalfield.[5] But the venture ended in failure. Next attempt was made 40 years after to develop coal mining.

In the absence of the necessary railway facilities the expansion of the coal industry for many years was but slow. From 1815 to 1860, over a period of nearly half a century, the output had nearly reached to an annual total of 370,000 tons. However, by 1897 some 20,000 miles of railway track had been opened and this facilitated the development in the coal mining industry.

In 1872 there were only a few companies at work in Raniganj coalfield consisting practically of five —The Bengal, Raniganj, Equitable, Burrakur and Beerbhoom and some Indian owned companies. There were 44 working mines of which more than half turned out less than 50,000 tons per year. Expansion of Railways to Jharia and other parts of the country facilitated the development of coal industry and by 1893 there were 129 Joint Stock Companies in India representing an aggregate ordinary capital of Rs. 867 lakhs. The increase in output kept pace with the development of railway facility (Table 1).[6]

Table I

Year	Output	Railway track opened
1815-1860	370,000 tons	1857 : 300 miles
1870	500,000 ,,	1877 : 6,000 miles
1890	2000,000 ,,	
1900	6000,000 ,,	1897 : 20,000 miles
1908	12,750,000 ,,	1960 : 30,000 miles

From 1905, the output of Jharia coalfield exceeded that of the Raniganj Coalfield.

Elsewhere the progress had become continuous during the second half of the nineteenth century. The beginning of coal mining in the central provinces dates back to the year 1862 and in the Rewa State to 1884. The Singreni field in Hyderabad State (now Andhra Pradesh) was discovered in 1872 and went into production some fifteen years

later. Appreciable developments took place in Upper Assam from 1881 and in Baluchistan and in the Punjab in the last decade of the 19th Century.

In the beginning of the twentieth century, coal production in India had reached a total of about 6 million tons, of which nearly 5 million tons were obtained from the Jharia, Raniganj and Giridih coalfields.

The early entrepreneurs had to conclude agreements with the coal landowners and the inevitable complexities and resultant legal disputes caused many failures.

Gold Mining

There are a large number of mines in the South India where gold is believed to have been mined in the ancient times. In 1802, Lt. Warren rediscovered the ancient workings for gold in the Kolar district. In his report Lt. Warren wrote: "I must, however, give it as my humble opinion these mines will never prove more worthy of notice than as a matter of curiosity"[7]. In 1871, Mr. Lamelle commenced prospecting on a small scale, and in 1876 a local syndicate was formed. By 1880, several London Mining Companies were in existence to explore the field, but their early efforts were unsuccessful. The Mysore Company, after nearly exhausting its capital without success in 1883 upon the recommendations of John Taylor and Sons and of Mr. Bell Davies decided to continue exploration rather than abandon the enterprise. Captain Plummer, after driving crosscuts to a distance of 40 feet towards the west side of the outcrop discovered ancient workings containing quartz worth 4 ounces of gold per ton. After this discovery the development of Mysore Mine was continued with success. Three Sterling Companies commenced working the mines on the dates as shown.

The Mysore Gold Mining Co. Ltd. 1880
The Champion Reef Gold Mining Co. (India) Ltd. 1889
The Nandydroog Gold Mining Co. (India) Ltd. 1880

The workings in these mines had gone to depths of over 300m by the end of the last century.

Copper Mining

From the last century copper has been mined in the Singhbhum Copper belt, first at Rakha Mines and then at Mosaboni and Surda Mines in the same belt[8]. Singhbhum Copper Company was formed in 1857 and commenced operations in Seraikela. The ore found was good but the establishment and plant costs and the royalties payable proved uneconomic and the operations ceased in about 1859. A second company Hindustan (Singhbhum) Copper Company shared the same fate at Rajdah in 1864. In 1891, Rajdah Mining Company started exploration and opened up a lode at Rakha but the operations were stopped. A systematic exploration was taken up by the Geological Survey of India in 1906-08 which proved the potentialities of the copper belt in Bihar and laid the foundation for its development.

At Khetri (Rajasthan) copper has been mined since ancient times. However, the first recorded mention of Copper Mining in Khetri is found, in the *Ain-i-Akbari* (*Ain* II Page 194) which was written in 1590 A.D. Subsequent to this until 1831 no records are available. Two mines were working in Singhana and Khetri towns up to 1859. In 1872 regular mining ceased except for sporadic activity. During 1915-18 and 1921-22 efforts were made again to open the mines again but with no success.

Lead and Zinc Mining

India had a flourishing lead and zinc mining from the ancient times. The mining and smelting operations must have been part of a large and a well organised industry as evident from extensive old workings (Fig.1) and vast heaps of slag and countless earthen retorts (Fig. 2) scattered around the ruins of Zawar[9,10]

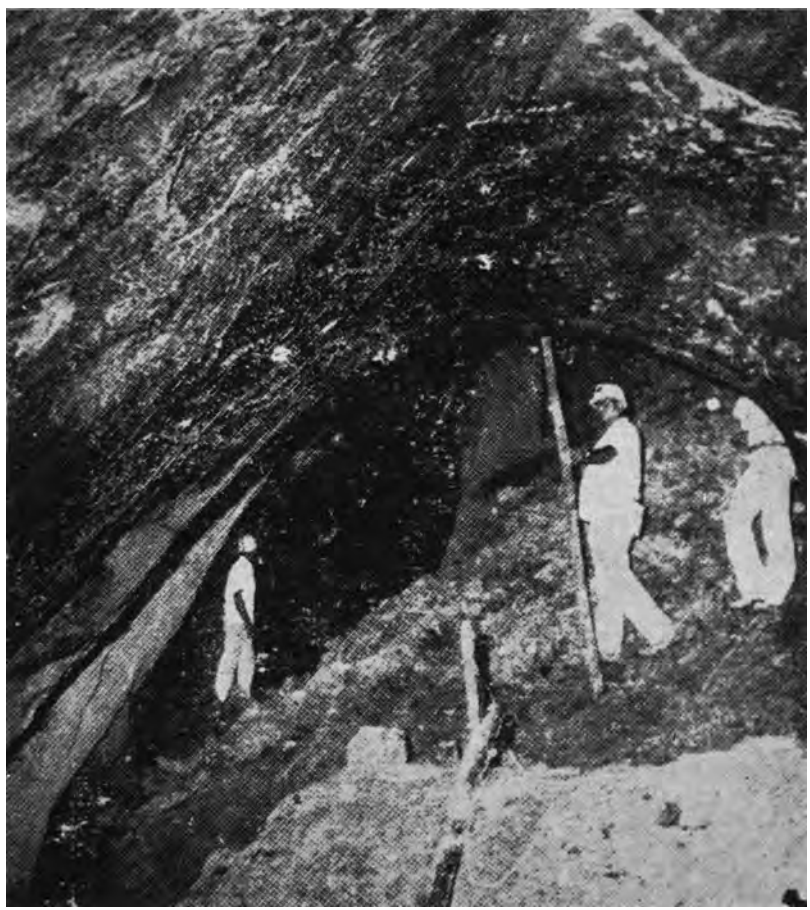

FIG. 1. A view of the old workings at Zawar

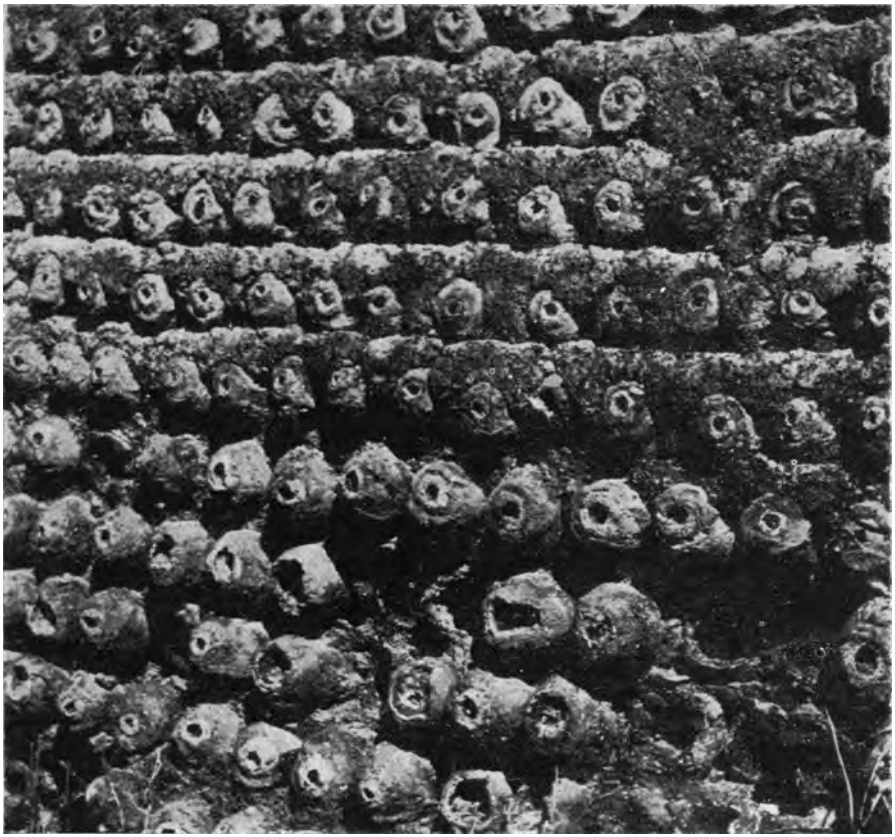

FIG. 2. A view of the clay retorts of furnaces at Zawar

Zinc was probably smelted commercially as early as 14th century. Rana Lakh Singh, Maharana of Mewar, was the first to work the mines, known as the Zawar deposits around 1382. Mining and smelting were interrupted from time to time because of feudal wars. These mines were abandoned by about 1813 and were not opened until 1935.

Iron Ore Mining

The modern ventures for iron production were started in Tamil Nadu, Kumaon (U.P) and Bengal by some local companies. But all those failed to prosper. In all these undertakings, charcoal was used as the fuel for smelting of iron ore and it was not until 1875 that advantage was taken of coke made from Indian coal.[11] In 1875 large furnaces were erected at Kulti, in Raniganj coalfield, which were taken over by Bengal Iron Works and which established iron smelting in India on firm foundations.

At the beginning of the present century, the Iron ore production was about 65000 tons. The hematite deposits of Mayurbhanj (Orissa) were discovered in 1904 and those of Singhbhum (Bihar) in 1907 (See ref. 11). These deposits were found to be extensive and rich in iron content and this discovery led to large scale iron ore mining in India.

Mining of other minerals

The mining of manganese ore was first started in Visakhapatnam district in 1891 after it had been noticed that the railway contractors were breaking up blocks of manganese ores for railway ballast and by 1907 India had become the world's largest producer of manganese ore and continued to be so until 1912. The production of manganese ore rose from 3,130 tons in 1893 to 127,814 tons in 1900 and to 247,472 tons in 1905 (Fig. 3). The number of men and women employed rose from 600-1,100 in 1895 to 4,242 in 1900 and to 5,122 in 1922.[12]

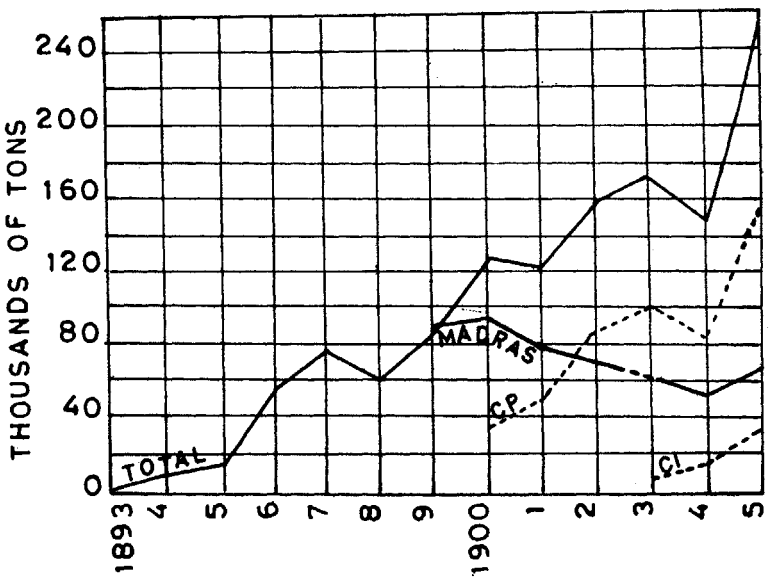

FIG. 3. Growth in the production of Manganese ore in India (1893-1905)

The production of mica both from Koderma and Nellore is recorded prior to 1910 when it was worked by several devoted bands of skilled workers. The first venture of Europeans failed. But it was well established under the direction of F.F. Chrestian in 1894 and by 1899 his company was operating 110 mines out of total of 170 mines in the Koderma micafield. The process of splitting discovered during this period gave a great impetus to the mica industry and the local workmen became very expert in this manual process and many countries in subsequent years began to export mica to India for fine splitting only. Modernisation of fine mining started in 1910 (See ref. 11).

Salt has been produced from Sambhar Lake since the time of Emperor Akbar. From 1856, the average annual output from Sambhar Lake has been about 25,346 tons. In 1879, the output increased to 110,204 tons. The rock salt mines or quarries of Mandi State are situated at Drang and Guma and were originally worked in most primitive manner, being open to drainage and caving every year during the rains. In 1879-80 the total quantity of salt received amounted to about 38,000 tons (see ref. 11).

Drilling for petroleum commenced in Assam in 1866-67 when one shallow well was dug near oil seepages near Jaipur and Makum. Although the discovery of Digboi Oil was made in 1866, but drilling was started only in 1889 and the first well completed in 1890 and produced only 200 gallons of oil per day. Another discovery was made later in 1901 near Badarpur in the Surma Valley. None of the organisations which made these discoveries had any specific knowledge concerning how to find and develop petroleum resources. Eventually the Burmah Oil Co., an organisation with established petroleum activities came on the scene and altered the picture after taking over the Badarpur Oilfield in 1915 and the Digboi Oilfield in 1921.[13]

From the records available it appears that in the beginning of the nineteenth century there were 360 metalliferous mines employing about 29,000 workers.

3. Development in Mining Technology

Coal Mining Technology

As said earlier coal was mined in the nineteenth century close to the outcrops by opencast methods or by shallow pits.

The pits were sunk close to each other. 'More hole more coal' was the policy. Depths of 91m were considered very great depths but in the beginning of 20th century some mines reached depths of 243-274 m in the Giridih Coalfield. Gin was in common use in the nineteenth century. Workings were generally on bord and pillar system and the pillars were rather small; even the shaft pillars were small. Extensive areas were developed on small pillars (Figs, 4 and 5)[14,15] which were often lost due to fire or crushes. Adequate provisions did not exist for isolation of fire.

"The almost universal system in vogue in India in the average seam 4.8 m thick dipping at 1 in 6 was to work galleries 4.8 m wide $\times$ 14.8 m high leaving pillars 6-12 m square. Unless dykes or faults intervened the whole of the workings were interconnected and by the time the boundary was reached the whole of the property was standing on pillars, the amount of coal extracted in the first working was 40-60% leaving on an average 50% in the pillars. After the dip boundary was reached, pillars were extracted retreating risewards and filling the goaf with water".[16] Formation of smaller pillars sometimes led to disastrous subsidence[17] as happened in 1901 in Dishergarh district lying to the north of Dishergarh colliery. The subsidence extended to an area of 3353.2 sq.m. The workings were at a depth of 44 m. The pillars were 4.5-6 m sq. and

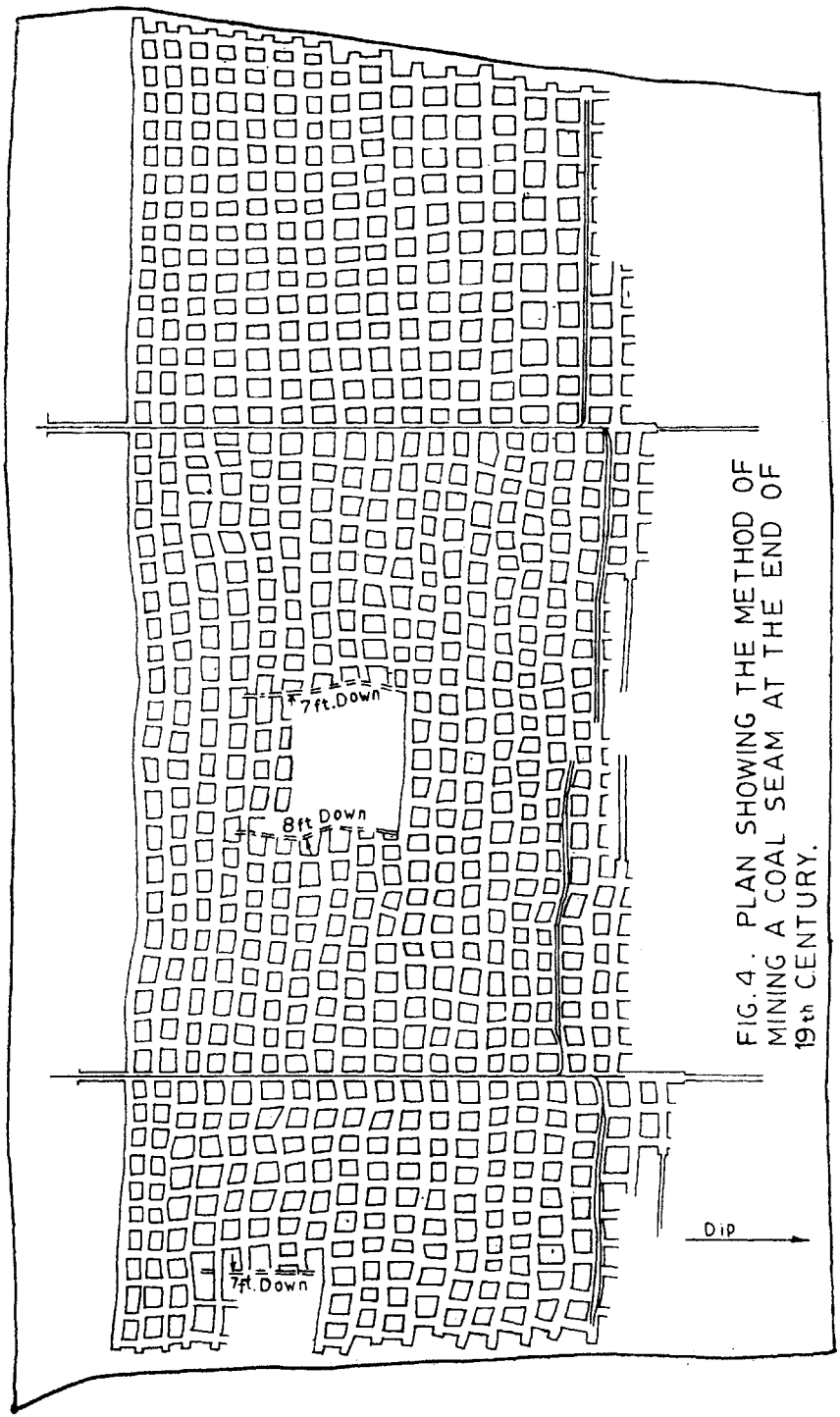

FIG. 4. Method of mining a coal seam at the end of 19th century

the greater number did not measure more than 3-4.5 m by 1.2-1.5 m or even less. The area subsided 5-6 years after the pillars were formed and the draw or pull was 26.5 m beyond where the coal had been worked in smaller pillars. The situation changed towards the end of the century. Faults and dykes were made use of to isolate areas or workings were laid out in panels. Size of pillars were increased and percentage recovery in depillaring was improved.

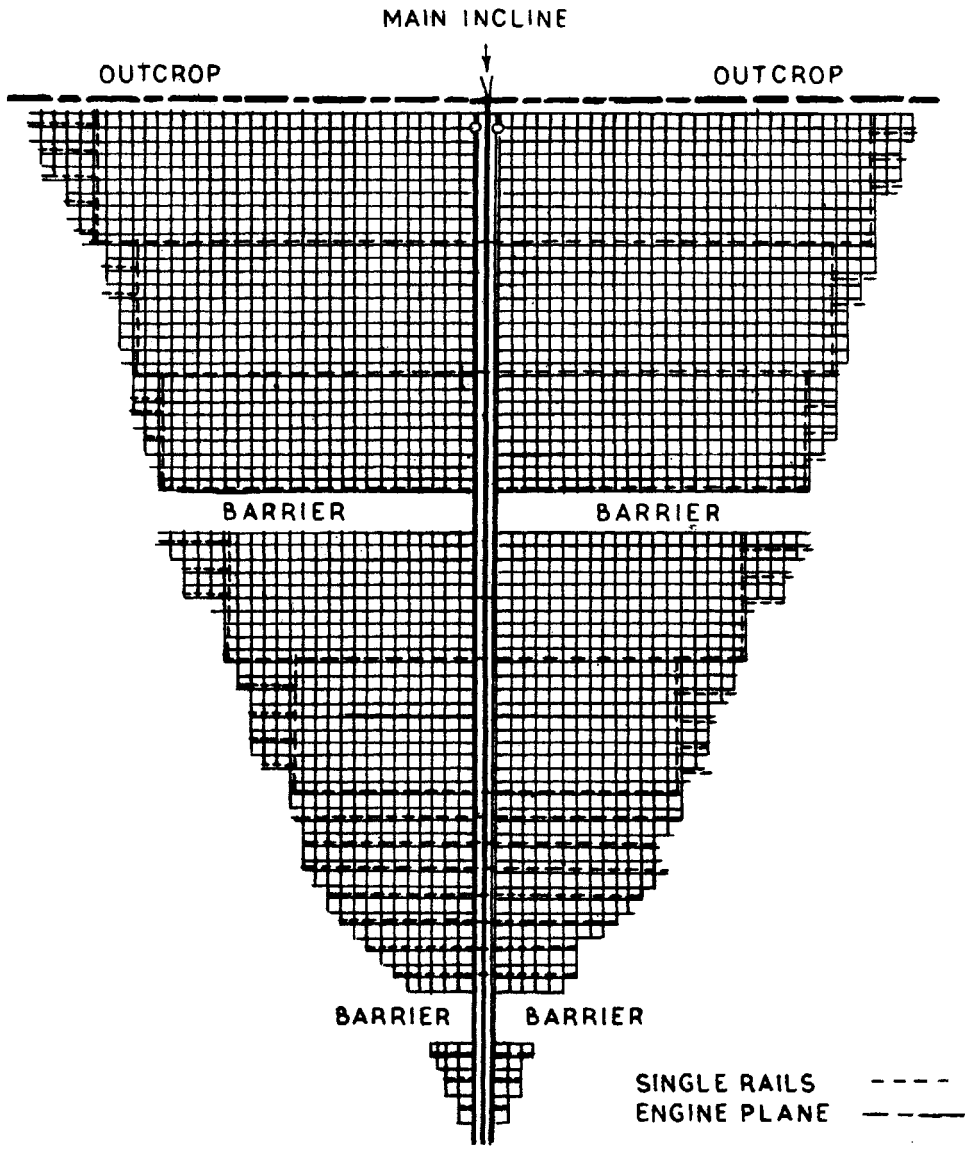

FIG. 5. Method of mining a coal seam at the end of 19th century

Quarrying was a favourite method of working, which got filled with water causing heavy pumping costs during the rainy season. The workings to the dip extended hundreds of feet from the shaft without mechanical haulage over which the coal had to be carried to the tramlines by hand. Towards the end of century use of mechanical haulages increased underground. Electricity was introduced for haulage, pumping and lighting, especially in deeper pit, where greater distances were involved for haulage of coal. The dangers of fire damp and coal dust in deeper pits were recognised. Even trials for the adoption of longwall mining were started and this method of mining was successfully carried out to work thin seams of 1.5 m in the Raniganj coalfield and since its commencement a coal cutting machine with conveyors was introduced. Recovery of bye product from the coking coal was also introduced.

In his Presidential Address to the Mining and Geological Institute of India in 1908 Mr. M. William[18] gave an excellent account of the status of coal mining technology in the nineteenth century in India, which is partly quoted as below:

"20 years before it was an exception to see a coal pit fitted with cage, now it is a rule. The winding and pumping plant was most primitive and also the general fit up of pithead arrangements. Underground, except where inclines were at work, tubs and tramways were practically absent and coal had to be carried long distances underground on the heads of coolies and native women to the pit bottom.

"At many collieries, especially the deeper ones, high level scaffolds with tippler and screening arrangements are in use. At one or two collieries, mechanically driven shaking screens and travelling belts or tables for picking purposes have been introduced. Underground, in the deeper workings, it has been found necessary to introduce haulage machinery. Formerly with shallow sinkings it was generally the rule when the underground workings advanced too far from the pit bottom, to sink a new pit. Often these shafts were not more than 400 to 500 feet apart. With the deeper workings, the cost of sinking becomes an important consideration and it is necessary for the mining engineer to place his pits farther apart, and in the most advantageous position in the property or area to be worked, so that they will work and win the greatest area of the available coal. The underground workings, therefore, in many of our collieries extend to very considerable distances from the pit bottom, and the introduction of a haulage system has become a necessity. At present these haulages are principally confined to hauling from the dip workings, and mainly are of the single rope type. The angle of the dip generally lends itself to this system.

"In the rise workings the brake wheel has been introduced for lowering the full tubs and raising the empty ones. Both systems are a great saving in labour as well as in cost, but the tail rope and endless rope systems should be more universally used, especially for hauling along the "levels" which, in some cases, extend to great lengths. Labour, of course, being cheap, has hindered the introduction of such haulages; but the labour saved by the introduction of a haulage could be very advantageously utilised on other work of the colliery.

"At several collieries air-compressing plant has been introduced, especially for underground pumping. For that purpose it lends itself better than steam power, which heats the workings and damages the roof. Compressed air has all the advantages of steam while the loss in power in long distance transmission is reduced. Further, it cools and helps to ventilate the underground workings and does no damage to the roof.

"The introduction of electricity as the driving power underground, it is pleasant to note, is also receiving attention from some of our coal companies, and doubtless this power, a few years hence, will be more generally needed in our coalfields for hauling, pumping, coal-cutting and other purposes.

"The universal system at present with one or two exception is "natural ventilation" .... In some of our collieries very good results are obtained from natural ventilation, aided of course by the heat from steam pipes in the shafts, and the exhaust steam from pumps in the pit bottom. The day is fast approaching when mechanical ventilation by exhausting or forcing fans will have to be more universally adopted. Only a few of these fans are at present day in use in our coalfields.

Mode of working was bord and pillar but "over 20 years ago at Sitarampur a seam about five feet thick was worked on the longwall system with fair success. I believe also at the present day the Sitarampore Coal Co. are working a five feet seam successfully on this system at the Nursomuda Colliery.

"In the former days about 60-80 per cent of the coal was worked out in galleries. This meant leaving smaller pillar for the support of the roof. These small pillars had to be left in when the mine was abandoned, necessitating the entire loss of 20 to 40 per cent of the coal in the seam. Gradually the advantages of leaving larger pillars are being recognised, but in many cases they are still left too small to be afterwards removed with the least possible loss."

Hard-rock Mining Technology

Impressive developments took place in gold mining in Kolar Gold Fields. Depths of up to 300 m were reached by 1400 A.D. A typical map showing the workings in Champion reef and Ooregum mines of Kolar Gold fields is shown is in Fig. 6. Mining in KGF has been beset with rock burst problems from the very beginning, although the depths of workings were comparatively shallow. The earliest official mention of rockburst in KGF is contained in the report of Dr. Smeeth, the then Chief Inspector of Mines in Mysore for the year 1898. It is reported that two workmen while working in a stope below 292 m level in the Ooregum mine received severe injuries by loose falling on them due to air blast. In the year 1899, sixteen men received serious injuries due to air blast of whom one died in the hospital and by 1901 air blast had increased both in number and intensity. These rock bursts menace the mine down to this date and considerable efforts have gone in to find ways and means to eliminate them.

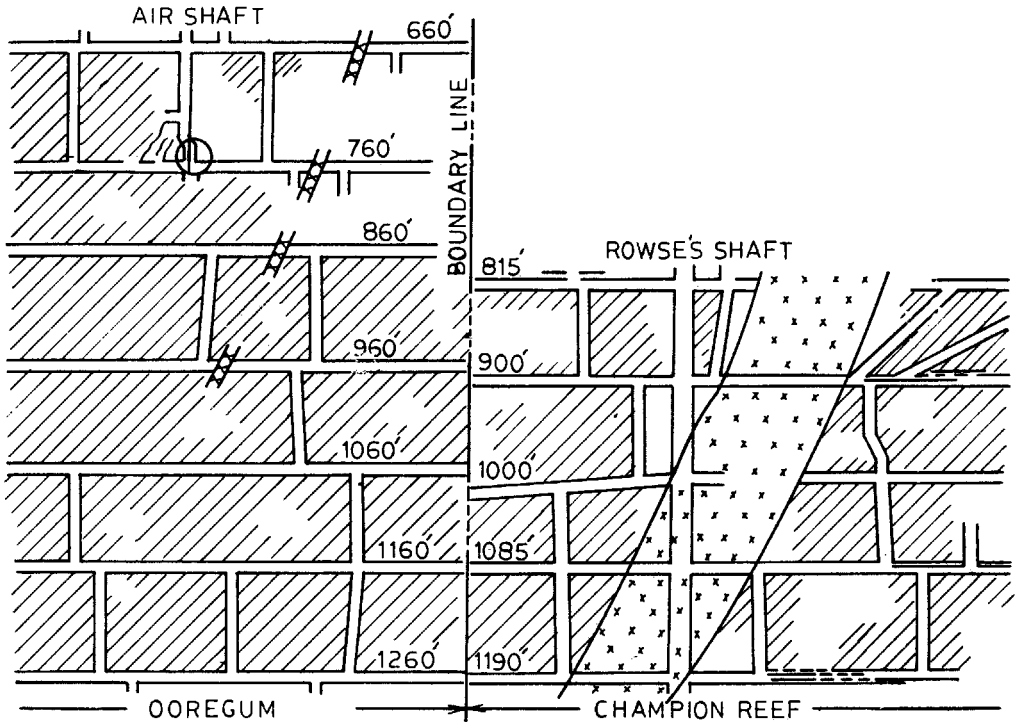

FIG. 6. A gold mine workings around 1900 A.D.

Started in 1891, the manganese mining in India developed by leaps and bounds and in a small period of seven years it dominated the world market by 1900 A.D.

Mining of manganese ore was done by quarrying (Fig. 7). The methods were "crude". Deposits were worked both above ground those which occurred in the form of hills as in Central Provinces and also below surface level as in Madras. In the former category there was no drainage problem; the ore could be transported easily down hill. But in the latter case when depths of 6-12 m were reached, water troubles began and pumping had to be resorted to.

In both classes of quarries nearly all the work was done by hand. In very hard compact masses the ore was first hand-drilled and then blasted or it was dislodged by crow bars and then broken into smaller pieces by sledge-hammers and then with but few exceptions, it was carried down the hill or out of the quarry, as the case was, on the heads of the women and children. At some quarries light rails were put to facilitate the disposal of both manganese ore and waste. The ore, if necessary, was cleaned by women, children and old men, with small cobbing hammer and finally piled into rectangular stacks ready for measurement. Where a chemist was employed, the stacks were usually sampled and assayed separately, and the ore then carted or trammed—

usually the former—to railway station, where the products of different quarries were mixed or blended so as to yield a cargo of certain standard. It was customary in the case of open quarries to follow an ore-body along its strike and to remove the overburden of alluvium or soil as required without any knowledge of what was to be expected next—that is, the then mining was crude, haphazard and no attempt was made to scientifically ascertain the structure.

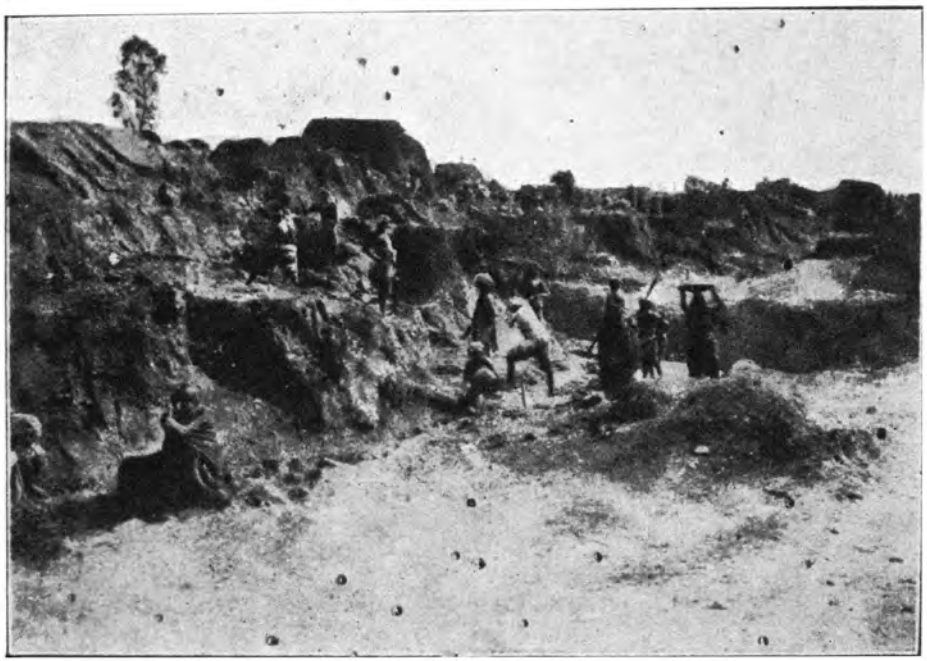

FIG. 7. Quarrying Manganese-ore at Kajlidongri-Jhabua State C. I. (After L. L. Fermor)[12]

At a few places, however, mining was organised on systematic lines. For example at Kandri, manganese occurring in a hill 76 m high was mined by a series of benches and the ore was transported by a system of aerial ropeways, inclined plane haulages and some zig-zag tramways. At Balaghat ore was transported down an inclined plane in trucks.

Mica mining developed in the Nellore District of Madras and at Koderma (Bihar) in the last decade of the nineteenth century.[19,20] Generally the ore was followed to a depth of 18-21 m by open cuts. In some mines at Koderma they went up to 30 m by opencuts after that cross cuts were driven or shafts were sunk. They usually followed the mica from book to book by running the opening zig-zag in a crude fashion. Blasting gelatine and dynamite were used as explosives. Fig. 8 shows a method of

working underground followed at Koderma. The adit cut through the lode, then the explorating drift were run along the hanging wall of the lode, and therefore followed it in all its irregularities. After this the main haulage way was driven in a straight line so as to allow the trolley free run, then the crosscuts 2, 2 were driven 2.4 m $\times$ 3 m and the lode was worked out. After the mica had been removed, broken rock was shot through the winze, connecting the two levels to fill the opening. The cut 3, 3 was treated the same way and so the work continued. As one level was completed the next above was started and carried on in the same manner until the entire lode was worked out. The material stoped in the upper level was shot down to the main haulage way through connecting chutes.

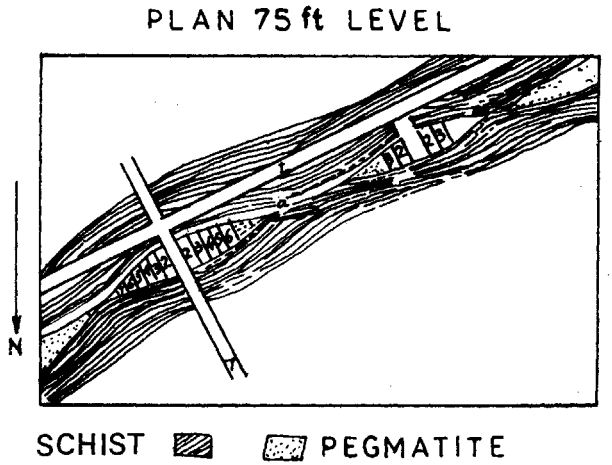

FIG. 8. Method of Mining mica at Koderma at the end of 19th century.

Power drills were not introduced until 1900 A.D. and the technology was in a very crude state.

During the last century copper mining was done at Khetri (Rajasthan) and at Rakha (Bihar). Mining was done by narrow adits or slopes driven from the strike of the orebody. The rock was broken by fire setting. The ore was transported in baskets and the mines were closed during the rainy season. The technology was in primitive state and it was not until 1928 when copper mining was put on proper footing with the formation of Indian Copper Corporation.

4. GROWTH OF SAFETY LEGISLATION

The first concrete proposal for the inspection and regulation of mining operations in India came in 1890 from the Secretary of State Lord Cross and Mr. James Grundy was the first Inspector of Mines appointed by the Government of India. He worked within the organization of Geological Survey of India and his duty was

to inspect mines and to make recommendations on the type of regulations needed. Mr. Grundy in his first report submitted to the then Director of Geological Survey of India stressed the need for passing mines regulations act which would amongst other things provide for the establishment of special rules having legal standing as the Act itself. Briefly the act was to provide for notices of opening etc. of mines and of accidents, minimum age for boys and girls employed underground, first aid, management and supervision and safety matters, special rules for coal and other minerals were to provide for additional safety matters including report of inspection of all parts of mines and machinery.

In 1895 Government of India appointed a Committee to frame general rules applicable to mines or groups of mines and to specify the heads on which legislation was desirable and the provisions which were made under each of the heads. The Committee submitted its report in 1896. In 1897 a big disaster occurred in the Kolar Goldfield in which 52 persons were killed in a shaft accident. In 1899 in Khost Coal Mine in Baluchistan (now in Pakistan) a mine fire occurred which caused the death of 47 persons. The finalisation of the mining legislation was therefore expedited and the Mines Act was enacted in 1901 and also brought in force the same year. The Mines Act which came in force in 1901 covered all minerals worked up to the depth of over 6 m. The main features of this Act were:

(*i*) Inspectors were empowered to enter and inspect mines, and to enquire into accidents,

(*ii*) The employment of competent managers in mines was required. Managers Competency Certificates were instituted,

(*iii*) The Government was empowered to frame rules, etc. for regulating work in the mines,

(*iv*) Penalties were prescribed for contravention of its various provisions.

Further progress of mining technology called for newer safety legislations and development of newer mining technologies and safety legislations proceeded simultaneously.

5. Development of Mining Education and Training

Mining courses were established at Shibpur College of Engineering in 1905 to train Indians in the science and art of mining. The Institutional instructions were supplemented by annual camps in the coalfields where the students were exposed to practical mining problems.

A scheme was launched in 1906 to give special lectures at various centres in the Jharia and Raniganj coalfields to enable mining officials to improve their standard

of mining knowledge. The then Mining Advisory Board had also recommended the compilation of Vernacular Text Books on practical coal mining so that intelligent workers could take advantage of such books for improving their knowledge.

The Mining and Geological Institute of India was established in 1906 which provided opportunity to publish and discuss papers in mining and geology and to exchange experiences. Thus the stage was set for scientific development of mining technology.

6. Concluding Remarks

After the establishment of British Rule in India finally in 1857, the then rulers put their attention on the exploitation of the natural resources of the country. Mining industry then received encouragement.

Europe had already considerably advanced then in the art and science of mining and these newer technologies were brought to India and applied in various facets of mining industry.

By the beginning of the present century coal mining and metalliferrous mining industry was firmly established in the country and was gearing itself to modernise and put the technology on scientific lines. The developments in this direction continues.

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