

**JOURNAL**  
OF THE  
**ASIATIC SOCIETY.**

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*Notes on the Pokree and Dhanpoor Copper Mines in Gherwal. By*  
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After the commissioner, Mr. Lushington's report, Vol. XII. Journ. As. Soc. 1843, little remains to be said about the situation of these mines. Pokree is on the right, Dhanpoor on the left side of the Douliganga, both about six miles horizontal distance from the river, and twelve miles between themselves. From Pokree I saw Dhanpoor distinctly, and it appeared about 1,000 to 1,500 feet higher situated. Putting the compass in h. 17 or hs. ( $15^{\circ}$  E. to S. or  $15^{\circ}$  W. to N.) I had on the bearing—therefore in one line—on one side the Rajah's mine, and (according to the statement of the people,) several places where the same talcose slate occurs as in the Pokree mine. On the other side, I had a place, called Deehoor, on the road to the valley of the Gunga; and on the Dhanpoor side a place little below the village, both places containing the slate. The layer of talcose slate containing the copper ore is therefore a very extensive one, and there is every reason to believe, that the copper goes as far as the slate, and the slate as far as the formation, to which I consider the slate to belong. Indeed it requires very little attention from an eye, practised in researches after minerals, to see that the whole of the known copper mines from the Nepal terace in the east, till beyond the Pokree mine in the west, are only parts of one layer of not very great thickness, which perhaps may have been subdivided in two or three thinner layers, by some other oreless layers of slate or limestone

now transformed into Dolomite. In a country where mining is more in use and better known than in India, lakhs of rupees would have been spent upon feebler indications of ores than are here seen. When I was at Pokree there was no work going on, but two or three native women washing old heaps of nearly exhausted rubbish. The "Khans" were nearly entirely broken down—that in which Mr. Wilkin put in timber, was yet open for about forty yards, but in all these very slight indications of ore, copper pyrites and blue and green carbonate. Since many hundreds or thousands of years that part of the layer has been alternately exposed to the access of air and water, and accordingly the copper pyrites has been transformed into sulphate of copper, which is dissolved and carried off by water. That process is going on still, the waters containing enough sulphate of copper to cause, by aid of Hanuman or some other old gentleman, the great wonder of metamorphizing—*i. e.* covering—iron nails, thrown into the water with copper. The natives showed me two of these nails as perfect miracles.

It was in this part of the layer where not only the native rulers worked, but also Mr. Wilkin. The slate in it is soft like soap, and very little ore remained, partly as pyrites, partly in sulphate, partly as blue or green carbonate of copper. From Mr. Wilkin's bad success no conclusions ought to be made, or can be made. An experiment on ore from Chili or Kamtschatka would be as decisive for the riches of Pokree mine as Mr. Wilkin's was, and when I heard that a "*sahablok*" worked  $2\frac{1}{2}$  years at Pokree I could scarcely believe it. But I admired Mr. Wilkin's proceedings, when I saw, from Mr. Lushington's report, the means Mr. Wilkin had at his disposal, and the object of his labour. I then acquitted Mr. Wilkin of every fault of which I had accused him in my mind when I saw that, with a sum scarcely sufficient to open the spot where the ore can be hoped for and collect materials for buildings, he had to decide upon the riches of *a mine at first to be created*. The layer dips in h. 23 ( $15^{\circ}$  N. to E.). The work to be commenced was, a gallery 30 or 40 fathoms below the old mines; and not the excavation of ores which are a very good addition in smelting better ones, but the smelting of which never would pay. If left to his own judgment, and having the whole sum at disposition, Mr. Wilkin probably would not have produced any ore in the first year and a half, at the end of which he would most probably have been able to show such

specimens of ore as would extinguish every doubt on the richness of the mine; then, and not before then, was the time to begin experiments; but also these ought to have been made in another way. Mr. Wilkin could not prepare the ore on hearths and with sieves, as undoubtedly he would have done, had there been more money at his command. Furnaces on a scientific system instead of the rough native hearths ought to be made, and these with powerful bellows put in regular motion by water-wheels instead of two goat skins moved by hand. In such fire-hearths, I saw in Dhanpoor two meltings, each continued through about four hours, and from beginning to end the flames (4 to 5 feet high, and 3 to 5 feet diameter) were perfectly green from loss of metal. The natives told me that such was the case in Pokree also! This shows that,

1. The necessary preparations before the smelting could not be made.
2. That the smelting was not properly conducted, the loss being too great.\*
3. That the ore used was not the ore which would be the object of mining on a large scale, it being impoverished by the slow metamorphosis of pyrites into sulphate of copper.

It must be confessed, that the Pokree mines are highly wronged by the conclusions made from results shown by any work done till now. It could be objected against p. 3, that the presence of better ore or richer ore, is only a supposition; but it is not so! I found in the Pokree bungalow a piece of hard rock talcose slate—with a high coloured pyrites of copper, taken *from the end* of Mr. Wilkin's "Khan." The ore was from a place where either no water came, or where it stood constantly; but all the pyrites *from the first 30 or 40 yards* had—so said the natives—a greyish-watery colour. This shows that ore in the bowels of the mountain is better preserved than on, or near the outside; consequently more ore must be there, for it cannot be supposed that an ore which for so many miles continues, and has so little thickness, should not go, with the layer in which it occurs, to a considerable depth at least. Analogy with thousands of cases leads to the supposi-

\* In a high furnace a large quantity of metal offers a nearly as little surface to the wind as a small one. In a high furnace the ore is only exposed to the stream of wind at the moment of melting, but in a hearth both ore and metal are constantly exposed.

tion mentioned, that in Pokree and its neighbourhood vast quantities of copper could, with advantage, be produced. And upon observation of analogies and anomalies in nature, hundreds of valuable rules are founded, and most of sciences based.

Assisted by these rules *mining is no lottery*, and not more hazardous than agriculture and manufactures.

I come now to other objections made to these mines,—1. The distance from Pokree to Almorah is *perhaps* one day's march farther than Almorah from the plains, to a point where several days' land-carriage for the metal from the river is required. Sreenugur is yet nearer than Almorah, and even Hurdwar can easily be reached from Sreenugur, by little flat boats steered by one man, loaded with a sufficient quantity of metal. The boats should be of a light construction, and would *as wood only* sell very well.—2. Articles of bulk are, for the beginning, not required, and should mining *become modern* in the Himmalayas, roads (which however in these parts are not so very bad, as not to be passable, after very little repair, by mules, horses, and even by elephants,) will soon be made; and in a later period larger articles certainly will be manufactured *in the hills*. Iron ore is plentiful there.

3.—The English copper is cheaper, because it is worse than the native copper. The natives in Sreenugur, Teeree, Hurdwar, etc., told me, they would not use the English wrought copper, but for the great size of the plates. For smaller work they prefer Dhanpoor copper. If the lessee had any difficulty in selling the metal at two rupees, he could easily give it cheaper; but his stores are always so small, that he is sure to sell even at the higher price. From cross-examination of his mookteear, and the miners and smelters, I calculated his profits at thirty per cent., and from the unwillingness of the first to tell me more, I had reason to think that my calculation was right. I told him so, and the result of my reckoning, and how I obtained the data without the reporter's knowing it. When I had left Dhanpoor, my servant told me that the mookteear abused the work people for their betraying him, and the people were quite astonished to hear they had done so. The Commissioner, Mr. Lushington, states the way in which the charcoal burners are going on. They will cease to do this if they hear that from the trees themselves better charcoal can be obtained than from the mere branches, and should they continue the work, nothing remains for the lessee but to send

his own coal-burners *for working up such wood as remained from the other burners*, saving thus the outlay for cutting down the trees. The lessee would have always charcoal enough, even for a large establishment, or several of them, for if the inhabitants see they can obtain a constant livelihood they will take care not to waste wood. Provision however for the renewal of the forest must always be made for the sake of future cheapness. I think too labor could be obtained cheaper than in England, even if the greater skill and bodily strength and good-will of European workmen is taken in account. The old smelter in Dhanpoor may be compared with the most skilful smelters any where. I believe now to have shown the possibility (and probability) of turning to advantage the riches of Pokree; the copper could support the concurrence of the English copper in the lower hills and part of the plains, and would have advantages over it, in the higher interior, and in such places at the foot of the hills where the English product cannot reach by mere water carriage.

The Dhanpoor mines, or holes, are worked to advantage, and no doubt could be made more so; but perhaps it would take more trouble to find the layer of copper than in Pokree. What till now is opened would under European superintendence be entirely exhausted in the course of one year or two. It is possible the layer may turn out to be a regular dyke, but I suppose it will not be so, but might be cut off by slate at no very great depth. The working on a large scale would be also more expensive in Dhanpoor than in Pokree, for the ore must be stamped, and washed on *moving hearths*. However, I will not say, that Dhanpoor mine could not be made, by continued labor, a very rich one. The situation of Dobri mine on the other side of the very same hill range, admits no doubt of the ore's extension; moreover the steepness of Dhanpoor hill admits shorter galleries and to greater depth. The present mine could not of course be of any use. There are galleries of several fathoms in height and breadth, following upon and preceded by others, which are so low and narrow, as to admit only children; and the slope goes downwards, then up again for a few yards, now to the right, then to the left; &c. A shaft in the mine is only passable for those who do not mind going about in the dress of Adam on the first day of creation, for only the adhesion of the skin to the nearly

polished rock, keeps the passenger in many places from falling down. The tools are only a chisel and a hammer ; blasting of course ought to be introduced.

From what is above said, it will appear as my conviction, that in the copper mines of Pokree and Dhanpoor, capital could most advantageously be employed. But it is not Government, in my opinion, who should work there. The best writers on national economy agree, that such speculations do not thrive in the hands of a Government. If Government would give these mines to any private individual or company, for as long a period as they pay regularly a certain duty from the produce, and would allow to any one else to begin mining wherever he could find an ore, in a very short time, certainly, many places where ore is known, would be taken up, and the revenues of Government, now derived from the mines, would be very considerably increased. Districts, now nearly empty of population, void of cultivation, useless to the treasury, would yield revenue, and the population would become acquainted not alone with European luxury, but with European skill and intelligence, which would be at first more useful than schools and missionary establishments. As the agriculturist prepares by ploughing the hard soil for the reception of the seed, so we may consider, the becoming acquainted with the advanced state of European arts would "plough" the *Paharri's* mind for the acceptance of higher objects, which they might be thought fit for being taught in some future time.

And did not nature show her intention of civilizing the inhabitants of these wild districts through mining, by her upheaving such mineral riches which, in their present state of civilization, they cannot appreciate ?

With regard to the capital required for the opening of Pokree mine and Dhanpoor mine, I think 40 to 50,000 rupees would be more than sufficient for both establishments, on a footing equal to the advantages which can be expected in the first result of an operation, which may be carried on through hundreds of years.

*Calcutta, September, 1845.*