

Moreover, on turning to the tables of conductivity and specific heat, I find for iron and bismuth—

| | | |
|-------------------------------------|-------|----------|
| | Iron. | Bismuth. |
| Ratio of thermal resistances | 1 | 6 |
| „ specific heats | 3·7 | 1 |

The theoretical resultant effect would seem to be indicated by compounding these ratios, which would still leave a decided balance in favour of iron.

It seems doubtful whether the law, distance of point of equal temperature from source $\propto \sqrt{\text{conductivity}}$, holds good in the case of bad conductors, and in any case it only applies when all parts of the bar have attained a constant temperature.

I must apologise for asking for information on so small a matter, but I should especially like the experiment to succeed if Nature will kindly permit it. At the same time, I hope that I shall not be accused of undue pessimism if I say that, according to my experience, the work of a natural science lecturer is simply a perpetual struggle against the malice of Nature.

Eton College, March 18

H. G. MADAN

Rookeries

CAN any of your readers kindly inform me how to establish a rookery. I have tried putting old nests into high elm trees, but they have not been taken to, although rooks are often in the trees.

THE MUG

Trueloves, Ingatestone, Essex, March 21

A Means of Saving some Lives in Colliery Explosions

WHATEVER brings about an explosion in a colliery, it appears that men often perish thereby not from burning, nor from injury, but from want of fresh air. It would now be easy, or might soon become so, for every collier, at a small cost, to keep near him always when at work, a little vessel full of compressed air, which being provided with a rather fine nozzle, and a stop-cock, and a small piece of india-rubber tube, might be a sufficient deliverance for him in the moment of need, should he in an explosion have escaped violent injuries.

D. RHYS JONES

Carmarthen, March 24

ECONOMIC GEOLOGY OF INDIA¹

I.—Precious Stones and Metals

THE concluding volume of the Manual of the Geology of India was issued from the Calcutta Press towards the last days of 1881, and a supply of copies may now any day be expected to arrive in London. This volume, published by order of the Government of India, brings to a worthy conclusion a most remarkable work, in which we find a general geological sketch map of nearly the whole of India, a descriptive account of its various formations, and a history of those geological products therein found which are of importance to mankind. When we stop to think of the immense area explored, of the enormous amount of details that had to be collected and sorted, of the dangers and trials which were encountered during the investigation of much of the country that had to be explored, we confess to being struck with amazement at the energy, zeal, and courage of the comparatively very small staff employed by our Government in this service, and we feel sure that those labouring in European or American fields will be the first to acknowledge how much is owing to the Geological Survey of India for the quality as well as the quantity of the work done by them in the plains of Asia.

But it is not only the geologists that will find an interest in this the third volume of the Manual. It treats of the economic products of the geological formations of India, and has a far greater interest even for the statesman than for the scientific man, and an interest too for the com-

¹ "A Manual of the Geology of India. Part III. Economic Geology." By V. Ball, M.A., F.G.S., Officiating Deputy Superintendent, Geological Survey of India. Published by order of the Government of India. (Calcutta, 1881.)

mercial man and the general reader, nay even more, there is much of interest in this volume for the student of history, for the student of mankind, about the origin of myths, and about the gradual development of the arts of working in iron and gold.

This volume is written by Prof. Valentine Ball, who was, until recently, officiating deputy Superintendent of the Geological Survey of India; an author well known by his pleasant record of many years' work in India, not long since published under the title of "Jungle Life in India," and one who, by many years' assiduous and patient labour as one of the Survey Staff, was fully qualified for the great task so well accomplished in this work. Not only has he brought together in this volume a great store of facts collected by others, but from his own personal knowledge of localities and details, he has been enabled to arrange these facts in orderly sequence in a way few others could have attempted, and he well deserves the high commendation of his chief, the Superintendent of the Survey, who writes: "The student, as well as the man of enterprise, will long owe him gratitude for what he has thus brought within their easy reference."

To give our readers an idea of the contents of this volume, we propose to treat of them in a somewhat arbitrary fashion. In this notice we would call their attention to the Precious Stones and Metals of the East. In a second notice to treat of its Iron and Coal resources, and of the important subjects of its Salt supply and Building Stones. It will not be in any sense our object to treat these subjects in an exhaustive manner, but to indicate to the reader what he will find in the 600 large octavo pages of this work, which is illustrated with numerous maps, lithographic plates, and woodcuts.

The diamond is the most important of the precious stones of India; it can be traced back to Sanscrit literature, in which the first mention of its actual localities is to be found. The famous Koh-i-nur is stated to have belonged to Karna, the King of Anga, about 5000 years ago; but this is not founded on any very reliable evidence. Tavernier and Marco Polo allude to a trade existing in diamonds between Asia and Europe, and before the first diamond mines in Brazil were opened (1728) nearly the whole supply of the old world went from India. There are in India three extensive tracts, widely separated from each other, in which the diamond is known to occur. Besides these principal tracts there are others where diamonds have been found, but precise details are wanting. The most southern of the three great districts has long borne the familiar name of Golconda, though Golconda itself never produced diamonds, and is in fact merely the mart where they were sold and bought. In this southern tract, which is in the Madras Presidency, either are or have been the mines of Kadapah, Bellary, Karnul, Kistna, and Godavari. The second great tract occupies a considerable area between the Mahanadi and Godavari rivers. The third is situated in Bundelkhand, near one of the chief towns of which, Panná, some of the principal mines are situated. In Northern India the diamonds, when found *in situ*, are in a conglomerate which is referred to the Rewah group of the Upper Vindhyan formation, while in Madras they are found under the same circumstances in the Banaganpilly sandstones, which form the base of the Karnul formation.

In connection with this geological position it is interesting to note that these Vindhyan rocks of India have been correlated with the diamond-bearing rocks of the Cape Colony in Africa. The examination of the diamond-bearing strata of India seems to throw no light on the as yet unsettled question of the conditions under which the crystallisation of carbon took place, which resulted in the formation of this precious gem, though synthetical operations in the laboratory seem to tend towards confirming Liebig's view, that it has been formed by crystallisation from a liquid hydrocarbon. It must however be remem-

bered, in treating of this part of the subject, that it is still a matter for doubt if the diamond in India has ever been found in its *original* matrix. The lowest diamond-bearing stratum at the base of the Karnul series is itself a detrital conglomerate, and it is not unreasonable to suppose that the diamonds in it may, like the other ingredients, have been derived from some older metamorphosed rocks.

Very copious details are given as to the various mines and as to their respective produce. The history of the great Mogul diamond is narrated, and the conclusion come to that it is probably now in part represented by the Koh-i-nur. As a practical application of known facts, the prospect of diamond mining in India under European direction is dismissed as unprofitable. With scientific guidance, backed by capital and proper mining appliances, it might at first appear that mining by Europeans ought to succeed, but on a closer investigation it will be gathered that there are in diamond-mining certain peculiarities which distinguish it from most, if not all, other forms of commercial enterprise; and as a principal of these the facilities for speculation in consequence of the readiness with which the gem can be secreted, must be reckoned. Furthermore, it would almost seem that, except under a system of slavery, the diamond cannot be worked profitably in India. The present system, though not so called, practically amounts to slavery; the actual miners are by advances bound hand and foot to the farmer of the mines, and these are content to wait for months together without any return; their outlay being very small, and there being no heavy expenditure of capital required.

The myth regarding diamond-seeking, made so familiar to every one by the travels of Marco Polo and Sindbad the Sailor is of great antiquity.

“Perhaps one of the best accounts of it is by Nicolo Conti, who travelled in India in the early part of the fifteenth century. He says that at a place called Albenigaras, fifteen days’ journey north of Bizengulia, there is a mountain which produces diamonds. This Albenigaras might be Beiragarh, the modern Wairagarh; that it was so is doubtful, but its identity is perhaps immaterial. Marco Polo undoubtedly referred to the localities in the Kistna Valley. Nicolo Conti says that the mountain being infested with serpents it is inaccessible, but is commanded by another mountain somewhat higher. ‘Here at a certain period of the year men bring oxen which they drive to the top, and having cut them into pieces cast the warm and bleeding fragments upon the summit of the other mountain by means of machines which they construct for the purpose. The diamonds stick to these pieces of flesh. Then come vultures and eagles flying to the spot, which seizing the meat for their food fly away with it to places where they may be safe from the serpents. To these places the men afterwards come and collect the diamonds which have fallen from the flesh.’ He continues with an account of how other less precious stones are obtained, and this part of his description is that of ordinary Indian diamond-mining. Allusion has been made to the native belief that the diamond mines were under the special patronage of the goddess Lakshmi, and that sacrifices were made to propitiate her. There is reason for believing that sacrifices were made on the opening of new mines, and probably also when the supply of diamonds ran short.

“The late Mr. M. Fryar, when visiting a stream-tin washing at Maleewoon, in Tenasserim, was requested first to remove his boots, being told that on a former occasion a European visitor insisted on walking up to the stream with his boots on, and that in consequence it ceased to yield ore until two buffaloes had been sacrificed to appease the insulted guardian spirits of the place.

“This is scarcely a suitable place for fully illustrating this subject, but the following, if put side by side with

Nicolo Conti’s account, so completely explains it that it will perhaps be sufficient for present purposes.

“Dr. J. Anderson, in his recent report on the expedition to Yunan, describes having witnessed the sacrifice of two buffaloes by the Kakhyens to the Nâts or evil spirits. The animals having been slaughtered on two bamboo altars were cut up and the meat distributed, *certain portions with cooked rice being placed on a lofty bamboo scaffolding for the use of the Nâts*. It goes without saying that birds would help themselves to these offerings.

“Credulous travellers in early times might very possibly have supposed, on witnessing such a preliminary sacrificial rite, if at a diamond mine, that it was an essential part in the search for diamonds, and it would not require any very great stretch of Oriental imagination to build up the fable on such a substratum of fact. The bamboo scaffolding in all probability represents the machine mentioned by Conti.”

Graphite or plumbago, as found native, contains from 90 to 99 per cent. of carbon. The only deposit in India, with the possible exception of another at Vizagapatam, which seems of any present promise is that which occurs over a wide tract in Travancore. At the present day nearly all the plumbago of commerce comes from Ceylon.

Of the precious metals Platinum occurs in very minute quantities, with gold-dust, and has been probably derived from metamorphic rocks.

Silver is found associated with gold, and in combination with sulphur, and as a sulphide it is often associated with sulphide of lead, antimony, &c., but the amount of silver produced over the peninsula is very small.

Gold is met with very generally distributed over British India. The ultimate derivation of most of the gold of Peninsula India, is doubtless from the quartz reefs which occur, traversing the metamorphic and submetamorphic series of rocks; but there is also evidence to show that in some parts of the country gold occurs in certain chloritic schists and quartzites, and possibly also in some forms of gneiss, independently of quartz veins. As to the relative productiveness of the reefs in the different groups or series of metamorphosed rocks, the imperfect evidence which at present exists is somewhat conflicting, the truth probably being that no one rule holds applicable to the whole of the country. The presence of gold, either as an original deposit, or as a detrital product from the older rocks, has not as yet been proved in any member of the great Vindhyan formation; but in the next succeeding formation several of the groups included in the Gondwana system are believed to contain detrital gold; of these the evidence seems clearest in the case of the Talchir. It is almost certain that the gold obtained in the Godavari, near Godaloro, is derived from rocks of Kamthi age, and the gold of the Ouli River, in Talchir in Orissa, is derived from sandstones. The only other sources in Peninsular India are the recent and sub-recent alluvial deposits, which rest on metamorphic or sub-metamorphic rocks. In the Extra Peninsula districts gold is met with in rocks of several different periods. In Ladak certain quartz reefs, which traverse rocks of the Carboniferous period are gold-bearing. In Kandahar gold occurs in rocks of Cretaceous age, and the deposit seems to be an original one, connected with an intrusion of granite. Lastly, all along the foot of the Himalayas, from west to east, from Afghanistan to the frontiers of Assam and Burma, the tertiary rocks which flank the bases of the hills, and which occur also in the Salt Range, and at Assam, south of the Bhramaputra, are more or less auriferous, but the gold is detrital.

The history of gold mining in India is lost in a very remote antiquity. Vast amounts of bullion were carried away by the Moslem armies of the fourteenth century. Some would place the Cphir of King Solomon on the west coast of India, and much of this precious metal as has been already collected from the golden sands of the

peninsula, it is possible that much more remains. Quite recently the gold fields of Madras have attracted a great deal of public interest, and a large amount of capital is being diverted to their exploration. For writing a history of British gold mining in India the time has not yet come, and we can only hope with Prof. Ball "that the actual results of this enterprise may come up to the high standard of success which has been predicted for it."

Amidst a variety of most interesting details as to the various gold diggings and gold workings in India, we select the following account of the Thibetan Gold Mines, which for many centuries and to the present day, send a regular supply of gold to India.

"Of the very highest interest are the accounts of the Thibetan gold mines, which are given by the Pundits attached to the Indian Survey for the purpose of exploring countries north of the Himalayas. Unwittingly these admirable native servants of the Government of India have furnished facts which have enabled Sir Henry Rawlinson, and independently Prof. Frederic Schiern, Professor of History at the University of Copenhagen, to clear up a mystery which has been a puzzle to the historians and philosophers of many countries for upwards of 2000 years. A translation of Prof. Schiern's paper,¹ by Anna M. H. Childers, will be found in the 'Indian Antiquary.'² It is a most remarkable example of learned research, and one very difficult to give in abstract. It is entitled 'The Tradition of the Gold-digging Ants.' But perhaps before giving the conclusions which Sir Henry Rawlinson and Prof. Schiern have arrived at, it will be best in this place to briefly describe the Pundits' observations:—

"During the expedition of 1867 the Pundit who had been at Lassa fell in at Thok Jalung, an important gold-field in the province of Nari Khorsam, with a large encampment of Thibetan miners, and took the opportunity to gain information relative to the working of the mines. In the third expedition, in 1868, another Pundit passed on as far as Rudok, at the north-west extremity of Chinese Thibet on the frontier of Ladak, and on his way back from Rudok visited the gold-fields of Thok Nianmo, Thok Sarlung,³ and Thok Jarlung. The map which accompanies Major Montgomery's narrative of the journeys of the Pundits gives in addition the gold-fields of Thok Munnak, Thok Ragyok, Thok Ragung, and Thok Dalung.' . . . 'The miners' camp at Thok Jarlung, according to the measurements of the Pundits, is 16,300 feet above the sea-level.

"The cold is intense, and the miners in winter are thickly clad in furs.

"The miners do not merely remain under ground when at work, but their small black tents, which are made of a felt-like material, manufactured from the hair of the Yak, are set in a series of pits, with steps leading down to them . . . seven or eight feet below the surface of the ground.' 'Spite of the cold the diggers prefer working in winter; and the number of their tents, which in summer amounts to 300, rises to nearly 600 in winter. They prefer the winter, as the frozen soil then stands well, and is not likely to trouble them much by falling in.'

"They are occasionally attacked by bands of robbers, who carry off their gold.

"Sir Henry Rawlinson's remarks on these reports of the Pundits' researches and travels are as follows:—

"Now, then, for the first time, we have an explanation

¹ Verhand Kgl. Danischen Gesellschaft der Wissenschaften für 1870. Printed separately in Danish, German, and French.

² Vol. iv. p. 225.

³ Thok Sarlung had at one time been the chief gold-field of the district, "but had in a great measure been abandoned on the discovery of the Thok Jarlung gold-field. The Pundit passed a great excavation some 30 to 40 feet deep, 200 feet in width, and two miles in length, from which the gold had been extracted."—*Jour. As. Soc., Bengal*, vol. xxxix., Pt. 2, p. 53, 1870.

Pall Mall Gazette, March 16, 1869, quoted in "Indian Antiquary," p. 225.

of the circumstances under which so large a quantity of gold is, as is well known to be the case, exported to the west from Khoten, and finds its way into India from Thibet; and it is probable that the search for gold in this region has been going on from a very remote antiquity, since no one can read the ex-Pundit's account of Thibetan miners 'living in tents some seven or eight feet below the surface of the ground, and collecting the excavated earth in heaps previous to washing the gold out of the soil,' without being reminded of the description which Herodotus gives of the 'ants in the lands of the Indians bordering on Kaspatyrus (or Kashmir) which made their dwellings underground, and threw up sand heaps as they burrowed, the sand which they threw up being full of gold.'

"Prof. Schiern points out that the tradition was mentioned in writings of the middle ages, and those by Arabian authors. It survived among the Turks. Strabo and Albertus Magnus treated the whole story as a fiction. Xivrey supposed that the animals had become extinct owing to the *auri sacra flammæ*. Major Rennell supposed that the dwellers in mounds were *termites* or white ants. Humboldt's observations in Mexico on the habit of certain ants to carry about shining particles of hyalith was quoted by those who believed that the animals were really ants. Other authorities suggested that they were marmots, jackals, foxes, or hyænas. Pliny having stated that horns of the Indian ant were preserved in the temple of Hercules at Erythræ, Samuel Wähl, who maintained the hyæna theory, proved equal to the difficulty by suggesting that the horns might have been a *lusus natura*. Prof. Schiern ingeniously argued that the horns had been taken from the skins of animals which formed the garments of the miners. It seems possible, however, that they were samples of the pickaxes made of sheep's horns, which, as is mentioned above, are used to the present day by the miners in Ladak.

"Prof. Schiern further points out that ancient writers say that the ants worked chiefly in winter, and connects this with the statement of the Pundit above quoted.

"In conclusion he writes:—

"For us the story partakes no longer of the marvellous. The gold-digging ants were originally neither real ants, as the ancients supposed, nor, as many eminent men of learning have supposed, larger animals mistaken for ants on account of their subterranean habits, but men of flesh and blood, and these men Thibetan miners, whose mode of life and dress were in the remotest antiquity exactly what they are at the present day.'"

The quotations that we have given will show the general reader what he may expect to find in this volume, in addition to the more scientific accounts of the several diamond and gold mines.

(To be continued.)

PRECIOUS CORAL

WHILST preparing a set of lectures on Corals, lately delivered at the Royal Institution, I made some inquiries as to the present state of the fisheries of precious coral from Messrs. Greck and Co., coral merchants, of Rathbone Place, who also have an establishment at Naples. They exhibited a very fine series of examples of raw and worked coral at one of my lectures, and also sent me the following short notes on the Italian and Sicilian coral fisheries, partly taken from an Italian newspaper, but which contain some facts which may be interesting to the readers of NATURE. I was shown a large number of the Sciacca specimens, all attached to groups of bivalve shells or pieces of dead coral. The blackened coral is described by Lacaze Duthiers in his famous monograph as "corail noirci dans la vase." It is very possible that the blackening substance is binoxide of manganese, since we dredged, in deep water during the *Challenger* Expedi-