lower tributaries of the Roseau River were very little swollen.

The scene of the eruption is about eight miles east from Roseau, and the volcanic ash was blown to the west, by the trade wind, in a narrow belt about one and a half miles wide. There is, unfortunately, no means of ascertaining the extreme limit of this belt; but a small vessel, which was about four miles out at sea at the time of the eruption, experienced a shower of ash similar in every respect to that which fell in Roseau. The area, then, over which the ash fell must have been at least twenty square miles.

On the 12th of January, I visited the Soufrière district, and found that a volcano had opened up about a mile to the south-west of the Boiling Lake. The Grande Soufrière lies in the depth of the primeval forest which covers the greater part of Dominica, so that no loss of life occurred; but for a considerable distance beyond the crater the trees have been destroyed, and the earth is covered several feet deep in some places, with volcanic *débris*. Here and there, stumps of blasted trees sticking up a few inches or a few feet from the gray ash give a striking evidence of the force of the explosion. Most of these stumps have been quite shattered by the ejecta, and in many were found embedded large pieces of trachytic rock. I did not observe any traces of fire, but on scraping away the ash from the ground at some distance from the lip of the crater, large splinters of wood and a few bleached leaves were discovered. Beyond this zone of desolation, the forest has been destroyed to a great extent by a whirlwind which appears to have occurred just before the eruption. Branches of trees, broken and twisted off from the parent stem, have fallen to the ground, and by their weight have crushed down all the forest undergrowth. In spite of the heavy rains, which had been almost continuous since the time of the eruption, I found the ash still tenaciously clinging to the leaves and the trunks and the branches of the trees. The swollen streams which run through the ravines radiating from the volcanic district, were in many places dammed up with large pieces of sulphur and pumice, and with splinters of wood. On reaching the lip of the crater, which was a work of some difficulty on account of the depth of the ash, the bottom was seen about 600 feet below. This appeared to be cooling down, for although commotions were observed in several places there was no flame or glow visible. Here and there, columns of aqueous vapour ascended and widened out into clouds before reaching the lip, so that the bottom of the crater could only be seen at intervals. The crater is ovoid, with its long axis running in a direction from west-south-west to east-north-east and the lowest part of the lip, as measured by the aneroid barometer, is 2,615 feet above the level of the sea. At the north-eastern extremity there is a break in the side of the crater, and through this a quantity of volcanic mud poured into the Point Mulatre river, which flows towards the eastern side of the island; it would appear that an enormous quantity of the gray mud was thrown out, for it is stated that at one time the bed of the river was nearly filled up, but since the eruption most of the mud has been carried out to sea.

Large masses of pumice and sulphur are seen in the vicinity of the crater; and I picked up, near to the lip, pieces of felspar and porphyry. Rocks containing augite are found in abundance, and the solid ejecta lying about in all directions are composed for the most part of grey trachyte, containing a large proportion of iron pyrites. Were these trachytic rocks pulverised they would form, with the addition of sulphur, a sand similar in appearance to that which fell in Roseau at the time of the eruption.

Strictly speaking, a new crater has not formed, for the eruption was only the breaking into activity of an old volcano. The Grande Soufrière district formerly included four solfataras and the Boiling Lake, and the most active of these solfataras was situated in the crater of the volcano which has again become active. With the exception of a part of the bottom and southern side occupied by the soufrière—as a solfatara is called in the West Indies—the crater was clothed with trees, many of which were of large size and considerable age; and a stream of strongly ferruginous water rising at its south-western extremity, ran through the ovoid basin and found an exit at the break in the north-eastern side. The path to the Boiling Lake passed through the crater, and the north bank of the chalybeate stream—which has now entirely disappeared—was the usual place selected for an encampment by those visiting the lake. No earthquake was experienced at the time of the eruption; and beyond the peculiar thunder there were no sounds, similar to the booming of cannon, which are usually mentioned as concomitants of all manifestations of volcanic energy. It is also to be noticed that there was no flow of lava, and on my visit to the volcano, I found no trace of this usual educt of an eruption. It may be that the resistance to the volcanic force, was too small to cause much tremulation except in the immediate vicinity; and the surrounding country is of so rugged and broken a nature—dislocated rocks, and sharp ridges alternating with deep ravines—that a seismic wave would be propagated with difficulty.

The ash and sand which fell in Roseau, was similar in many respects to that ejected from Tomboro in April, 1815, for on that occasion the Commander of the H.E.I.C. cruiser *Benares*, reported concerning the ash which fell at Macassar, "though an impalpable powder or dust when it fell, it was, when compressed, of considerable weight; a pint measure of it weighed twelve ounces and three-quarters, it was perfectly tasteless, and did not affect the eyes with painful sensation, had a faint burnt smell, but nothing like sulphur; when mixed with water it formed a tenacious mud, difficult to be washed off." The ash which fell in Roseau was heavier, for a pint measure of it without compression weighed twenty-one ounces and fifteen drachms; this heaviness may however, be accounted for by the large proportion of iron pyrites, and the presence of this mineral was the cause of the metallic glistening first noticed when the ash fell.

M. Bert, a resident in Roseau, has made a qualitative analysis of the ash, and he informs me that he found the following bodies:—ferric sulphide, magnesia, potash, soda, silicon, sulphur, carbon, oxides of iron, lead, and alumina. M. Bert also found traces of other bodies, but their proportion was so small that he was unable to determine their exact nature with the means at his disposal.

H. A. ALFORD NICHOLLS

JUNGLE LIFE IN INDIA[2]

OF the many volumes published about the British possessions in Asia not one of them appears to us to go over the same ground as Mr. Ball's "Jungle Life in India." For nearly fifteen years the author, as one of the staff of the Geological Survey of India, was engaged in the work of the survey in parts of the Central Provinces and of Western Bengal far out of the ordinary tracks. Fond of sport, an excellent ornithologist, and a good botanist, there was much to engage his attention outside the ordinary routine of his daily duties—duties indeed which by their very nature brought him into everyday contact with all sorts of natural objects, both great and small. A specialist, it is true, has the proud satisfaction of knowing the subject he works at perhaps better than any one else, but he too often acquires the knowledge by the sacrifice, dismal to contemplate, of his love for almost all other subjects, and he can look for sympathy with his

1 Memoir of Sir Thomas Stamford Raffles, F.R.S. London, 1830, p. 246.

2 "Jungle Life in India; or, The Journeys and Journals of an Indian Geologist," by Valentine Ball, M.A., of the Geological Survey of India. London: Thos. De la Rue and Co., 1880.

labours to a very select few. Not so with our Indian geologist; his special work is but little touched on in this volume, though a glance at its 702nd page (Appendix G) shows the amount of that work accomplished, in the form of Memoirs, Records, and Reports published from time to time by the Geological Survey of India, to have been both important and great. One great charm of this journal lies in its many touches of nature. One feels as one reads it that for the moment they are with the journalist as he travels through some jungle, wanders along the bed of some mountain torrent, or explores some new coal-field big with promise. As a personal narrative it is full of life, and what it may want in precision is more than made up by the vivid pictures it presents.

The volume opens with an account of the Ranigunj coal-field, the largest and most important of those in which coal is worked in India :—

"The Ranigunj coal-field is the largest and most important of the areas in which coal is worked in India. Its proximity to the main line of railway, and also to the port of Calcutta, tends to give it pre-eminence over other less favourably situated localities. In the year 1774 coal was known to occur there, and so long ago as 1777 was actually worked. In 1830 several collieries of considerable extent had been opened out, and were, we have reason to believe, in a flourishing condition. The total area of coal-bearing rocks which is exposed is about 500 square miles; but it is possible that the real area may be even double that, since on the east the rocks dip under and are completely concealed by alluvium. Throughout this area a central zone includes the principal mines, and the chimneys which dot this tract constitute it the black country of India. At the present time (1879) there are about six principal European companies engaged in the extraction of coal, while many minor firms and native associations contribute to swell the total amount raised.

"Formerly a large proportion of the coal was obtained by open workings and quarries: but at the present day most of the seams which were accessible in this way have been exhausted, and regular mining is now carried on with more or less system. The miners are, however, individually, in some cases, allowed a degree of freedom, or rather licence, which would never be permitted in European mines. They chiefly belong to two races, the Bhowries and the Sontals; the former using the pick, while the latter cannot be induced to work with any other tool than a crowbar, with which they produce an altogether disproportionate amount of small coal and dust. The pillar and stall is generally practised in preference to the long wall system of 'getting' the coal. None of the mines are of great depth, and a perfect freedom from fire and choke-damp renders it possible to carry on the work without its being necessary to adopt the precautions which in England only too often fail to secure the object aimed at. Many of the seams are of considerable thickness; one which is worked contains nearly forty feet of coal. As a rule, however, the thick seams, especially those in the lower measures, do not contain the best coal. Compared with ordinary English coal, the Ranigunj coals, and Indian coals generally, are very much inferior in working power, still they are capable of generating steam in both locomotive and other engines, and for this purpose several hundred thousand tons are raised annually from Indian mines."

The many details in reference to articles of commercial value to be found scattered through this volume may be well illustrated by the following extracts, the first relating to "cutch," the second to shell-lac :—

"At this season a particular class of the natives were engaged in preparing the substance called *Koir*, which bears the commercial name of cutch, and is otherwise known as catechu. The chopped heart-wood of *Acacia catechu*, Willd., is boiled down in earthen vessels, and the resultant red liquid is subjected to further boiling, and, on arriving at a treacly consistency, is poured into clay moulds or wooden troughs. In some places I have been told that the finer qualities are improved by being buried for some months in the earth. It is an article of great value, and the right to manufacture is farmed out by the Zemindars. It is exported to Europe for dyeing and tanning, and in India it forms one of the constituents of pawn for chewing. It is also employed for various other purposes."

In these countries the consumption of cutch is very considerable; it is chiefly in use for tanning manufactured articles, such as the nets used in the herring and mackerel fisheries. Our next extract relates to an important production called shell-lac. Why is this term sometimes, and in standard works, spelled with but two ll's?

"This morning, before leaving the station, we visited a shell-lac manufactory, and as the method by which that useful article of commerce is prepared, and the source from which it is derived are not generally known, I shall endeavour to convey what I know of the subject as briefly as possible.

"Lac (or as it is called in Hindustani, *lah*) is secreted by an insect (*Coccus lacca*) on the branches and twigs of certain jungle trees. The principal of these are the khusum (*Schleichera jujuga*), plas (*Butea frondosa*), and bier (*Zizyphus jujuba*). The lac from the first-mentioned, the khusum, is more highly esteemed than that from the others. To some extent the lac is found occurring, so to speak, spontaneously, and is collected by the forest tribes, and brought by them to the fairs and bazaars for sale. Where, however, there is a regular trade in stick-lac, propagation of the insect is systematically carried on by those who wish for a certain and abundant crop. This propagation is effected by tying small twigs, on which are crowded the eggs or larvæ of the insect, to the branches of the above-named species of trees. These larvæ are technically called 'seed.' The larvæ shortly after sowing spread themselves over the branches, and, taking up positions, secrete round themselves a hard crust of lac which gradually spreads till it nearly completes the circle round the twig. At the proper season the twigs are broken off, and we must suppose them to have passed through several hands, or to have been purchased directly from the collectors by the agents of the manufacturer. On arrival at the factory, they are first placed between two powerful rollers, which, by a simple arrangement, admit of any degree of approximation. The lac is then crushed off and is separated from the woody portions by screening; it is next placed in large tubs half-full of water and is washed by coolies, male or female, who, standing in the tubs, and holding a bar above with their hands, stamp and pivot about on their heels and toes until, after a succession of changes, the resulting liquor comes off clear. Of the disposal of the liquor drawn off at the successive washings I shall speak presently. The lac having been dried is placed in long cylindrical bags of cotton cloth of medium texture, and which are about ten feet long and two inches in diameter. These bags when filled have somewhat the appearance of an enormous Bologna sausage. They are taken to an apartment where there are a number of open charcoal-furnaces. Before each of these there is one principal operator and two assistants. The former grasps one end of the long sausage in his left hand, and slowly revolves it in front of the fire; at the same time one of the assistants, seated as far off as the sausage is long, twists it in the opposite direction. The roasting before the glowing charcoal, soon melts the lac in the portion of the bag nearest the operator's hand, and the twisting of the cloth causes it to exude and drop into a trough placed below. The troughs which I saw in use were simply leaves of the American aloe (*Agave americana*). When a sufficient quantity, in a molten condition, is ready in the trough, the operator takes it up in a wooden spoon and places it on a wooden

cylinder some eight or ten inches in diameter, the upper half of which is covered with sheet brass. The stand which supports this cylinder gives it a sloping direction away from the operator. The other assistant, generally a woman, now steps forward holding a strip of the agave or aloe between her hands, and with a rapid and dexterous draw of this the lac is spread at once into a sheet of uniform thickness which covers the upper portion of the cylinder. The operator now cuts off the upper edge with a pair of scissors, and the sheet is then lifted up by the assistant who waves it about for a moment or two in the air till it becomes quite crisp. It is then held up to the light, and any impurities, technically 'grit,' are simply punched out of the brittle sheet by the finger. The sheets are laid upon one another and the tale, at the end of the day, is taken, and the chief operator paid accordingly, —the assistants receiving fixed wages. The sheets are placed in packing-cases, and when subjected to pressure break into numbers of fragments. In this fresh state the finest quality is a very beautiful object having a rich golden lustre. On seeing it thus, one cannot help feeling regret that it is not nice to eat—the best Everton toffee never looked more tempting. The above is the history of shell-lac, from its birth in the jungle to its appearance in the world as the commercial article. From the manufacturer it passes through the broker's hands to the merchant, and from him again to the manufacturers of varnishes, sealing-wax, and other commodities of which it is an ingredient.

"The dark red liquor resulting from the washing above described, is strained, in order to remove all portions of woody fibre and other foreign materials. It is then passed into large vats, where it is allowed to settle; the sediment is subjected to various washings, and at last allowed to settle finally, the supernatant liquor being drawn off. The sediment, when it is of the proper consistency, is placed in presses, from which it is taken out in the form of hard dark purple cakes, with the manufacturer's trade-mark impressed upon them. This constitutes what is known as lac-dye. By the addition of mordants, this dark purple substance yields the most brilliant scarlet dyes, which are not inferior, I believe, to those produced by cochineal. The dye which is thus separated from the lac by washing is said to be the body of the insect, not a separate secretion."

One more extract we venture to make, which gives a description of the uses made of the flowers of the *Bassia latifolia*, Roxb. Not only are the fruits of this tree used as an article of food, but "the fleshy deciduous corollas are likewise largely employed for the same purpose, and, in point of fact, constitute a staple and sometimes almost the only article of diet available to the poorer classes during several months of each year. Towards the end of February or the beginning of March, as the crop of mhowa flowers approaches ripeness, the corollas, becoming fleshy and turgid with secreted juices, gradually loosen their adhesion to the calyx, and fall to the ground in a snowy shower. The duty of collecting the fallen blossoms is chiefly performed by women and children; at dawn they may be seen leaving their villages with baskets and a supply of water for the day's use. Before the crop has begun to fall they take the precaution to burn away the grass and leaves at the foot of the trees, so that none of the blossoms may be hidden when they fall. The gleaners generally remain under the trees all day, alternately sleeping and collecting the crop, and the male members of the family visit the trees once or twice during the day, in order to carry away what has been collected. At night bears, deer, and other animals visit the trees to take their share of the crop. In the early mornings, and late in the evenings, the less frequented trees, on the borders of the jungles, attract numbers of jungle and pea fowl. Cattle also are very fond of the flowers, and cow's milk has in consequence, at this season, a strong flavour of mhowa.

"It often happens that the people who collect come from a considerable distance, in which case they erect with the branches of the sál a temporary encampment of huts, in which they live until the crop is all gathered in. In front of each of these huts a piece of ground is made quite smooth and hard, for the purpose of spreading out the flowers to dry in the sun. When perfectly dry they have a reddish-brown colour, and in size they have lost three-fourths of their original dimensions, and about half their original weight. It is the custom with some of the natives, before spreading them out to dry, to pull off the ring of minute foliaceous lobes which crowns the fleshy corolla. It is very difficult to obtain any trustworthy statements as to the yield of the mhowa trees. A first-class tree, I have been told, will continue to shed its blossoms for fifteen days, at the rate of 120 pounds a day; but this estimate is, I believe, at least double what it ought to be. The rent of the trees varies with the abundance of them in the district, the quality of the previous rice harvest, and various other circumstances affecting the demand and supply. Twopence to four shillings were the extremes of prices which, in various places, had, I ascertained, been actually paid for permission to collect. As does the rent of the trees, so the saved crop varies much in price—the limits being from 120 to 480 pounds for the rupee or two shillings, but when, as is most frequently the case, the exchange is in kind, the merchants only give a small quantity of salt and six or eight pounds of rice for a maund (80 lbs.) of mhowa. During the famine in Manbhum the price of mhowa averaged about 24 lbs. for the rupee.

"Two maunds of mhowa are stated by some to furnish a month's food to a family consisting of a father, mother, and three children. It is, however, seldom eaten alone, being mixed with the seeds of the sál, or with the leaves of jungle plants; sometimes a small quantity of rice is added. It is the custom to cook but once a day, and each member of the family helps himself whenever he feels hungry.

"When fresh the mhowa has a sweet taste, with an odour somewhat suggestive of mice; when dried it presents some resemblance to the inferior kinds of figs. Cooking renders it vapid, and utterly devoid of flavour. On distillation the newly dried flowers yield a highly intoxicating spirit called *daru*; this is generally diluted with from five to ten times its bulk of water, and is then sold at about the rate of a penny for a quart. Its odour is most offensive to Europeans, but British soldiers have been known to secure for themselves the pleasures of intoxication by drinking it with held noses, as a child takes a nauseous draught. By careful distillation it is possible to get rid of the essential oil which causes the unpleasant flavour. From the seeds a sort of oil is expressed, which is used for cooking purposes and to adulterate ghi. Although the natives protect such mhowa trees as exist I am not aware that they do anything to increase the number.

Some of the most interesting parts of the work are those describing two trips made in 1869 and 1873 to the Andaman and Nicobar Islands. These trips served the purpose of bracing up our author for a renewed jungle life. As an example of the excellent illustrations, we give one showing a group of Nicobarese at Nankowri Island. The origin of these people "is still shrouded in much obscurity. According to themselves they all came from the Great Nicobar. They are said to possess two traditions as to their primary origin: the first being that they are sprung from ants, and the second that they are descended from a man and a dog, the sole survivors of a great inundation. This latter, however, may very possibly be a comparatively modern idea, derived from some jumbled account of the Noachian deluge taught them by the earliest missionaries. To what I have already said as to the probable affinities of the Nicobarese with the Malays and Burmese, I would here add that I have

noticed among them certain traits which seem to me to point to an affinity between them and two tribes of Dravidians, with whom I have some acquaintance; these are the Malés, or Rajmehal Paharias, and the Sowras, or Savaras, of the tributary states of Orissa. The grounds for this identification are not, it is true, very definite; but when visiting the villages of the Malés, many little things, such as the erection of ornamental bamboos to ward off evil spirits, and the store-houses raised on posts, recalled to my mind similar objects in the Nicobars. In order to test this supposition I have compared lists of Nicobarese and Dravidian words, and the result is that some few have proved to be identical, or nearly so."

The following curious phenomenon is worthy of being noted. Presumably the lime must be taken up in solution by the roots in large quantities, and then deposited in the manner described.

"Some white marks on the cut stump of an Asan tree (*Terminalia tomentosa*, W. and A.) caught my eye, and these on examination proved to be the sections of laminæ of calcareous matter, which alternated with the ordinary rings of woody growth. How this calcareous matter found its way into such a position it is difficult to say; but its occurrence is perhaps not more singular than that of silica in the joints of bamboos, where, as is well known, it sometimes forms what is called 'tabasheer.' The rocks about were gneisses and schists, and I could discover nothing in the soil to account for the peculiarity.

"About a year previously, or in April, 1870, the fact of the occurrence of calcareous masses in timber had been brought to the notice of the Asiatic Society of Bengal by Mr. R. V. Stoney, who stated that many trees in the Orissa Tributary Mehals have pieces of limestone (or calcareous tufa) in fissures in them, but principally Asan

Group of Nicobarese, Nankowri Island.

(*Terminalia tomentosa*, W. and A.), Swarm (*Zizyphus rugosa*, Lam. ?), Sissu (*Dalbergia sissu*, Roxb.), and Abnus (*Diospyros melanoxylon*, Roxb.). In some cases, irregular-shaped pieces, seven inches long by two inches thick, were met with in the trunks at a height of about six feet from the ground. By the natives the lime is burnt, and used for chewing with pawn. On examination it was found that there was no structure in these masses which would justify a conclusion that they had been formed by insects. Some included portions of decayed wood seemed to be cemented together by the lime. Though I have not had an opportunity of consulting many botanists on the subject, I believe it to be the case that the occurrence of deposits of carbonate of lime in timber has not been met with elsewhere. Oxalate of lime is sometimes met with in vegetable tissues, but in the form of carbonate, I am informed, however, that there is no recorded case of lime having been found, and such also appears to have been the opinion of the late Dr. Kurz."

We had marked for further extracts some passages from the author's account of his second trip to the Andamans and Nicobars, made in 1873, and from his account of the district about Orissa, and of his visit to Afghanistan, but for these and many other such we must refer the reader to the volume, feeling assured it will be found very pleasant reading. In it there is much about the economic resources of a great country, and very many interesting details of several of the native races.

The Survey is happy in having on its staff one who by this volume has proved the good use he has made of his small amount of leisure time. We wish we could add that such zeal and such knowledge had met with or were sure to meet with a proper reward from those in whose hands the destinies of India now lie