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Author(s): James Sibree

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then comes the very large and important race of Haussas, the original people of those regions, and a race of traders; they have practically no religion whatever, although nominally Mahomedans. The great masses of the people of the southern regions of Sokoto and Gandu are in their superstitions and manners as Pagan as before the Fellatahs came. We have not to deal, as has been the case in India, with civilised races, but gradually to train many millions of people more or less quite unaccustomed to work. That is the first great difficulty to be encountered in all Central Africa—labour. I have already kept you longer than I intended; and having given you an idea of one difficulty we have to contend with, this should explain to you the slow progress we must expect. It will be a matter of generations before these peoples will be able to understand law, government, and work. I believe the time will come when our grandchildren will reap the fruits of what we are doing; we are laying the foundation, and must be content to raise the building a very little distance.

The CHAIRMAN: I beg to return a vote of hearty thanks to Major Macdonald for his very interesting lecture.

The Volcanic Lake of Tritriva, Central Madagascar.

By the Rev. JAMES SIBREE, Jun.

THE great island of Madagascar is not at present one of those regions of the earth where volcanic disturbances occur; but there is ample evidence, from the numerous extinct craters found in various parts of the island, that at a very recent period, geologically considered—possibly even within the occupation of the country by its present inhabitants—it was the theatre of very extensive outbursts of subterranean energy. The whole island has not yet been examined with sufficient minuteness to determine the exact extent of these old volcanoes, but they have been observed from near the south-east coast in S. Lat. 23°, and in various parts of the centre of the island up to the north-west and extreme north, a distance of 680 miles; and probably a more careful survey would reveal other links connecting more closely what is at present known as only a series of isolated groups of extinct craters. In the central provinces of Madagascar there are two large clusters of old volcanic cones and vents; one of them in and about the same latitude as the capital (19° S.), but from 50 to 70 miles away to the west of it, in the neighbourhood of Lake Itasy; the other in the district called Vakinankaratra, situated about 80 miles to the S.S.W. of Antananarivo, and south-west of the great central mountain mass of Ankàratra.

This second volcanic region stretches from 20 to 30 miles from Antsirabè away west to Bétafo and beyond it, and contains numerous and prominent extinct craters, such as Ivòko, Iatsifitra, Vòhitra, Tritriva, and many others, some of which have been described by the graphic pen of the late Dr. Mullens, in his 'Twelve Months in Madagascar'

(pp. 214–219). The doctor says that he counted in this southern group about 60 cones and craters.

There are also many hot springs in this Vakinankaratra region, the most noted of which are those at Antsirabé. At this place one of the chief springs is largely charged with lime, which has formed an extensive deposit all over a small level valley sunk some 20 feet below the general level of the plain around the village. For a long time past this place has furnished almost all the lime used for building in the capital, and the central province of Imèrina. Besides the deposit over the floor of the valley, there is also a compact ridge-shaped mass of lime accretion, 70 feet long by 18 to 20 feet wide, and about 15 or 16 feet high. This has all been deposited by the spring which kept open a passage through the lime to the top. Within the last ten or twelve years, however, the spring has been tapped by a shaft, of no great depth, a few yards to the north, over which a large and commodious bath-house has been erected by the Norwegian Lutheran Mission; and here many visitors come to bathe in the hot mineral water, which has been found very beneficial in rheumatic and other complaints. A little distance to the south-west is another spring, not, however, hot, but only milk-warm, the water of which is drunk by those who bathe in the other spring. This water has been shown to be, in chemical constituents, almost identical with the famous Vichy water of France. All over the valley the water oozes up in various places; and about half a mile farther north are several other springs, somewhat hotter than that just described, to which the natives largely resort for curative bathing.

During the excavations for the foundations of the bath-house, the skeletons of several examples of an extinct species of hippopotamus were discovered, the crania and tusks being in very perfect preservation. Some of these are now in the Museum at Berlin; the finest specimen was sent to the Museum of the University of Christiania in Norway. This Madagascar hippopotamus was a smaller species than that now living in Africa, and is probably nearly allied to, if not identical with, another hippopotamus (*H. Lemerlei*) of which remains were found in 1868 by M. Graudidier, in the plains of the south-west coast. I was informed by the people that, wherever in these valleys the black mud is dug into for a depth of three or four feet, bones are sure to be met with. Probably a series of excavations would reveal the remains of animals, birds, and reptiles formerly inhabiting Madagascar. From the internal structure of the teeth and bones of the hippopotami discovered at Antsirabé, traces of the gelatine being still visible, it is evident that the animals had been living at a comparatively recent period. There have been occasional vague reports of the existence of some large animal in the southern parts of the island; possibly the hippopotamus is not yet absolutely extinct there; and perhaps the half-mythical stories of the *Songòmbi*, *Tòkandia*, *Làlomèna*, and other strange creatures current

among the Malagasy are traditions of the period when these huge pachyderms were still to be seen in the lakes and streams and marshes of Madagascar.

Within a few miles of Antsirabè are two crater lakes. The nearer and larger of these is called Andràikiba, which lies distant about four miles due west. This is a beautiful sheet of water, blue as the heavens in colour, in shape an irregular square, but curving round to the north-west, where it shallows into a marsh, which is finally absorbed in rice-fields. The lake is said to be of profound depth, but the hills surrounding it are not very lofty, rising only about 200 feet above the surface of the water, from which they rise steeply. Fish and water-fowl and crocodiles also are said to be very abundant in and on its waters.

But the most interesting natural curiosity to be seen in the neighbourhood of Antsirabè is the crater-lake of Tritriva. This is situated about 10 miles to the south-west, and is a pleasant ride of two hours by palanquin. Travelling at first in a westerly direction, the road then turns more to the south-west, and skirts the southern foot of the old volcano of Vòhitra (already mentioned): Passing some mile or two south of the high ground round the southern shores of the Andràikiba lake, the road gradually ascends to a higher level of country, so that in about an hour and a-half's time we are about as high as the top of Vòhitra—probably about 500 feet. Reaching a ridge between two prominent hills, we catch our first sight of Tritriva, now about two or three miles distant in front of us. From this point it shows very distinctly as an oval-shaped hill, its longest axis lying north and south, and with a great depression in its centre; the north-eastern edge of the crater wall being the lowest part of it, from which point it rises gradually southwards and westwards, the western edge being, at the centre, from two to three times the height of the eastern side. To the north are two much smaller cup-like hills, looking as if the volcanic forces, after the main crater had been formed, had become weaker and so been unable to discharge any longer by the old vent, and had therefore formed two newer outlets at a lower level.

Descending a little from the ridge just mentioned, we cross a valley with a good many scattered hamlets, and in less than half an hour reach the foot of the hill. A few minutes' pull up a tolerably easy slope, perhaps 200 feet in height, brings us to the top, at the lowest part of the crater edge; and on reaching the ridge the crater of the old volcano and its lake is before us, or, rather, below us. It is certainly an extraordinary scene, and unique of its kind. The inner sides of the crater dip down very steeply on all sides to a deep gulf, and here, sharply defined by perpendicular cliffs all round it, except just at the southern point, is a rather weird-looking dark-green lake far below us, the water surface being probably from 200 to 300 feet lower than the point we are

standing upon, and consequently below the level of the surrounding country. The lake, exactly shut in by the cliffs of the crater surrounding it, is not blue in colour, like Andràikiba, although under a bright and cloudless sky, but a deep and somewhat blackish green. It must look, one would suppose, like ink under a stormy sky, or in the shadows of evening.

We sit down to rest and try to take in all the details of this novel picture. It is undoubtedly an old volcano we are now looking down into; the spot on which we rest is only a few feet in breadth, and we can see that this narrow knife-edge is the same all round the crater. Outside of it the slope is pretty easy, but inside it descends steeply, here and there precipitously, to the edge of the cliffs which so sharply define the actual vent and, as distinctly, the lake which they enclose. Looking southwards, the crater edge gradually ascends, winding round the southern side, and still ascending as the eye follows it to the western, the opposite side, where the crater wall towers steeply up from 200 to 300 feet higher than it does on the east, where we are standing. The lake we judge to be about 800 to 900 feet long and 200 to 250 feet wide, forming a long oval, with pointed ends. The cliffs which enclose it appear to be from 40 to 50 feet in height, whitish in colour, but with black streaks where the rain, charged with carbonic acid, has poured more plentifully down their faces. These cliffs are vertical and in some places overhang the water, and from their apparently horizontal stratification are no doubt of gneiss rock. In coming up the hill I noticed a few small lumps of gneiss among the basaltic lava pebbles. The strongest feature of this Tritriva is the sharply defined vertical opening of the vent, looking as if the rocks had been cut *clean through* with an enormous chisel, and as if they must dip down—as is doubtless the case—to unknown depths below the dusky-green waters. At the northern end of the lake is a deep gorge or cleft, partly filled with bushes and other vegetation. Southward of this, on the eastern side, the cliffs are still lofty and overhang the water, but at about a third of the lake's length they gradually decrease in height, and at the southern point they dip down to the level of the lake, so that at that part only can the water be approached. On the western side the cliffs keep a pretty uniform height all along the whole length.

So steep is the inward slope of the crater walls, that we all experienced a somewhat "eerie" feeling in walking along the footpath at its edge; for at a very few feet from this a false step would set one rolling downwards, with nothing to break the descent to the edge of the cliffs, and then to the dark waters below. Yet there was a strange fascination in the scene, and the variety and contrast and depth of the colours would make the Tritriva lake and slopes a striking subject for a painting from many different points along its crater wall. When we arrived, the sun, yet wanting an hour and a half of noon, was still

lighting up the grey-white stone of the western cliffs, but the shadows were every minute growing more intense as the sun became more nearly vertical. Far below us was the deep-green oval lake; above it, the stratified gneiss cliffs with their black streaks, diversified here and there by patches of bright-green bush. Then again from their edges sweep steeply upwards the grey-green sides of the crater, culminating in the lofty western ridge opposite to us. And over all was the blue sky flecked with cirrus clouds; altogether a scene such as I have seen nowhere else in Madagascar, or, indeed, in any other country.

After fixing in our minds the view from the north-east, we proceeded southwards along the crater edge to the higher part at the south-east, where the view is equally striking, and the depth of the great chasm seems still more profound. Here we waited some time, while most of our men went down to one of the hamlets in the plain to the east to get their meal, in which quest, however, they had only poor success. On expressing a wish to taste the Tritriva water, one of our bearers took a glass, and descending by a breakneck path, went to fetch some water from the lake. He was so long away that we were beginning to feel uneasy, but after a quarter of an hour, he reappeared with the water, which tasted perfectly sweet and good. He also entertained us with some of the legends which were certain to have grown up about so weird looking a place as Tritriva. Pointing to two or three small trees or bushes growing on the face of the cliffs near the northern point of the lake, he told us these were really a young lad and lass who had become attached to each other; but the hard-hearted parents of the girl disapproving of the match, the youth took his loin-cloth, and binding it round his sweetheart and his own body, precipitated her with himself into the dark waters. They became, so it is said, two trees growing side by side, and they now have offspring, for a young tree is growing near them; and in proof of the truth of this story, he said that if you pinch or break the branches of these trees, it is not sap which exudes, but blood. He appeared to believe firmly in the truth of this story.

He also told us that the people of a clan called Zànatsàra, who live in the neighbourhood, claim some special rights in the Tritriva lake; and when any one of their number is ill, they send to see if the usually clear dark-green of the water is becoming brown and turbid. If this is the case they believe it to be a presage of death to the sick person.

Another legend makes the lake the former home of one of the mythical monsters of Malagasy folk-lore, the *Fanànim-pito-lôha* or "seven-headed serpent." But for some reason or other he grew tired of his residence, and shifted his quarters to the more spacious and brighter lodgings for seven-headed creatures afforded by the other volcanic lake of Andràikiba.

This same bearer assured us that in the rainy season—contrary to what one would have supposed—the water of the lake diminishes, but

increases again in the dry season. He told us that there is an outlet to the water, which forms a spring to the north of the mountain. I noticed a white line a foot or two above the surface of the water all round the foot of the cliffs, showing a probably higher level than at the time of our visit. The lake is doubtless profoundly deep. I was told that a few years ago Mr. J. Parrett sounded it with a line 600 feet long, but found no bottom at that depth.

Walking round to the southern end of the crater edge, the lake, here foreshortened, has a somewhat close resemblance in outline to that of the Lake of Galilee, as seen on maps; but I must confess that the first sight of it in its deep chasm made me think much more of the other lake of Palestine, the Dead Sea, in its profound gorge between the Judean hills and the highlands of Moab. After making a slight pencil sketch or two, I proceeded up the far higher saddle-back ridge on the western side. Here the lake seems much diminished in size, and lying far down at an awful depth. But a magnificent and extensive view is gained of the surrounding country; the long flat-topped lines of hill to the east running many miles north and south, and surrounded directly east by two perfect cones (old volcanoes, Vòtovòrona and Ihankiana) the peaked and jagged range of Vòambòrona to the south-east; the enormous mass of Ibity to the south; and then west, a flat region broken by abrupt hills; to the north-west are the thickly populated valleys towards Bètàfo, with many a cup-shaped hill and mountain marking old volcanic vents; and beyond this a high mass of country, with serrated outline against the sky, showing the district of Vāvavàto and the peaks of Iāvohàika; and finally, coming to due north is the varied grouping of the hills which form the northern termination of the central mountain mass of Ankà-ratra. Between us and these again is the extensive plain of Antsirabè, with the white walls and gables of the church and the mission buildings plainly visible in the bright sunshine, although 10 or 11 miles distant—altogether a panorama long to be remembered. From this point also the significance and appropriateness of the name given to the old volcano is clearly seen: Tritriva is a combination of the words *tritry*, a word used to describe the ridge on the back of a chameleon or a fish, and *iva*, low, deep; so that the name very happily describes the long steep western ridge or crater wall, and the deep chasm sweeping down from it.

It may be added in conclusion, that the slopes of the crater both inside and out are covered over with turf, which grows on a dark-brown volcanic soil, mingled with rounded pebbles of greenish or purple lava, very compact and close in structure, and containing minute crystals scattered sparingly through it. Occasional blocks of this are found round the edge of the crater wall, and the same rock crops out at many places on the steep inner slopes. I did not notice any vesicular

lava or scoria; and at a little homestead not far from the north-eastern foot of Tritriva, I was surprised to find the *hàdy* or fosse dug to 12 or 14 feet deep almost entirely through the red clay or earth found all through the central regions of the island. The dark-brown volcanic soil, here seen in section, appeared to be only 18 inches deep, with layers of small pebbles. So that the discharge of the volcanic dust and ash appears to have extended only a short distance from the mountain, at least it does not appear to have been very deep, unless, indeed, there has been much denudation. It must be remembered, however, that this point is to the windward side of the hill; probably the volcanic soil is deeper to the west of it. The much greater height of the western wall of the crater is no doubt due to the prevailing easterly winds carrying the bulk of the ejected matter to the west, and piling it up to two or three times the height of the eastern side. After seeing the amount of gneiss rock which must have been blown out of the vent, I expected to have found much greater quantities of it, and in larger blocks, than the very few and small fragments actually seen on the outer slopes. The greater portion, however, is probably covered up under the quantities of volcanic dust and *lapilli* which were subsequently ejected.

Tritriva, it will be evident from this slight sketch, will greatly interest those who have a taste for geology and physical geography; while its peculiar and somewhat awe-striking beauty makes it equally worthy of a visit from the artist and the lover of the picturesque. Certainly it has become photographed upon our memory with a distinctness which will render it a vivid mental picture for many a day to come.

GEOGRAPHICAL NOTES.

Mr. Theodore Bent's Explorations at Zimbabwe.—A telegram from the Cape appeared in the daily papers of the 23rd July, announcing the discovery by Mr. Bent, in the course of his excavations at Zimbabwe, of images and pottery supposed to be of Phœnician origin. Important finds of this nature were expected, and we look forward with interest to news of the discovery, with details, from Mr. Bent himself; at present we have no information from him direct.

The International Congress of Geography at Berne.—The Berne meeting of this Congress commences on the 15th August next. The Delegates appointed to represent our Society at the Congress are the Right. Hon. Sir George Bowen, G.C.M.G., Dr. R. N. Cust, Admiral Sir Erasmus Ommanney, Mr. Delmar Morgan, and Mr. J. Scott Keltie. Among the subjects to be discussed at the Congress is the production, by

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