sage through the forest, the flow encountered trees of all sizes, to a yard or more in diameter. Flowing around these, it solidified sufficiently to retain a complete mould of the trunks before they burned off. By means of these upright moulds or wells it is comparatively easy to measure the depth of the lava at any point throughout this portion of its length. This I found to average about twenty feet, though varying very much in particular instances, according to the nature of the surface over which it flowed.

As their trunks burned off, the trees fell upon the surface of the still plastic lava with sufficient force to impress upon it a mould of a portion of their outline.

In both the vertical and horizontal moulds a peculiar impression was made upon the surface of the lava in contact with the tree. It took on a honeycomb structure, presenting a series of indented squares. The cause of this peculiar form I have been unable to determine. The indentations are certainly not the impression of the bark of the trees, and they are altogether too regular to be the result of the expansion of gases.

The general structure of the flow, throughout its entire length, is that of a long, central tunnel with numerous lateral branches. Flowing lava cools very rapidly, — indeed, so quickly, that I have often passed over the surface of that which I had seen flowing fifteen minutes before. Being a good non-conductor, the heat of the inner portions is long retained after the surface is once solidified. In this way a long central tube is formed, from the lower end of which the lava continually flows, while it continually extends the length of the tube. The pressure along the tube is constantly becoming too great for its sides to bear, and lateral off-shoots are formed, increasing the width of the flow. These lateral tunnels usually fill up, and finally become solid. The central tunnel, however, remains hollow throughout a large portion of its length, and may often be traversed for long distances after the flow has become cool. On my first visit to the flow, the top of this central tunnel had fallen through in many places, and I was able to look into it for some distance; but in every case I found the heat still too intense to allow me to descend into it. At later visits this became possible. The roof is commonly rough, a broken surface of lava, but in many cases is smooth and shiny, and covered with numerous stalactitic forms, seldom more than an eighth of an inch in diameter, but often having a length of five and six inches.

The stalagmite form was very rare, and only in one case did I find any of large size. In this instance the lava had flowed over a small precipice in a sheet in such a manner as to leave an opening between the sheet and the face of the precipice. Directly at the foot of the precipice were two peculiar stalagmitic forms made of drippings of lava about a quarter of an inch thick and three and four inches long. The larger of these was about a foot in height; the smaller, not more than half that size. These had evidently been formed by the lava covering a small spring, the steam generated from which had kept the lava above in a semi-plastic condition for some time. These specimens attracted much attention, as nothing of the kind had before been found. They may now be seen in the museum of the Boston society of natural history.

Owing to this peculiar property of lava to form tubes for itself in which to flow, it has the power to flow over small elevations, thus presenting the phenomenon of a liquid flowing up hill. It has the power to continue this till the pressure becomes too great for the strength of the sides of the tube.

The opposite view is from a photograph taken on the spot during the flowing of the lava. It shows the lava in the act of flowing over a precipice about fifteen feet in height. Each of the small streams seen trickling down the face of the rock is red-hot lava. This illustrates the fact that lava flows at the steepest angles, which is sometimes questioned. In this view the lava is flowing into a small pool of water, the resultant steam from which is seen arising like the mist of a cataract. This depression was afterward so entirely covered by the lava, that at my visit the spot could not be distinguished.

It would be interesting, if possible, to give an approximate estimate of the amount of lava which was forced above the surface during this eruption; but with the present data it is impossible. No survey of the flow has been made, and it is exceedingly difficult to estimate its dimensions by the eye. As a very rough estimate, I should place it at something more than five hundred million cubic yards.

GEO. H. BARTON.

THE STATE OF EXPLORATION IN AFRICA.

THE exploration of the dark continent continues with unabated vigor, in spite of the occurrences in the Sudan which nevertheless, in the form of disturbing rumors, must, even at a considerable distance, exercise an evil influence upon the native population.

Humblot, the French naturalist, has been commissioned by his government to investigate the botany and zoölogy of the river-basins of the Kongo, Ogowé, and Gaboon. The Portuguese officers, Capello and Ivens, have been authorized to take up their studies in the same region, and to prepare a chart of the northern part of the province of Angola, belonging to the basin of the Kongo. Lieut. Wissmann is about to return to Central Africa, where Dr. Pogge still remains, and to continue for several years systematic explorations in the Kongo region. A large subscription for the support of the work has been raised in Berlin from scientific and especially from commercial sources, and the results for science and trade will doubtless prove important. His compatriot, Flegel, after exploring the sources of the Benowé, has been directed to proceed in a south-easterly direction, toward the Kongo. For this purpose the German government has reserved a considerable sum of money. He was at last reports about three hundred kilometres from the mouth of the Niger, at Abutchi, near Oniga. The Kongo question continues to form the subject in Europe of a host of pamphlets representing the views of the different parties contending for the control of trade on that great water-way. Most of them seem to carefully avoid touching the real and practical questions now at issue, and devote much space to considerations of a sentimental nature, growing out of matters a century or two old. The day for such reminiscences to have weight in practical politics would seem to have passed.

The French continue the work of establishing better means of communication in upper Senegal, for which the Chambers have recently voted five million francs. Kayes, at the head of navigation on the Senegal River, is now quite a well-constructed, active little town, where two years ago there was little more than a desert. Above this point, only flat boats are available as far as Bafulabé. From this point between one and two hundred kilometres of road, suitable for light two-wheeled vehicles, have been constructed, and fortified posts established at intervals, which are supplied by parties of armed natives, employing in the work more than three thousand pack or draught animals. The part of the railway already constructed is of great use in forwarding material for its extension. Small tramways or horse-railroads have been found of great use in the work of constructing the main line, and ten thousand kilometres of a patented form of tramway have been ordered for this purpose. The object of this at first sight extraordinary project of running a railway into a savage country, beside the protection of the rich colony of Senegal from the devastating incursions of the interior tribes, also includes tapping the Niger at its head waters, and securing the immense traffic of that great river without forcing a way through the pestilential swamps of its miasmatic delta. This is a commercial prize worth a round sum to secure, and in which French courage and enterprise will find an abundant recompense.

From South Africa, Coillard writes that he has reached his old station at Leribé in Basuto-land. Since his previous visit, war has desolated that fine country, and degenerated into guerilla warfare, by which the traveller suffered greatly on his journey. Later he proposes to strike out into the interior.

From equatorial Africa it is reported that Revoil, leaving important collections to be forwarded to Paris from Mogadoxo, had pushed on to Guélidi. Nothing has been heard from Giraud, who is following a route not in use by caravans; but news is shortly hoped for by way of Kakoma. Capt. Bloyet and his brave wife have arrived at Zanzibar, where he will prepare a report of his last expedition for the French committee of the International African association, and then continue his triangulation in the Usagara region, south-west from Zanzibar. Madam Bloyet has accompanied her husband everywhere, and rendered valuable service, both in his collecting and exploring work. The labors of the missionaries in this region appear to be producing some effect in doing away with the barbarous human sacrifices due to the belief in sorcery, formerly universal. These sorcerers are truly the plague of Africa.

The return of Dr. Fischer terminates one of the most important of recent journeys in Central Africa; and the publication of the results will be awaited with the highest interest. Joseph Thompson, who followed nearly the same route, was last heard from at Wandarobo, having suffered great hardships and many losses from wars waged by the cannibal and ferocious Massai tribe.

Fischer attempted to pass through the Massai country, yet untrodden by the whites, and to reach the reported Lake Baringo. When only six days' march from the object of his journey, he was forced by overwhelming numbers to retrace his footsteps, and pass around Lake Naivasha, where a large hot-spring was found by the Natron Lake near the Doego-ngai volcano, and thence, *viâ* Angaruka, to Mont Macru. Among other things, two hundred and sixty species of birds were collected.

Dr. Stecker has returned in good health from his explorations in the Galla country, south of Abyssinia, having mapped a large extent of country very carefully and thoroughly.

The usual tribute of noble lives has been demanded by the pestilential climate of Africa. Ernest Marno recently succumbed to fever in the upper Sudan, after having rendered, during fourteen years, distinguished services in the exploration of Central Africa. The unfortunate Dr. Matteucci arrived in London with Massari, from their recent journey across Central Africa, undermined by fever, wrote to his mother that he was about to join her, and in a few hours was no more. Schweinfurth sends an account of the assassination of Sacconi in the Somali country, during his attempt to reach the Wabbi River. He was cut to pieces by five Somalis, under circumstances almost identical with those attending the murder of Mademoiselle Adeline Tinne by the Tuaregs of Fezzan. His servant, who had been charged in such an event to secure the record of the journey, attempted to do so under cover of night, but was surprised, and barely escaped with his life. The record was torn and deliberately burned by a fakir of the tribe.

The unfortunate end of the Marquis Antinori is known. His successor, Count P. Antonelli, more happy, has returned to Rome, and has recently given an account of his investigation of Shoa, in south-eastern Abyssinia, to the Italian geographical society. This society is publishing the results of the Italian expedition. An interesting account of the fresh-water fishes of Shoa has already appeared. Soleillet, the French explorer of Shoa, appears from his reports to be living *en grand seigneur*, under the protection of his Shoan Majesty, King Menelik II., having been appointed to a feudal office somewhat between a baron and a justice of the peace. Bremond's report of his scientific and commercial expedition from the French colony of Obock to Shoa has recently been printed in *L'Exploration*. This region, though but a few years since untrodden by civilized men, offers rich rewards to traders; and the privileges of trade have lately been the object of lively competition between the commercial explorers of several nations. W. H. DALL.

GREEN MOUNTAIN RAILWAY, MOUNT DESERT ISLAND.

THE Green Mountain railway on Mount Desert Island, Me., is intended for pleasure-travel. It was operated for the first time during the last summer season. It is in a great measure a copy of the railway up Mount Washington, New Hampshire, built some thirteen years ago. These two lines, and the Mount Righi railway in Switzerland, are the only ones employing the central cog-rail as a means of surmounting steep gradients. The trip for tourists from Bar Harbor to the summit of Green Mountain is made, first, by wagons or stages, two miles and a half to Eagle Lake; thence by steamer on the lake two miles; and finally by rail sixty-three hundred feet, in which latter distance the ascent is twelve hundred and seventy feet to the summit, fifteen hundred and thirty-five feet above the sea. While the grade averages about a foot rise in four feet and a half distance, in some places it is as steep as one in three.

Surveys were made, and the work of clearing and grading was begun, in the winter of 1882–83. In April a large force of men was employed, and the road was completed by July 1. The track is not raised on trestle-work, as is the case at Mount Washington: much of it, especially on the heaviest grades, is constructed on the solid ledge. Where the longitudinal timbers, or stringers, rest directly upon the rock, iron bolts one and a quarter inches in diameter, six feet apart, are driven through them into holes drilled in the ledge. Where it is necessary to raise the stringers above the surface in order to make a regular inclination, bed-ties are used every six feet, secured against slipping by two or three one and a quarter inch iron bolts firmly fixed in the rear of each tie. All longitudinal timbers required to bring the line to grade are fastened to the bed-ties with iron bolts of the same size. The timbers and ties in contact with the rock were carefully hewed, and fitted to place. The spruce timber needed for this portion of the work was obtained from a forest-growth on the mountain itself.

The sleepers or ties, six inches square and six feet long, are laid upon the stringers at a distance of two feet from centre to centre, and two seven-eighth inch iron bolts are driven into the stringers, immediately in the rear of each tie, in grooves in the tie, which serve to prevent lateral motion. Upon the ties lie 'T'-rails, joined by fish-plates and bolts, and spiked in the usual way. The rack or cog-rail in the middle of the track is made of two angle-irons which have between them cogs of one and a quarter inch iron accurately rolled to uniform size. This cog-rail is secured to the ties by two lag-screws, five inches and a half long, in every tie, and additional ones at each joint. The rack was manufactured by the Atlantic iron-works, East Boston.

The engine weighs ten tons, and embodies all the improvements suggested by the operation of the White Mountain road. Its entire mechanism is double, — four cylinders, two cog-wheels, and two driving-shafts. Intermediate gearing between the crank-axles and cog-wheels reduces the speed, and increases the tractive force. The cog-wheel axles carry ratchet-wheels with pawls; and either one of these ratchet-wheels, in case of accident to the engine, will hold the train on any grade. In addition, two band-brakes on the smaller shafts may be instantly applied by the engineer. The ascent is made by steam-power; and the engine, when backing down the mountain, is still kept in forward gear, that is, with valves set to go ahead, so that it is constantly pumping air into its boiler; and this air, allowed gradually to escape, exerts an upward tractive force, thus easing the descent.

The floor of the passenger or observation car is adjusted so as to be level on the average grade, and the sides are open to admit of an unobstructed view. The car is always pushed ahead of the engine, and is provided with double hand-brakes, two cog-wheels, ratchet, and pawl, which will easily control the car in descending. CHARLES E. GREENE.

ANTHROPOLOGICAL PAPERS IN PETERMANN'S MITTHEILUNGEN FOR 1883.

IN order to keep pace with the growth of knowledge respecting the natural history of man, one must not neglect the geographical journals. The files of *Petermann's mittheilungen* for the past year will be found quite rich, especially in ethnographic information. The following summary will guide to the most important contributions.

Upon the subject of the variation of climate in the region of the southern Mediterranean and northern Sahara, Professor Fischer of Kiel holds, that, in this locality, a diminution of precipitation has taken place, the influence of which on health, population, and the means of living, is easily conjectured (pp. 1–4).

The subject of marshes, *instabilis terra nec navigabilis aqua*, begetter of pestilence, precursor of fertile