Explosive Action of Lightning.

THE following particulars of the circumstances attending a lightning flash are perhaps worth recording.

A cedar tree (deodar) 50 feet high stood at a distance considerably less than its own height from a house at Englefield Green. The lady of the house was sitting watching the storm, but in such a position that she could not see the cedar, but could see a large part of an Araucaria (the common "monkey puzzle") just outside her window, and only 30 or 40 feet from the cedar. While watching this tree the lady saw, as she thought, a "rod" or "stick" of fire come crashing down through its branches—beating them down so that she distinctly saw them rebound. This was accompanied by a fearful noise as of a thousand pistol cracks, beside which, however, the lady had an impression of hearing the branches of the Araucaria beating together, and immediately afterwards a cloud as of steam rose from the lawn on which the trees stood. It was found that the cedar tree had been wrecked entirely. About 15 feet of the top was broken off, and apparently fell straight down—sticking in the ground almost vertically—close to the stump of the tree. The main portion of the trunk, to about 4 feet from the ground, was roughly split in two—falling right and left—one half being further burst into several pieces. There was the usual "smell of sulphur," but no sign of scorching on either of the trees.

A gentleman who saw the flash from a distance of about one-third of a mile noted that it was a straight (non-forked) flash from a small cloud low down. Other observers noted flashes of a similar character during the same storm.

The cedar tree was in vigorous growth, full of sap, and well above its *immediate* surroundings, but there were elms and a lime tree of greater height within fifty yards of it.

The movement and the "fire" in the branches of the Araucaria seem to me to suggest an electrostatic effect—a side splash—rather than the mere reflection of the flash which struck the cedar. Could the beating down of the branches be explained as the result of the sudden pulse in the air? What produced the cloud of "steam"? It would be interesting to have the opinion of an authority on lightning discharges with regard to these points.

R. A. WEST.

Ordnance College, Woolwich, October 27.

The "Sky-coloured" Clouds.

DURING this summer I have seen only one display of the "sky-coloured" clouds, or "night-shining clouds" as the late Herr O. Jesse used to call them. It was on July 8, and was a bright display, the brightest I have seen for some years. It is rather singular they did not appear on other occasions so far as I have observed, and no mention of them has been made in your periodical. It may be that now Herr Jesse is deceased there has not been such a good and systematic watch maintained as formerly, or else, if they have been observed abroad, notices have not been copied into English papers. Whether the brilliancy of this one display was connected with the eruptions in the West Indies is a matter of conjecture. The volcanic dust continues to be very visible in the sky in producing the great corona round the sun all day.

T. W. BACKHOUSE.

West Hendon House, Sunderland, October 28.

THE GEOLOGY OF VANUA LEVU.[1]

VANUA LEVU, one of the two principal islands in the Fiji archipelago, according to Mr. Guppy's summary of previous investigations, has received less notice than Viti Levu, or even some of the smaller islands. The late Prof. Dana made a small collection of its rocks in 1840, and published some observations on its geology. It was visited in 1878 by Mr. J. Horne, of Mauritius, but no collections were made by him, by the *Challenger*, or by investigators under the direction of Prof. A. Agassiz, so that it offered a very promising field of research, which occupied Mr. Guppy for two years. The results, so far as concerns its geological and general physical features, and the petrology of its rocks, are described in the present volume, with reproduced photographs and other illustrations.

The long irregular outline of Vanua Levu contrasts strongly with the comparatively rounded one of Viti Levu. Its length is about 98 miles, with a breadth averaging 15 to 20 miles, its estimated area being about 2400 square miles, nearly equal to that of the county of Devon, while its maximum elevation is almost 3500 feet. Both this island and Viti Levu rise from a submarine plateau, in shape a broad irregular ring, broken in one place. An elevation of less than 100 fathoms would convert the whole area into one great mountainous island, pierced on the southern side by a fjord more than 200 fathoms deep. This platform Mr. Guppy considers to have been built up from the deeper ocean floor by submarine lava flows and associated deposits, and Vanua Levu as a composite island, formed, during a long period of emergence, by the union of a number of large and small islands, the products of submarine eruptions. The process probably began in the later Tertiary period, and volcanic eruptions have now ceased, but hot springs are not uncommon, though limited to regions where basic rocks occur. They are also restricted in vertical range, for they have not been found above the 300 feet contour line. Their temperature mostly ranges from 100° to 150° F., reaching 180° only in one case, the latter group precipitating siliceous sinter. Mr. Guppy thinks these springs are largely supplied by the "soakage" of the heavy rainfall in the mountains; if so, there must be rapid local rises in the underground temperature. A submergence of 300 feet would bring the sea over a considerable tract, chiefly basaltic plains, which are obviously continuous with the submarine plateau. One of 1000 feet would greatly reduce and indent the remaining axis of the island, while 800 feet more would convert it into a few scattered islets, which would represent the nuclei of the present composite Vanua Levu. This mode of building accounts for the irregularities of its physical structure, in which respect it contrasts markedly with the other large island, Viti Levu.

Proof of this great elevation is found in the occurrence of muds and tuffs with marine organisms up to at least 2000 feet above sea-level. Shelly and foraminiferal limestones, composed, as so often in tropical islands, partly of reef débris, partly of more or less broken shells of Mollusca, partly of Foraminifera, occur up to a height of 1100 feet, and they sometimes overlie palagonite tuffs and clays, also foraminiferal. Pteropod ooze, containing a large amount of palagonitic débris, is found up to about 500 feet, but volcanic muds, which are very abundant on the basaltic plains in association with the lava flows, reach the former elevation, while tuffs, sometimes agglomeratic, may be traced up beyond 2000 feet—all these containing Foraminifera. An instance of these deposits is shown in the illustration. Raised coral reefs are not very common, and appear to be limited to a vertical range of about 100 feet above sea-level, so that in this respect Vanua Levu contrasts strongly with Viti Levu. But Mr. Guppy thinks this scarcity to some extent the result of denudation, for he has found silicified corals, representing reef-forming types, lying about on the surface, abundantly in some places, together with nodules of chalcedony and other siliceous concretions. These, however, do not more than double the vertical range, so that during the actual building of the island circumstances were not favourable to reef-

[1] "Observations of a Naturalist in the Pacific between 1896 and 1899." By H. B. Guppy, M.B., F.R.S.E. Vol. i. Vanua Levu, Fiji. Pp. xix+392; illustrations and map. (London: Macmillan and Co., Ltd.; New York: The Macmillan Co., 1903.) Price 15s. net.

formation. It is possible, as Mr. Guppy explains, that the island even now is slowly rising.

A considerable part of the volume is devoted to the petrology of Vanua Levu. Plutonic rocks occur, though on a smaller scale than in Viti Levu. These are norites (hypersthene-gabbros) and a few diorites (without augite). The rest of the igneous rocks are volcanic, consisting of olivine-basalts, augite-andesites with and without hypersthene, and acid andesites passing into dacites, in which sometimes the ground-mass exhibits a felsitic structure. Mr. Guppy's careful study of these is a valuable addition to knowledge, though the volcanoes of Vanua Levu have not yielded any rock of exceptional interest. But we think he lays too much stress on varietal details, and that his "orders, suborders, genera and subgenera" have often no more than a specific value, and that he attaches too much classificatory importance to the presence or absence of phenocrysts (to follow him in using this modern petrological slang-word). They have an important relation to the history of the rock, but not very much to its chemical composition, and thus to its position among the magmatic products of the earth. A porphyritic rock is a "rock with a past," which a non-porphyritic rock either is free from, or successfully conceals. Mr. Guppy has "gone one better" than most modern terminologists. Throughout his descriptions he talks of felspar-lathes, meaning thereby the microliths, generally called lath-like. In English a lath means a long blade-like strip of wood, used, for instance, in ceilings, and not inaptly designating microliths of felspar, especially plagioclastic, while a lathe is a machine for turning wood, &c. We doubt also whether the formulæ which Mr. Guppy employs to summarise the characters of his rocks will be any real help to the memory, for they introduce the perplexities of gibberish without attaining the simplicity of mathematical symbols. Palagonite is very abundant at Vanua Levu, "from the sea border to the mountain top." Mr. Guppy discusses at some length the origin of this substance, coming to the conclusion that it is usually associated with basalt of an ophitic or semi-ophitic habit, is likely to be formed extensively on the surface of submarine basaltic flows, and is a vitreous condition of magma that remains fluid after the mass of the rock has solidified. An exceptionally hydrous state of a basic magma would probably be very favourable to the formation of palagonite, but whether the proposed petrological relation will hold generally good is perhaps doubtful.

But in expressing dissent on a few points, which are really of minor importance, we gratefully acknowledge that Mr. Guppy has accomplished a very laborious and often difficult, if not dangerous, task, and that his book, when completed by accounts of his botanical and other work, will be a most valuable addition to our knowledge of this group of islands and to the past geological history of a large area in the Pacific Ocean.

T. G. BONNEY.

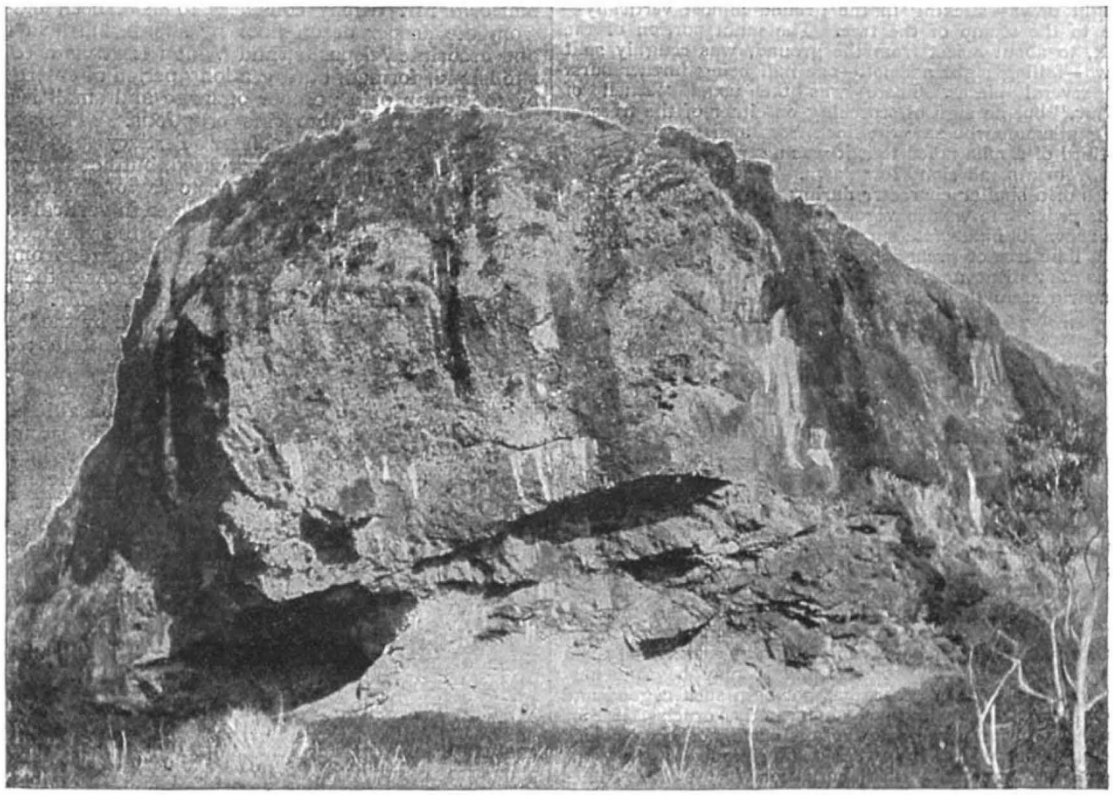

FIG. 1.—Mbenutha. Agglomerates on tuffs, &c., containing Foraminifera and Pteropods, now 1100 feet above sea-level.

ELECTRIC CONVECTION.[1]

THIS paper closes in a satisfactory manner an important controversy. It follows from the views of Faraday and Maxwell that a charge of electricity when in motion produces a magnetic field in its neighbourhood. It is this effect on which the modern

[1] "Recherches Contradictoires sur l'Effet magnetique de la Convection électrique." Par MM. Harold Pender et Victor Crémieu. (*Journal de Physique*, September, 1903.)