

shaken, and on the same day Osorno, at a distance of 400 miles, renewed its activity. "These facts," says Lyell, "prove not only the connection of earthquakes with volcanic eruptions in this region, but also the vast extent of the subterranean areas over which the disturbing cause acts simultaneously." In 1836, on June 22 (or May 22-23) different places in Central America were shaken, and this was accompanied by the eruption of a volcano east of Omoa. In this year there was an eruption in Guadeloupe.

Without continuing these extracts further, it seems that the sequence of events which has recently taken place since the catastrophe in Guatemala on April 19 is but a repetition of very similar sequences which have taken place in the same quarter of the globe during the past two hundred years. The Antillean range is apparently one that is extremely susceptible to seismic disturbances originating at a distance, and that it may be so is suggested by its recent geological history. According to Dr. J. W. Gregory, when the Isthmus of Panama was submerged it is possible that "Antillia" existed connecting North and South America, and the Caribbean Sea was then a gulf of the Pacific. In Lower or Middle Miocene times this was submerged, and abyssal ooze was deposited which are now raised in the Barbados to a height of 1095 feet above sea level. The magnitude of these movements and their rapidity, which has often been referred to by the opponents to the theory of the permanence of continental masses and oceanic basins, indicate that we have in the Antillean ridge a line of weakness characterised by unusual instability, and it is in all probability this instability which renders the Windward Islands so responsive to hypogenic changes in the neighbouring continent.

Seismic Disturbances.

The earthquake recorded at Shide on May 8, commencing at 2h. 49'5m. a.m., was also recorded at Kew, Bidston, Edinburgh and Potsdam. The times of maximum motion at Shide, Kew and Bidston were 3h. 21'7m., 3h. 18'2m. and 3h. 23m.

The time taken for this movement to travel from the West Indies to Kew would be about 37 minutes. The local time of origin in the West Indies would therefore be May 7, 10.37 p.m. This time, calculated from other data, was given in NATURE, May 29, p. 111, as being about 10.33 p.m. Two other seismograms relating to this disturbance as recorded at Shide have not yet been examined. When this is done more certainty respecting this time is to be expected.

Assuming the clock in St. Pierre, which stopped at 11.50 (or 7.50 a.m. local time) to have been correct, this earthquake took place about twelve hours before that event occurred.

It is curious that although this earthquake was noted in Potsdam it does not appear to have reached Laibach and certain other European stations.

At Shide a slight earthquake was recorded on May 25 about 5.28 p.m., and a second shock at about 4.20 next morning. They are both small, and the relationship between the preliminary tremors and maximum motion is too ill defined to state definitely the distance at which they originated.

J. MILNE.

RECORDS AND RESULTS OF RECENT ERUPTIONS.

SEVERAL interesting observations and records connected with volcanic eruptions and earthquakes have come under our notice during the past week. As has already been remarked, the exact cause of the sudden destruction of the inhabitants of Martinique after the eruption of Mont Pelée is a little difficult to determine. Witnesses who were on the *Roddam* in the bay of St. Pierre at the time of the disaster on May 8, state that when the eruption occurred the vessel was struck with such force by the material

ejected that she was nearly capsized and seemed to be enveloped in "a whirlwind of fire." Apparently what burst from the volcano was highly heated gas carrying with it immense quantities of white-hot volcanic ash. The vessel eventually reached the harbour of Castries, St. Lucia, and a survivor gave a correspondent of the *Times* the following account of his terrible experience:—

No human being could stand against that terrific deluge of molten ashes. Even those who reached the cabin or hold did not escape, almost every nook and cranny of the ship being filled with the blazing dust. Captain Freeman sought shelter in the chart-room, but, the portholes being open, the fire streamed in and burnt him badly on face and hands.

The heat was awful, for the mass of ashes which poured into the ship all aglow still retained its heat, and it was only with great difficulty and caution that it was possible to move about at all.

When the ship reached Castries, every part was found to be covered thickly with volcanic ash. More than 120 tons of ash were taken from the ship, and as this was precipitated in a white-hot condition it is remarkable that anyone passed through the burning storm alive.

The eruption of the Soufrière of St. Vincent was accompanied by the same kind of "hot blast" as that of Mont Pelée. Many victims of the St. Pierre disaster bore no outward sign of injury or scorching, but after autopsy they were found to have been burnt internally. A *Daily Mail* correspondent at St. Vincent records, from the words of a survivor, how most people died:—

A dark cloud came from the Soufrière about 4 p.m., and a fine leaden powder penetrated doors and windows and filled the air. People breathed it in, and it was so hot it burnt the flesh. The people in the house began to cry out, and struggled, shouting for water, and placing their hands on their stomachs. They gasped, fainted, and died. All was over in three minutes. It is said that this hot blast killed most people, and wherever the powder touched people it burnt their flesh.

Prof. A. E. Verrill states in *Science* the opinion that the ejection of explosive gases was one of the causes of the sudden destruction of life in the Martinique eruption. His view is as follows:—

The heat was sufficient to cause the dissociation of hydrogen and oxygen from the water on coming suddenly into contact with highly heated lava, and in case of sea-water the chlorine would also be dissociated from the sodium. These gases suddenly ejected with great violence and exploding in the air, above the crater, would produce precisely the effects witnessed on an unusually large scale at Martinique. The people were mostly killed by the sudden explosion of a vast volume of hydrogen and oxygen, which will account for the sudden burning of flesh and clothes, as well as of the buildings and vessels. The chlorine, at the same time, combining with some of the hydrogen, would produce hydrochloric acid, a poisonous and suffocating gas, which would quickly kill most of those not instantly destroyed by the explosion.

As to the changes which have occurred at St. Vincent, it is reported that a party of American investigators who ascended the Soufrière found that the lake had disappeared, leaving a cavity 2000 feet deep. Vapour was still issuing from the new crater.

The Imperial Commissioner of Agriculture for the West Indies has informed Kew that the botanic station and agricultural school in St. Vincent are untouched beyond a fall of volcanic dust.

It is reported in the *Barbados Advocate* that the volcanic ash is adding to the difficulties of sugar-making. The dust is everywhere. It has worn some mill-rollers so smooth that they can hardly draw in the canes. In places the machinery is much injured, and everywhere the dust gets into the juice and has to be strained out, flannel bags having to be used to strain the liquor. On the evening of May 19 a fine dust of a light grey colour was observed to be falling on the Oxford plantation, and it was conjectured that it came from Mont Pelée, in Martinique.

The Royal Mail steamer *La Plata* had a fall of dust on board when between St. Vincent and St. Lucia, while the barque *Jupiter* had a heavy fall far to the eastward of Barbados. From the great mass which fell in the sea around the latter ship, actually colouring the water, it was known that some extraordinary phenomenon must have occurred. There was also such a darkness that lamps were alight at an unusually early hour.

Magnetic Disturbance.

Dr. L. A. Bauer reports in *Science* that a magnetic disturbance was recorded at two magnetic observatories of the U.S. Coast and Geodetic Survey on May 8, at 7.45 St. Pierre local mean time, that is, at the time of the great eruption. The disturbance was distinctively a magnetic and not a seismic one, and hence was not recorded on seismographs. The magnetograms obtained at Cheltenham, seventeen miles from Washington, exhibit magnetic disturbances amounting at times to 0.00050 to 0.00060 C.G.S. units (about 1/350 of the value of the horizontal intensity) and from 10' to 15' in declination, beginning at the time stated and continuing until midnight of May 9.

"Until further information has been received from other observatories," says Dr. Bauer, "it cannot be determined definitely whether this magnetic disturbance was due to some cosmic cause or came from within the earth's crust and was associated with the Martinique eruption. The coincidence in time is, however, a remarkable fact."

Earthquake of April 19.

Some valuable notes on the earthquake in Guatemala on April 19 are given by Mr. Rockstroh in a letter published on another page (p. 150), with a map of the district seriously affected. Prof. Milne obtained a record of this earthquake at Shide, and it was reproduced in *NATURE* of May 29 (p. 109). Miss G. M. Johnson sends us a cutting from the *Yorkshire Post* of April 19 containing several letters upon an earthquake which was distinctly felt in parts of Yorkshire and Lincolnshire on April 14. At Beverley the time noted was 11.51 a.m., at Greetwell 11.45, and Hatfield 11.40. At Belton the disturbance shook a bedstead four inches from its place.

Volcanic Ash from Mont Pelée.

Prof. T. G. Bonney writes:—

I am indebted to Sir W. Crookes for a mounted specimen of the dust from Mont Pelée, which fell on the deck of the *Roddam*. The fragments are commonly about .007" in diameter, but range between .005" and .01", minerals and rocks being in about equal quantity, the former consisting of labradorite, augite (bottle-green) and a pleochroic (green to brown) hypersthene, the latter rather scoriceous, a brownish-grey in colour. I have mentioned some minor details in a short communication to the Geological Society. This dust has a general resemblance to that from the Soufrière which fell in Barbados, and both represent hypersthene-andesites.

Analyses of Soufrière Dust.

For educational purposes all the agricultural colleges in this country, and a number of the principal schools—Westminster, Harrow, Eton, Rugby, &c.—have received from Mr. Harries, of the Meteorological Office, a sample of the Soufrière dust which descended on Barbados during the night of May 7-8. It had been collected by Dr. Morris, the Imperial Commissioner of Agriculture, as it fell, and a portion submitted to investigation at the Government Laboratory on the spot yielded the following results:—

Prof. d'Albuquerque's chemical analysis showed the substances soluble in strong hydrochloric acid to be:—

Percentage.		Percentage.	
Iron oxide ...	4.7	Silica ...	1
Alumina ...	12.5	Sulphuric anhydride...	1
Lime ...	5.9	Insoluble in hydro-	
Magnesia78	chloric acid:—	
Soda ...	1.2	Silicates ...	75.2
Potash08		

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Also a trace of sulphides and a faint trace of sulphurous anhydride—a product of the combustion of sulphides and sulphur.

The mineralogical examination by Dr. Longfield Smith gave the following as the results of the sieve analysis:—

Diameter of particles.	Percentage.
1 to .5 millimetre ...	0.01
.5 " .35 " ...	3.06
.35 " .20 " ...	7.21
.20 " .15 " ...	66.20
.15 " .10 " ...	0.89
.10 and less " ...	22.63

The particles from .5 to .35 mm. diameter were wholly composed of volcanic glass crowded with gas inclusions and containing small lath-shaped crystals of felspar. The gas inclusions in many instances were so numerous as to render the particles quite opaque. The particles of .35 to .2 mm. were of similar volcanic glass and partly of crystals of felspar. Those of .2 to .1 mm. were almost entirely composed of mineral crystals, consisting chiefly of lime and soda felspar and of a ferromagnesian mineral not yet definitely determined. They also contained a quantity of magnetite and a very few crystals of a dark blue doubly-refracting mineral not yet determined. The particles finer than .1 mm. were chiefly composed of comminuted fragments of felspar.

A comparison of the dusts of 1812 and 1902 points to the recent eruption as being much the more violent, it being very rare to find so many mineral particles in volcanic dust scattered so far from the seat of eruption. The fact that particles of magnetite, a mineral of specific gravity 5.5 to 6.5, of more than 1 mm. diameter, should be found in the dust more than ninety miles from the seat of explosion is significant of the prodigious height to which the particles must have been ejected.

The subjoined diary of events is in continuation of those already given.

Diary of Events.

June 4, *Kingstown (St. Vincent)*.—Vessels leaving Martinique have experienced upheavals of the sea between that island and St. Lucia, indicating submarine eruptions. Clouds of steam, accompanied by flashes of flames at night, have been continually rising from the Soufrière since May 16.

June 4, *Cornwall*.—A slight shock of earthquake was felt in the neighbourhood of Camborne about 10.20 p.m. It was accompanied by a low rumbling noise. In some houses ornaments were shaken from the shelves on which they stood.

June 4, *Valparaiso*.—According to a despatch from La Paz, a volcanic eruption has occurred in the Choico (Chaco?) territory, by which two villages were destroyed and seventy-five persons killed.

June 4, *Baku*.—The journal *Kaspi* reports an eruption of the mud volcano in the neighbourhood of the village of Kobi, district of Baku. The eruption, which lasted about five minutes, was accompanied by a detonation resembling the report of cannon, and the country around for some distance was enveloped in flames.

June 4, *Rome*.—A slight earthquake shock was felt last evening at Velletri, twenty miles south-east of Rome. No damage was done.

June 6, *Melbourne*.—A slight earthquake shock was experienced in South Australia to-day.

June 6, *Seattle*.—The steamer *Berthaw*, which has arrived from Alaska, brings advices to the effect that the volcanic mountains Redoubt, Llanna and Augustine at Cook's inlet have been smoking and giving off steam for a month past. On May 26 Mount Redoubt threw up a quantity of ashes.

June 6, *Fort de France*.—Another eruption of Mont Pelée took place to-day. A gigantic cloud extended to the south, covering Fort de France with darkness, but no ashes fell. The sea here receded for several feet, and did not return for some time.

June 6, *Kingstown (St. Vincent)*.—Simultaneous with an eruption of Mont Pelée, the Soufrière in St. Vincent belched out a heavy cloud of smoke, and at 2 p.m. Kingstown was wrapped in pitch darkness.

June 7, *Fort de France*.—A terrible eruption took place. Fort de France was in darkness from 10 a.m. until 2 p.m. The plains of the Morne Rouge were covered with hot mud.

June 7, *Hawaii*.—The volcano Mauna Loa has become active.