

this submarine slope, which forms one of the longest and sharpest contours on the surface of the earth, earthquakes are frequent. Some opinions have been expressed that the disturbance had its origin in a sudden collapse of the sides of the subterranean crater known as the Tuscarora Deep, a triangle-like depression off the north-east coast of Japan, which has a depth of 4665 fathoms, or over five and a half statute miles. This deep, however, lies too far away from the supposed site of the generation of the wave. The kind of disturbance that probably occurred in the bed of the ocean may be illustrated by what happened on land at Bandai-San in 1886. Here millions of tons of earth and rocks were hurled in a given direction with such force that an enormous wave of solid material traversed a distance of many miles at great velocity. Any similar disturbance happening at the bottom of the ocean might fully account for what took place on the coast of Japan in June last. The earthquake which took place in Japan in 1891, the shock of which was so great as to be sensible in Europe, resulted in a fracture upon the surface of the earth for a distance of from forty to sixty miles. The ground, which on one side rises from 4000 to 6000 feet, was lowered relatively to that on the other side from 20 to 30 feet; river-beds were compressed, and valleys narrowed by the lateral movement.

That great submarine earthquakes result in the change of the ocean bed, is well known to those who have charge of cables near volcanic regions. It has been ascertained that when a cable has been broken at two points, the soundings have shown that there has been so great an increase in the depth that it has been necessary to select a fresh line for the cable in order to avoid the site of the disturbance. That the movement originated in the bed of the ocean, is evidenced by the fact that deep-sea shell-fish were found stranded on the high ground swept by the waves; and that in one place the fishermen found their nets floating on the surface upside down, they evidently having been cast up by the submarine disturbance.

Ever since the ninth century records exist of earthquake-waves which have devastated these coasts, but in no case have the results been so disastrous as on this occasion. The great earthquake-wave of 1891 caused the loss of life of over 7000 persons.

The exact locality of the disaster extends from the island of Kinkwa-San to the south (N. lat. $38^{\circ} 15'$, E. long. $141^{\circ} 30'$) to Hachinohe to the north (N. lat. $40^{\circ} 30'$, E. long. $131^{\circ} 30'$), the coast here assuming a convex shape. Between these points nearly every town and village were visited by the wave. The general direction of the wave appears to have been north by east.

Of previous examples of earthquake-waves, that due to the Lisbon earthquake of 1755 is matter of history. This wave rose to a height of forty feet in the Tagus, leaving the bed of the river dry as it rolled inwards. It was experienced at sea 120 miles west of St. Vincent, shaking vessels so violently that men were thrown from the deck; and its effect reached as far as this country, the water rising from eight to ten feet on the coast of Cornwall.

In 1868, and again in 1877, earthquake-waves rolled over the coasts of Peru, causing great devastation and loss of life. On the former occasion the U.S. warship *Waterloo* was thrown up on the coast and carried inland one and a half miles; the second wave, in 1877, carrying it inland a still further distance. These waves, originating at a distance of about 9000 miles, off the South American coast, took nearly twenty-four hours before their effect reached the coast of Japan, where they rose and fell at intervals varying from ten minutes to half an hour, alarming the inhabitants and causing them to fly to the high land.

The volcanic upheaval at Krakatoa, in 1883, shook the whole of Java, and the sea-wave inundated the coasts of that country and Sumatra, causing a loss of 36,000 lives. The lava, mud, and ashes from this eruption darkened the air for fifty miles, and reddened the light of the sun for months after the catastrophe. The coast-lines were altered, and peaks on which lighthouses had been erected disappeared.

Several instances were given in NATURE of March 7, 1895, of earthquake-waves having been encountered by vessels at sea; and again, in November 10, 1895, of an earthquake-wave which burst on the shores of Madeira in 1891.

In January 1894, the *Normania* (of the Hamburg-American line), when 750 miles out from New York, encountered one of these waves. A stiff gale which had been blowing had moderated, and, while the vessel was running at full speed, an enormous wave was observed "masthead high" coming forward like a solid wall, and reaching as high as the bridge, wrecking

the upper-deck-house, containing the music-room, ladies' room, and officers' quarters, and injuring several of the crew.

Numerous other instances could be quoted of these waves, which are frequently erroneously called "tidal waves," but which no doubt have their origin in some volcanic disturbance in the bed of the sea.

THE AMERICAN ASSOCIATION MEETING, 1896.

THE forty-fifth annual meeting of the American Association took place from August 24 to 29, at Buffalo, at which town it has now met four times, and although one of the smallest attended of recent meetings, seems to have been a very pleasant gathering. In most of the Sections full complements of communications were presented, notably so in those devoted to Chemistry, Botany, Geology, Anthropology, and Physics. The arrangements, a programme of which has reached us, appear to have been made with great care, and evidently no pains were spared to ensure the success of the meeting. Space will not permit us to print the addresses of the retiring President and Vice-Presidents; suffice it to say that they well sustain the standard of merit fixed by previous deliverances.

The retiring President, Mr. Edward W. Morley, took as the subject of his address "A Closed Chapter in Science." He spoke of the investigations into atomic weights of elements, in reference to their mutual relation so long supposed to be expressed in integrals in accordance with Prout's hypothesis. This hypothesis is now seen to be erroneous, so that it marks a closed chapter. The careful and repeated investigations of Morley himself and of others for many years, but mainly during the decade since the last Buffalo meeting, have proved that the ratio of atomic weights of hydrogen and oxygen, for instance, can only be expressed by a fraction, and is very nearly that of 1 to 15.88; it cannot possibly be that of 1 to 16. The same result has been found for many other elements with sufficient accuracy to establish the conclusions finally, and beyond the possible limits of error.

Mr. Carl Leo Mees, Vice-President of Section B (Physics), spoke on "Electrolysis and some associated Problems in Molecular Dynamics." In Section C (Chemistry), Mr. W. A. Noyes took as the subject of his address "The Achievements of Physical Chemistry." Mr. F. O. Marvin, in Section D (Mechanical Science and Engineering), discoursed on "The Artistic Element in Engineering." The subject of the address of Mr. B. K. Emerson, before Section E (Geology and Geography), was "Geological Myths." Section F (Zoology) was addressed by Mr. Theodore Gill on "Some Questions of Nomenclature." In Section G (Botany) the address was by Mr. N. L. Britton on "Botanical Gardens." Miss Alice C. Fletcher spoke to Section H (Anthropology), on "The Emblematic Use of the Tree in the Dakotan Group"; and Section I (Social and Economic Science) was addressed by Mr. Wm. R. Lazenby, on "Horticulture and Health."

It will have been noticed that no mention is made in the foregoing list of Section A (Mathematics and Astronomy); but we are informed that Mr. Wm. E. Story, the Vice-President of the Section, was not present at the meeting, and his proposed address was not received, and could not therefore be delivered. The Vice-President of Section F (Zoology), instead of speaking, as he intended, on "Animals as Chronometers for Geology," spoke on nomenclature.

A commemorative meeting was held in recognition of the sixty years of professional work of Prof. James Hall. Prof. Hall was present at the meeting of the Association, as was another founder of the Association, Dr. Charles E. West, of Brooklyn.

Three founders of the Association have died within a few months, viz. Bela Hubbard, Thomas T. Bouvé, and Josiah D. Whitney.

The nominating Committee have presented the name of Wolcott Gibbs for President, and they recommend that the next meeting be a merely formal one, to be held at Toronto, August 17, 1897, to welcome the British Association for the Advancement of Science.

Among the business transacted was a resolution deprecating legislation against vivisection; while another favoured the metric standard of weights and measures, and recommended further legislation to secure its adoption.