Pickering telegraphs, also on September 1, from Cambridge, Mass., to the following effect: "Bailey at Arequipa finds μ' Scorpii spectroscopic binary. Period 35h."

THE PLEIADES.—Some time ago, we gave an account of several legends and myths connected with that most interesting cluster of stars, the Pleiades. These myths were, for the most part, gathered from an article which appeared in *Globus* (Bd. 64, p. 362). It seems, however, that our stock is by no means complete, for Dr. Heinrich Samter, in the current number (Bd. 70, p. 176) adds considerably to it. We make this reference for those readers who take a special interest in folk-lore, and would wish to look up this article.

METEORS TRANSITING THE SOLAR AND LUNAR DISCS.—What apparently appear to be unique observations, recorded quite recently in America, are given in the current number of the *Revue Scientifique*. It seems that during the night of July 21 and 22 last, Mr. William Brooks, the director of the Smith Observatory at Geneva (New York), saw all at once a round dark body pass slowly before the bright disc of the moon, the latter being almost full. The apparent diameter of the body is given as about one minute, and the duration of its transit amounted to three or four seconds, its direction being from the east towards the west. The second observation was made about midday on August 22, by Mr. Gathmann, an American astronomer, but the place of observation is not stated. He saw a meteor pass before the solar disc, occupying a period of time amounting to eight seconds in its transit. It is suggested that this body is one of a great number which circulates round our planet; it does not seem at all necessary to assume that our earth is the centre of attraction, indeed it seems rather improbable, as the observation would then, no doubt, be more common. Our present idea of space is that it is a meteoritic plenum, and full of bodies traversing through it at various speeds and at various distances from us, so that the chances of making such an observation, especially at periods of shooting-stars, is not altogether impossible, but is likely to occur, provided the observer is fortunate and happens to watch a comparatively slow-moving meteor.

THE GREAT SEISMIC WAVE OF JAPAN.

FULL particulars of the terrible wave which devastated the coast of Japan last June, causing the destruction of 20,000 lives and 12,000 houses and other buildings, have recently been given in the daily papers. The official report made to the Japanese Government having now reached this country, it may be interesting shortly to summarise the particulars of this occurrence, and to give the causes which have been assigned for its creation; and also to refer to waves of a similar character that have occurred on former occasions and in other localities.

The wave appears to have originated at a short distance from that part of the coast of Japan which trends in a north-easterly direction from the northern part of Sendai, midway between Tokio and the island of Yezo or Hokkaido. From Kiukasan, the northern island of the Archipelago, the coast is fjord-like in character, abrupt mountain ridges running down almost to the water edge. In the bays and estuaries that interrupt the shore line several important towns and many fishing villages were situated; with a few exceptions these have all been destroyed. The distance over which the effect was felt has been variously given as extending over a length of coast of from 200 to 300 miles.

Suddenly, almost without warning, between eight and nine o'clock in the evening of the 15th, three successive waves, the highest estimated as being fifty feet in height, swept over the land bordering on the coast, and in a space of a few minutes had caused a frightful devastation of property and the death of nearly all the inhabitants. There was nothing to presage the disaster or give warning. The barometer gave no indication of anything abnormal in the atmosphere. About half an hour before the catastrophe three or four shocks of earthquake were felt—not violent shocks, but of the vertical kind, which are known to be dangerous. Shortly afterwards a booming sound came from the direction of the sea. At first the noise was only like that of a coming gale; rapidly it increased until the sound assumed the volume and din of artillery; then in a moment three successive waves, varying in height from twenty to thirty feet, came rolling on the shore. In a space of time of about two minutes these waves had accomplished their fearful work of devastation and ruin.

Beyond the destruction of life and property some remarkable incidents occurred. At Kamaishi one wave came curling round the land-locked bay from the left in a semicircle, meeting another wave, which came in from the right, and before the waters could recede a third wave came in from the centre. In five minutes the town was wiped out. Temples, houses, and vessels lying in the bay, were alike swept away, broken up and destroyed. A large two-masted schooner of 200 tons was left lying almost uninjured five hundred yards inland, in the centre of what had been a wheat field. Another had its bows stove in, its stern post and rudder carried away, its deck ripped open, and the planking of its sides broken in short lengths. Altogether nineteen schooners and junks were cast ashore, In one place, men swept out to sea from one side of a bay were thrown up alive on the opposite beach; and in another case, several persons were deposited on an island nearly three miles from the town whence the wave had carried them.

The disturbance was not felt at sea at any great distance from the shore. Fishermen engaged in their occupation near the centre of the disturbance off the coast of Shizukawa heard, as they supposed, the booming of big guns in the distance; looking seawards they saw the surface of the ocean heave in huge masses, which, after rising to a great height, broke in the middle and swept northward and southward, striking the coast with a deafening roar. The waves passed under the boats without swamping them, but the water in the vicinity of the shore remained so rough throughout the night that the fishermen could not make the land until the morning. In other parts fishermen, plying their trade four miles from the coast, on returning to shore in the early morning after the catastrophe, received the first notice of what had occurred; others, engaged three miles out in the same locality, encountered heavy breakers rolling from the north. A steamer which left Hakodate in the morning of the day of the disaster, and must have been near the scene of the calamity at the time it occurred, experienced nothing out of the common; and other passing steamers reported only an abnormal current.

The Japanese Government have self-recording tide gauges fixed at various parts of the coast. The three nearest stations to the scene of disturbance are situate at Ayukawa, in the Oshiaka district; at Hanasaki-mura, in the Hanasaki district; and at Misaki-Machi, in the Miura district in Choshi Bay. At the first station the sea had been calm all the day of June 15. Suddenly at 8.25 p.m. the water fell 7·9 inches; five minutes after it rose 4·59 feet; and after an interval of five minutes had fallen down again. After this there occurred a succession of waves at intervals of about four or five minutes. At 11 p.m. the height of the wave, as indicated on the gauge, was 6·56 feet; the difference between the maximum and minimum height of the waves being 8·86 feet. After this the water gradually subsided to the ordinary sea-level.

At the second station, at 8.50 p.m. the water fell 3·28 feet, followed by five or six disturbances in an hour. After this an accident to the gauge prevented any further record. At 8.10 the next morning, when the gauge was visited, the sea had become calm.

At the third station some small waves began to show at 8.40, their height being 7·90 inches, and occurring at intervals of five minutes, gradually decreasing in height until the normal condition was obtained.

From these records it appears that the influence of the wave was greatest at the north station, and that an interval of twenty minutes elapsed before the gauge at the southern station was affected.

The effect of this seismical disturbance of the crust of the earth was sensible all over its surface, so far as may be judged from the records of instruments thousands of miles distant. On June 15, the day of the earthquake at Japan, at about 8.30 p.m., Prof. Vicentini, in Italy, noted the commencement of the disturbance on the seismograph, and a similar disturbance was recorded on the instrument at Shide, in the Isle of Wight.

As to the cause of the disaster, Prof. John Milne, in an article in the *Geographical Journal*, states his opinion that this was due to a seismic, rather than volcanic origin. The disturbances which have occurred in this locality have been, without exception, confined to the eastern sea-board of Japan, where the land suddenly sweeps downward beneath the deep Pacific. Along the line of

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 on the south (N. lat. 38° 15′, E. long. 141° 30′) to Hachinohe on the north (N. lat. 40° 30′, E. long. 131° 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 *Watteree* 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.