

on Lake Nyassa was determined by exchanges of signals between this station and the Observatory, made by Captain Close, R. E., and Dr. E. Kohlschutter. The adopted value for the longitude of the station occupied (which was 5'2s. west of the Bay) was

2h. 17m. 7'6s. E.,

and thus the previously accepted longitude was about six miles in error. This work was undertaken in connection with the delimitation of the Anglo-German boundary between Lakes Nyassa and Tanganyika.

Longitude of Umtali.—Similar operations undertaken by Captain Watherstone, R. E., in connection with the Anglo-Portuguese Barú Delimitation Commission, gave the longitude of Umtali as 2h. 10m. 41'2s. E.

Time Service.—The usual distribution of time signals for commercial and navigation purposes has been carried out.

PROF. F. OMORI ON EARTHQUAKE-MOTION.

THREE important memoirs have recently been published by Dr. F. Omori, Professor of Seismology at the Imperial University of Tokio.¹ In the first he describes a form of horizontal pendulum adapted for mechanical registration, a method which, like the Italian seismologists, he prefers on account of its cheapness and the more open diagrams which it provides. The pendulum consists of a thin brass cylinder, filled with lead, and weighing about 14 kg. This is attached to a horizontal tubular strut of iron, which ends in a sharp conical steel point, working in a conical steel socket fixed to the wall of an earthquake-proof house. A fine steel wire connects the heavy-bob with a triangular steel prism, whose knife-edge works in a steel V-groove mounted on a projection from the upper part of the wall. The vertical distance between the points of suspension and support is $2\frac{1}{2}$ metres, the horizontal distance being, as usual, very small. The length of the strut from its pivot to the axis of the cylinder is one metre. The complete period of vibration is at present 28 seconds in one pendulum, and 17 seconds in the other. The record is made by a light pointer, connected at one end with the cylinder and turning about a vertical axis working in a stirrup rigidly connected with the ground. At the end of the long arm is hinged a light triangular writing index, the point of which rests on smoked smooth paper, which is wrapped round a light wooden drum, 942 mm. in circumference, and revolving once an hour. While the Italian seismologists endeavour, as a rule, to render their instruments sensitive by using a heavy steady mass, Prof. Omori attains the same end by reducing the friction between the parts of the machine; for instance, the pressure of the writing index on the smoked paper is only $\frac{1}{2}$ mgm. Prof. Omori also describes a portable form of the pendulum, in which the dimensions and heavy mass are smaller, and the points of suspension and support are connected with a cast-iron stand. The paper is illustrated by some interesting typical diagrams given by the pendulums of pulsatory oscillations and earthquake disturbances of neighbouring and distant origin.

It is well known that most earthquakes begin with a preliminary tremor, consisting of vibrations whose amplitude is very small and whose period is generally very short. When the origin of the earthquake is distant, the duration of the tremors, as noticed by Prof. Milne and others, increases with the distance of the observing station; and a similar relation, as Prof. Omori points out in his second paper, is evident from an examination of different seismograms obtained in Japan. He shows that the duration of the preliminary tremor does not depend on the magnitude of the disturbed area of the earthquake, for no difference of this kind is to be seen between the disastrous Mino-Owari earthquake of 1891 and its five strongest after-shocks. He finds, moreover, that, for great earthquakes originating at distances between 100 and 1000 km., the duration increases by 15 seconds for every increase of 100 km. in the distance from the origin. The duration of the tremor being ascertained at two or more stations, it is thus possible to determine the position of the epicentre; and, in two cases

which are given the results agree closely with those obtained from isoseismal lines. Prof. Omori remarks that the approximate variation of the duration of the early tremors with the distance from the origin can be explained by assuming the existence of two sets of waves, which, starting simultaneously, are propagated with different velocities. The mean velocities for the Mino-Owari earthquake of 1891 and the Hokkaido earthquake of 1894 are 2.2 km. per sec. for the preliminary tremors and 1.7 km. per sec. for the principal waves.

The third paper, written in conjunction with Mr. K. Hirata, is a valuable discussion of the earthquake measurements made at Miyako from June 1896 to June 1898. The observatory, which contains a Gray-Milne seismograph, is situated on a small promontory of palæozoic rocks (in lat. $39^{\circ} 38' N.$ and long. $141^{\circ} 59' E.$), and the records may therefore be regarded as good illustrations of earthquake measurements in a rocky district. Of the twenty-five earthquakes which form the principal subjects of the discussion, six originated in the mountainous regions to the west, and the remaining nineteen under the Pacific Ocean, the point one degree east of Miyako being the most active centre of the earthquakes which disturb the eastern part of Northern Japan. The authors arrive at the following important conclusions. As a general rule, the duration of an earthquake seems to vary directly as the magnitude of the disturbed area and inversely as the distance of the observing station from the origin. The average duration of the vertical component is about four-fifths that of the horizontal component. The period of the maximum movement, both horizontal and vertical, ranges between 0.53 and 1.7 seconds for slow undulations, and between 0.12 and 0.15 second for ripples. The average period of the horizontal slow undulations is approximately constant in the principal and end portions of an earthquake, while that of the ripples is slightly greater during the principal portion than during the preliminary tremors and end portion. It is remarkable that the average period of ripples is roughly constant in all the earthquakes here considered, never varying much from one-tenth of a second. The range of the vertical motion was invariably less than that of the corresponding horizontal motion, the maximum vertical motion being on an average one-fifth of the maximum horizontal motion; and this is true both for ripples and slow undulations. The direction of the maximum earthquake movement, as a rule, is coincident with the direction of the line joining the observing station to the centre. In two earthquakes (those of February 7 and April 30, 1897), the angle of emergence can be ascertained as well as the position of the epicentre, and from these data the focal depths are found to be 15 and 9 km. respectively.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

MR. A. W. BRIGHTMORE has been appointed professor of engineering construction and surveying at the Royal Indian Engineering College, Cooper's Hill.

ALL particulars referring to the technological examinations conducted by the City and Guilds of London Institute, and the regulations for the registration and inspection of classes in technology and manual training, will be found in the official "Programme" just published by Messrs. Whittaker and Co. The syllabuses of the seventy different subjects, with the list of works of reference in each, and the examination papers set this year, should prove of service both to teachers and students of technology.

THE ninth summer meeting of University Extension Students in Oxford terminated on Wednesday, August 24. The meeting was throughout uniformly successful. It was divided, as usual, into two parts, the first part terminating on August 9. The number of visitors to the meeting amounted to about 1000. Of these considerably over 100 came from Germany and the United States, other nationalities being fairly well represented. The historical period selected for study was the nineteenth century from 1837, and the scientific section of the meeting was therefore necessarily occupied with the more important results obtained during that period. The lectures were well attended and excited considerable interest. In Part I., Prof. Gotch gave two lectures on "The physiology of sensation," Mr. G. C. Bourne two on "The growth of the living organism," and Prof. H. A.

¹(1) "Horizontal pendulums for registering mechanically earthquakes and other earth movements": *Journ. Coll. Sci., Imp. Univ., Tokio*, vol. xi. 1899, pp. 121-145; (2) "Note on the preliminary tremor of earthquake-motion": *ibid.*, pp. 147-159; (3) "Earthquake measurement at Miyako": *ibid.*, pp. 161-195.