OUR ASTRONOMICAL COLUMN.

THE RECENT SOLAR ECLIPSE IN INDIA.—From a brief paragraph which appears in the *Pioneer Mail* for January 25 we learn that some interesting photographs of the partial eclipse of the sun were obtained at Dehra Dun (N.W. Prov. India) on January 14. A drop in the temperature of 4° corresponded with the passage of the shadow, and there was a very marked decrease in the illumination of the surrounding landscape. Venus became clearly visible to the naked eye.

THE LATE DR. ROBERTS'S CELESTIAL PHOTOGRAPHS.—A preliminary catalogue of Dr. Roberts's collection of photographs of various celestial objects and regions, comprising some 2485 original negatives, is published by Madame Dorothea Isaac-Roberts in No. 4154 of the *Astronomische Nachrichten* (February 9). An introductory statement which accompanies it gives a brief account of the various classes of negatives, the period during which they were obtained, and the instruments employed by the observer. A complete list of Dr. Roberts's tribute to astronomy is to be published as soon as circumstances permit, and, as the number of copies of the paper will be limited, those interested in photographic astronomy, and desirous of receiving a copy, are requested to send in their names at once to Madame Dorothea Isaac-Roberts, Château Rosa Bonheur, By-Thomery, S.-et-M., France. Positives on glass reproduced from the Isaac-Roberts negatives will be lent for the purpose of micrometric measurements if application be made, and provided that the documents be returned after the completion of the measurements.

A LOST COMET (1905*f*).—Whilst examining three photographs taken at Mount Wilson on July 22, 1905, Prof. Barnard found the trail of a comet which appears to have evaded all other observations, and, as the object might prove to be a periodic comet, he now publishes some measures of position which he has made in order to determine, if possible, an approximate orbit, in No. 4153 of the *Astronomische Nachrichten* (February 6).

The positions (1905·0) of the comet at the beginning and end of the trail were:—

$$\text{R.A.} = 18\text{h. } 23\text{m. } 16{\cdot}4\text{s.}, \quad \delta = -20^\circ\ 30'{\cdot}0,$$

at 16h. 20m. G.M.T., and

$$\text{R.A.} = 18\text{h. } 23\text{m. } 41{\cdot}2\text{s.}, \quad \delta = -20^\circ\ 31'{\cdot}9,$$

at 18h. 55m. G.M.T., respectively; the position angle and length of the trail were found to be 288° 24′ and 368″, thus giving a daily motion amounting to 3m. 49·5s., −17′ 55″. On examining the Harvard plates for this date, Miss Leavitt was unable to find any trace of the object, which must have been much smaller than Giacobini's 1905 III. comet, and at least six or eight times less bright.

THE SPECTRUM OF MIRA.—Four photographs of the spectrum of Mira were obtained at the Lowell Observatory during the recent maximum of the star's brightness, and a brief discussion of them is published by Mr. V. M. Slipher in No. 1, vol. xxv. (February), of the *Astrophysical Journal*. The first spectrogram, obtained on December 13, 1906, included the region λ 4300 to λ 5000, and shows both $H\beta$ and $H\gamma$ as strong, bright lines. The second photograph was taken on December 18, and shows the four hydrogen lines $H\alpha$, $H\beta$, $H\gamma$ and $H\delta$ as bright lines increasing in intensity in the order given, $H\alpha$ being notably weaker than the others. Numerous absorption bands, sharp and intense on their more refrangible edges, and gradually fading out towards the red, are shown, in addition to the hydrogen lines, on the plate taken on December 21. On the last plate taken, December 24, all the hydrogen lines were bright, $H\alpha$ being bordered on the violet side by a strong and rather broad absorption line. Of the metallic absorption lines, those due to vanadium are recorded as being especially strong.

SUN AND PLANET CHART.—We have received, from the firm of Carl Zeiss, 29 Margaret Street, W., a copy of a very useful chart which enables a ready determination to be made of the position of the sun, or of any of the planets, in regard to the fixed stars during 1907. It consists of a chart of the equatorial constellations, together with right ascension and declination curves, on the same scale as the chart, of the objects to be found. By simply drawing ordinates for the required date, as found on the chart, and projecting the points where they intersect the R.A. and declination curves on to the star chart, the relative position of the sun or planet may be determined in less than one minute.

THIRTY-SIX NEW VARIABLE STARS.—By superposing positive and negative copies of six photographs taken with a 1-inch Cooke lens, Miss Leavitt discovered thirty-six new variable stars in a region 30° square, having its centre at R.A. = 12h., dec. = −60°. These variables are mostly situated in the constellations Carina and Centaurus, and six of them are probably of the Algol type. Nova Velorum was discovered, and sixteen known variables were rediscovered on the same plates (Harvard College Observatory Circular, No. 122).

SEISMOLOGICAL NOTES.

Valparaiso Seismograms.

ON August 17, 1906, Valparaiso was visited by an earthquake of unusual severity. Seismograms of this disturbance were obtained at all observatories throughout the world which were properly equipped with apparatus to record teleseismic motion. The seismograms obtained in this country, as was pointed out to me by Mr. R. D. Oldham, and noted by other observers, exhibit a dual character. This duality is clearly seen in the annexed seismogram from Kew, reproduced by the kind permission of Dr. R. T. Glazebrook. After preliminary tremors, there is a "shock" or maximum, marked A, at 1.5 G.M.T., and a second "shock" or maximum, marked B, forty-five minutes later, or at 1.50. If the latter shock originated in or near to Valparaiso, and took 1h. 5m. to travel from that part of the world to Britain, it originated there at 7.59 in Valparaiso time. The most accurate time received from Santiago is 7.58.40, or practically 7.59. We may therefore conclude that B represents the disturbance which led to devastation in Valparaiso and places in that vicinity. The question now arises as to what is shock A at 1.5 G.M.T. From the duration of its preliminary tremors, it evidently came from some place about 105° distant, which happens to be the situation of Valparaiso, and the time of its origin, wherever that may have been—Central Asia or South America—was in G.M.T. 0h. 0m. (7.14 Valparaiso time), but up to date I am not aware that the inhabitants in Valparaiso know anything about a shock at 7.14. Shock A and shock B may have a direct relationship, or they may be independent disturbances which occurred about the same time. Together they make a jumble which might be compared with the meeting of waves at the mouths of two opposing estuaries. The International Seismological Association, which met last year in Rome, issued from its headquarters in Strassburg a circular to seismological stations generally asking for seismograms of "the Valparaiso earthquake." These and a variety of detail about instruments and the stations where seismograms were obtained are to be placed before the delegates of that association when they meet at the Hague for their study.

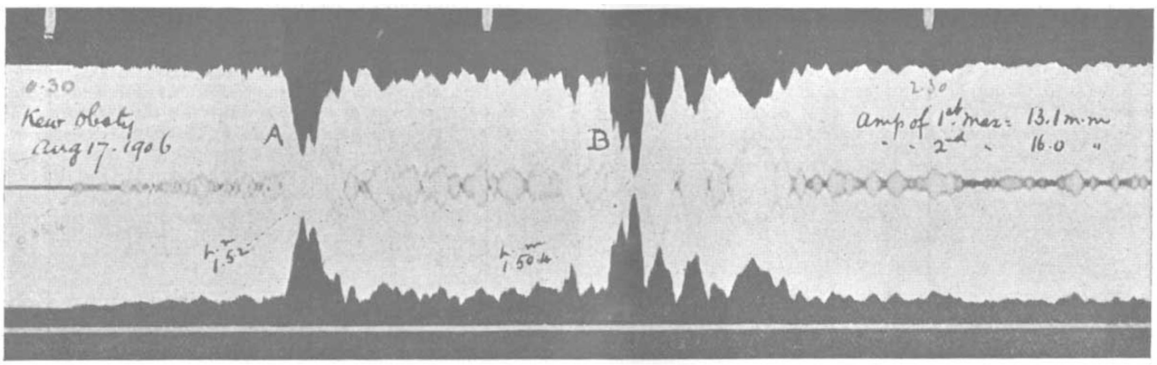
A New Seismometer.

The International Seismological Association offers prizes of 50*l*., 35*l*., 25*l*., and 15*l*. for the construction of a seismometer. It is to record earthquakes which have their origin near to the place of observation, which we assume means earthquakes that can be felt. It must register both horizontal and vertical movements. No doubt the authors of this condition are well aware that vertical displacements are accompanied by angular displacements. Any recording seismometer under the influence of vertical movement at its best becomes an indifferent variety of clinometer. Usually its records have no more value than those from a seismoscope. One remarkable condition is that the new instrument must have a magnification of not less than forty to fifty times. Seismographs used in Japan, and by all who have had experience in recording earthquakes of local origin, find a magnification of from six to ten quite sufficient. If a shock has a range of a quarter of an inch, which in soft ground may well be the case, this would appear on the record-receiving surface of the new seismograph more than a foot or 30 cm. in length. It is, of course, possible to construct a large record receiver, but is it necessary? About a record of time, which is probably the most important element required by the working seismologist, nothing whatever is said.

Seismographic and other Record-receiving Surfaces.

The record receivers to which I refer are the types used in connection with horizontal pendulums adopted by the British Association, and now in use at many stations widely distributed round the world. Nearly all of these record on a surface of photographic paper moving at the rate of 60 mm. per hour. There are, however, one or two instruments where the paper moves at a rate of about 250 mm. per hour. With very large earthquakes, the times of commencement or the commencement of the preliminary tremors, as recorded on either the slow or comparatively rapidly moving paper, are identical, the seismographs being similar and placed side by side. With earthquakes of moderate intensity this is not always the case. On the slowly moving paper the commencement of the preliminary tremors may be lost. The explanation apparently rests in the fact that slowly moving paper passing beneath two illuminated cross slits or an illuminated "pin-hole" has a longer exposure than that which is moving quickly. The longer the exposure the broader the line. In one case the film takes about twelve seconds to pass beneath the "pin-hole," and in the other between two and three seconds. In either case, when the boom of the pendulum, which at its outer extremity carries the equivalent of a "pin-hole," is steady, we get a straight line on the film moving beneath the same. Very slight movements of the boom, however, are to be seen on the film which has passed quickly beneath its spot of light which cannot be seen on the film which has moved slowly. On the latter minute ripples have been eclipsed in the broadened line. The meaning of this, not only to practical seismologists, but to all who have to deal with photographic recording apparatus, is that the best result which can be obtained from a given instrument largely depends upon the speed of the photographic record-receiving surface.

JOHN MILNE.



Seismogram of the Valparaiso Earthquake, August 17, 1906.

SCIENCE IN INDIA.[1]

THE "narratives" from which extracts have been taken for publication in the report before us are those of officers of the Indian Survey Department who are employed on work of scientific investigation. There is little of topographical, and nothing of geographical, interest in them if we except certain results derived from Captain Wood's mission to Nepal. They afford, however, most convincing proof of the strenuous nature of the work of the scientific branch of the department, and should serve amply to justify the maintenance of a well-matured system of scientific investigation in the eyes of those critics who are disposed to assert that India cannot afford to be scientific.

No less than 128 pages out of the 187 which comprise the report are devoted to the reproduction of tables giving the results of magnetic observations, which are further illustrated by a map showing the stations of observation of the magnetic survey. Since the year 1901, these have been carried practically over the whole peninsular area with the exception of the Central Provinces. A description of some of the stations and of the instruments used completes the narrative, but no general deductions are made, nor is any indication afforded as to the practical result of these undoubtedly valuable observations.

Major Conyngham's report on the pendulum observations for determining the force of gravity is directly interesting. The latest instrumental equipment for this class of observation includes "half-second" pendulums, which are only one-quarter the length of those previously used in the department. A new method (an Austrian invention) has also been introduced for registration of the coincidence of beat between the free pendulum and the clock pendulum, the pendulums being no longer swung *in vacuo*. A considerable increase in accuracy of observation has thus been assured, further refinements being introduced in the corrections applied for the minute vibrations (or "wagging") of the stand on which the instrument is fixed, due to the swing of the pendulum. Some of the results are curious. For instance, it was found at Calcutta that the perpetual tremor, or vibration, set up by traffic, due to the nature of those alluvial deposits on which the city may be said to be floating, absolutely negatived the value of the observations, whilst, on the other hand, observations taken at Colaba, in Bombay, were not affected appreciably by the firing of the big guns of the fort in their vicinity.

The value of "g" (force of gravity) being used to determine the figure of the spheroid and the density of the earth's crust, it was found at Colaba that the excess of attraction indicated by the observations equalled that which would be accounted for by a disc of earth matter below the instrument 2530 feet thick with an excess of density equal to 2·8 above the average of surface density. At Dehra Dun, on the other hand, the defect in "g" indicated a deficiency in density of 2·8 extending to 2930 feet in depth. Assuming that the surface density is 2·8, this means that we must imagine a cavity 2930 feet deep under Dehra Dun; in other words, "the matter underlying Dehra Dun is so deficient in density—we do not know to what depth this deficiency may extend—that it would have to be pressed downwards until the surface of the land was 2930 feet below its present position before it would attain the average density of the crust of the earth. Likewise at Colaba an expansion of the underlying strata until a hill 2500 feet high had been formed would be requisite to reduce the excessively dense rock that is found here to the average density of 2·8."

Certain levelling operations referred to in another part of the report have been undertaken in the interests of these

[1] "Extracts from Narrative Reports of Officers of the Survey of India for the Season 1903–04." Pp. 187. (Calcutta.)