It was natural to suppose that the iron vapour producing the cooler lines was higher up than that responsible for the enhanced line at 4924·1. Hence a crucial observation was planned for the eclipse of 1882. If the vapour were higher it should be dimmer, and its lines should, if seen at all, be seen long and faint very near the beginning of totality, while the hotter line, being produced by vapours relatively low and at a higher temperature, should be seen short and bright some time before the beginning of totality.

Fig. 12 will show how absolutely the prediction was verified by the event.

J. NORMAN LOCKYER.

(*To be continued.*)

## *ON LUNAR AND SOLAR PERIODICITIES OF EARTHQUAKES.*

THE investigation of small periodical changes is rendered difficult chiefly by the doubt which so often exists, whether the results obtained by the ordinary methods are due to accident or prove some real periodically acting cause. Attention need only be drawn to the many calculations which have been made to trace the sunspot period in terrestrial phenomena, such as rainfall or temperature, to show that widely different conclusions may be drawn from the same evidence according as greater or smaller value is attached to the element of chance. I have been engaged for some time to apply the theory of probability to investigations of this nature, with a view if possible to being able in every instance to assign a definite number to the probability that any periodicity which may be found in the record of some physical phenomenon is of an accidental nature. In a paper recently communicated to the Royal Society, I have applied the results obtained to the periodicities of earthquakes. Mr. Knott (*Proc. Roy. Soc.*, vol. lx. p. 457) has recently published some investigations, conducted with skill and labour, which in his judgment were favourable to the existence of a true lunar influence on earthquakes. The theory of probability, however, does not support that view. The number of earthquakes treated by Mr. Knott is 7427, and Fourier's series is applied to determine the amplitudes of the changes which have periods coincident with the lunar day, the half-day and the third or fourth part of a lunar day. The method employed would always give some results whether a true periodicity existed or not, and I have calculated what the average amplitudes would be if earthquakes were distributed quite at random. These amplitudes depend, of course, on the number of events taken into the calculation, and are found to vary inversely as the square root of that number. The following table will show how the amplitudes found by Mr. Knott compare with those calculated by the theory of probability. $C_1$ in the table refers to the lunar day, while $C_2$, $C_3$ and $C_4$ refer to its submultiples.

| Coefficients | $C_1$ | $C_2$ | $C_3$ | $C_4$ |
|---|---|---|---|---|
| Expectancy for the coefficients | 19·3 | 15·7 | 10·6 | 5·2 |
| By the theory of probability... | 10·3 | 17·9 | 10·9 | 3·97 |

As it may further be shown that cases will frequently occur where the amplitudes found are equal to twice the expectancy, the table may be considered as conclusive that if a lunar effect exists, it must be so small that it is quite hidden by accidental effects. For the present, at any rate, the evidence is against such a lunar influence. A discussion of the periods, coincident with the lunar months, leads to the same conclusion.

It is otherwise with the annual and daily periods, which have recently been discussed by Mr. Davison. Here the amplitudes found are decidedly too large to be due to accident; and we may therefore say, with a degree of probability amounting practically to certainty, that there is a yearly period giving a maximum of earthquakes in December, and a daily period giving a maximum some time between ten o'clock in the morning and noon.

ARTHUR SCHUSTER.

## *NOTES.*

A SMALL committee has been appointed by the Treasury "to consider and report upon the desirability of establishing a National Physical Laboratory for the testing and verification of instruments for physical investigation, for the construction and preservation of standards of measurement, and for the systematic determination of physical constants and numerical data useful for scientific and industrial purposes, and to report whether the work of such an institution, if established, could be associated with any testing or standardising work already performed wholly or partly at the public cost." The following will be the members of the committee:—The Lord Rayleigh, F.R.S. (chairman), Sir Courtenay Boyle, K.C.B., Sir Andrew Noble, K.C.B., F.R.S., Sir John Wolfe Barry, K.C.B., F.R.S., Prof. W. C. Roberts-Austen, C.B., F.R.S., Mr. Robert Chalmers, of the Treasury, Prof. A. W. Rücker, F.R.S., Mr. Alexander Siemens, Dr. T. E. Thorpe, F.R.S.

AT a meeting of the Royal College of Physicians of London, on Thursday last, the College, on the recommendation of the Council, awarded the Moxon gold medal to Sir Samuel Wilks, F.R.S., the President of the College, for having especially distinguished himself by observation and research in clinical medicine, and the Baly medal to Prof. Schäfer, F.R.S., for having especially distinguished himself in the science of physiology. The Harveian oration will be delivered by Sir William Roberts on October 18, St. Luke's Day. Dr. E. Markham Skerritt, of Bristol, will give the Bradshaw lecture on November 4; and Dr. F. Pavy will deliver a special lecture, supplementary to the Croonian lectures, delivered in 1894, on November 11. The following were announced as lecturers for next year:—Goulstonian lectures, Dr. John Rose Bradford; Lumleian lectures, Sir Richard Douglas-Powell; Croonian lectures, Dr. Sidney Martin.

A PARLIAMENTARY paper has just been issued giving an additional Civil Service Estimate, amounting to 10,000*l.*, for Art and Science buildings of Great Britain. The total original net estimate for 1897–98 was 26,000*l.*, and this has been increased to 36,000*l.* The British Museum and the Science and Art Department buildings receive 5000*l.* each for new works, alterations, and additions. The increased grant to the Science and Art Department is on account of the cost of carrying out certain urgent works and services at South Kensington, designed to give effect to the recommendations made in the first report from the Select Committee on the Museums of the Department. It is proposed to remove the more dangerous buildings on the east side of Exhibition Road (including the "boilers" and the electric lighting plant), to displace the occupants of the official residences, and reconstruct the entrance to the galleries on the west side of Exhibition Road.

THE Weights and Measures Bill (Metric System), the scope of which has already been described (p. 275), was read a third time and passed in the House of Lords on Friday last.

WE notice with regret that the Hon. Ralph Abercromby, who did so much for the advancement of meteorological science, died at Sydney, New South Wales, on June 21, at fifty-four years of age.