

brightness in each 6-hour interval of the period was set down for each group, together with the corresponding time and the number of observations. In this way the whole of the materials collected by Schmidt from 1844 to 1879, and thus covering eighteen groups of 100 periods each, are expressed in tabular form on p. 21 of Dr. Lockyer's dissertation. The numbers for each period were then plotted on millimetre paper; tentative and afterwards definite curves representing the fluctuations of the star's light were drawn through the points thus obtained. The resulting eighteen curves representing Schmidt's observations are reproduced one above the other on a small but distinct scale on Plate I., each curve being prolonged by about one-third of the period to bring out the form of the minimum. A study of these curves shows that Argelander's period cannot, at present, be improved on as a mean value. The *time* of Argelander's epoch 400 is, however, shown to be too early by an interval which the author fixes at 3:26:55 hours. The curves also show conclusively that the epoch of maximum oscillates to and fro to the extent of five hours on either side with a period comprising 400 maxima. In the same way the minima are subject to an oscillation of about three hours in approximately 2400 periods. The combined effect of these variations causes the light-period to vary between 7d. 4h. 14m. 40s. and 7d. 4h. 13m. 28s. also in 2400 periods. Superposed on the main light curve are four subordinate undulations, of which more hereafter.

Much the same method was followed with regard to the observations of Argelander, Schönfeld, Heis, Plassmann, Oudemans, Pannekoek, Auwers, Knopf, Sawyer and Schur; but with the further step of reducing the estimated grades to Argelander's scale. This reduction, carried out with scrupulous care by the method of least squares, brings out several interesting facts regarding the values which the grade, or unit of brightness, assumes in the case of the different observers, or for the same observer at different times. Here there is only space to mention the observations made by Knopf in Jena. Contrary to the general usage of comparing a variable with stars differing from it in brightness by at most five or six grades, Dr. Knopf often allowed himself a range of no less than nineteen grades. This new departure has most unexpectedly had no injurious effect on the accuracy of the observations, as is abundantly proved by the smallness of the residuals in the evaluation of the brightness of the comparison stars. From the materials collected by the observers just named, the author constructed nineteen further curves, which confirm in a high degree the results from Schmidt's observations alone. Dr. Lockyer also tests the accuracy of his conclusions by means of the long series of observations made by Wurm in the course of twenty-seven years, beginning with 1785. The detail, indeed, of these observations seems never to have been published, but the actual length of the period in accordance with Schmidt, for the epoch of Wurm's observations, differs but seven seconds from Wurm's value; and since the early observations also show decided indications of the oscillation of the time of maximum, it seems certain that the general character of the variability of  $\eta$  Aquilæ has not materially changed in the course of the last hundred years.

As regards the four secondary fluctuations, they are found to recur at intervals of forty-three hours, or one quarter of the main period, the first of these secondary maxima occurring fifteen hours after the chief minimum. The author is the first to have clearly brought out this feature, and he explains it by assuming, in accordance with his father's hypothesis, that the system of  $\eta$  Aquilæ consists of three meteoric swarms, of which the two lesser revolve about the greater in periods of 1d. 19h. + and 7d. 4h. + respectively (see "Meteoritic Hypothesis,"

*passim*, but particularly pp. 475-6). The irregularities in these fluctuations are set down to the perturbations necessarily occurring in such a system, but their investigation did not come within the scope of the essay before us. Figs. 1 and 2 of the dissertation show the proportions of the assumed orbits, together with the form of the light curve resulting from the combination of the two elementary curves. In conclusion, I must express my admiration of the skill and untiring perseverance which Dr. Lockyer has shown in dealing with a large mass of somewhat intractable material. Wherever possible the deductions were made from the original manuscripts, concerning which interesting particulars are given on pp. 19 and 20, where we learn that Schmidt's original notes are preserved at Potsdam, while those of Heis have wandered across the Atlantic to the observatory of Georgetown College.

R. COPELAND.

#### BRITISH ASSOCIATION TORONTO MEETING.

##### III. LOCAL ARRANGEMENTS.

THE two leading Hydraulic Companies of Niagara Falls are making special arrangements for the reception of the members of the British Association.

The Carborundum Company of Niagara Falls has extended an invitation to the members of the Association to visit and inspect the Company's works on Saturday, August 21. The manufacture of carborundum by this Company has been fully described in NATURE for May 13 (p. 42).

The Atlantic Cable Companies have generously arranged that members from Great Britain may send two free cable messages from Toronto, and they will then be entitled to two free replies. Each message and reply are not to contain more than ten words each, and they are to be forwarded by agents recognised by the Cable Companies. The agents in Great Britain will, in all probability, be Messrs. Cook and Son, and in Toronto the Honorary Local Secretaries; but the arrangements in regard to this are not complete, and a fuller announcement will be made later. It is to be noted that the transmission of the messages within Great Britain to and from the head office of Cook and Son will be charged for as ordinary telegraphic messages. The arrangements in this respect are the same as those made in 1884.

In order to avoid delay in the Customs examination of the members' luggage, the Hon. Mr. Paterson, the Minister of Customs, has given special instructions to the Customs officers at Quebec, Montreal and Niagara to facilitate in every way the examination. A larger number of examining officers will be on duty at Quebec, and one will accompany each steamer from Quebec to Montreal to make the examination of the luggage during the passage. As a result of this arrangement, all delay at Quebec and Montreal will be avoided. The Minister of Customs has also arranged that all scientific apparatus or material for use during the meeting of the Association shall be admitted free of duty if forwarded to me at Toronto, and marked, "For British Association."

It is expected that there will be in attendance at Toronto more than twenty continental men of science of a representative character. Amongst those who have intimated their intention to be present are Prof. Charles Richet, Prof. Yves Delage, both of Paris; Prof. Meslans, University of Nancy; Prof. Gilson, of Louvain; Dr. van Rijckevorsel, of Amsterdam; Dr. Pauli, of Frankfort; Prof. Ladenburg, of Breslau; Prof. Runge, of Hanover; Prof. Brauner, of Prag; Prof. Penck, of Vienna; M. Letourneau, of Paris; M. Gobert, of Brussels; and Prof. P. Magnus, of Berlin.

A. B. MACALLUM.