that observatory during the total solar eclipse of August 30, 1905, and the days immediately preceding and following it.

Extraordinary deviations from the normal diurnal curves were registered in all three elements, and these are plainly shown on the photographic copy of the records which accompanies Father Cirera's communication.

OBSERVATIONS OF JUPITER.—Major Molesworth's report of his observations of Jupiter, made at Trincomali, Ceylon, during 1904–5, appears in No. 3, vol. lxvi., of the *Monthly Notices R.A.S.*, and records the times of rotation of, and the changes in, most of the Jovian features.

One especially remarkable observation was that the following and preceding ends of the large mass of dark matter, known as the Great S. Tropical Dark Area, appeared, on comparing the observations, to have crossed the whole Red Spot bay simultaneously. As it seems impossible that there could be any such instantaneous transference of material, Major Molesworth explains the phenomenon by the suggestion that the movement of the dark area into the belt following the bay caused the extrusion of an equal amount of dark material from the belt preceding the bay.

GRANULATIONS ON THE SOLAR SURFACE.[1]

AN interesting research which promises fair to lead us to an increased knowledge concerning the nature of the sun's photosphere has recently been instituted by Prof. Hansky at the Pulkowa Observatory. On examining the splendid collection of photographs of the solar surface obtained by Prof. Janssen at Meudon, Prof. Hansky was not able to satisfy himself that the whole of the *réseau* seen on the negative was actually of solar origin; it seemed probable that some parts of it were produced by waves in our atmosphere, and on no two consecutive negatives, nor even on two taken simultaneously, could the same granules be recognised. For this reason he attacked the problem at Pulkowa, bringing into operation the astrographic telescope in order to obtain photographs on a large scale.

The solar image at the focus of this instrument has a diameter of 3 cm., which by the use of a concave lens was increased to about 54 cm. (*i.e.* 21·3 inches). With this apparatus numerous photographs were obtained during May and June, 1905, and showed many of the finer details of the granulations which cover the solar surface; but even on this scale it was impossible to recognise the same features on successive photographs. A further improvement was then made, so that the intervals between the exposures might be appreciably shortened—in no case had it been less than five minutes—and with the new arrangement adapted to the astrograph it became possible to take eight consecutive photographs with intervals of fifteen to thirty seconds' duration. These showed the changes taking place in the sizes and relative positions of the granules very plainly, and from them the author has chosen six for reproduction in his circular. Fig. 1 is a copy of one of these reproductions, and shows the general nature of the photographs which Prof. Hansky is obtaining, and from which he hopes to derive valuable results. The scale is such that the solar diameter would measure about 0·6 m., or 23·5 inches. The large black portions represent parts of sun-spots which came within the region photographed.

Although on this scale obvious changes in the size and arrangement of the granules took place in twenty-five seconds, it was impossible to measure their magnitude, so Prof. Hansky intensified the photographs by successive copying, and finally obtained positives showing portions of the disc on such a scale that the length of the solar diameter would be about 6 m. (19·7 feet), that is to say, 1 mm. = 0″·32, or 233 km. on the solar surface.

An examination of these positives showed that the primary desideratum had been attained; the same granules were recognisable on successive photographs, and the scale was large enough to enable measurements of the granules themselves and of their movements to be made. The displacements were measured with the stereo-comparator, and were referred to a neighbouring small spot, movement towards the spot being indicated by the negative, and away from the spot by the positive, sign. The diameter of the actual sun was taken as 1,400,000 km., and on June 21 this gave 1″ = 740 km. The mean variation of any two settings on the same object was ±0″·12, and the probable error for the relative displacement ±0″·10.

The displacements of the granules during the twenty-five seconds which elapsed between two successive photographs taken on June 25 were very diverse. In that interval five of the granules had moved −0″·9, −0″·55, −0″·77, −0″·48,

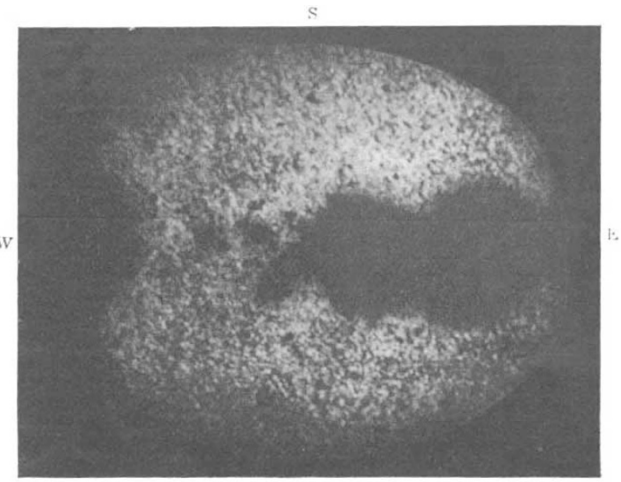

FIG. 1.—June 25, 1905, 5h. 0m. 20s.

and −0″·80 respectively, which in the mean gave −0″·70, or −518 km., *i.e.* about −21 km. per second. Another group gave −38 km. per second, whilst for a third the comparatively low velocity of −14 km. per second was recorded.

Comparisons of other photographs showed that some granules were moving away from the spot with various velocities, and, as shown by the following figures, it appeared that the periodic movement of the granules materially affected the size of the spot. The diameter of the spot is given for different times on June 25:—

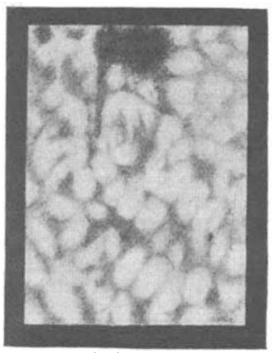

FIG. 2.—June 25, 1905, 4h. 17m. 15s.

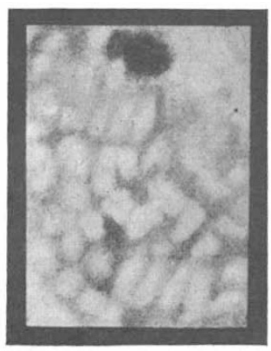

FIG. 3.—June 25, 1905, 4h. 17m. 40s.

4h. 17m. 15s., 2″·64; 4h. 17m. 40s., 2″·25; 5h. 3m. 15s., 3″·03; 5h. 4m. 15s., 1″·35; 5h. 5m. 50s., 2″·70; 5h. 6m. 20s., 2″·88.

On consecutive photographs taken with an interval of one minute the same granulation was recognised with difficulty, whilst with a three-minute interval the whole *réseau* was practically re-arranged beyond recognition, although in one or two cases it was possible to trace a granule after this interval, and in two cases it was remarked that gemination had taken place.

The dimensions of the granules varied greatly between

[1] "Photographies de la Granulation solaire faites à Poulkowa." By A. Hansky.

670 km. and 2000 km., the mean diameter being 1″·9, or about 1400 km. Figs. 2 and 3 illustrate the type of photograph on which the measures were made. These were taken with an interval of twenty-five seconds, and even a cursory glance will show that during that time the arrangement and forms of the granules have altered considerably; on this scale the diameter of the sun would be about 3 metres.

It seems probable that these researches will lead to most important conclusions concerning the nature and the periodicity of the changes in the granules themselves, their influence on the solar spots and faculæ, and, in general, to the resolution of many outstanding problems concerning the nature and action of the photosphere, which are at present unsolved. Prof. Hansky intends, therefore, to pursue this line of research, but, as he points out, it will only be during the comparatively rare moments of atmospheric calm, and with such a powerful equipment as he now possesses, that fruitful results are likely to be obtained. In any case, he is to be warmly congratulated upon those he has already published. W. E. ROLSTON.

PRACTICAL SCIENCE FOR SCHOOLS.[1]

PROF. PERRY said that in the early days of the society, when he had the honour of acting as a secretary, and when Guthrie and Foster, Kelvin and Fitzgerald were presidents, no presidential addresses were delivered, and he questioned whether we were not overdoing the business of requiring general addresses, which must almost always have as their theme the progress of science. Seldom did we find in such addresses new accounts of important original work, and he felt the inappropriateness of such an address in speaking before a society the Proceedings of which were more intense with original work of the best kind than any other society known to him with the exception of the Royal Society. He thought that every young reader of a paper before a scientific society made the mistake of assuming that his audience knew a great deal of the subject so familiar to himself, and hence his paper was not understood. Writers of books on physics assume their readers to be all truly logical students; they use words properly in a technical sense, and forget that many of their readers may use them in the newspaper writer's sense. For example, take the expression "adiabatic expansion." There are people who insist on finding that Rankine, Maxwell, and all others of our most exact writers are not only inconsistent with one another in the use of the expression, but that each is inconsistent with himself. If a portion of fluid expands slowly without gain or loss of heat, we know the way in which its p, v, and t alter as it changes state; this was originally called "adiabatic expansion," and the term has become a technical term for that kind of alteration of p, v, and t, however it may occur. Steam or air may be throttled through a non-conducting reducing valve, but the expansion is not adiabatic, although there is no gain or loss of heat. Steam or air passing along a pipe with friction, if it can only be made to lose heat through the metal of the pipe at exactly the proper rate at every place, is expanding adiabatically. When it is assumed that steam or air flows without friction from a vessel through an orifice, it is said that the expansion is adiabatic although it is rapid.

Referring to the teaching of physics to students entering upon the engineering profession, the president remarked that such teaching was nearly always slipshod. Many men enter a science college at the age of eighteen or more, knowing nothing of physical science. In the case of a great percentage of such men, it is impossible that they should acquire the scientific habit of thought. It is because so much of this kind of material is dealt with that much of our teaching is slipshod. Every pupil entering a science college ought to have been experimenting and working graphically and numerically on physical science problems from a very early age, and then our science classes would deal with them in a scientific way. The causes of the unfitness of the average student are two: one that his instincts and habits of thought were not trained from early youth; the other that his teachers in science colleges have absurd and uninteresting courses of study for him. In physics we are dealing with ideas which are not familiar to young students, ideas which can only become familiar in the laboratory. For example, such a simple mathematical idea as that of a decimal cannot be given in elementary schools in less than five or six years, whereas one week of weighing and measuring would give young children familiarity and clear ideas about decimals. Numerous examples could be given to prove that the principles of physics cannot be understood unless there has been early experimental training, and this is the reason why the professors of science in colleges of university rank and the professors in technical colleges obtain such poor reward for their labour. Referring to the many hundreds who every year take science degrees at the universities, and the thousands who pass the London University matriculation examination, Prof. Perry remarked that if that was the standard of excellence of those present, his address could serve no useful purpose. Nothing ought to be compulsory in schools except the study of English and of natural science. The object of a matriculation examination is to test whether a student entering a college will be able to benefit by the course of study there. The only language which ought to be compulsory in the science department of a university is English. A professor of science ought to be allowed to teach his students in the way that seems best to him, and he should examine his students himself. Hedge him round with rules and regulations framed by boards of studies; tie him down to a syllabus, and the work he will do might be much better, certainly much more cheaply, done by a grinder at low wages. There is no one general elementary course in physics which all students ought to take; neither by their previous training nor from the uses which they will make of the principles of physics are they fit to be taught together. What is wanted is more classes, more rooms, and more teachers.

[1] Abstract of the presidential address delivered before the Physical Society on February 9, by Prof. J. Perry, F.R.S.

THE NEW ORLEANS MEETING OF THE AMERICAN ASSOCIATION.

THE New Orleans meeting of the American Association for the Advancement of Science, as stated in our issue for January 25 (p. 303), began on December 29, 1905, and continued for five days. At a meeting of the general committee it was decided to hold a special summer meeting at Ithaca, New York, to close on or before July 3, 1906, and an ordinary winter meeting in New York City to begin on December 27, 1906. The presidential and vice-presidential addresses will be omitted at the summer meeting and given at the winter meeting. The officers elected at the New Orleans meeting will, therefore, hold office until the close of the New York meeting. Chicago was recommended as the place of the winter meeting of 1907.

The following officers were elected for the Ithaca and New York meetings:—President: Dr. W. H. Welch, Baltimore, Md. Presidents of sections: A, Dr. Edward Kasner, New York City; B, Prof. W. C. Sabine, Cambridge, Mass.; C, Mr. Clifford Richardson, New York City; D, Mr. W. R. Warner, Cleveland, O.; E, Prof. A. C. Lane, Lansing, Mich.; F, Prof. E. G. Conklin, Philadelphia, Pa.; G, Dr. D. T. MacDougall, Washington D.C.; H, Prof. Hugo Münsterberg, Cambridge, Mass. I, Mr. Chas. A. Conant, New York City; K, Dr. Simon Flexner, New York City. General secretary: Mr. John F. Hayford, Washington, D.C. Secretary of council: President F. W. McNair, Houghton, Mich.

The following resolutions were adopted by the association:—(1) That the association instructs its president and secretary to communicate to the president of the Senate and to the speaker of the House of Representatives of the United States its strong conviction that Niagara Falls should be preserved as a natural wonder, and further expressing the earnest hope that the congress now in session will take prompt and energetic action looking toward an international consideration of the impending danger to Niagara Falls. (2) *An Appalachian Forest Reserve.*—That the association again respectfully calls attention to the rapid rate at which the forests of the