cules coming up to the heater in equal numbers and with equal velocities from *all* directions in front, and by molecules receding from the heater equally in all directions, although with augmented velocities. Under these circumstances there would be no difference in the pressure on the front and back of the disc, except during the very brief period of adjustment.

By making this assumption Prof. Reynolds leaves the part of Hamlet out of the play; for Crookes's force arises out of the very circumstance which has been omitted, viz., that the molecules that come up to the heater or cooler, arrive in the form of a rain which predominates in a definite direction, a direction which is normal to the heater and cooler in the simple case of their being parallel.

G. JOHNSTONE STONEY

A Double Rainbow

ON the 28th inst., at about 6.30 P.M. while myself and some ten or twelve other gentlemen were playing cricket, we were surprised to see what we all considered a most novel phenomenon—a *double rainbow*. The sky was cloudy and the weather was thundery. At the time referred to a shower of rain fell; the sun was about 10° above the horizon, shining out very brilliantly and reflecting upon the waters of St. Vincent's Gulf. Great wonder was expressed at the strange appearance, and much curiosity as to the cause.

The appearance was as follows:—There were two distinct and well-defined bows; the feet were united, but the apices were a considerable distance apart.

I am of opinion that the lower bow was caused by the direct light of the sun, while the light reflected from the sea produced the upper one.

THOMAS NOYÉ

Willunga, South Australia, November 30

SCIENCE IN TRAINING COLLEGES

THE Science and Art Department has just issued a circular having an important bearing on the teaching of science is to take in our training colleges, and therefore also in elementary schools.

The Lords of the Committee of Council on Education believe that the time has arrived when a special examination should be instituted at a period of the year better adapted to the training colleges than May, and that the nature of the examination and the payments made on the results should be modified to suit the circumstances of those colleges. They have therefore determined that in future a special examination in science shall be held in training colleges in December, immediately before the ordinary Christmas examination.

The examination will not be open to acting teachers. It will be held in those subjects only for which a special course of instruction is provided in the time-table of the College, and will be conducted by one of her Majesty's inspectors or by an officer of the Science and Art Department. Special committees will no longer be required for the training colleges; such returns as are necessary will be made by the principal. No student in a training college will be allowed to attend the May examinations of the Science and Art Department, except in physical geography in May, 1878.

The examination will be confined to the following nine subjects:—1. Mathematics. 2. Theoretical Mechanics. 3. Applied Mechanics. 4. Acoustics, Light, and Heat. 5. Magnetism and Electricity. 6. Inorganic Chemistry, including Practical Chemistry. 7. Animal Physiology. 8. Elementary Botany. 9. Physiography.

No student will be permitted to take up more than two subjects in any one year, and women will not be permitted to take more than one subject in a year.

The examination, except for mathematics, will be based on the syllabus of the several subjects given in the Science Directory; but the two stages, elementary and advanced, will be treated as a whole—one paper only being set. These examination papers will be framed much as the present May papers are framed, that is to say, with a

certain number of compulsory questions and a certain number of optional questions, some of the latter being more difficult and more highly marked than the rest. Questions will also be set on the method of teaching various branches of the subject.

The successful students will be placed in the first or second class, the standard for a second class being as high as that of a *good* second class in the present advanced stage, and for the first class of a *good* first class in the advanced stage. All students who pass will be registered as qualified to earn payments on results and will receive certificates, but no prizes will be given. A payment of 3*l.* will be made on account of each first class, and 1*l.* 10*s.* on account of each second class obtained by a student in a training college.

In addition to the payments for theoretical chemistry, payments will be made for practical chemistry, of the same amounts and on the same conditions as those detailed in the Science Directory, § XLV. The circular contains an appendix with a syllabus of the subjects for mathematics in training colleges. We should advise all interested in this matter to obtain a copy of the circular.

SUN-SPOTS AND TERRESTRIAL MAGNETISM

I HAVE seen only to-day the number of NATURE (vol. xvii. p. 220) containing a letter from Prof. Piazz Smyth on the above subject. I have also just now seen for the first time a communication from M. Faye to the French Academy of Sciences on July 30 last, in which there is a reference to the same subject; this I regret much, as M. Faye, through an incomplete acquaintance with my investigations, has drawn conclusions from one of them which are not exact. I shall at present refer only to the subject of Prof. Smyth's letter.

M. Faye considers the difference of the periods found by Dr. Lamont and myself for the diurnal oscillations of the magnetic needle (10[·]45 years) and by Dr. Wolf from the sun-spots (11[·]11 years), a sufficient proof that these cycles are not synchronous, and therefore that there is no causal connection between the two phenomena. Prof. Smyth asks an explanation relatively to this difference, upon the supposition that the two periods found are the true mean durations of the cycles for the respective phenomena. This supposition, however, is erroneous, and consequently M. Faye's deductions from it fail.

I have shown in a paper cited by M. Faye¹ that if we determine the epoch of the maximum diurnal oscillation of the needle from Cassin's observations made at Paris, and from Gilpin's observations made at London, we find it to have occurred in 1787[·]25. This epoch agrees very nearly with that deduced by Dr. Wolf for the maximum of sun-spots. If we compare this epoch with that of the last maximum which occurred for both phenomena near the end of 1870, we shall obtain a mean duration of 10[·]45 years, upon the assumption that eight cycles happened between these two epochs. There is no difference between Dr. Wolf and the magneticians excepting upon the question whether there were eight or only seven cycles. Dr. Lamont considers that the data existing between 1787 and 1818 are worthless for a decision upon this point, and by induction from the known cycles has concluded that three cycles must have occurred in the thirty-one years 1787 to 1818. Dr. Wolf believes there were only two. I have given the evidence which makes the existence of three extremely probable. This question has no relation whatever to the synchronism of the two phenomena.

If we could accept Dr. Wolf's view we should find, as I have shown, that the mean duration of a cycle for *both* phenomena since 1787 would be 11[·]94 years, while the sun-spot results for eight cycles determined by Dr.

¹ "On the Decennial Period," *Edinb. Trans.*, vol. xxvii.