may answer the purpose for others as it has now for some time answered mine. THOMAS FAWCETT

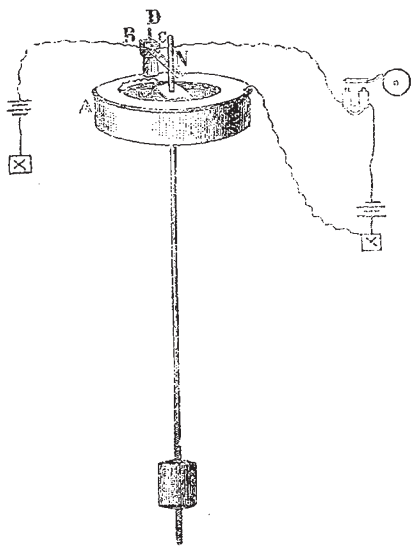
Blencowe School, Cumberland, November 6

Electric Motor Pendulum

THE following very simple apparatus may I think be of use in any laboratory or other place where at times it is necessary to have a pendulum beating seconds in order to give the time for any experiments needing it.

It consists of a Siemens' galvanoscope, A, to which is attached the pendulum; the needle N, preferably with platinum contacts, works between two platinum wires, B and C, with a small amount of play; these platinum wires are insulated from one another by being fastened into a piece of ebonite, which works on a pivot D. The needle is connected by its support to one end of the coil of the galvanoscope, the other end being to earth. To the wires, B and C, are connected the opposite poles of a small battery, the centre of the battery being to earth.

The action of the instrument is as follows:—On slightly oscillating the pendulum the needle N makes contact between B say, and the coil, the magnet being so arranged that the needle then deflects towards B, thus carrying with it the movable contact wires until the pendulum reaches its limit of oscillation, when it



falls, breaks contact with B and makes contact with C, which thus tends to pull the needle over to C, and so on; in this way the pendulum receives at each oscillation the impulse necessary to overcome the forces tending to stop it; and thus will keep oscillating as long as the battery supplies the motive power. For small arcs the beat is *not affected by variation in battery power*.

In the circuit of the battery we can introduce an electro-magnet which at each contact of the pendulum on one side will make a stroke on a bell, or indeed by a detent will move by a small train of wheels the hands of a clock. If the pendulum is made to beat half seconds, then the contact being made alternately on each side, the bell stroke would beat seconds. We could of course introduce any number of arrangements of this sort at any intervals along the circuit, and so move any number of clocks at different positions in a large establishment, only one pendulum being requisite to control the whole set.

P. HIGGS

PROF. YOUNG ON THE SOLAR SPECTRUM

THE paper of Prof. C. A. Young read at the last meeting of the American Association for the Advancement of Science describing his recent measures of the displacement of the D and other absorption lines at the receding and approaching limbs of the sun, has a double interest.

By careful measures to which all the necessary corrections have been rigorously applied, obtained by using a diffraction grating in combination with a prism, Prof. Young deduces from observation of the D lines a value of 1·42 ± 0·035 miles per second for the surface velocity of rotation at the sun's equator Direct observation of the motion of spots gives 1·25 miles per second, and the author thinks that the difference of these two values being so many times larger than the probable error of the spectroscopic method, the result of which agrees so well with Vogel's result, indicates that a portion of the displacement observed is produced by the difference in the angular velocity of rotation of the solar atmosphere which causes the absorption lines and the underlying luminous surface, and the sign of the difference would indicate that the atmosphere is swept forward with the greater velocity of the two.

This conclusion is itself one of great interest, but for many persons the fact that it is based on the acceptance of Doppler's theory will be a source of satisfaction as indicating that the recent disputes as to its soundness are beginning to be considered settled and in its favour, as at any rate a near approximation to the truth.

One of its first assailants, on mathematical grounds, was Prof. Petzvall. But, as was pointed out by Mach in a "Contribution to Doppler's Theory," published at Prague, in 1874, his main argument fell beside the mark, while the only one which touched it went to prove that for comparatively small velocities of translation in the source of sound or light, compared to the velocity of wave transmission, Doppler's theory was a correct approximation.

More recently Van der Willigen's mathematical objections have been apparently fairly disposed of by Mr. Christie, while the discrepancy that Father Secchi has lately pointed out between the measures of displacement of spectral lines in the case of certain stars as observed by Mr. Huggins on the one hand and at Greenwich on the other, does not really affect Doppler's theory at all, but only the degree of certainty with which it can be applied to the determination of stellar motion. But the facts are not as Father Secchi represents them. He points out, in a list of thirteen stars, that the displacement in the case of some five stars as observed by Huggins is in the opposite direction to that observed at Greenwich. But the Greenwich observations that he takes are some early tentative observations. We have taken the trouble to refer to the most recent Greenwich measures, and find that of the five disagreements insisted on only one holds.

INDIAN GEOLOGY

THERE seems to be a very pretty quarrel just now—and one urged with the usual absence of acrimony in scientific controversies—as to the age or ages of an important group of rocks in Her Majesty's Indian empire.

For years it has been known that while a large mass of the rocks forming the Peninsula of India are unfossiliferous, there is also in that country an extensive series of beds the predominant, and frequently the only, fossils of which are vegetable remains. These beds were often spoken of as the Plant-beds of India. Among the flora certain forms which used to be called *Palæosamiæ*, now *Ptilophyllum*, were pretty generally distributed, while the genera *Schizoneura* and *Glossopteris* were found in lower portions of the series.

On the evidence of the first-named fossils and several others, a Jurassic age was assigned to the containing beds, while the identity of the *Glossopteris* with Australian forms involved these Indian beds in the dispute as to whether the coal-rocks of that country were likewise Jurassic or really carboniferous.

One portion of the Indian plant beds contained a limited terrestrial fauna which on high authority (Hux-