from line PT to line PR, and thence through centre C upon line PR′. Moreover, the point P is the point of intersection of lines PT′ and PR′; wherefore, by Theorem I., the lines PT′ and PR′ are in perspective.

In order to find the centre of perspectivity of lines PT′ and PR′, we have the point k on line PT correlative of the point at infinity on PT′, k being determined by drawing Bk parallel to PT′. The point k_1' on PR′, correlative of k on PT, is found as before by projecting k first upon PR in k' and thence upon PR′ in k_1'. Thus, the required centre of perspectivity must lie somewhere on the indefinite line joining k_1' with the point at infinity upon PT′. Again, the point i' on PR corresponds to the point at infinity on PR′, to point i on PT, and to point i_1 on PT′; hence the sought centre must lie somewhere on the indefinite line joining i_1 to the point at infinity on PR′; wherefore it coincides with the intersection of lines i_1S and k_1'S.

Similarly it can be shown that the lines PT and PR′ are in perspective; for the line drawn from C, the centre of projection for line PR′, to S_∞, the centre of projection for line PT, or, in other words, the line drawn from C parallel to dd', ee', &c., is a coharmonic ray common to both lines; therefore, according to Theorem II., the lines PT and PR′ are in perspective. The corresponding centre of perspectivity is determined as follows. When the line oo', moving parallel to itself, passes to infinity, or, in other terms, when the points o and o' pass to infinity on lines PT and PR, the ray Co' takes up the position CF, parallel to PR. Hence, F is the point on line PR′ corresponding to infinity on PT; wherefore the required centre must lie somewhere on the line through F parallel to PT. But i is the point on PT corresponding to infinity on PR′; therefore the centre must lie somewhere on the line through i parallel to PR′. Hence we conclude that it must coincide with the point of intersection of lines FG and iG.

In this short paper we have made an honest attempt to trace one filament of the great stream of modern science to its original source. The space at our service may not admit of much more. Still, such a study, however limited its scope may be, is interesting, not only on account of the novel nature of the demonstrations which the proof of connection involves, but even more because of the reflex light thus cast upon recent invention.

Robert H. Graham.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Cambridge.—The Observatory Syndicate Report as follows:—

That they have considered the proposal made in the Report of the Newall Telescope Syndicate for the purchase of an acre or an acre and a half of land adjoining the grounds of the Observatory for the erection of the Newall telescope and its appurtenances, and they are of opinion that, in view of possible future requirements of the Observatory, it will be desirable to secure now the larger area—namely, an acre and a half.

They have consulted the Bursar of St. John's College, and have learnt that the College is willing to sell to the University an acre and a half at the price of £250. Further, Prof. Adams has offered to contribute £100 towards expenses.

Under these circumstances the Syndicate recommend that Prof. Adams's generous offer be accepted, and that the Vice-Chancellor, on behalf of the University, be empowered to enter into an agreement with St. John's College for the purchase of an acre and a half of land adjoining the grounds of the Observatory.

SOCIETIES AND ACADEMIES.

London.

Royal Society, May 1.—"Photographic Determination of the Time-relations of the Changes which take place in Muscle during the Period of so-called 'Latent Stimulation.'" By J. Burdon Sanderson, F.R.S.

It is now forty years since Helmholtz published his fundamental experiments on the time-relations of muscular contractions. The purpose of this investigation was to ascertain "the periods and stages in which the energy of muscle rises and sinks after instantaneous stimulation"; the word energy being defined as the "mechanical expression of activity"; and one of the most important conclusions of the author was that, in the muscles investigated by him, contraction does not begin until nearly one hundredth of a second after excitation. This interval has, by subsequent writers, been called the period of "latent stimulation."

Helmholtz subsequently (1854) showed, by experiments of surpassing ingenuity, that during this period an electrical change of very short duration occurs, which culminates at about one two-hundredth of a second after excitation. The fact discovered by Helmholtz was further investigated by Bernstein in 1866, with the aid of the repeating rheotome, and subsequently (1875) by du Bois-Reymond, whose statement of the actual time-relations of the electrical response to an instantaneous excitation of the gastrocnemius of the frog is embodied in a curve which denotes that the muscular surface becomes negative to the tendon about three thousandths of a second after excitation, that this effect culminates at seven thousandths of a second, and that it is immediately followed by a change of opposite sign, which culminates at about ten thousandths.

By a new method—that of photographing in succession the mechanical and electrical responses in muscle on a rapidly moving sensitive surface—the author has shown that the mechanical response occurs much earlier than has been hitherto supposed; and that it is, in fact, simultaneous with the electrical change above described—that is, with the so-called negative variation.

The method consists in projecting the movement to be recorded, whether of the muscle or that of any instrument which serves as an index of change, on a vertical slit on which the vibrations of a tuning-fork and the motion of a signal are also shadowed. Immediately behind the slit is a photographic plate, which is carried by an equilibrated pendulum. The approximately uniform rate of motion of the sensitive surface which receives the light-written record is about one metre per second, but is determined in each experiment by reference to the rate of vibration of a tuning-fork.

In the experiments on direct excitation, the muscles used were the *gastrocnemius* and *sartorius* of the frog. In the former the movement of contraction was communicated to a light index, which was supported by a fine spring. One end of the index rested on the muscle, while the other occupied the front focus of a projection apparatus, the slit being in the other focus. When the sartorius was used the surface of the muscle was itself brought for a moment into the focus, at the seat of excitation. The unavoidable exposure of the structure to the electric light, which this method involved, lasted scarcely more than a second. In successful experiments, the interval between excitation and the beginning of the contraction was $2\frac{1}{2}$ thousandths ($= \frac{1}{400}$) of a second.

For measurement of the delay in indirect excitation, the gastrocnemius (with the index) only was used, the exciting electrodes being applied either at 12 or at 37 mm. from the muscle. The results were not so constant. Corrected for loss of time by propagation along the nerve, the intervals between excitation and beginning contraction varied from 0·0025″ to 0·0035″.

In the experiments for determining the time after excitation at which the electrical response begins and culminates, the capillary electrometer was used, as in the author's experiments on the heart and on the leaf of *Dionæa*, as a signal, but with much improved apparatus for recording.

In the gastrocnemius of the frog, the electrical response to an instantaneous stimulus is indicated by a sudden movement of the mercurial column of so short a duration, that to most persons it is invisible. Its photographic expression is that of a spike projecting from the dark border of the part of the plate which is unprotected by the mercurial column. The electrical interpretation of this spike is that between the contacts two electrical changes of opposite sign and not more than one two-hundredth of a second in duration have immediately followed each other, or, more explicity, that the spot excited became, for about 0·0005″, first negative, then for a similar period positive, to the other contact.

In the muscle (the leading off contacts being on the Achilles tendon and muscular surface respectively, and the nerve excited at a distance of 12 mm.) the electrical response begins at 0·004″ and culminates at about 0·012″ after excitation. Deducting the delay due to transmission along the nerve, we have, as the time between excitation and response, 0·0035″. It is thus seen that the electrical response, instead of preceding the mechanical, is