10 per second, the lag is inappreciable, but for considerably faster movements it becomes important.

In duplex working when the sending current has to be balanced so as not to affect the receiver, quick, "jarry" movements are very difficult to eliminate, but the lag in the thermo instrument reduces these movements very considerably and is a valuable property.

When the thermopile is in its central position and no current is flowing both junctions are at a dull red heat, and when fully deflected one junction becomes bright red and the opposite one is black or very faintly red. In intermediate positions the current generated by the thermopile is nearly proportional to the deflection.

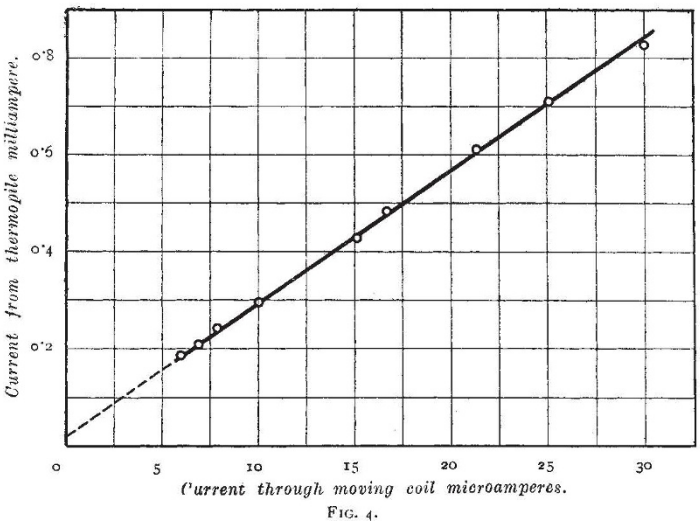

FIG. 4.

The curve (Fig. 4) was taken from a thermopile with seven junctions on each side. When the thermopile was deflected 0·075″ the current it sent through a resistance of 42 ohms (equal to its own resistance) was 0·81 milliampere. With the natural period of the coil equal to 8·7 per second and a 480-ohm 480-turn coil, a current of 0·03 milliampere through the coil gave a current of 0·81 milliampere from the pile through an external resistance of 42 ohms. For slowly changing currents this corresponds to a magnification of power of about twenty-seven times, and, of course, this can be greatly increased by reducing the period of the coil. For quickly changing movements the power magnification is not so great, owing to the back E.M.F. of the coil.

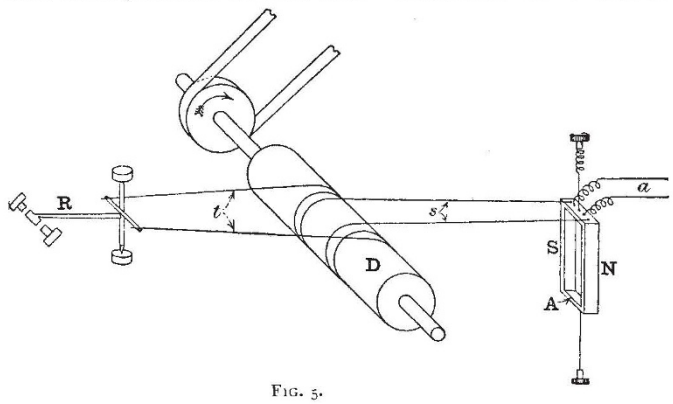

FIG. 5.

Trials of this instrument on an Atlantic cable have shown an increase in speed of about 40 per cent.

Mechanical Relay.

The instrument just described is a magnifying relay—that is to say, it multiplies the impulses received in exact proportion to their strength. This form of relay is quite distinct from an ordinary make-and-break relay, which delivers a constant current for any impulse over a certain strength. For very many purposes it is essential that received impulses should be magnified without altering their shape, and this can only be done by an instrument with a constant magnifying power.

That this is the case in the thermo relay is shown by the diagram (Fig. 4), where the current supplied to the coil and the current delivered by the thermo-junctions are plotted. Within the range of the instrument the points lie on a straight line and represent, in this case, a constant magnification in current of about twenty-seven times.

This property I will now illustrate in an entirely mechanical relay in which movements operated by very small forces are largely increased in strength without affecting their motion. The relay consists in principle of a rotating spindle around which are wound one or more turns of a flexible cord. The spindle is revolving in such a direction as to pull away from the magnified forces and towards the small forces that control the movement. Suppose a heavy weight has to be raised by a force of one-tenth of the amount, it will obviously be necessary to supply 90 per cent. additional energy, and this is supplied by the motor driving the spindle. The magnification of force and energy depends on the number of turns which the cord makes round the spindle and follows a compound interest law.

In the model shown it will be seen that a large magnification of power can be easily obtained by very simple means. Thus I can move this 14 lb. weight rapidly up and down by pulling upon this silk fibre.

Fig. 5 shows an application of the principle to cable work, in which the small forces operating the coil A are intensified sufficiently to work the coarse relay arm R. The spindle rotates away from the relay arm R and towards the coil, and produces a much greater tension in the fibres *t* than in *s*. When the coil swings on its axis the tension is increased in one of the fibres and diminished in the other, and a similar change in a magnified degree takes place in the fibres *t*.

By using means of this sort it is possible to work an ordinary siphon direct writer which normally requires some 3 milliamperes by a current of 10 microamperes.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A SUMMER School in Geography will be held at the University College of Wales, Aberystwyth, on July 28–August 16. Among the subjects included in the scheme of work are:—Human geography, Prof. H. J. Fleure; climatology and trade routes, W. E. Whitehouse; land forms and natural regions, E. S. Price; field classes and excursions.

THE Department of Agriculture and Technical Instruction for Ireland has now published particulars of the summer courses for teachers it has arranged to hold in July and August next. With few exceptions the courses will be held in Dublin. In July teachers will have the opportunity of selecting their study from a wide variety of subjects of experimental science and technology. In August, practical mathematics, rural science, and a number of domestic arts will be taught. These courses are open only to persons who are over twenty years of age, and, except in the case of the courses in rural science (including school gardening) and drawing and modelling, only to teachers who are engaged (*a*) by local committees of technical instruction; or (*b*) in schools receiving grants either directly from the department or under the provisions of an approved local scheme of technical instruction. Application to attend the courses must be made before April 15.

THE Education Committee of the West Riding County Council proposes to hold at the Training College, Bingley, in August next, a vacation course for teachers in secondary, technical, elementary, and other schools, beginning on August 5. The course will not be limited to West Riding teachers, but will be open to all on payment of the fees. The aim of the course is to stimulate teachers and to give them opportunities of studying new methods of teaching the various subjects rather than to give specific instruction in the subjects themselves. The subjects to be dealt with cover most branches of the curriculum, and include the following:—The teaching of practical arithmetic, Mr. J. R. Deeley; the teaching of handwork, Miss K. Steel; the teaching of domestic subjects, Miss G. E. Irons; physiology, Miss F. E. Relf; the teaching of experimental science, Prof. Arthur Smithells, F.R.S., and Mr. H. Calam; and nature-study, Miss Mary Simpson.

IN his report for the academic year ending June 30 last, a copy of which has reached us, President Ira Remsen, of Johns Hopkins University, refers to the inauguration of a school of technology in the University. The creation of a new department of the University has been made possible by an Act of the Legislature of Maryland, in its session of 1912. The sum of 120,000*l.* was granted for the construction and equipment of buildings for a school of advanced technology. A further continuing annual grant of 10,000*l.* was also provided for maintenance. The provisions of the Act include the granting of 129 free scholarships to residents of the State. These scholarships are apportioned to the various legislative districts, to seven colleges in the State, and six may be awarded at large. Among the numerous public lectures given in the University during the year, we notice a course of eight on solar and terrestrial physics, by Prof. A. Schuster, one by Prof. W. Paszkowski, of the University of Berlin, on the organisation and work of that institution, and four by Prof. W. L. Iohannsen, of the University of Copenhagen, on heredity and variation.

LORD HALDANE gave an address on the problem of national education at the conference of the National Union of Teachers on Tuesday, March 25. He stated that he could not describe the details of the scheme proposed by the Government, but he could give his own views. In the course of his remarks he said:—"If we do not keep abreast in the training of the national mind with those other countries which are organising their education systems, and which in many respects are our superiors, it is inevitable that in these days, when science and knowledge are the conditions of all success, industrial and generally, we shall fall behind in the race. It is a question of national safety, and nothing else, with which we are dealing. I am sometimes very much concerned about our industries when I think of the backwardness of our educational system, but man does not live by bread alone, and we shall not get even a good technical education system unless we put it on a broad foundation of national education. The State has a deep and direct interest in seeing that its people are educated, just as it has in seeing that they are healthy. A national system must take cognisance of all the means by which education is provided in a country like this. The highest means, the lowest means, the university, the secondary and the elementary school—they must all be fitted into their place in one system. Ten years ago there were only six teaching universities, but since then five more have been established. Putting outside Oxford and Cambridge, the number of students working in the day time has doubled in the last ten years. The number of degrees obtained by students in England and Wales in 1911 is more than twice the number obtained in 1901. There are things which cannot be secured outside the atmosphere of the university. I can never admit that an external student is the same as an internal student. The internal student has matured his mind in the university atmosphere. The external student is working hard, but only for the external examination, and some people with much less aptitude than their neighbours in what is best in the realities of education have much greater aptitude in passing examinations. Therefore the external examination is not a real test of learning. The only real test of learning on which I should like to give a degree exclusively is the record of the student during his time at the university."

SOCIETIES AND ACADEMIES.

LONDON.

Geological Society, March 5.—Dr. Aubrey Strahan, F.R.S., president, in the chair.—S. S. **Buckman**: The "Kelloway Rock" of Scarborough. The author has studied the types of ammonites from the Kelloway Rock described by Leckenby, preserved in the Sedgwick Museum, Cambridge, and a series of Yorkshire Kelloway-Rock ammonites from the Museum of Practical Geology, London. He has grouped these ammonites according to their different matrices, and finds that they indicate several different zones. These zones he arranges in sequence, and suggests how they may be compared with the sections of Kelloway Rock of Scarborough given by Leckenby and by Fox-Strangways. The exact order of the zones is, in one or two cases, not considered to be proved, but the paper is offered with the idea of indicating where further work is required.—L. F. **Spath**: Jurassic ammonites from Jebel Zaghuan (Tunis). Jebel Zaghuan, the best-known and most conspicuous, though not the highest, mountain of the Tunisian Atlas, is built up largely of massive bluish-grey limestones of confused stratification which have been referred to the Middle Lias on the evidence of badly preserved belemnites and Terebratulæ, notably "*Pygope*" *aspasia, Columna* sp. Middle Liassic (Domerian) ammonites are now recorded for the first time. A new classification of the Domerian genera of the family Hildoceratidæ, to which the fossils from Jebel Zaghuan belong, is proposed. Moreover, the ammonites collected by the author afford sufficient evidence of the presence of the zone of *Reineckia anceps,* which occurs in Algeria, but had been supposed absent in Tunis, together with the other beds intervening between the Middle Lias and the Corallian.