

### The Physical and Optical Societies Exhibition.

THE Physical and Optical Societies held their eleventh annual exhibition of scientific apparatus at South Kensington on January 5-6. There was a record attendance. The demonstrations and discourses were unusually attractive, a considerable number of visitors failing in their attempts to attend the discourses because of the overcrowded condition of the large lecture theatre. Sir W. H. Bragg gave an interesting lecture on "Sounds in Nature," and Mr. C. R. Darling showed by means of beautiful experiments some little-known surface-tension phenomena. On behalf of Prof. Archibald Barr, Dr. Morrison gave two addresses on the optophone, the instrument exhibited being the result of much patient research and development work by Messrs. Barr and Stroud. In the optophone a selenium bridge is exposed to successions of sets of light pulsations, which vary according to the forms of letters as these are passed over in traversing a line of printed type, each letter being indicated in a suitably connected telephone by a characteristic succession of single notes and chords. Printed letters are thus translated by the optophone into a sound alphabet which can be readily learned. Miss Mary Jameson, a blind girl, who attended the exhibition, read ordinary type at about ten words per minute, but when undisturbed her normal rate is about twenty-five words per minute. Many blind people were present.

Thermionic tubes and associated appliances were much in evidence. Prof. C. L. Fortescue and Dr. Bryan gave a very instructive demonstration of well-known circuit arrangements having all the parts exposed to view. The "heterodyne" or "beat" method of reception was demonstrated, and surprised many visitors because of the clearness of the beat tone. Another demonstration involving the use of valves was given by Messrs. Creed and Co. The apparatus which was shown received and recorded wireless messages at a working speed of 200 words per minute. The record is a punched slip of paper which by means of a printer is transcribed into Roman characters. The research laboratories of the General Electric Co. exhibited a number of valves with a new type of filament. This filament runs at a much lower temperature than the ordinary tungsten filament in the valves in general use at present. The increased strength resulting from lower temperature permits the use of finer filaments, the watts for heating these being only one-twentieth to one-fortieth of usual values. Thus it is possible to work a six-valve amplifier with a current consumption of half an ampere. Characteristic curves for these valves are very similar to those for existing types in use for wireless telegraphy.

In the optics section, Mr. Aldis exhibited a comparatively cheap but very perfect projector specially suited for projecting pond-life on the screen. With live specimens and a magnification of 300, the alimentary canal and internal organs of many specimens were shown with great clearness. There should be a good future for this projector for educational purposes. Messrs. Adam Hilger demonstrated a little-known application of the Fabry-Perot interferometer. A beam of white light is caused to traverse

successively two plates of air, each with silvered faces, a system of fringes being obtained whenever the differences of path occasioned by each of the plates bear to each other a simple relation. If, then, a Fabry-Perot étalon is placed in series with a Fabry-Perot interferometer (the air plate in the étalon having a constant thickness and in the interferometer a variable thickness) a system of white-light bands is produced every time the distance between the silvered surfaces of the interferometer mirrors is either a multiple or sub-multiple of the distance between the plates of the étalon. Messrs. Hilger also demonstrated the Zeeman effect with a wave-length spectrometer and a Lummer-Gehrcke parallel plate. Messrs. R. W. Paul and F. Twyman demonstrated by the use of a Hilger-type interferometer the distribution of temperature around a hot body. The convection currents produced in air by electrically heated wires were beautifully shown.

Cathode-ray workers were interested in a 12,000-volt direct-current generator set shown in operation by Messrs. Evershed and Vignoles. A cathode-ray tube was placed in circuit and some of the possibilities of the method of investigating rapid changes of current were demonstrated.

The general display of all exhibits was particularly good, and great credit is due to the forty-eight instrument-making firms who exhibited for the excellence of their manufactures and for the care taken in arranging and explaining the purposes of their instruments. The finish of electrical instruments was of a very high order—much higher than last year, when many mass-production instruments were shown. In many cases it was gratifying to find that elegance of production was accompanied by a surprising robustness. As an example a simple galvanometer which appeared to be very good for schools was shown by Messrs. Gambrell Bros.; this has a self-locking device when it is not supported on a table, and, in consequence, it withstands extraordinary shocks in transit. The Cambridge and Paul Instrument Co. showed for the first time a modification of the Einthoven string galvanometer having six strings, the deflections of which are recorded on a moving band of photographic paper. This type of galvanometer was first used in sound-ranging in France, and was of great service during the war. An excellent amplifier for cable work (but it should have many other applications) was exhibited by Mr. H. W. Sullivan; the amplifier is a selenium-cell relay which is acted upon by a light beam from a galvanometer; a magnification of 10,000 was obtained. As usual, the Weston Instrument Co. had an excellent display of meters and parts of meters which only required inspection for one to understand why a Weston instrument is always trustworthy.

The optical section of the exhibition attracted increased attention because of the position of the optical trade as a key industry. The exhibits were certainly of a high class, and it is hoped that the efforts of the optical industry to establish itself firmly and to make its products inferior to none will receive support from the large number of visitors who admired the exhibits.

### The Headmasters' Association.

THERE was a large muster at the annual meeting of the Association of Headmasters held in the Guildhall of the City of London on January 5. In his presidential address Mr. J. Talbot, headmaster of the Royal Grammar School, Newcastle-upon-Tyne, handled the new psychology in a sensible way. No

one can question the results of psycho-analysis when applied to cases of neurosis. Many a soldier owes his recovery from shell-shock to the skill of men like Dr. Rivers, Prof. Elliot Smith, and Prof. Pear. But when a smatterer who has merely "read a book," or perhaps only listened to a lecture, begins to fumble

round with the souls of healthy boys and girls it is a different matter, and teachers have no more right to experiment upon them in psychical matters than to make them the vile body for testing the properties of a patent nostrum. It may be true, as Dr. Crichton Miller has pointed out, that in nineteen out of twenty cases examined by the expert analysts the results point to faulty upbringing, either at home or at school, but it must be borne in mind that these twenty cases are not normal or typical in any way. When Dr. Mary Bell says there is no sin in a child helping itself to the contents of the mother's purse in order to buy presents for a teacher, this is simply playing fast and loose with the distinctions between right and wrong. Most homes and most schools will be well advised to stick to the Ten Commandments. If a child gets into serious trouble or is not healthily happy, there is a clear case for psychotherapy. Every schoolmaster of experience knows how helpful it may be in suggesting a hopeful method of treatment, for there were cases of shell-shock among children in the raid areas as well as among soldiers at the Front; and so long as boys are boys there will be cases of practical jokes, such as those which drove the poet Gray out of Peterhouse at Cambridge, and there will be cases of bullying, though these are now, happily, very rare. But for the normal treatment of normal school-life, the best training of the unconscious life, as Mr. Talbot said, is through the school games, school camps, scouting, and everything which enables a child's psychical faculties to function freely in relationship both to his teachers and to his fellows. Inasmuch as every child does not find itself in cricket, football, and hockey, it is well to widen the field of opportunity and to offer as large a variety as possible, so that no child in any school may live such a cowed life as Cowper lived at Westminster.

Prof. Percy Nunn's address on testing intelligence was as full of humour as of practical help and suggestion. Clearly the secondary school needs a certain *quantum suff.* of knowledge as well as of intelligence, and therefore written examination cannot be superseded in the selection of free-place holders. Both these forms of test bring out the child that has the power of rapid mental mobilisation, and the ablest child of all may very likely fail to shine. "Sentimental Tommy" failed to win his place on the list because he spent half the time available in thinking out the exact word which he wanted to fit his thought. Clearly the consummate artist in words is not a successful examinee. There is, in addition, the child who thinks below the surface of things, whom psychologists call the "introvert." He will take the question proposed and look at it in its bearings in relation to other deep thoughts which occupy his mind, and, as likely as not, he will want to reformulate the question altogether before he sets himself to answer it. As Prof. Nunn admitted, our present methods pass over this child; a Newton or a Coleridge would in all probability fail to win a scholarship. This is one point which calls for further work for the psychologists. Profs. Terman and Thorndyke have not yet faced this question, and the American Army had probably no use for a Coleridge or other poetic soul. This is only one of many questions which call for further research. It is important to be able to measure the vital force of the competitor, for a fund of vitality is quite as important for effectiveness in study, and, indeed, in life in general, as intelligence. It would be interesting to know how much deep breathing and cardiac strength have to do with that tenacity of purpose which so often wins through to high achievement, when mere brilliance of intellect fails because it is not backed by strength of perseverance.

### The Mathematical Association.

AT a crowded annual meeting on January 4, Prof. A. S. Eddington gave an account of relativity. Those who wish to inform themselves on this subject will naturally go to Prof. Eddington's attractive book, "Space, Time, and Gravitation." No experiments to determine the motion or whereabouts of the æther had ever led to any but a negative result, as if one solving an equation should end up with the disappointing result  $0=0$ . The view had therefore been put forward that there were certain compensating influences concealing the motion of the æther from detection. But Einstein had dared to take up the attitude of Betsey Prig in the matter of Mrs. Harris, "I don't believe there's no sich a person!" The party of Mrs. Harris, however, protested against being called upon actually to produce her.

Two points of pedagogic importance were made. First, there is geometry. In Prof. Eddington's opinion geometry is not the science of space relations in an empty world, but the science of space relations of material objects; its fundamental assumptions are to be ascertained by measurements made on such objects. From this it would follow that the philosophical way to begin the study of geometry is by playing with mathematical instruments and bits of cardboard. This is what teachers have been discovering, beginning at the other side of the problem—beginning, that is, with the boy into whom they have to insert learning. Prof. Eddington reaches the same conclusion by considering the nature of the learning that is to be inserted into the boy. So the two sets

of workmen meet in the middle of the tunnel and the line is clear for traffic.

Secondly, there is dynamics. Consider the case of a pendulum. On one side of the equations we have been accustomed to write the forces, including gravity. On the other we write inertia and acceleration, including the acceleration towards the centre. But the last term could algebraically be written on the force side, with sign reversed; it would be identified with what has been known popularly as centrifugal force. Teachers have generally been rather prudish about this term, but Prof. Eddington assures us that centrifugal force and weight are equally real or unreal; it would appear, then, that they should be on the same side of the equation. (But which side?) Similarly, the passenger walking along the aisle of an accelerating tube-carriage is justified in considering himself in equilibrium under a pressure from the floor and a gravitational force equally inclined to the vertical; and gravity is, in practice, not disentangled from the centrifugal force of the earth's rotation.

Dr. Brodetsky followed with a paper proposing to inject fresh blood into dynamics by using the aeroplane. He explained that the problem could be so simplified that, after a year's study of dynamics, the student could work problems on the motion of aeroplanes, including climbing, *vol plané*, and banking. We shall look forward to seeing these suggestions worked out in detail in a forthcoming issue of the *Mathematical Gazette*.