obliquely upon a lens can be verified in an exactly similar manner. It follows from the formulæ given in Parkinson's "Optics" (p. 101) that, with the usual notation—

$$\frac{u - v_1}{u - v_2} \cdot \frac{v_2}{v_1} = \mathrm{scc}^2\phi.$$

The verification of this formula by the method of observation described above has been found to be a very useful and satisfactory class experiment.

W. N. SHAW

Cavendish Laboratory, Cambridge

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—The election of Mr. A. Marshall as Professor of Political Economy will be welcomed by all who knew the value of his work when formerly in residence as Lecturer at St. John's College.

The Senate has sanctioned the recommendation that 700*l.* be expended on the purchase of microscopes for the biological classes, on which sum interest at 4 per cent. is to be paid, a small terminal charge being made to the students for the use of the microscopes.

The Botanic Garden Syndicate have recommended the increase of the stipend of the Curator of the Botanic Garden from 150*l.* to 200*l.* The Syndicate have watched with interest the zeal and skill with which Mr. Lynch has applied himself to the conduct and development of the garden. The improvement during his curatorship has been very considerable, in fact remarkable; and the reputation of the garden among botanists and horticulturists, both at home and abroad, has risen so much that it is now considered to hold a place in England second only to the Royal Gardens at Kew. Sir Joseph Hooker has said that the Garden, under Mr. Lynch's able management, is rapidly rising to eminence as one of the very best in Europe. The Syndicate express their strong approval of the assistance which Mr. Lynch's intelligent appreciation of the requirements of botanical teaching has enabled him to render to the University.

DR. GILBERT, Professor of Rural Economy at the University of Oxford, and the associate of Sir J. B. Lawes in the Rothamsted experimental work, has accepted the post of Honorary Professor of Agricultural Chemistry at the Royal Agricultural College, Cirencester, rendered vacant by the death of Dr. Voelcker.

MR. D'ARCY WENTWORTH THOMPSON, B.A., was on Monday elected Professor of Biology, University College, Dundee.

SOCIETIES AND ACADEMIES

LONDON

Physical Society, December 13.—Prof. Guthrie, President, in the chair.—The following communications were read:—On the effect of an electrical current on the rate of thinning of a liquid film, by Profs. A. W. Reinold, F.R.S., and A. W. Rücker, F.R.S., read by Prof. Reinold. In 1877 the authors communicated to the Royal Society an account of some experiments upon the electrical resistance of liquid films. The results then obtained showed that there was some disturbing influence present, and the authors now find this to be the action of the current upon the film itself. The films experimented on were, as in the original experiments, cylindrical and vertical, formed upon two coaxial platinum rings which are the electrodes by which an electric current can enter or leave the film. The mode of formation of these films and the precautions necessary to keep them from gaining or losing moisture by condensation or evaporation have been already described before the Royal Society (*Phil. Trans.*, 1881, part 2). When such a film, just formed, is left to itself, it shows a set of colours of different orders arranged in horizontal bands; as it thins under the action of gravity, these bands gradually broaden out, and descend; a black band soon appears at the top, which likewise extends downwards. If a current is now passed downwards through the film, the motion of the colour-bands is accelerated, showing that the effect of the current is to assist gravity in thinning the film; the black band, however, becomes in part or entirely white. This upon examination is found to be due to the following action; the film is not directly dependent upon the upper ring, but is attached to it by a comparatively thick mass of liquid. The action of the current is to transfer liquid in its own direction, thus, like gravity, thinning the film; the mass of liquid, however, on which the film hangs, by this same action is forced down into the black portion, which consequently becomes white. If the current be passed upwards, the reverse effects occur: the downward motion of the bands is retarded, or, with a strong current, reversed. The explanation is precisely the same as before: the liquid is transferred along the film in the direction of the positive current; it sometimes collects in the form of pendent drops attached to the upper ring; these increase in size, and stream down the sides of the film. Prof. Reinold then formed a plane film between two horizontal wires; the film was illuminated by the lime-light, and its image projected upon a screen; the motion of the bands of colour in the direction of the current produced by fifty Grove's cells was clearly shown.—In a discussion which followed upon the transference of matter with the current, Prof. Ayrton described some experiments recently made by Prof. Perry and himself, which showed that certain metals were carried through mercury in the direction of the current. Mr. Boys remarked upon the apparent inertia of the film; the current seemed to require time to develop its action, no motion of the colour-rings being visible for some seconds after making the current.—Dr. Stone exhibited a tuning-fork interruptor commutator. This is an instrument for reversing an electric current through a circuit a given number of times per second. From the free end of a spring, kept vibrating in unison with an electrically maintained fork, by an electromagnet in the circuit of the fork acting upon an iron armature attached to the spring, project two small aluminium plates, side by side, but insulated by ebonite from the spring and from each other. These are connected by fine wires, which do not interfere with the vibration of the spring, to screws upon the base of the instrument, to which the poles of a battery are joined. The motion of each plate is arrested upwards and downwards by aluminium-stops, so that there are four such stops arranged at the corners of a rectangle. They are connected in pairs diagonally, and each pair is in communication with one end of the external circuit. Thus, when the spring is up, the current flows to the aluminium plates, and is transmitted through the circuit in one direction; when the spring is down, it flows by the lower stops in the opposite direction. The electromotive force is thus reversed in the circuit twice as many times as the fork vibrates per second.—Mr. Lewis Wright exhibited his new oxy-hydrogen lantern microscope. Details of this instrument will shortly be published. Geological, medical, and biological specimens were exhibited upon the screen with great distinctness, the definition being singularly perfect under the highest powers.

Anthropological Institute, December 9.—Prof. Flower, F.R.S., President, in the chair.—The election of Miss Müller was announced.—Sir John Lubbock read a paper on marriage customs and relationships among the Australian aborigines. Many tribes are divided into families or gentes, and no man may marry a woman of his own gens. For instance, among the Mount Gambier (South Australia) natives every man is a Kumite or a Kroki, every woman a Kumitegor or a Krokigor. No Kumite may marry a Kumitegor, nor a Kroki a Krokigor. In many cases the divisions are more complex, but the general principle is that no man may marry a woman of the same gens as himself. These divisions often extend through many tribes and over hundreds of miles. But while these restrictions are imposed on marriage, on the other hand, in one sense, every man is considered as a husband of every woman belonging to the gens with which he is permitted to marry; so that, as Messrs. Fison and Howitt forcibly put it, he may have 1000 miles of wives. But though we may call this marriage, and it is a right which in old times was generally, and to a certain extent still is, recognised as perfectly legal and respectable, it does not help us to the origin of marriage in our sense. "Communal marriage" (as he had proposed to call it) was no doubt aboriginal, and founded on natural instincts. But how did the institution of "individual marriage" arise? "Individual marriage" cannot be derived from "communal marriage," because, however much the gentes may be subdivided, the wives must remain in common within the gens. Messrs. Fison and Howitt did not, he thought, sufficiently realise the fundamental distinction between these two customs. They spoke of both as "marriage," and indeed we had no other word for them. Yet they were radically distinct, and even opposite in their characteristics. Sir John Lubbock had suggested, in his work on the "Origin of Civilisation," that, while in such a state of things no man could

appropriate a woman belonging to his own tribe exclusively to himself, still that, if he captured one belonging to another tribe, he thereby acquired an individual and peculiar right to her, and she became his exclusively, no one else having any claim to, or property in, her. He considered that this explained the prevalence of the form of capture in marriage, first pointed out by the late Mr. McLennan in his excellent work on "Primitive Marriage," but which Mr. McLennan attributed to the prevalence of exogamy, or the custom of marrying outside the tribe; while, on the contrary, Sir John Lubbock maintained that individual marriage was founded on capture, because this could alone give a man an exclusive right. This view has recently been contested by Messrs. Fison and Howitt, but Sir John replied in detail to their arguments, and supported his suggestion by strong evidence, some even taken from their own work.—The Director (Mr. Rudler) read a paper on the Jeraeil or initiation ceremonies of the Kurnai tribe, by A. W. Howitt, F.G.S., in which the author gave a detailed account of a Jeraeil at which he himself was present, and drew attention to the manner in which it differs from, or has resemblance to, the Kuringal of the Murring.

EDINBURGH

Royal Society, December 1.—Thos. Stevenson, C.E., President, in the chair.—Mr. Stevenson made some remarks in connection with his election as President.—Sir W. Thomson communicated a paper on the distribution of energy between colliding groups of molecules, in which he drew attention to Boltzmann's extension of a theorem given by Clerk Maxwell for the first time twenty-four years ago. He pointed out that, while Maxwell made his simple theorem the basis of his kinetic theory of gases, Boltzmann's extension would, if true, be fatal to that theory. Prof. Thomson also stated that the proofs of Boltzmann's theorem are not satisfactory. The theorem itself seems improbable, and cannot be accepted unless rigidly demonstrated. He wished to draw the attention of mathematicians to the subject, so that the truth of the theorem might be tested. Prof. Crum Brown remarked that, even in the simplest cases to which the theorem might be applied, there seemed no accordance between its results and actual fact. Prof. Tait stated that the truth of the theorem had seemed to him to be so doubtful that he had called the attention of the Society to it two sessions ago, and had also referred to the matter in his recently-published book on "Heat."—Sir W. Thomson then communicated a paper on the dynamics of reflection and refraction in the wave-theory of light. He gave a complete mathematical theory of reflection and refraction of light supposed to consist of vibrations in homogeneous elastic media of different densities and rigidities in the two substances through which the sight was considered to pass. The theory confirmed the views of Stokes, Lorenz, and Rayleigh, that the density of the luminiferous ether is different in different transparent substances, while its effective rigidity is equal.—Sir W. Thomson then gave a paper on Kerr's discovery regarding the reflection of light from a magnetic pole. Kerr's discovery forms an extension of Faraday's observations on the action of magnetism on polarised light passing through transparent substances. The plane of polarisation of light reflected from a polarised magnetic pole is rotated through a definite angle in a direction opposite to the conventional direction of the Amperian currents. Some time passed before Kerr's results were obtained by any other observer. Kundt finally succeeded in verifying them, and added the new discovery of the rotation of the plane of polarisation of light passing through a transparent film of iron. In his paper Sir W. Thomson gave a dynamical explanation of these phenomena.—Prof. Tait exhibited a new form of apparatus for determining the compressibility of water. Formerly he measured the compression produced by a given pressure. In his new method he measures the pressure required to produce a given compression. His arrangement allows him to make any number of measurements in rapid succession at any one temperature. Then the temperature can be raised, and corresponding measurements made without once opening the compression-apparatus. Thus experiments which formerly would have taken weeks for their completion could now be accomplished in a single afternoon. Rude results only have been obtained as yet with the old very massive compression-apparatus. These seem to show that the diminution of compressibility at higher pressures becomes less at higher temperatures, and may possibly even become an increase for the first few hundred atmospheres pressure. But no very definite statements can be made till the new, light but strong, apparatus now being made is available for experiment.

PARIS

Academy of Sciences, December 15.—M. Rolland, President, in the chair.—On the forms of the surface of the luminous wave in an isotropic environment situated in a uniform magnetic field: probable existence of a peculiar double refraction in a direction normal to the lines of force, by M. A. Cornu.—On the algebraic relations between the hyper-elliptic functions of the n-order, by M. Brioschi.—On the determination of a special case of isomerism in the acetones, by M. G. Chancel.—On a method of inoculating the large ruminants with the virus of tuberculosis, by M. G. Colin. The experiments made on these animals afford a means of exactly measuring the period of incubation of the tuberculous elements, and determining the time required for the tubercules to pass to the state of transparent granulation.—On the variations of the ozone present in the atmosphere during the late outbreak of cholera in Paris and Marseilles, and on the advantages obtained from ozoneine, by M. Onimus. In both places there was a perceptible diminution of the atmospheric ozone during the prevalence of the epidemic, while a marked difference was observed between the ozonometric condition of the air this year compared with the preceding. In Marseilles the mean for July of this year, when the epidemic was at its height, was 0·86; that for the corresponding period in 1883 as high as 2·17. In Paris the mean for November was 0·44 and 1·82 respectively. The author infers, not that the absence of ozone is the cause of the disorder, but that it is a favourable condition for its development, while it is certain that the presence and persistence of ozone helps materially to arrest its progress. His experiments with Beck's preparation of ozoneine on men and animals were attended with excellent results, and produced no ill effects, even when administered in large doses. Its action affects chiefly the central nervous system, on which it produces a sedative effect, tending to show that this region is the main seat of the malady.—On the theory of the figure of the planets, by M. O. Callandreau.—On a trigonometric formula of interpolation applicable to any values of the independent variable quantity, by M. G. Fouret.—On the sections of mathematical functions, by M. Laguerre.—On the conditions necessary to determine the photometric value of intense foci of light, whether electric or solar, by M. Berthelet.—On some processes of practical spectroscopics, by M. Eug. Demarçay.—On the mutual attraction of bodies in solution and of solid bodies immersed, by M. J. Thoulet. The author shows that, when a salt is dissolved and a solid body immersed in the solution, an attraction is set up between the two substances altogether independent of any chemical action, and that this attraction is in direct proportion to the surface of the solid body.—Note on the dissociation of the hydrate of chlorine, by M. H. Le Chatelier.—Contributions to the study of brucine, by M. Oechsner de Coninck. It is shown that, like cinchonine, brucine contains in its molecule a tetrahydruret of quinoleine. Thus is again confirmed Wischnegradsky's hypothesis that the pyridic and quinolic bases exist in the state of hydrurets in the fixed alkaloids.—On the formation of the shell of the egg of *Scyllium canicula* and *Scyllium catulus*, by M. E. Perravex.—On the biological development of the Chelifer group of Arachnida, by M. Ch. Robin.—On the structure of the digestive apparatus of *Cantharis vesicatoria*, *Epicauta verticalis*, *Lytta fabricii*, *L. atrata*, and some other members of the Cantharides group of insects, by M. Alph. Milne-Edwards.—On the anatomical structure of the peduncles, compared with that of the ordinary axes and of the petioles in plants, by M. E. Laborie.—Account of two specimens of abnormal growth in the mushroom family, by M. Ed. Heckel.—Generic characteristics of Pleuraspidotherium, a mammifer of the Lower Eocene formations from the neighbourhood of Rheims, by M. V. Lemoine.—On the fossils of the Carboniferous strata found in a well recently sunk at Lubière in the Brassac Basin, by M. Grand'Eury.—Note on the periodical recurrence of the crepuscular glows, by M. J. J. Landerer. The recent reappearance of this phenomenon precisely at the same period as last year is regarded by the author as an argument in favour rather of a cosmic than of a volcanic origin.—M. Mascart was elected a member of the Section of Physics, to replace M. Jamin, recently appointed Perpetual Secretary.

BERLIN

Physiological Society, November 14.—Dr. König spoke on colour-blindness. A ray of light decomposed by calc-

spar into two polarised beams perpendicular to each other showed, after passing through a quartz plate, when viewed through a Nicol prism, two halves of different colours in the field of vision of the ocular lens, the colours of these halves varying with the position of the Nicol prism. In the case, however, of a so-called colour-blind or bichromatic eye there was a position of the Nicol prism in which the two different colours in the halves of the field of vision appeared alike. The position in which the colours appeared alike was not always the same, but varied with the thickness of the quartz plate, with the intensity of the light examined, and with the individuality of the bichromatic eye. An instrument of this description was therefore an apparatus that might be depended on for the detection of colour-blindness. Normal eyes, in whatever position the Nicol prism might be held, saw different colours; colour-blind eyes, when the Nicol prism was held in a certain position, saw similar colours. The person whose eyes were to be tested was made to look through the apparatus towards one or other source of light, and if at last, after a greater or less number of turns of the Nicol prism, he saw but one colour, then that person was proved to be colour-blind. The examination of a large number of persons—about fifty—who confounded red and green colours, usually distinguished as red- or green-blind, resulted in showing that, with an equal intensity of light, and with the same apparatus, a part of the colour-blind, on the Nicol prism being placed in a certain position, saw similar colours, while the remainder observed a corresponding similarity of colours with another position of the Nicol prism, this second position producing the same result for all persons of that category. The colour-blind being by this means separated into two sharply-defined groups, neither shading into each other nor into the group of normal eyes, it was a matter of much interest to investigate whether these two groups of colour-blind eyes showed any other characteristic peculiarities. Among the methods adopted for determining the colour-blind, that of examining their spectrum, which was said to appear always shortened in different ways in the different cases of the red- and green-blind, was largely applied. It was seen, however, that there were so many particulars to be taken into account as affecting the extent of the spectrum, even in the case of sound eyes, that that method was by no means available for the precise and distinctive measurements here required. Another method, that of determining the neutral point, seemed well adapted for exact physical utilisation. As was known, Young's theory of the perception of colours assumed that in the retina there were three different nerve-elements perceptive of colour: one perceiving red, another green, and the third violet. If the perceptive capacities of each of the nerve-elements were traced as ordinates on the spectrum as abscissæ, three curves would appear, of which the first would have its maximum in red, the second in green, and the third in violet. If all three nerve-elements were acted on with equal force by a stimulus of light, then the sensation of white was produced; but if they were affected in different degrees, then the sensation of partial colour was the result. In the case of the colour-blind there was, according to this theory, one curve wanting, the red, or green, or violet. The two remaining ones, in that case, must now cut each other in one point, and at the spot where this point hit the spectrum, the colour-blind person, his colour-perceptive elements thereby being affected with equal force, must see white: at that spot was the neutral point. The finding of this neutral point by means of a movable slit through which a spectrum could be viewed was, however, attended with several inconveniences prejudicial to precision. Dr. König had therefore constructed a special apparatus for ascertaining the neutral point. [This was described at length by the speaker in his communications to the Physical Society, NATURE, vol. xxix. pp. 168, 496.] In nine persons, some of whom were red, and others green-blind, the neutral points were determined, and the following observations made: (1) The neutral point was able to be measured with great precision in each case of colour-blindness, the average error being at the greatest, 0·4 millionth of a millimetre, wave-length, and in the least 0·1 millionth of a millimetre. (2) The neutral point in the case of all colour-blind persons, green- as well as red-blind, was situated at one spot of the spectrum, in the green-blue, between the wave-lengths 492 and 505 millionths of a millimetre. A division of the colour-blind into two groups, such as could be so exactly carried out with the leucoscope, was, however, not possible through determinations of the neutral point, for on the leucoscope colour-blind persons of different descriptions had their neutral points quite close to each other, while eyes leucoscopically alike had their neutral points most remote from each other. (3) With increasing intensity of light the neutral point was displaced in all cases of colour-blindness towards the more refrangible end of the spectrum. Among the results of the measurements referred to, that cited under (2) was of extreme interest for the theory of colour-blindness. One conclusion it yielded was that the idea of the nature of colour-blindness derived from Young's theory received no support from the experimental examination of the consequences deduced from it. Dr. König had occasion quite recently to examine a so-called violet-blind person, and another who was totally colour-blind, but he had not yet had time to reduce the measurements he had carried out respecting these two cases, and would therefore reserve further particulars of them to another opportunity. The fact established in (1), that with the apparatus constructed for ascertaining the neutral point separate small sections of the spectrum may be so sharply marked off and determined according to their undulatory length, induced Dr. König to make use of this apparatus for investigations respecting the colour-perceiving capacities of normal eyes. In co-operation with Dr. Dietrici he had first examined the degree of sensitiveness to distinctions of colour in the different parts of the spectrum between 650 and 430 millionths of a millimetre, undulatory length, and gave a summary of the results thereby obtained which he had already communicated to the Physical Society (NATURE, xxix. 496, xxx. 308). It deserved here, however, to be brought prominently forward that the maximum of colour-sensibility of the two normal eyes coincided with that spot of the spectrum at which the neutral point occurred in the colour-blind, and that this maximum of colour-sensibility shifted, in the same way as the neutral point, with increase of the intensity of light towards the blue end. The further investigations contemplated by Dr. König relate to the colour-sensibility beyond the wave-lengths 650 and 430 millionths of a millimetre, and determinations in regard to colour-contrast.

CONTENTS