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Schools and Universities.

"On the truth which Science has revealed, and is revealing, we build the new humanism of our age."—Dr. Barnes, Bishop of Birmingham.

Returning in 1925 from a world tour, Haber, concerned with the economic plight of Germany, her lack of raw materials, the inconsiderable increase of agricultural efficiency, delivered this message to the German people: "Man kann nämlich den Reichtum nicht nur aus dem Boden holen, sondern auch aus dem menschlichen Verstande." He declared this 'invisible item' of the national balance sheet, the trained human intelligence, to be of vital importance for the resuscitation of his country. He claimed, and rightly, that the German system of higher education has proved more effective than that of any other country in producing men of creative achievement in technical science; they are the geese which lay the golden eggs. That it has not failed in pure science is amply evidenced by the list of Nobel prizemen. He disclaimed any intelligence for his own people higher than in other countries; he attributed the success to the method by which the intelligence has been trained and then utilised, France being inferior in the higher education, England lacking co-operation between university and industry, America being deficient in depth and patience though replete with cash and equipment.

How, indeed, is it with us? In the ten years preceding the War we had made rapid strides in secondary and university education, during the War we envisaged still greater progress, but we chose the policy of the 'knock-out blow' and must wait for the fabric of the vision. Just seven years have slipped away since the Peace Treaty was signed, and we do not yet know whether our ship is slowly sinking or will right herself. Our cousins, over yonder, say we are 'down and out.' They relish exaggeration; yet who can study the events of 1926 and remain blind to the threat that Britain's days as the workshop of the world are numbered? The coal and iron and engineering genius, which together with our coast-line placed us far in the van of industrial development, can keep us there no longer, but our industrial population remains. Trained intellect alone can enable us to hold our own until the transformation of our social organisation shall have been accomplished without catastrophe. Trained intellect—not only, nor even chiefly, trained in technical science. It is true that science furnishes the key to Nature's storehouse of power, that the trained intellect has made man a

creator, but of even greater importance is the use he makes of the power and the kind of life he creates. Science is determining the material conditions; the new humanism must rise to the occasion and teach us how to live. Creative thought is what the world is needing in all departments of life; it will express itself in literature and other arts, and it will issue in new hope and energy in all ranks of society. The destiny of Great Britain, and even its immediate future, hang upon the success we can achieve in leading the right men to devote their lives to science, in supplying the needs for their work, and in permeating the nation with a sense of responsibility that the gifts of science shall not be misused.

Great Britain has indeed been exporting much of its 'invisible item' for many years to India and other parts of the globe, carrying the white man's burden. There are obvious signs that this export, like others, will diminish in the near future—no other country has suffered such a drain—and with this leak stopped, the home level may be expected to rise.

No one can doubt that the talent is there. Does any one claim that we make the most of it? The practical problem is beset with difficulties, complexities, incompatibilities. There is no single simple solution possessing all the virtues and omitting none; and time is precious. Ought boys to leave school and approach their university studies fresher in mind? Is too early specialisation in schools a cause of sterility later; and when is *too* early? Is our conception of the university as a sort of examination mill wholly mistaken, if not immoral, and the German plan wholly right, with its freedom from mark-grubbing, and only a *viva voce* on subjects subsidiary to a thesis? And if not absolutely ideal, is it not at any rate more effective in developing the right man and discouraging the rest? The fact is that we are even now engaged on a new synthesis in education, one which bids fair to spare the wheat and straw the chaff. Our national genius is not logical but practical—logic thrives on narrow premises. We have succeeded in producing a multiplicity of types of schools and universities, and rightly used this multiplicity will ease the problem; it may go far to solve it.

The time between educational seed-time and harvest is long, but intensive culture in the last years at school and during the university period may bring forth fruit in a few years. Further, school and university interact rapidly; the effect is like that of the 'reaction' on a radio receiving set, and if judiciously applied the result is harmonious 'amplification,' for the man fresh from the university brings new life back to the schools. Unfortunately, at present the effect of the university on some of the most promising boys is as though the coils were wrongly connected; we get not amplification but *damping*. Many a teacher, not alone the science master, knowing the keenness and capacity of his most brilliant scholars, has felt sick at heart as he noted the effect upon these boys of the enforced repetition of work done years before at school.

The universities do their best to deal with the heterogeneous crowd that presents itself, but the lecturers are frequently overworked and underpaid and are possibly not adequately aware of the thoroughness and high standard of the teaching in many schools. They wearily resist all suggestion of exemption from the first-year courses, or complain that the students are packed with much knowledge but little intelligence. Ought the boys to leave school earlier? Some universities think they ought, and prefer them not to have taken the higher certificate; others regard it as equivalent to their intermediate examination and grant exemption accordingly; some accept it in lieu of the first M.B. if the appropriate subjects are taken, and the reason is a good one, for it is based on the long period of later medical courses.

Obviously the problem of the best development of a *person* is a personal matter, and whenever possible a personal solution should be sought; but schools and universities are institutions, and organisation is paramount. For the purpose of this discussion boys may be divided into the precocious clever and the slow-maturing capable. If the leaving age is eighteen or nineteen, as is usual in the best schools, both types will benefit greatly in character by the sense of responsibility developed in the last year of school life; this would not be very seriously reduced if all boys left a year earlier, for the responsibility would be the same; but if two years were cut off, the boys would not be mature enough and would lose something of great value. Going up to a university at nineteen, the clever boy finds he need not work hard in order to get a good degree, and may seize the wider social and educative opportunities of university life—he may seize them too hard if thwarted in his keenest interest, his life's work; the slower boy, faced by an examination test unsuited to his type, makes inconspicuous progress. If both boys were to go up at seventeen, the slow boy would have to work harder for his degree and the clever boy would do well in his

examination, but both of them would have two more years to spend at the university free from the warping strain of examinations, free to develop under guidance along lines of natural inclination and innate ability. The fact that the two boys are being compared after the degree examination means that the clever boy has as good a chance as ever of showing what is in him, and the slower maturing boy is being given his chance, at the latest possible academic period and under the most favourable conditions of concentration, to show his capacity. A third plan suggests itself. If nineteen years were adopted as the leaving age, a two-year degree course might be a possibility, ending with an examination, but followed by two more years of post-graduate training of some creative kind and a thesis.

The age at which specialisation should be allowed in schools might also be regarded as dependent on the precocity or otherwise of the boy. On the other hand, it is a matter of experience that the obvious development of the less precocious boy dates from the moment when he was allowed to specialise on a subject of his own choice. The precocious boy is quite usually, though not always, blessed with wide intellectual interests which continue throughout life, and concentration does him no harm. But something more may be required of the university than satisfaction with courses all severely scientific. All science students should be expected to attend at least one course such as philosophy, English literature, and history or economics, preferably in the post-graduate period when their minds will be free to enjoy them, and not for an examination test but for an essay. Similar courses in the sciences might prove of inestimable value for students in arts, if the right men were chosen to create them.

At present, if a student goes up to the university younger than his competitors, he risks getting a poorer degree and making a poorer impression on his teachers, and with it he reduces his chance of post-graduate opportunities. While this remains so, it is scarcely fair to leave the momentous decision to the individual; the handicap is too heavy.

One further point arises. The schools like to keep boys until nineteen years of age. The British type of university does, at least, produce science teachers whose enthusiasm and ability is a great asset to the country. Compared with German universities, where there is almost no routine teaching for degrees by examination and everything is ordered for what we treat as post-graduate work, the science staff of our universities is lamentably small, and the salaries much lower than in the schools. If the universities continue to have to provide instruction, which in Germany is done in the schools, by men who have in addition to master the mass of literature and prosecute research, they will need a corresponding increase of staff or find the task an impossibility. If the schools send their boys at seventeen, then possibly some of the science masters might return to the university with riper teaching experience than the ordinary lecturer can ever hope to acquire; but unless the university authorities cease to override the recommendation of the Treasury Grants Committee, they would do so at heavy pecuniary loss.

The introduction of the Ph.D. degree has created a new situation: the universities must make adequate arrangements for post-graduate work. The crux of the question is the relative value to a man leaving the university at twenty-two years of age, of two more years at school or two years' post-graduate work at the university. Under one system the absorptive sponge may prosper, readily yielding its secreted information under pressure of examinations, but for the development of creative thought the post-graduate years are incomparably more fertile.

The Interior of a Star.

The Internal Constitution of the Stars. By Prof. A. S. Eddington. Pp. viii + 407. (Cambridge: At the University Press, 1926.) 25*s.* net.

ATTEMPTS to construct theories about the physical conditions inside a star need, of course, no excuse. Such theories are on the same footing as other physical theories, inasmuch as many intermediate steps will be inaccessible to the test of observation. They have, therefore, the right to a fair and serious judgment on a par with ordinary physical theories, according to agreement with observation, inner consistency, or beauty and simplicity.

In his recent book Eddington attempts to give a complete review of current theories concerning the state of things in the stellar interior. This field of theoretical investigations was, in fact, first opened up seriously by Eddington himself not more than ten years ago; and although quite a number of investigators have entered the field since that time, still his own work predominates, and 'Eddington's theory' has become a popular abbreviation for prevailing, and sometimes conflicting, views on this subject.

The growth and development of the theory of

matter under stellar conditions has, as might have been expected, run closely parallel to the growth of knowledge about atomic structure. Apart from the point stressed in Eddington's first paper on this subject, namely, that inside a star energy is primarily transferred by radiation, most recent progress in this field is directly traceable to some recent progress in atomic physics. Thus the recognition that the mean molecular weight of matter inside a star may approach a limit in the vicinity of 2 was suggested (by Newall and Jeans) as a direct consequence of the fact known from X-ray experiments that even the most strongly bound electrons may be knocked out of the atoms by suitable stimuli. Eddington's theory of 'white dwarfs' is based directly on the small dimensions of atoms in *K*- or *L*-states predicted by Bohr's theory. The theory of the stellar absorption coefficient, imperfect as it is, was based on recent measurements of X-ray absorption coefficients. When astronomical theory is still groping in the outermost darkness concerning the source of stellar energy, or the origin of the penetrating radiation discovered by Hess and Kolhörster, is it not ultimately because essential facts concerning possible transformations of matter are still out of touch with the technique of the physicists? Eddington's book gives, of course, full recognition to the dependence of astrophysics on physics, and may, just for this reason, cause grief and humiliation to the classical astronomical reader who is out of touch with the modern trend of science in this field.

The general run of the book is as follows. After a short survey of the main features of the problem, both from the observational and from the theoretical side, two chapters are devoted to basic physical theories concerning radiation, atomic structure, and the statistical theory of gaseous assemblies. The fifth and sixth chapters give a thorough discussion of the theory of hydrostatic equilibrium of gaseous stars. In the seventh chapter the theoretical formula connecting the total luminosity of a star with its mass, dimensions, and mean opacity (suitably defined) is calibrated by comparison with observations. The result is that the mean opacity is about constant for stars with the same mass, while it *does* vary for stars with different masses. The relation in question is, therefore, essentially one between luminosity and mass, the dimensions of the star being of no particular concern. The theory thus amplified is, in Chap. viii., applied to different problems concerned with variable stars. The pulsation theory of Cepheid variability is given in full, its odds and ends are looked into; and a similar theory of long-period variability is tentatively suggested.

So far, the constancy and numerical value of the opacity appearing in the mass-luminosity relation has been used as an observational fact. In Chap. x. this question is taken up from the physical point of view, and it is shown how ionisation theory, coupled with almost any reasonable radiation theory, accounts satisfactorily for the observed constancy of the opacity in stars with the same mass as well as for variation with mass. The numerical value of the opacity predicted by theory seems, however, to be decidedly smaller than the observed one, a riddle which is left unsolved by the author. In the tenth chapter several accessory problems are considered, such as the exact degree of ionisation of stellar material, the validity of perfect gas laws, distribution of different elements throughout a star, and the problem of rotation.

The discussion of the delicate question of the source of stellar energy is reserved for the last chapter in the series. There is no doubt that this problem is one of the most urgent in modern astronomy. It seems, however, that we still are remote from an adequate solution, and the author has therefore concentrated his attention on a thorough and open-minded discussion of suggested possibilities, and has not endorsed any hypothesis in particular. This chapter closes the book, as defined by its title. Two chapters on allied subjects are, however, added, one on the theory of stellar spectra, and the other on the state of matter in interstellar space.

The book will doubtless be heartily received, not only by astronomers, but also by physicists as well, many of whom are deeply interested in astronomical problems. It is stimulating reading; not only where one agrees, but also where one does not agree with Eddington. I feel myself in opposition as regards quite a number of (minor) points. Take, for example, the chapter on quantum theory. Here the requirement of reversibility of physical processes in a state of thermal equilibrium, which was established long before the advent of quantum conceptions, is raised to the rank of *Law I.* of quantum theory. In the same chapter a hardy attempt is made, on the basis of this Law I., to construct a new statistical technique, which evidently is intended to supersede ordinary statistical mechanics. Without passing any judgment as regards the failure or

not of this attempt, I should much have preferred the use of ordinary statistics in a book intended for the general reader. The statement in § 193 that radiation pressure acts primarily on atoms, not free electrons, seems to me to need further elucidation, especially in view of the statement made in § 147, that "there can be little doubt that the principal process of absorption in the stars is the photo-electric effect." There are other places, too, where I doubt if the statements are adequate to the facts. Further, I have the impression that the book might have been easier and more straightforward reading if less attention were given to theories which might better have been left to a merciful oblivion.

It is no use, however, to dally long over such questions. The book is undoubtedly destined to exercise a great and healthy influence on the scientific activity in this field; and nobody who reads it can fail to feel a deep admiration for the extraordinary flexibility of mind of its author, for his power of going to the root of difficult questions of the most diversified kinds, and for his remarkable ability of expounding his results in intelligible language.

SVEIN ROSSELAND.

The Life of a Nilotic Tribe.

Die Schilluk: Geschichte, Religion und Leben eines Niloten-Stammes. Nach P. Banholzers F.S.C. und eigenen Auszeichnungen dargestellt. Von Wilhelm Hofmayr. (*Anthropos*, Ethnologische Bibliothek: Internationale Sammlung ethnologischen Monographien, Band 2, Heft 5.) Pp. xvi + 521 + 35 Tafeln. (Mödling bei Wien: Verlag der Administration des *Anthropos*, St. Gabriel, 1925.) 20 gold marks.

FATHER HOFMAYR has produced the first monograph on a tribe of the Anglo-Egyptian Sudan, and is therefore to be congratulated. Yet, grateful as ethnologists must be for this volume, the author has distinctly lessened the value of his monograph by limiting the material he has used. So far as the Shilluk themselves are concerned, he seems to have depended for the bulk of his material on the unfinished notes in the journal of the late Father Banholzer; it is true that he has supplemented these by a number of his own observations made between the years 1906 and 1916, as well as those of two other missionaries, Fathers Kohnen and Stang, and added some useful comparative material collected by Father Crazzlara among the Acholi, but he has not availed himself of the material which has appeared during the last few years in *Sudan Notes and Records*; indeed, the reviewer has not noticed any reference to this most useful periodical. These remarks are made in no carping spirit, but are necessary, for in an important work such as this it is advisable that the reader should realise the extent to which omissions are probable. There is no index; only a table of contents.

This said, there can be little but praise for the work. The book is divided into four main parts, the first of which deals with the early wanderings of the ruling stock, and ends with their settlement in their present land under Nyakang—the founder of the Shilluk nation and the first king. Here the most important fact that is brought out is the former existence of a Jur-Shilluk tribe, the people of Dimo, who remained as Jur in their present country, while the adherents of his father's half-brother, Nyakang, followed the latter in his migration. The second part might be called the Book of Royalty, since it treats of the dynasty founded by Nyakang, gives a genealogy of the royal family, examines the reign and chief doings of each king, describes the life of a king from birth, through youth, adolescence, maturity, to death and burial, and ends with a short account of the court language, *i.e.* the vocabulary, not a very copious one, applied especially to the king and his doings. A number of tables of succession are given, three collected by Europeans and four derived from natives; that accepted differs from those previously collected by Banholzer, C. G. Seligman, and Westermann. Chal is given as son and immediate successor of Nyakang, while a queen, Abudok, daughter of Boc (Bwotch), is admitted to the list of reigning sovereigns. This queen was unpopular, her judgment and awards being doubted on account of her sex, and her manner of death is unknown. There are other minor differences, and, considering the authority of Father Hofmayr's native informants, it seems that the list he compiles (p. 42) should be regarded as authoritative and be accepted in future, while the 'queens' of whom the writer heard vaguely in the south can be accounted for as the princesses referred to as chiefs (p. 71). History is considered to begin with the fifth king, Ochalo (Ocwolo), about 1600, but no evidence is adduced for this date, which gives an average of about thirteen years for each reign.

The life and activity of the Shilluk king is dealt with at length, many fresh details being given, but nothing that substantially contradicts earlier accounts. Thus the suggestion put forward by Seligman that the folklore account of the king

having at one time to fight for his life actually refers to a former condition is supported by the sham fight, theoretically the first indication of his election, between the king-elect and one of the four 'high chiefs' of the Shilluk country. At Debalo, the first village that the king-elect enters ceremonially, three fires—kindled by friction—are made in front of a large hut which is specially built for the occasion and where the king-elect should spend a month. One of these fires becomes the life-token fire of the new king, and a brand therefrom is carried to the capital—Fashoda. The description of the royal entry into the capital differs but little from that of previous authors. Father Hofmayr, however, has recorded an interesting addition; the king treads on an old man laid bound on the ground for the purpose. According to an account given to the reviewer in 1921, this was substantially a human sacrifice, for the old man was covered with flour paste, and was so betrodden by the multitude that he was expected to die.

The king passes three days in a special hut, and then on the fourth day is carried by the Ororo to Aturwic, his home on the built-up mound at Fashoda; here a further period is spent in retirement. After this the king is for the first time acknowledged throughout the nation. On his first leaving the mound the king is engaged in a sham fight, in which he vanquishes his opponent, and the ceremony is brought to an end with a sacrifice. The chiefs make oration on the rights and duties of the ruler, emphasising their points by brandishing their spears and thrusting them into the ground. The king promises to be a just ruler, to punish wrong, and to protect the weak, and then dismisses the people with an exhortation to remain true to Nyakang and the ancient customs.

A new fact with regard to the king's part in the rain ceremony is that as a last resource, after repeated failure, a man or boy might be sacrificed, and this might also be done for success in war.

The third part of the volume, dealing with religion, begins with a most stimulating discussion of the meaning of the word Jwok (Juok), not only in Shilluk but also in those of the related languages sufficiently well known to permit comparison. So far as the Shilluk are concerned, Jwok is certainly the high-god, the creator, now but little concerned with mankind, but it is noted that disease might be spoken of as *jwok*, though (alternately) each disease has its own name, while in Shilluk folklore men endowed with super-normal powers may also be called Jwok; moreover, the actual practice of sacrifice to benefit a sick man suggests a closer connexion (on this occasion almost a synonymy) of Jwok and ancestral spirits. It may be added that certain spirits of the river and bush of considerable importance among the Acholi (who speak a simplified Shilluk dialect) are recognised by the Shilluk, though among these they have little importance.

The account of Jwok is followed by that of the *ajwogo* (*adjuago*), the 'man of Jwok,' or the 'good medicine-man,' as he has been called, whose actions are, generally speaking, social and beneficent even if they clash with European ideas; it is the *jalyat* who is the 'witch,' the evil medicine-man who by his magic kills people for his own ends, or, more generally, incited thereto as the result of private enmity.

The observations on totemism constitute an important addition to our knowledge. It should, however, be noted that the belief is less obvious, and, apart from exogamy, has less social importance, and is certainly less loaded with effect, than among such frankly totemistic tribes as the Dinka.

The fourth section of the work, entitled "Country and People," contains a deal of heterogeneous information, much of which is new, *e.g.* the political divisions of the country, the greater part of the life-history of the individual (pre-natal to burial), technology, forms of salutations, oaths, stories, riddles, and a most valuable *corpus* of more than 100 songs, providing much material for future analysis. The book concludes with a number of plates and useful technological diagrams.

BRENDA Z. SELIGMAN.

Experimental Embryology.

An Introduction to Experimental Embryology. By G. R. de Beer. Pp. iv + 148. (Oxford: Clarendon Press; London: Oxford University Press, 1926.) 7*s.* 6*d.* net.

MR. DE BEER has written an excellent little book. It is the first attempt in English to survey the field of experimental embryology since the publication of the late J. W. Jenkinson's "Lectures" in 1917, and in the interval much new work has been done. The author does not attempt to include an account of all this work; on the other hand, he has purposely selected from an extensive literature descriptions of those experiments which have a common bearing in elucidating the more essential problems. The consideration of the development and determination of the sexual characters has been deliberately excluded on the ground that this subject has been dealt with recently in works by Goldschmidt and Crew. This

is perhaps to be regretted, since some of the best examples of the successful application of the experimental method might have been drawn from recent investigations in this branch of study, and many of them without encroaching on the subject matter of either of the two books referred to. It was inevitable, however, in a work of this size, that the author should select his material, and as it is, he has succeeded in covering a wide field. At the end of the volume is a tabulated list of the experiments cited, with due references to the authors and to the literature.

Mr. de Beer begins by pointing out the relation between descriptive and experimental embryology; in so doing he might have added that the relation is essentially the same as that between descriptive and experimental physiology. Embryology, like descriptive physiology, differs from morphology in the introduction of the time factor; that is to say, it deals with sequences of events. The study of the processes of salivary secretion or the œstrous cycle can be undertaken without recourse to experiments (unless the killing of the animal at a particular stage of activity be held to involve an experiment) in just the same kind of way as the tracing of the progress of development. But it is only by the use of the experimental method that we can study the mechanism of the secretion and the nature of the stimulus which produces it, or the interaction of the ovaries and the other organs concerned in accounting for the œstrous cycle. The subject of this book, therefore, is the experimental physiology of the developing animal.

After a chapter on fertilisation, in which Lillie's theory is duly set forth, the author proceeds to the consideration of parthenogenesis and the factors which activate the egg. The evidence from experiments on larval hybridisation is then separately discussed, and it is shown that the activating effect of the sperm can be distinguished from its hereditary effect. Sections follow on the relation between the sizes of nucleus and cytoplasm and the value of the chromosomes. Unlike a recent reviewer in NATURE (June 5, 1926, p. 781), the author adopts the view (in our opinion with justification) that the chromosomes are the bearers of the hereditary characters, and he points out further that experimental embryology provides evidence that each chromosome of the sets brought in by the nuclei of the sperm and ovum has a particular and essential part to play.

The next four chapters are on cleavage, and the internal and external factors in development are then discussed. There are admirable summaries of the important work of Child on 'axial gradients' in the rate of metabolism of the tissues, and that of Spemann and others on differentiation and the reverse process of reduction. The latter occurs normally in the resorption of the amphibian tail, or abnormally by starvation, as with the planarian. The self-regulating power of the organism is discussed under the head of 'regeneration,' as well as in a later chapter. The action of hormones as factors in development is illustrated by the part played by the thyroid in amphibian metamorphosis, and it is shown that the 'all-or-none' law, which Lipschütz has sought to apply to the working of another hormone, does not hold here. In the next chapter the author deals with the relation of nerve to muscle in embryonic growth. Finally, there is a brief review of development, in which certain general principles are discussed.

The author does well to remind us that "with regard to the term 'explanation' . . . ultimately nothing can be really explained." He might have elucidated the matter further by saying that the term is used in science to denote the process of co-ordination of facts whereby these can be brought under general schemes or laws which enable us to generalise and to predict. A distinguished physicist is reported to have said that a law of Nature is not a statement of fact but of policy. The test of the soundness of the policy or the validity of the law is that the events we expect are the events which come about. The author of the book under review is not certain whether the processes that go on in the living organism can be satisfactorily interpreted on a physico-chemical basis or whether they may "require non-physical categories to contain them." It is clear that the conceptions he employs as to the self-regulating capacity belong to teleological categories, like those relating to 'compensatory hypertrophy' in the physiological text-books. The only test of the validity of such conceptions is whether they enable us to advance our science by generalisation and prediction. If they do this, they reflect recognisable degrees of reality.

F. H. A. MARSHALL.

British Aphides.

The Plant Lice or Aphididæ of Great Britain. By Fred. V. Theobald. Vol. 1. Pp. ix + 372. (London: Headley Bros., 1926.) 25*s*.

IT is fifty years since the first volume of Buckton's monograph on British aphides was published. Since that time, plant lice have been widely studied in Europe and America, and more recently in

Japan and other countries. Mr. Theobald has studied the aphides of Britain for some thirty years, and has published numerous papers on them from time to time. Every one interested in insects, particularly economic entomologists, will welcome, therefore, the publication of this up-to-date monograph, based on the author's extensive studies.

The classification adopted follows closely that of Baker (1920), which is certainly the most rational and logical one in existence. It is proposed to deal only with the family Aphididæ, and this first volume is concerned with the sub-tribes Macrosiphina and Pentalonina. Fourteen genera and 133 species are recognised, and in addition four other species are noted in the appendix. Descriptions of the parthenogenetic females of the species together with keys are given, the salient external features being figured. In addition, notes on synonymy, food plants, localities and biology are added. The sexuales are unknown in many species of aphides, and it is surprising that in only nineteen of the above species are both sexual forms described in this volume. In five other species the male only is described, and in five further cases the sexual female only is described. It is not clear whether we are to conclude that the sexuales are unknown in all the other species, or whether they are omitted in some cases because they do not require special notice. For example, on p. 216 the apterous oviparous female of *Rs. ligustri* is stated to be abundant, but it is not described. Similarly, on p. 14 the sexual female of *C. rosarum* is referred to, but no description of it is given under that species.

A useful introductory chapter gives an account of the general morphological and biological features of the Aphididæ. The statement on p. 6: "The rostrum was formerly looked upon as the labium, but it is really an extension of the body," requires further explanation; the available embryological evidence indicates that the rostrum in Rhynchota is labial in origin. The old nomenclature for the wing veins is used. One feels it might have been better to have adopted the nomenclature of the Comstock and Needham system, as Patch has worked out the homologies in aphides.

Two misprints not included in the errata have been noted: the genus Aphidiella should read Aphidella; the specific name *M. scropulariæ* should read *scrophulariæ*.

Entomologists owe a great debt of gratitude to the author for the laborious task he has so faithfully carried through, and will look forward to the early publication of further volumes. J. D.

Our Bookshelf.

A Nineteenth-Century Teacher: John Henry Bridges, M.B., F.R.C.P., sometime Fellow of Oriel College, Oxford, and late Medical Inspector to the Local Government Board. By his Niece, Susan Liveing. Pp. xv + 262. (London: Kegan Paul and Co., Ltd., 1926.) 7*s.* 6*d.* net.

DR. J. H. BRIDGES was the most philosophic and scientific mind among the leaders of the positivist movement at the end of the last century, and it is good to know that he will at last be recalled to mind, while many who knew him in person are still alive. For he was unique in many ways, a most attractive and lovable character, above all a thoroughly typical Englishman who had succeeded in putting himself in the right European and international position without forfeiting a jot of his national qualities and attachment. He became, by his training at Oxford and as a doctor and by his attachment to Comte, the most all-round man of his time, specially interesting to readers of NATURE and contemporary men of science generally.

After taking the ordinary course of 'Literae Humaniores' at Wadham, Dr. Bridges qualified himself thoroughly as a physician, and throughout his life kept the balance true between scientific and literary and historical studies. Had he not been preoccupied with the organisation of the Poor Law infirmaries of London, there can be no doubt but that he would have contributed largely to historical writing of the type now so much needed, namely, synthetic history, in which the due place of scientific thinking in building up the social structure is duly recognised and maintained. As it was, he wrote a number of valuable short studies, of which Mrs. Liveing gives a useful list. Apart from its success as a personal portrait, her book is well worth getting for its inimitable picture of the life in the evangelical parsonage where Bridges spent his youth, and to which he always turned back with affectionate memories in spite of his later developments. One must read the literal account of all this in Mrs. Liveing's authentic narrative before one can believe it, and it would be a pity to spoil the enjoyment of this or of the delightful figure of his mother by quoting any fragments. The whole is the best recent biography which has appeared, sympathetic, well-balanced, sufficiently detailed, and not too long. It gains much in value by the extremely interesting study of positivism and science by Prof. Patrick Geddes. F. S. M.

Tafeln zur Bestimmung des Wasserdampfgehaltes der Luft mittelst eines Haarhygrometers und Thermometers gerechnet und erläutert. Von Dr. J. N. Dörr. *Anleitung zur Behandlung eines Haarhygrometers und zur Verwertung für die lokale Wettervorhersage.* Von Dr. A. Schlein. (Wien: Selbstverlag von Dr. A. Schlein, 1925.) n.p.

THESE tables have been prepared for use in place of a similar set of tables by Perntner, which were printed as an appendix to Jelinek's "Psychrometer-

tafeln." They are issued by the Austrian Central Institute for Meteorology and Dynamics for use at Austrian meteorological stations. The tables give vapour pressure in millimetres in terms of the two arguments, dry-bulb temperature and relative humidity, the latter to be observed by means of the hair hygrometer. In a general discussion of the question of measurement of humidity, Dr. Schlein recommends the use of the hair hygrometer in preference to other methods, quoting a statement by Pircher that the indications of the hair hygrometer are independent of the air-pressure and of wind velocity. He also quotes a remark made by de Saussure in 1783: "When all other possible hygrometers have been tried, one will always fall back on the hair hygrometer."

There is a brief account of the precautions necessary to obtain accurate results by the use of Lambrecht's polymeter, which appears to be the standard type of instrument used by the Austrian service. This is followed by some remarks on the use of the readings in local forecasting, particularly forecasting of frost. A conversion table is given for converting pressure in millimetres to millibars. The discussion by Dr. Schlein will be read with interest by all who are interested in questions of humidity.

The tables, which were prepared by Dr. Dörr, are printed in a very clear and convenient form, and will doubtless be regarded as the standard tables for use when relative humidity is observed directly.

Primitive Trade: its Psychology and Economics. By Prof. Elizabeth Ellis Hoyt. Pp. vi+191. (London: Kegan Paul and Co., Ltd., 1926.) 7*s.* 6*d.* net.

IF it were necessary to classify Miss Hoyt's "Primitive Trade" as anthropological, economic, social, or psychological science, it would be difficult to assign it to its proper category, for it belongs to all. It is essentially a study of values, and all the various influences, social, religious, customary, and personal, which can be held to bear in determining values have been brought into the account. Miss Hoyt visualises the central problem of economics as a study of the attempt to arrive at a 'perfect price.' This involves a full satisfaction of needs, while how it is to be attained necessitates a study of the underlying psychological processes and their development. This in turn is dependent upon a survey of the facts—the data provided by the anthropologist showing what people actually do at various stages of culture when they fix 'price' either explicitly or implicitly. She begins with the consideration of interests and passes on to the objectifying of needs, and shows how these interact and are brought into operation in the beginnings and extension of trade. Miss Hoyt has clearly been strongly influenced by Dr. Malinowski's studies of primitive trade and economic conditions in the Trobriands, which demonstrated clearly that in determining the factors of value, we must extend our vision far beyond the vistas of the economist of the schools. Her treatise is a stimulating and really original contribution to the literature of economic science.

Microscopic Fresh-Water Life. By F. J. W. Plaskitt. Pp. xi+278+14 plates. (London: Chapman and Hall, Ltd., 1926.) 13*s.* 6*d.* net.

IT is with regret that one learns of the sudden death of the author of this book almost immediately after its publication. But though the author has passed away, his book remains, and sentimental considerations must not prevent a reviewer from giving a plain statement of his impression of it. The book is meant primarily to assist the beginner and to instil into him some enthusiasm for that most fascinating of hobbies, the study of pond life. In his desire to popularise this subject, the author has certainly written a very attractive and interesting book. He had considerable experience of the subject, and has therefore been able to give much valuable information on the habitat and the best method of collecting fresh-water organisms. Both animals and plants are treated very fully. Most of the illustrations are admirable, and there are a great many remarkably fine photo-micrographs, the majority of which are taken with dark-ground illumination.

There is a useful glossary at the beginning of the book, and a really valuable chapter has been written by Mr. Chas. D. Soar on Hydracarina.

Unfortunately, the book contains much that is both incorrect and unscientifically written. A list of a few such blemishes has been sent to the publishers. A. G. L.

Riemannian Geometry. By Prof. L. P. Eisenhart. Pp. vii+262. (Princeton: Princeton University Press; London: Oxford University Press, 1926.) 13*s.* 6*d.* net.

THE recent physical interpretation of intrinsic differential geometry of spaces has stimulated the study of this subject. Riemann proposed the generalisation, to spaces of any order, of Gauss's theory of surfaces, and introduced certain fundamental ideas in this general theory. Bianchi, Beltrami, and others made substantial contributions to the subject, which was extended by Ricci with the use of tensor analysis and his absolute calculus. Recently there has been an extensive study and development of Riemannian geometry, and the book before us aims at presenting the existing theory.

The first chapter contains an exposition of tensor analysis sufficient for the reader who has not previously studied this subject. Most of the contributors to the theory of Riemannian geometry have limited their investigations to spaces with a metric defined by a positive quadratic differential form. The theory of relativity, however, deals with spaces with an indefinite fundamental form, and the former restriction is not made in the present book. Although many results in the older theory have been modified to meet the demands of relativity, much remains to be done in the unrestricted field.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Thermodynamic Diagrams in the Study of the Upper Air.

SOME months ago a letter appeared in NATURE (November 14, 1925, vol. 116, p. 709) from Mr. J. S. Dines, directing attention to the usefulness of setting out the results of the observations of pressure, temperature, and humidity in the upper air upon a diagram in which temperature and entropy are the co-ordinates, entropy and the logarithm of potential temperature being convertible terms so far as the atmosphere is concerned.

Circumstances have led me to pay further attention to that subject, and I find that the diagrams may be very useful in other ways, especially as a means of evaluating the height of an ascent.

Curiously enough, the most direct avenue to the determination of the height of a point is a previous determination of the geopotential at the point—by geopotential is to be understood the work which would be required to lift unit mass, a gram of balloon, for example, or in England, I suppose, a pound of aeroplane, against gravity to the level of the point.

A very simple calculation shows that if the graph of the ascent be set out on an entropy-temperature diagram, which involves no observations except those of pressure and the corresponding temperatures —the primary observations in all soundings or height measurements of the upper air — the geopotential difference between the start and the finish (or any other point on the graph) is made up of two terms. The first is the work done by unit mass in describing the graph, which is in fact proportional to the area that lies between the graph on the left, the vertical of absolute zero on the right, and the two horizontal lines of equal entropy, top and bottom. This sounds very alarming, but on the diagram it only means running a planimeter round an area. The second term is proportional to the temperature difference between start and finish, and is, in fact, proportional to the difference of pv for unit mass between the start and the finish.

Expressed otherwise, the first term is the dynamical equivalent of the heat which must be supplied to the ascending unit to keep it in thermal equilibrium with its environment throughout its journey; and the second term is the equivalent of the heat taken from the ascending unit itself in consequence of the reduction of its temperature.

With a planimeter one can allow for all the sinuosities of the graph, an allowance which, so far as I know, is not made in ordinary practice when evaluating the height from the trace of a meteorograph.

The calculation is thus simple enough, in spite of the forbidding words used in connexion with it; and it can be verified by making a graph for the ascent, referred to pressure and temperature, with pressure on a logarithmic scale and temperature linear. Again it is only the measurement of an area on the paper.

The step from the geopotential thus computed to height in the ordinary sense is the simple one of using a conversion table. The process is much simpler than the other way round, because the variable g only comes into the conversion table.

I refer to these methods for a special reason. Prof. V. Bjerknes and others insist upon the propriety of using 'levels' (expressed numerically as geopotential) instead of ordinary heights in all dynamical study of the atmosphere; and, without a consciousness of special pleading, it is scarcely possible to resist their contention.

The ordinary exculpation for using heights instead of 'levels' is that we compute heights that one can see; and altimeters, for example, are graduated in heights; but when we find that it is really 'levels' that are easy to calculate and come directly from our curves by so simple a process as measuring an area, we may think it worth while, not only in meteorology but in aeronautics also, to learn to think and talk and work in levels and not in the customary but more complicated dynamical conception of heights.

NAPIER SHAW.

10 Moreton Gardens, S.W.5,
Dec. 14.

The β Bands of Nitric Oxide.

As has been shown by the work of E. P. Lewis and of Strutt and Fowler, the spectrum of active nitrogen consists of three systems of bands (α, β, and γ bands of Strutt and Fowler), of which only the α bands (part of the first positive nitrogen bands) appear if oxygen is carefully excluded. The investigations of Lewis, and later those of Strutt, indicated that the γ bands (third positive nitrogen bands) and β bands are both due to the presence of small amounts of oxygen as nitric oxide. Dr. H. Sponer has recently shown (Sponer, NATURE, 117, p. 81, Jan. 16, 1926, and Sponer and Hopfield, *Phys. Rev.*, 27, 640, 1926) that this is certainly true, and that the β and γ systems have a common final state which is the normal state of NO. This is in agreement with the calculations of Birge and of Mulliken, which indicated that, with a certain assignment of quantum numbers, the vibrational constants for the final state are identical in the two systems. In a recent paper in the *Philosophical Magazine* (Sept. 1926, p. 621), Dr. R. C. Johnson and Mr. H. G. Jenkins give equations for the frequencies of the β system heads in terms of the vibrational quantum numbers. The proper assignment of quantum numbers was self-evident after the common final state of the β and γ bands had been recognised.

The β bands were first observed by Lewis in 1899 while studying the nitrogen afterglow. These bands were later measured and arranged in Deslandres' progressions by Fowler and Strutt, using photographs obtained with a quartz spectrograph. We have now photographed the bands in the second order of the 21-foot concave grating at Harvard University, using as a source active nitrogen to which enough air had been added to quench completely the α bands. Practically all of the β bands hitherto reported appear on our plates, and we have undertaken a comprehensive analysis of the system.

It has recently been shown (cf. R. T. Birge, NATURE, Feb. 27, 1926; R. S. Mulliken, *Phys. Rev.*, Nov. 1925 and Sept. 1926) that the electronic states of many molecules show a close parallelism to those of certain corresponding atoms. In particular, these analogies indicate that the NO molecule should have a doublet P (^2P) normal state like the aluminium atom. Assuming that the γ bands correspond to a $^2S \rightarrow {}^2P$ transition in NO (cf. Mulliken, *l.c.*, and *Phys. Rev.*, Dec. 1926), the observed doublet separation $\Delta\nu$ of 122 wave-number units for these bands should represent the separation between the $^2P_1$ and $^2P_2$ sub-levels of the ^2P normal state. Now the β bands also show a double

electronic frequency for which, according to our analysis, $\Delta\nu = 91{\cdot}05$. Assuming identity of the final states of the β and γ bands, we may reasonably conclude that this $\Delta\nu$ represents the difference between an electronic doublet separation $\Delta\nu = 31$ for the initial state of the β bands and the separation $\Delta\nu = 122$ of the final state. The relations just discussed are illustrated in Fig. 1 (the energy levels are not drawn to scale).

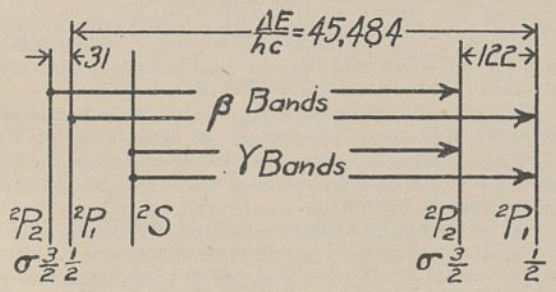

FIG. 1.

Each of the two heads, in each β band, corresponds to a series of lines which constitutes a P and an R branch of the ordinary type, except that in the high-frequency sub-band *two* lines are missing in the otherwise continuous series, and *four* in the low-frequency sub-band. Quantum analysis shows that each complete band involves four distinct sets of rotational levels, two initial and two final, *i.e.* one set for each of the four electronic states above assumed. The analysis shows further that the rotational quantum numbers are *integral* in all four cases if the rotational terms are of the form $B(j^2 - \sigma^2) + \ldots$ The missing lines then correspond to the rotational transitions $0 \rightarrow 1$ and $1 \rightarrow 0$ in the high-frequency, and to $0 \rightarrow 1$, $1 \rightarrow 0$, $1 \rightarrow 2$, and $2 \rightarrow 1$ in the low-frequency bands. They are completely accounted for by $\sigma = \frac{1}{2}$ (for both initial and final states) in the high-frequency and $\sigma = 1\frac{1}{2}$ in the low-frequency sub-bands, since j is necessarily limited to values equal to or greater than σ. Here σ is an electronic quantum number; $\sigma h/2\pi$ is the resultant electronic angular momentum of the molecule, which is here directed along the internuclear axis. The high-frequency bands then correspond to a transition $^2P_1 \rightarrow {}^2P_1$ and the low-frequency bands to a $^2P_2 \rightarrow {}^2P_2$ transition. This interpretation is completely in harmony with the generalisations of one of the writers (Mulliken, *l.c.*) in regard to j and σ values, etc., in odd and even molecules.

The above description requires slight modification in that the lines of the higher frequency bands are very close doublets, the separation of which is apparently proportional to j. They begin to be resolved, on our plates, at about $j = 16$, where the separation is 0·24 wave-number units. This shows that the rotational levels in one, or both, of the $^2P_1$ states are double.

Intensity relations among the band lines give strong support to the above interpretation. For the intensity I of any line, one expects $I = ie^{-E'/kT}$, where E is the energy of the initial state, T the absolute temperature, and i a probability coefficient. The observed intensities of the P and R branches rise to a maximum and then fall, the distribution being almost completely symmetrical in the two branches, as in the CuH and HCl bands. For high j values, however, the P branch is somewhat the stronger, as would be expected due to the factor $e^{-E'/kT}$. At first sight the bands appeared to contain only P and R branches, but on careful inspection a very weak Q branch was found in each band, with the intensity *decreasing steadily* from the first line. The Q branch is much weaker for the higher frequency ($^2P_1$) than for the lower frequency ($^2P_2$) bands. In the former the first line is fainter than the first lines in the P and R branches, but in the latter it is somewhat stronger. All the above intensity relations are in exact accord with the intensity formulæ (for the i values in the equation above) deduced with the aid of the summation rule by Hönl and London (*Zs. für Physik*, vol. 33, p. 803, 1925) for the case where the electron transition involves no change in σ. Even the particular values $\frac{1}{2}$ and $1\frac{1}{2}$ for σ are definitely justified by the observed intensities in the Q branches (according to Hönl and London's equations the intensities of the Q lines should be approximately proportional to σ^2/j).

Preliminary values for the moment of inertia and internuclear distance in NO have been calculated. In the initial states the latter has the values $1{\cdot}44 \times 10^{-8}$ and $1{\cdot}40 \times 10^{-8}$ cm., in the final (normal) states the values $1{\cdot}16 \times 10^{-8}$ and $1{\cdot}14 \times 10^{-8}$ cm. We have also found a difference in the vibration frequency for the two components of each doublet, which is evident from gradual changes in the frequency separation of the double bands. In the normal state it is about one part in 5000, and in the excited state somewhat larger and apparently in the opposite sense.

From the data now available it will be possible to calculate exactly the specific heat and magnetic susceptibility of gaseous nitric oxide.

Referring again to Fig. 1, we see the possibility of two other transitions, $^2P_2$ to $^2P_1$ and $^2P_1$ to $^2P_2$, which, however, are completely absent from our photographs. Their absence and the presence of the other two transitions are in agreement with the new theory of Hund (*Zs. für Physik*, vol. 36, p. 657, 1926). A complete account of our results will appear later, probably in the *Physical Review*.

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Inheritance in *Gammarus chevreuxi* Sexton.

AN account was recently given of some new mutations in *Gammarus chevreuxi* Sexton (NATURE, Feb. 6, 1926). A certain 'white-body' mutation did not behave in a simple Mendelian manner. In this mutant the body is devoid of the normal green and brown pigments. The mutant is recessive to the normal 'black-eyed' form, and the homozygote mutant has black eyes and white body (white-body Black). With certain exceptions to be considered later, 'White-body' is recessive to another mutant, the 'New Red' (with red eyes and normally pigmented body). But if homozygous for 'White-body,' the 'Red' fails not only to develop body-colour but also the red eye colour; a 'White' individual in both eyes and body results.

That these 'Whites' do carry 'Red' can be seen by crossing them with normals, Reds appearing in F_2.

From this it is evident that a cross between 'White' and 'New Red' should by simple Mendelian principles yield in F_1 either all Red-eyed individuals or 50 per cent. Red-eyed, 50 per cent. 'Whites,' according as the 'Red' individual was homo- or heterozygous for the body-colour factor. This does occur when a 'White' male is crossed with a 'New Red'

female. But the offspring of a 'White' female and a 'New Red' male are *always white*. This is no question of sex-linkage, since both males and females homozygous for the 'White' mutation can be found.

The F_1 Whites are by no means all simple 'Whites.' Many of them belong to the class of 'changelings'; these are 'White' at birth, but take on the appearance of 'Reds' as life proceeds. Broods consist either of all 'changeling' or 50 per cent. Changeling to 50 per cent. true 'White' according as the Red male is pure, or is heterozygous for 'White.' Changelings can be obtained not only from 'White' mothers, but also from certain matings of 'White-body Black' mothers, if carrying New Red.

The following conclusions have been invariably substantiated in the history of the stocks:

(1) Changeling whites occur only where 'Reds' would be expected.

(2) They *always* have a mother with a *white* body.

(3) They always behave genetically simply as Reds, but

(4) They are always heterozygous for 'white-body.' This last conclusion follows from their maternal derivation, since a 'white-body' individual is always homozygous for that mutation.

These facts seem impossible to fit into an ordinary Mendelian scheme, but the following considerations appear to provide a working hypothesis. Normal individuals possess a gene for 'body colour' which corresponds to the 'white-body' mutant gene. Individuals homozygous for the 'white-body' factor (whether 'White' or 'white-body Black') cannot lay down body pigment or red eye pigment. So long as its normal counterpart the 'body-colour' factor is present, the presence of the 'Red' factor ensures the manufacture of these pigments. We may therefore suppose the normal 'body colour' gene is concerned with the manufacture of some precursor from which pigment can be formed. In the 'white-body' mutant, failure to form the precursor consequently gives the 'Red' factor no precursor on which to act; a 'White' individual results.

'White-body' females ('White' or 'white-body Black') are unable to lay down any precursor in the egg-cytoplasm; its abundance in the normal egg is testified by intense pigment formation in the ovaries. When, therefore, a white-body female is crossed with a 'New Red' (possessing the normal 'body-colour' factor) the F_1 embryo is at a disadvantage. It possesses the necessary factors to change precursor into pigment, but at first the precursor itself is absent. (The amount brought in by the cytoplasm of the sperm may be neglected.) The embryo certainly possesses the 'body-colour' factor introduced by the sperm, but this must make a store of precursor *ab initio*, and probably this cannot be done until feeding commences. In any case it will be long before the deficit is made good, and it is thus easy to see why the embryos are 'white' on hatching. But as feeding and growth proceed the precursor deficit will be gradually made good; pigment can be laid down and the animal can assume its true 'genetic' appearance of 'Red.'

In the converse cross, White male by Red female, the eggs have the normal amount of precursor, so that the genetically 'Red' embryos are at no disadvantage and can form pigment immediately in the normal manner.

Further results may be predicted from this hypothesis. A 'Red' female forms eggs containing the precursor. If she carries 'white-body' and is mated with a male containing 'white-body,' some embryos will not possess the 'body-colour' factor and cannot therefore form the precursor. But the initial presence of a limited supply might allow the embryo to form pigment for a short time, though later it would be unable to do so. Consequently we might expect retrograde 'changelings' genetically 'white,' but starting with a faint colour which does not develop or is lost as life proceeds. Cases of this have been observed.

Again, except for the possession of the black eye, the 'white-body Black' resembles a true 'White,' and its relation to 'Normal Black' is the same as the relation of 'White' to 'Red.' Therefore 'white-body Black' changelings should occur, which later develop into 'Normal Blacks' and behave genetically as such. These cases have also been found.

The phenomena described above are of interest because they seem to present a clear case of the relation of the cytoplasm to Mendelian factors. It should be understood that no question of cytoplasmic inheritance is involved.

The hypothesis outlined is simply a physiologically legitimate extension of the Mendelian theory. It may be illustrated by the not improbable supposition that the basis of the actual pigment of the body and the red pigment of the eye is some substance never formed by the animal itself but is of vegetable origin. In the normal egg sufficient of this basal substance (or precursor) is contained in the yolk to provide what is necessary for the body-colour and red eye-colour of the newly born animal, later supplies coming directly from the food. When the yolk of the egg contains no basal substance, the red eye colour and the body-colour are absent in the just-hatched young, though some or all of these young are genetically 'Red.' As they feed they obtain the necessary basal substance from their vegetable food, and by converting this into special pigments become normal red-eyed animals with full body-colour. These are the 'Changeling whites.' It ought to be possible to test this supposition experimentally.

E. W. SEXTON.
C. F. A. PANTIN.

Marine Biological Laboratory,
Plymouth, Dec. 21.

The Formation of Twin Metallic Crystals.

THE paper by Messrs. Carpenter and Tamura in the November number of the *Proceedings of the Royal Society*, on "The Formation of Twin Metallic Crystals," presents a picture of the twin boundary which seems to me to be incorrect. The authors have assumed that the two halves of a twinned crystal are derived from each other by reflection in a plane which does not pass through atom-centres, but passes, in the case of face-centred cubic crystals, exactly half-way between two consecutive planes, through atom-centres, of the form {111}. This is improbable, because it requires, as its proponents themselves point out, abnormally small interatomic distances across the twinning plane, and correspondingly high local stresses, for which there is no experimental evidence. It seems much more reasonable to suppose that the two halves of the twinned crystal are reflections of each other in a {111} plane which *does* pass through atom-centres. This picture of the boundary involves no abnormal distance between any atom and its immediate neighbours. Experimentally observable relations between twins are, of course, the same on either hypothesis.

Messrs. Carpenter and Tamura have been led, on the basis of their hypothesis, to conclude that in the diamond-like structures of silicon and germanium, twinning must involve even greater local distortions

than those they have accepted as necessary in copper or nickel. If the view here advocated is the correct one, however, it appears that twins in silicon and germanium may have the relation of mirror-images in a common plane, through atom-centres, of the form {100}. This requires no abnormality in the least interatomic distances, and the twins can only be made one continuous crystal by rotation of either half through 90° about a normal to their common plane at a common atom-centre, or by a geometrically equivalent process. (In the case of twins on a {111} plane the corresponding rotation is through either 60° or 180°.)

L. W. McKEEHAN.

IN reply to the remarks of Mr. McKeehan regarding the paper which we have recently published, the point in question is whether twins of metallic crystals form a plane which passes through atom-centres. According to the hypothesis brought forward by us, the twinning of the face-centred cubic lattice takes place on the octahedral planes. Thus the two halves are arranged in a symmetrical position after a rotation of 180° about an axis normal to the octahedral plane. Obviously, in this case, the twinning plane does not pass through any atom-centres. In the face-centred cubic lattice the closest interatomic distance is $L/\sqrt{2}$. When twinned in the way mentioned above, however, the closest distance apart between atoms along the twinning plane is $L/\sqrt{3}$, where L is the lattice parameter in both cases. The change in the closest interatomic distance on twinning appears to be the cause of the local stress to which Mr. McKeehan refers, although, as he says, "there is no experimental evidence" regarding this point.

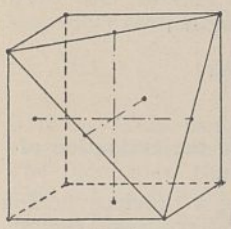

FIG. 1.

His view is apparently as follows: Two portions of two face-centred cubic lattices, both having the same geometrical form as in Fig. 1, are in contact with a plane of the octahedron passing through atom-centres so as to form the structure of mirror-images. The two portions thus share three corner atoms and three face-centred atoms in the octahedral plane. In this case, however, so far as the unit lattice form is concerned, the face-centred cube is not twinned but simply grouped in a reverse position.

With regard to the question of twinning in tetrahedral cubic crystals, Mr. McKeehan has suggested that a possible twinning plane is the cubic plane which passes through atom-centres. By a rotation of either half of the cube through 90° about an axis normal to that plane, mirror-images result, but the relations of the crystallographic axes do not change. The planes of densest atomic concentration are, however, the dodecahedral planes on which twinning does not occur. From this it would appear that the octahedral planes which possess the next densest atomic concentration are likely to be possible twinning planes. On the basis of this assumption, the closest interatomic distance of the twinned tetrahedral cubic lattice is $L/2\sqrt{3}$ instead of $\sqrt{3}L/4$, which is the closest interatomic distance of the tetrahedral cubic lattice. This is apparently the conclusion which Mr. McKeehan has considered improbable because of high local stress. It is suggested that, as in the case of the twinning of face-centred cubic crystals, if two parts of the tetrahedral cubic lattice (both having the same geometrical form) are in contact with a plane of the octahedron passing through atom-centres, the structure of mirror-images can be obtained without a change in the closest interatomic distance. These mirror-images, however, are not called twins of the tetrahedral cubic lattice. The crystallographic axis takes up a twinning position relative to the other, thereby resulting in the change of orientation. As a whole, the result is similar to that which we have assumed.

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S. TAMURA.

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S.W.7.

The Scattering of Gamma Rays.

IN a letter to NATURE of December 4, Prof. J. A. Gray pointed out that a study of radiations of shorter wave-length than 0·02 Å.U. is complicated by the scattered radiations accompanying them, about which little is known. That gamma rays under certain experimental conditions appear to become less penetrating as they pass through matter was shown by Dr. Gray in 1913. Recently it has been shown by me (*Phil. Mag.*, Oct. 1926, p. 785) that the scattered radiations were considerably softer than the gamma rays producing them, and evidence was given of a comparatively soft radiation from air penetrated by gamma rays. Confirmatory experiments have since been made, a brief reference to which may not be without interest.

A given source of gamma rays was set up at different distances from an electroscope and, for each position of the source, a curve was obtained showing the apparent transmission of these rays through lead. With a lead electroscope of wall thickness 1·0 cm. the apparent transmission of lead was independent of the distance of the source from it. When the thickness of the wall was reduced to 0·17 cm. the slope of the transmission curves became less and less steep as the source was moved farther from the electroscope.

The curve, shown as Fig. 1, was obtained when a

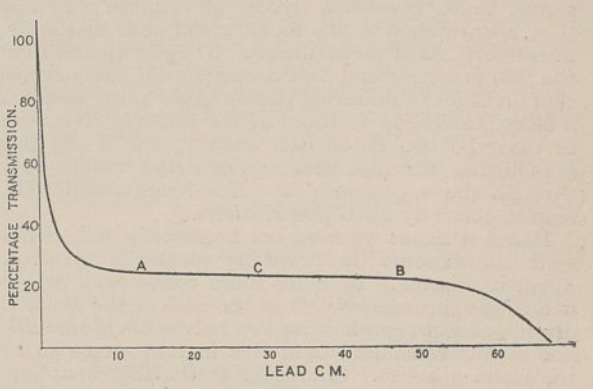

FIG. 1.

radon source equal to 127 millicuries was placed at 71 cm. from an electroscope of aluminium 0·005 cm. thick. Over the range AB of the curve the recorded ionisation is due almost solely to radiation scattered from the air around the electroscope. When the lead filters are so thick that they begin to screen this air from the direct primary rays, the ionisation decreases as shown by the curve. The transmission of the scattered radiation through aluminium was found for the experimental conditions represented by point C in Fig. 1, namely, the primary beam screened by nearly 30 cm. of lead. The scattered radiation

is heterogeneous, the coefficient of absorption in aluminium of the softest and hardest components being respectively 39·7 cm.$^{-1}$ and 0·051 cm.$^{-1}$. In order to determine the nature of the radiation scattered from air it is being subjected to a magnetic field, and experiments of this kind are in progress.

Some experiments to determine the effect upon ionisation measurements of lining the electroscope with different substances have also been made. A comparison of the curves, showing the transmission of radiation through lead obtained with an electroscope (*a*) unlined and (*b*) lined with cardboard 0·18 cm. thick, affords very definite information about the quality of the radiation responsible for the ionisation observed. It was found that, when the ionisation was due to radiation of the same wave-length as the primary gamma rays, the insertion of the lining increased the apparent transmission of a filter, the transmission value for a lead filter 10·1 cm. thick being 1·27 times that found with the lining removed. When the ionisation was due partly to scattered radiation, the apparent transmission of the filter was decreased by inserting the lining into the electroscope. The unlined electroscope in this case gave a transmission figure for a lead filter 6·0 cm. thick, which was 1·39 times that found when the electroscope was lined with cardboard. One has therefore a means, likely to prove useful in absorption experiments, of detecting any change in the quality of the radiation entering the electroscope, with the thickness of the filter placed in the primary beam.

L. H. CLARK.

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Multiple Chromosomes and Reduction Division in Flowering Plants.

IT has been the general practice to speak of the chromosomes shown in the metaphase plates in the root-tips (and other somatic tissues) of flowering plants as single chromosomes. They are never, it seems, called bivalents, dyads, or disomes; though they always show a fine longitudinal split distinctly, in correctly fixed preparations. The chromosomes of the late prophase and first metaphase of the maturation divisions in flowering plants have, in my opinion, a close parallelism to those of the somatic divisions; in that the two chromatids of any one of the two homologous chromosomes are rendered visible only through the appearance of a fine longitudinal split, seen in correctly fixed preparations.

Hence it seems we need not necessarily call such a split chromosome (in flowering plants) a bivalent, dyad, or disome. It seems more convenient to call it a single chromosome, as in the case of the somatic division, and to speak of its two halves as chromatids, not as chromosomes; and this in fact seems to be the usual practice. Similarly, at the first anaphase and second metaphase, where the two chromatids have usually separated, except at the points of constriction, we usually, it seems, call the double *V*, etc., as it proceeds to the pole, a single chromosome. When it appears again in the second metaphase plate, as a double *V*, or a four-lobed cross, we again usually call it a single split chromosome. Hence we may perhaps define a single individual chromosome as normally consisting of two halves (chromatids) which have not yet completely separated. When they have *completely* separated, we have two chromosomes.

The reverse does not hold. For when two completely separate chromosomes come together (as in the prophase of maturation) they do not form a single chromosome, but a bivalent, dyad, or disome; and show double in well-fixed preparations. (The above seems to embody the prevailing usage with regard to flowering plants.)

The reduction division, in one of the old senses of the term—namely, reduction in the number of each gene from two to one—has, with the discovery of segmental interchange (crossing-over), ceased to have a signification, as Bridges has already pointed out.

In the second meaning of the term, namely, a reduction in the number of chromosomes, it seems still available. Using the limits of the term 'chromosome' as defined above, at the first maturation division the reduction is from nuclei with n bivalents, which must of course count as $2n$ chromosomes, to nuclei containing only n chromosomes. Hence the reduction division in the diploid flowering plants yet examined is the *first* of the two maturation divisions. This is confirmed by true triploid plants, in which the reduction metaphase has n trivalents, giving $3n$ chromosomes, as defined above. There are formed, after reduction, nuclei with groups of split chromosomes, each consisting of $2n - p$, where p has the values from 0 to n. Here again there is a reduction from $3n$ to something between $2n$ and n. Also in some haploid plants at least, with n single chromosomes (each presumably consisting of two chromatids), these chromosomes proceed to either pole without distinctly splitting, and split there. In this case there is a reduction from n to $n - p$, where p has the values from 0 to n.

JOHN BELLING.

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Colorimetric Determination of the Oxidation of Hæmocyanin.

IN a recent paper confirming a previous finding by myself (*British Journal of Experimental Biology*, vol. 3, 1925) to the effect that the hæmocyanin of Cancer has minimum affinity for oxygen at a *p*H *circa* 7·0, Stedman and Stedman (*Biochemical Journal*, vol. 20, 1926) make the following comment on the colorimetric method:

"Although the colorimetric method might be expected to give accurate results and possesses the advantage of being rapid and simple, it is evident that curves obtained by this method under different conditions of acidity will not be comparable unless the standards are in each case maintained at the same degree of saturation. This condition will not be fulfilled in the case of hæmocyanin from Cancer and Homarus, if the standards are in equilibrium with air and the temperature is as high as 23° C. It is improbable that they were fulfilled at the slightly lower temperature of 18·7° employed by Hogben in the case of Cancer serum. . . . While the colorimetric method is undoubtedly capable of indicating the general influence of *p*H on a particular hæmocyanin, the results so obtained can have no quantitative significance unless care is taken to avoid the sources of error indicated above."

This criticism is surprising in view of the fact that the standards used, as explicitly mentioned both in published statement and in personal communication to the Stedmans, were prepared from normal serum of Cancer. It has been shown by these authors (*Biochemical Journal*, vol. 19, p. 547) that the normal serum of Cancer at room temperature is 88·1 per cent. saturated at an oxygen partial pressure of 21·7 mm., and 100 per cent. saturated at 80 mm., *i.e.* at half the partial pressure of oxygen in the atmosphere.

Moreover, their curve on p. 548, fig. 1, shows that the normal serum of Cancer is fully saturated at little over 40 mm. But if this were not so, it is not necessary to subject the serum to a pressure of 360 mm. oxygen to ascertain whether the blood is fully saturated. Since the curve for normal serum is itself determined as a preliminary procedure, such information is provided by the fact that over the greater part of the range of pressures employed, the curve is asymptotic to a line parallel with the abscissa.

I may further add that the colorimetric method employed is not, as the Stedmans state, a modification of the one proposed by Redfield and Hurd. The colorimetric method for determining the dissociation curve of hæmocyanin advocated by Mr. Pantin and myself (*Jour. Marine Biol. Ass.*, 1925) is in both essential points entirely different from that which Redfield and Hurd applied to the study of Limulus.

LANCELOT HOGBEN.

Zoology Department,
McGill University,
Dec. 4.

Decomposition of Nitrogen Pentoxide.

IN a recent paper read to the Chemical Society on December 2 last, I described experiments which show that when nitrogen peroxide is illuminated by light from the mercury vapour lamp a photochemical stationary state of the nature

$$2NO_2 \underset{\text{dark}}{\overset{\text{light}}{\rightleftharpoons}} 2NO + O_2$$

is set up. This change involves a slow but perfectly reversible pressure increase in the gas when illuminated. The light from the mercury vapour lamp between 4360 Å.U. and 3650 Å.U. was shown to be probably wholly photochemically active, but the experiments did not show definitely if light of longer wave-length than this contributed to the effect, since the mercury spectrum is weak between 5460 Å.U. and 4360 Å.U. In view of these results, it does not seem advisable to retain Fazel and Karrer's hypothesis of the photochemical decomposition of nitrogen pentoxide in the presence of nitrogen peroxide (*J.A.C.S.*, 28, 2837, 1926). Arguing from the apparent analogy with other photosensitised systems, these authors suggest that photoactive molecules of NO_2 activate molecules of N_2O_5 by collisions of the second kind, and bring about the decomposition of the latter.

In view of the experiments referred to above, a more probable explanation of the effect of the nitrogen peroxide would seem to be according to the following scheme :

$$(1)\ 2NO_2 \xrightarrow{\text{light}} 2NO + O_2;$$
$$(2)\ NO + N_2O_5 \longrightarrow 3NO_2.$$

In the absence of N_2O_5 the reverse of equation (1) occurs. If nitrogen pentoxide be added to the system, reaction (2) occurs in preference to the reverse of reaction (1), since it is a bimolecular change, while the latter is definitely termolecular (Bodenstein and Lindner, *Zeit. Phys. Chem.*, 100, 87, 1922). It would therefore appear that the decomposition of nitrogen pentoxide is not a true photosensitised reaction, but rather a secondary dark reaction occurring between the nitrogen pentoxide and one of the products of photochemical decomposition of nitrogen peroxide. It is obvious from this explanation that nitrogen peroxide should have no effect on the thermal decomposition of nitrogen pentoxide, in agreement with the experiments of Hirst (*J.C.S.*, 127, 657, 1925), and of White and Tolman (*J.A.C.S.*, 47, 1240, 1925).

R. G. W. NORRISH.

Department of Physical Chemistry,
University of Cambridge,
Dec. 9.

Winter Thunderstorms in the British Islands.

APPEALS were made on several occasions during last winter for reports of any thunder or lightning which might be observed during the first three months of 1926. The census of storms was carried out in conjunction with the Meteorological Office, and efforts were made to secure the co-operation of observers in all parts of the British Isles. Between two and three thousand records were sent in, showing the number of days on which thunder or lightning was reported from each country, between Jan. 1 and Mar. 31, 1926, to be as follows :

1926.	England and Wales.	Scotland.	Ireland.	British Isles.
January . .	17	4	15	21
February . .	11	6	5	13
March . .	9	11	6	15
Totals (3 months)	37	21	26	49

The figure—49 days—for the British Isles is eight days less than that obtained during the same period in 1925. The number of days for Scotland and Ireland is very probably too low, on account of the small numbers of observers in those parts.

In England and Wales there were four very prominent stormy areas : one of these was in south-west Yorkshire and south Lancashire, and another was the district round the Severn Estuary. There was a belt of country free from storms in the Midland counties : a similar feature has been noticed in previous winters.

The investigation is being continued during the present season, and I shall be very grateful for reports of any thunder or lightning which may be observed by readers of NATURE before April 1 next. A note of the place, date, and time of the occurrence, with the direction in which the lightning is seen, especially at night, will be very valuable. Any additional information of the following character will be welcome :

1. The time when the storm passed overhead, or was nearest, with its direction ; how long it lasted.
2. Severity of storm ; much or little thunder, or lightning.
3. Whether it was accompanied by rain, hail, or snow.
4. Direction and strength of wind ; change of wind (if any).
5. Whether there was a change in temperature during the storm.

S. MORRIS BOWER.

Langley Terrace,
Oakes, Huddersfield, Jan. 8.

The Infra-Red Spectrum of Hydrogen.

IN view of the considerable attention given to the secondary spectrum of hydrogen in recent investigations, it may be worth announcing that this spectrum has been extended photographically so far as 9300 Å.U. into the infra-red. Neocyanin plates were used, hypersensitised by an ammonia bath. About 170 additional lines to those recently published by Allibone (*Proc. Roy. Soc. A.*, 112, 196, 1926) were measured, about 120 of these being above his uppermost limit. Some of the more intense lines beyond

the highest values hitherto published are (Int. Å.U. vac.):

9161·9	8586·9
8970·3	8577·5
8901·3	8548·8
8878·5	8538·1
8810·2	8530·7
8797·6	8522·9
8749·6	8488·6
8726·8	8446·6
8673·4	8400·9
8666·6	8369·5

Since dispersion was sacrificed for the sake of intensity in this preliminary work, these values may be in error by several tenths of an angström. The work is to be repeated under higher dispersion.

By altering conditions of the discharge to obtain a practically pure monatomic spectrum, five higher members of the Paschen series, the fourth to the eighth inclusive, were obtained photographically. Their measured wave-lengths agree with the values calculated according to the Bohr formula to within the limits of experimental error. The wave-lengths are (Int. Å.U. in air):

Line.	Observed λ.	Calculated λ.
P_δ	10049·8	10049·5
P_ϵ	9546·2	9546·0
P_ζ	9229·7	9229·1
P_η	9015·3	9014·9
P_θ	8863·4	8862·9

A. H. POETKER.

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Nov. 24.

Lengthened Chain Compounds of Sulphur.

DR. G. M. BENNETT, in comments on a note on the above subject published in NATURE (Oct. 16, 1926, p. 555), questions the purity of the compounds of the type $Br . C_2H_4(S . C_2H_4)_nBr$ obtained by the interaction of dithioethylene glycol and ethylene dibromide. From a consideration of melting-points some of the lower homologues may be regarded as 'impure,' but it should be borne in mind that the presence of minute traces of impurities would raise or depress their melting-point, but all the same, analyses of the compounds would establish definite composition. This does not, however, apply to the case of $Br . C_2H_4(S . C_2H_4)_{48}Br$. The preparation of this compound was repeated at least two dozen times under the experimental conditions detailed in the original paper, and the melting-point and analytical results agreed remarkably well. Moreover, it retained, even on crystallisation from molten naphthalene, the same melting-point and composition. These facts are sufficient to justify our claims to the purity of the compound. Further, the suggestion of Dr. Bennett that the compound might be contaminated with "substances some of which do not contain bromine," is rather doubtful in view of the fact that non-brominated substances could not be found after the disruption of the molecule by ethylene dibromide.

In conclusion, I may point out that chain compounds of sulphur having high molecular weights and definite structures are but few. Ray and Guha (*J. Chem. Soc.*, 115, 547, 1919) obtained a chain compound of (sulphonium) sulphur having so high a molecular weight as 3472.

P. C. RÂY.

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and Technology,
Calcutta.

Tuning-Forks with Parallel Prongs.

WHEN the butt end of a vibrating tuning-fork is placed on a table, the fork will give out, under certain conditions, in addition to its fundamental, a note which is of frequency one octave higher than the note heard when the fork is held to the ear. This fact has been stated by Ellis (Helmholtz, "The Sensations of Tone" second English edition, p. 54), but apparently no explanation has been put forward.

That the effect is to be expected on theoretical grounds may be made clear by considering a fork with two parallel prongs. When the fork vibrates the prongs oscillate on either side of the mean position, and they pass through the parallel position *twice* during each complete vibration. If the fork were freely suspended the centre of mass would not move, and therefore the butt would be at its maximum displacement whenever the prongs are parallel. Consequently the octave should be present when the butt of the fork is pressed against the table. Most forks do not show this effect, as they are constructed with their prongs inclined at a small angle to each other. Therefore when they are set in vibration the prongs never reach the parallel position, and the octave is not present.

At the suggestion of Dr. L. F. Richardson an experiment was made on a tuning-fork with prongs inclined outwardly, which did not previously show the effect. The steel of the fork was softened and the prongs were put in a vice, so that they could be bent into any desired position. It was found that the octave was not present when the prongs were inclined either towards or away from each other, but occurred very markedly when they were made parallel. It was also noticed that the octave was most pronounced for large amplitudes and gradually died away as the amplitude decreased, leaving only the fundamental present.

R. S. MAXWELL.

Westminster Training College,
Horseferry Road, S.W.1, Dec. 22.

Polar Pressures.

As I happen to be the author of a sentence quoted by Prof. Hobbs (NATURE, Dec. 25, p. 915) from a review in the *Geographical Journal* (Sept. 1926) of his recent book on the glacial anticyclones, may I be permitted to point out that an essential word is omitted from the quotation and that Prof. Hobbs thus misrepresents what I wrote. My full statement was this: "Prof. Hobbs seems to think that the observational evidence fails to warrant the prevalent idea that there are vast circum-polar cyclonic whirls, which he is unable apparently to co-ordinate with his Antarctic glacial anticyclone. Yet in a masterly analysis Dr. Jeffreys has recently demonstrated (*Q. J. R. Met. Soc.*, vol. 52, p. 85) that whatever superficial increase of pressure there may be over either pole, or over Greenland, in consequence of the cold, this is a shallow surface effect; and that both poles are fundamentally seats of low pressure."

By the omission of the word *fundamentally* from the quotation, Prof. Hobbs deprives my sentence of the power to indicate the very co-ordination which I hold him to be incapable of effecting. The high pressures of the glacial anticyclones of Antarctica and Greenland, and of the North Polar wind-divide, are relatively slight, as Prof. Hobbs himself apparently allows, and can be reconciled with circum-polar low pressure at higher levels, for which there is a good deal of evidence apart from any theoretical considerations. The rest of the matter I leave to Dr. Jeffreys as more immediately concerned.

L. C. W. BONACINA.

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Hampstead, N.W.3, Dec. 29.

A Dynamical Theory of the Electromagnetic Field.[1]

THE proposed Theory seeks for the origin of electromagnetic effects in the medium surrounding the electric or magnetic bodies, and assumes that they act on each other not immediately at a distance, but through the intervention of this medium.

The existence of the medium is assumed as probable, since the investigations of Optics have led philosophers to believe that in such a medium the propagation of light takes place.

The properties attributed to the medium in order to explain the propagation of light are—

1st. That the motion of one part communicates motion to the parts in its neighbourhood.

2nd. That this communication is not instantaneous but progressive, and depends on the elasticity of the medium as compared with its density.

The kind of motion attributed to the medium when transmitting light is that called transverse vibration.

An elastic medium capable of such motions must be also capable of a vast variety of other motions, and its elasticity may be called into play in other ways, some of which may be discoverable by their effects.

One phenomenon which seems to indicate the existence of other motions than those of light in the medium, is that discovered by Faraday, in which the plane of polarisation of a ray of light is caused to rotate by the action of magnetic force. Professor W. Thomson[2] has shown that this phenomenon cannot be explained without admitting that there is motion of the luminiferous medium in the neighbourhood of magnets and currents.

The phenomena of electromotive force seem also to indicate the elasticity or tenacity of the medium. When the state of the field is being altered by the introduction or motion of currents or magnets, every part of the field experiences a force, which, if the medium in that part of the field is a conductor, produces a current. If the medium is an electrolyte, and the electromotive force is strong enough, the components of the electrolyte are separated in spite of their chemical affinity, and carried in opposite directions. If the medium is a dielectric, all its parts are put into a state of electric polarization, a state in which the opposite sides of every such part are oppositely electrified, and this to an extent proportioned to the intensity of the electromotive force which causes the polarization. If the intensity of this polarization is increased beyond a certain limit, the electric tenacity of the medium gives way, and there is a spark or "disruptive discharge."

Thus the action of electromotive force on a dielectric produces an electric displacement within it, and in this way stores up energy which will reappear when the dielectric is relieved from this state of constraint.

A dynamical theory of the Electromagnetic Field must therefore assume that, wherever magnetic effects occur, there is matter in motion, and that, wherever electromotive force is exerted, there is a medium in a state of constraint; so that the medium must be regarded as the recipient of two kinds of energy—the actual energy of the magnetic motion, and the potential energy of the electric displacement. According to this theory we look for the explanation of electric and magnetic phenomena to the mutual actions between the medium and the electrified or magnetic bodies, and not to any direct action between those bodies themselves.

In the case of an electric current flowing in a circuit A, we know that the magnetic action at every point of the field depends on its position relative to A, and is proportional to the strength of the current. If there is another circuit B in the field, the magnetic effects due to B are simply added to those due to A, according to the well-known law of composition of forces, velocities, &c. According to our theory, the motion of every part of the medium depends partly on the strength of the current in A, and partly on that in B, and when these are given the whole is determined. The mechanical conditions therefore are those of a system of bodies connected with two driving-points A and B, in which we may determine the relation between the motions of A and B, and the forces acting on them, by purely dynamical principles. It is shown that in this case we may find two quantities, namely, the "reduced momentum" of the system referred to A and to B, each of which is a linear function of the velocities of A and B. The effect of the force on A is to increase the momentum of the system referred to A, and the effect of the force on B is to increase the momentum referred to B. The simplest mechanical example is that of a rod acted on by two forces perpendicular to its direction at A and at B. Then any change of velocity of A will produce a force at B, unless A and B are mutually centres of suspension and oscillation.

Assuming that the motion of every part of the electromagnetic field is determined by the values of the currents in A and B, it is shown—

1st. That any variation in the strength of A will produce an electromotive force in B.

2nd. That any alteration in the relative position of A and B will produce an electromotive force in B.

3rd. That if currents are maintained in A and B, there will be a mechanical force tending to alter their position relative to each other.

4th. That these electromotive and mechanical forces depend on the value of a single function M, which may be deduced from the form and relative position of A and B, and is of one dimension in space; that is to say, it is a certain number of feet or metres.

The existence of electromotive forces between the circuits A and B was first deduced from the

[1] Abstract of a paper by Prof. J. Clerk Maxwell communicated to the Royal Society on Oct. 27, 1864. Reprinted from the Proceedings of the Society, vol.13, p. 531, Dec. 8, 1864.

[2] Proceedings of the Royal Society, June 1856 and June 1861.

fact of electromagnetic attraction, by Professor Helmholtz[3] and Professor W. Thomson,[4] by the principle of the Conservation of Energy. Here the electromagnetic attractions, as well as the forces of induction, are deduced from the fact that every current when established in a circuit has a certain persistency or momentum—that is, it requires the continued action of an unresisted electromotive force in order to alter its value, and that this "momentum" depends, as in various mechanical problems, on the value of other currents as well as itself. This momentum is what Faraday has called the Electrotonic State of the circuit.

It may be shown from these results, that at every point in the field there is a certain direction possessing the following properties :—

A conductor moved in that direction experiences no electromotive force.

A conductor carrying a current experiences a force in a direction perpendicular to this line and to itself.

A circuit of small area carrying a current tends to place itself with its plane perpendicular to this direction.

A system of lines drawn so as everywhere to coincide with the direction having these properties is a system of lines of magnetic force ; and if the lines in any one part of their course are so distributed that the number of lines enclosed by any closed curve is proportional to the "electric momentum" of the field referred to that curve, then the electromagnetic phenomena may be thus stated :—

The electric momentum of any closed curve whatever is measured by the number of lines of force which pass through it.

If this number is altered, either by motion of the curve, or motion of the inducing current, or variation in its strength, an electromotive force acts round the curve and is measured by the decrease of the number of lines passing through it in unit of time.

If the curve itself carries a current, then mechanical forces act on it tending to increase the number of lines passing through it, and the work done by these forces is measured by the increase of the number of lines multiplied by the strength of the current.

A method is then given by which the coefficient of self-induction of any circuit can be determined by means of Wheatstone's electric balance.

The next part of the paper is devoted to the mathematical expression of the electromagnetic quantities referred to each point in the field, and to the establishment of the general equations of the electromagnetic field, which express the relations among these quantities.

The quantities which enter into these equations are :—Electric currents by conduction, electric displacements, and Total Currents ; Magnetic forces, Electromotive forces, and Electromagnetic Momenta. Each of these quantities being a directed quantity, has three components ; and besides these we have two others, the Free Electricity and the Electric Potential, making twenty quantities in all.

There are twenty equations between these quantities, namely Equations of Total Currents, of Magnetic Force, of Electric Currents, of Electromotive Force, of Electric Elasticity, and of Electric Resistance, making six sets of three equations, together with one equation of Free Electricity, and another of Electric Continuity.

These equations are founded on the facts of the induction of currents as investigated by Faraday, Felici, &c., on the action of currents on a magnet as discovered by Oersted, and on the polarization of dielectrics by electromotive force as discovered by Faraday and mathematically developed by Mossotti.

An expression is then found for the intrinsic energy of any part of the field, depending partly on its magnetic, and partly on its electric polarization.

From this the laws of the forces acting between magnetic poles and between electrified bodies are deduced, and it is shown that the state of constraint due to the polarization of the field is such as to act on the bodies according to the well-known experimental laws.

It is also shown in a note that, if we look for the explanation of the force of gravitation in the action of a surrounding medium, the constitution of the medium must be such that, when far from the presence of gross matter, it has immense intrinsic energy, part of which is removed from it wherever we find the signs of gravitating force. This result does not encourage us to look in this direction for the explanation of the force of gravity.

The relation which subsists between the electromagnetic and the electrostatic system of units is then investigated, and shown to depend upon what we have called the Electric Elasticity of the medium in which the experiments are made (*i.e.* common air). Other media, as glass, shellac, and sulphur have different powers as dielectrics ; and some of them exhibit the phenomena of electric absorption and residual discharge.

It is then shown how a compound condenser of different materials may be constructed which shall exhibit these phenomena, and it is proved that the result will be the same though the different substances were so intimately intermingled that the want of uniformity could not be detected.

The general equations are then applied to the foundation of the Electromagnetic Theory of Light.

Faraday, in his "Thoughts on Ray Vibrations,"[5] has described the effect of the sudden movement of a magnetic or electric body, and the propagation of the disturbance through the field, and has stated his opinion that such a disturbance must be entirely transverse to the direction of propagation. In 1846 there were no data to calculate the mathematical laws of such propagation, or to determine the velocity.

[3] Conservation of Force, Berlin, 1847: translated in Taylor's Scientific Memoirs, Feb. 1853, p. 114.

[4] Reports of British Association, 1848. Phil. Mag. Dec. 1851.

[5] Phil. Mag. 1846. Experimental Researches, vol. iii. p. 447.

The equations of this paper, however, show that transverse disturbances, and transverse disturbances only, will be propagated through the field, and that the number which expresses the velocity of propagation must be the same as that which expresses the number of electrostatic units of electricity in one electromagnetic unit, the standards of space and time being the same.

The first of these results agrees, as is well known, with the undulatory theory of light as deduced from optical experiments. The second may be judged of by a comparison of the electromagnetical experiments of Weber and Kohlrausch with the velocity of light as determined by astronomers in the heavenly spaces, and by M. Foucault in the air of his laboratory.

Electrostatic units in an electromagnetic unit . . .	310,740,000 metres per second.
Velocity of light as found by M. Fizeau	314,858,000.
Velocity of light by M. Foucault	298,000,000.
Velocity of light deduced from aberration . . .	308,000,000.

At the outset of the paper, the dynamical theory of the electromagnetic field borrowed from the undulatory theory of light the use of its luminiferous medium. It now restores the medium, after having tested its powers of transmitting undulations, and the character of those undulations, and certifies that the vibrations are transverse, and that the velocity is that of light. With regard to normal vibrations, the electromagnetic theory does not allow of their transmission.

What, then, is light according to the electromagnetic theory? It consists of alternate and opposite rapidly recurring transverse magnetic disturbances, accompanied with electric displacements, the direction of the electric displacement being at right angles to the magnetic disturbance, and both at right angles to the direction of the ray.

The theory does not attempt to give a mechanical explanation of the nature of magnetic disturbance or of electric displacement, it only asserts the identity of these phenomena, as observed at our leisure in magnetic and electric experiments, with what occurs in the rapid vibrations of light, in a portion of time inconceivably minute.

This paper is already too long to follow out the application of the electromagnetic theory to the different phenomena already explained by the undulatory theory. It discloses a relation between the inductive capacity of a dielectric and its index of refraction. The theory of double refraction in crystals is expressed very simply in terms of the electromagnetic theory. The non-existence of normal vibrations and the ordinary refraction of rays polarized in a principal plane are shown to be capable of explanation; but the verification of the theory is difficult at present, for want of accurate data concerning the dielectric capacity of crystals in different directions.

The propagation of vibrations in a conducting medium is then considered, and it is shown that the light is absorbed at a rate depending on the conducting-power of the medium. This result is so far confirmed by the opacity of all good conductors, but the transparency of electrolytes shows that in certain cases vibrations of short period and amplitude are not absorbed as those of long period would be.

The transparency of thin leaves of gold, silver, and platinum cannot be explained without some such hypothesis.

The actual value of the maximum electromotive force which is called into play during the vibrations of strong sunlight is calculated from Pouillet's data, and found to be about 60,000,000, or about 600 Daniell's cells per metre.

The maximum magnetic force during such vibrations is ·193, or about $\frac{1}{10}$ of the horizontal magnetic force at London.

Methods are then given for applying the general equations to the calculation of the coefficient of mutual induction of two circuits, and in particular of two circles the distance of whose circumferences is small compared with the radius of either.

The coefficient of self-reduction of a coil of rectangular section is found and applied to the case of the coil used by the Committee of the British Association on Electrical Standards. The results of calculation are compared with the value deduced from a comparison of experiments in which this coefficient enters as a correction, and also with the results of direct experiments with the electric balance.

The Induction of Melanism in the Lepidoptera, and its Evolutionary Significance.

By Dr. J. W. HESLOP HARRISON.

IN recent years no more remarkable evolutionary phenomenon has been observed than the development and progress of melanism amongst British native Lepidoptera. Species after species of moth with pale ground colour has given rise to forms so heavily pigmented that they appear in some cases to be dark grey and in others perfectly black. Further, the course of events has not ended with the mere appearance of these melanic forms; in affected species a state of equilibrium has only been attained in the areas concerned when the whole of their representatives has assumed the melanic guise. On Tyneside, for example, twenty-five years ago the species *Boarmia repandata* (the Mottled Beauty) was quite typical; now every specimen captured is black. Moreover, the advance of this progressive melanism is not stayed locally, for new species fall under its influence every year, the latest to yield being *Phigalia pedaria* (the Pale Brindled Beauty) and *Tephrosia bistortata* (the Engrailed).

Clearly, in the development of these melanic insects we are concerned with a very noteworthy phase of evolutionary activity—noteworthy because it is taking place before our eyes. But the import-

ance of the phenomenon does not rest here; no matter what attempts are made to minimise the connexion, it cannot be denied that upon the industrialisation of the affected area depends the incidence of melanism, or, in other words, the two are related in the way of cause and effect. Thus we are dealing with a case of evolution directed by the environment, and presumably, therefore, of the Lamarckian order.

Naturally, this view has been strongly contested by the opponents of the Lamarckian position, but, let it be emphasised, not one of those so opposed has studied the subject in the field. On the other hand, field workers are unanimous in giving it vigorous support.

At first it was the practice amongst the anti-Lamarckians, in their endeavours to explain it away, to point triumphantly to the absence of melanism in continental industrial areas, and then, when in the end such localities did provide melanic species, to account for them on the basis of chance importations from England. However, the advent of melanic varieties of species like *Cymatophora or* (the Poplar Lutestring) and *Boarmia roboraria* (the Great Oak Beauty) on the Continent, prior to their appearance in Britain (an occurrence depending simply on the fact that the species in question do not approach the smoke zones in Britain as they do in Germany), rendered this position untenable, and a new line of defence was forthwith constructed. Appeal was now made to the failure of melanic forms in the manufacturing districts of the United States. Again the irresistible weight of facts broke down the defence, for the very first species to 'go black' in England, the Peppered Moth (*Amphidasys betularia*—known in America as *Lycia cognataria*), did the same at Pittsburg. Nor is this an isolated case, for in America Holarctic species like *Tephrosia crepuscularia* (the Small Engrailed), already melanic in Europe, with typically Nearctic forms like *Phigalia titea*, have succumbed to the same influence, to be followed assuredly by many others.

Hence, whether we like it or not, the dependence of melanism on industrialisation must be granted.

With the recognition of this fact, field workers and others very early indeed began to construct theories to explain it, cold, humidity, smoke, soil, and light deficiency all being invoked as inciting agents, either in the crude form of a prime cause or as cogs in a more complex mechanism. The inadequacy of such theories, even when supplemented by natural selection, has already been demonstrated by me in an early[1] paper. In their stead, in the same publication, an alternative suggestion was put forward that metallic salts ingested with the larval food of affected species might so act directly on their germplasm as to alter its potentialities. If such a belief was correct it seemed an easy matter to devise conclusive tests of its validity.

By direct analysis of the deposits on the foliage of trees in Middlesbrough Park, it was discovered that they contained relatively large quantities of salts of manganese, iron, sodium, potassium, and other metals. Furthermore, investigations as to the manganese content of hawthorn leaves near Newcastle-upon-Tyne revealed the presence of unusual percentages of that metal, with a progressive diminution as we passed westward into rural areas.

From these, and other considerations arising out of the peculiar properties of the oxides of manganese, it was determined to supply the larvæ of carefully selected species from nonmelanic regions with food (1) artificially charged with small percentages of manganese compounds, or (2) so contaminated by having been grown within the limits of a smoky manufacturing town. In addition, it was decided to supplement the manganese cultures with parallel ones in which lead salts were employed, the exact salts utilised in the two cases being manganese sulphate and lead nitrate.

Suitable species for the investigations were found in *Tephrosia bistortata*, *T. crepuscularia*, *Selenia bilunaria* (the Early Thorn), and *S. tetralunaria* (the Purple Thorn), all of which under experimental conditions gave rise to melanic individuals. Nevertheless, by far the most important and exhaustive work[2] was carried out with southern strains of *S. bilunaria* and *T. bistortata*.

In the case of *S. bilunaria*, melanics appeared both in the lead and the manganese cultures, the critical lead broods yielding three melanics and fifty-three types and the manganese brood eight melanics and twelve types; the controls from the same source provided nothing but types.

This induction of melanism had, of course, but little significance unless the melanism was inherited, and in each of these cases, to test this, since melanics of the opposite sexes failed to synchronise in emergence, melanics were paired with types.

The F_1 batches so reared in the lead series, supplied, of course, with untreated food, contained 26 insects, all quite typical; obviously, if inherited at all, the melanism was acting as a Mendelian recessive. Inbreeding the F_1 insects provided three F_2 batches containing a total of 70 types and 23 melanics—a ratio of 3·04 : 1, which approximates exceedingly closely to the expected ratio of 3 :1.

Similarly, the F_1 manganese family contained only typical insects which, inbred to secure the critical F_2 lots, gave two broods composed of 90 types and 27 melanics—a ratio of 3·3 : 1, again suggesting that melanism was inherited as a Mendelian recessive.

Various matings designed to confirm this were made, with the outcome that, totalling all the figures pertinent to the inquiry, it was found that four families bred from the pairing of homozygous type and homozygous melanic yielded 230 types and 0 melanics, three from heterozygous type × homozygous melanic giving 93 types and 77 melanics, seven from heterozygous type × heterozygous type 363 types and 105 blacks, seven from homozygous

[1] Harrison, "Genetical Studies in the Moths of the Geometrid Genus Oporabia, with a Special Consideration of Melanism in the Lepidoptera," *Jour. Genet.*, vol. 9, 1920.

[2] Harrison and Garrett, "The Induction of Melanism in the Lepidoptera and its Subsequent Inheritance," *Proc. Roy. Soc.* B, vol. 99, 1926.

blacks mated *inter se* 316 blacks and 2 types, and finally, two families of the origin homozygous type × heterozygous type included 132 types, all of which results lead to the same conclusion.

With the results, those secured in the *T. bistortata* work were in perfect agreement—a rather unexpected fact, for, in the Boarmiinae, including the allied *T. crepuscularia*, the melanism, whether induced or natural, is always a Mendelian dominant.

As stated in the concluding remarks of the Royal Society paper (Harrison and Garrett), this work left undecided the question whether it was the metal or the acid radical which played the active part. To determine this, additional work was undertaken with a Saxon strain of *Selenia bilunaria*. This strain, after five inbred generations reared on food charged with manganese chloride, has just (Dec. 19, 1926) supplied three female insects, two types and one melanic, a further induction of melanism rendering it probable that it is to the metal that we have to look for the inciting agent.

No matter what the exact meaning of these experiments, they demonstrate, without any possibility of contradiction, that the germplasm can be influenced by external agencies; therefore, if not of direct Lamarckian import, they lend weighty support to Lamarckian views, for what is in more intimate contact, chemically or otherwise, with the germplasm than the soma?

Irrespective of this, they supply, what evolutionary theories all lack, an experimental demonstration of at least one cause of variation; in fact, they go beyond this, for they actually provide the principle, new in evolution, that food not normal to any given organism may so affect its germplasm as to give rise to heritable variations. This being granted, we see at once how a change in habitat can originate new forms and finally new species.

In no group of organisms would this be more potent than in plants, and thus, instead of an appeal to the sorting out of various genotypes as urged by Turesson [3] to account for the existence of localised genotypes in various plant species, we can conceive of their origin in the stations in which they now exist. So, too, in the variation of cultivated plants influences of the same order are at work.

Nor are animals in Nature exempt from its operations; local races of animals, under the workings of this principle, find a ready explanation, and so do the various forms into which wild animals break when domesticated. In no group of animals are its workings so beautifully illustrated than in the Insecta, particularly in the phytophagous groups.

Often enough, owing to the preference of plants to grow in definite associations, different species of plants grow intermingled. What then is more likely than the accidental transference of eggs or larvæ to the wrong foodplant? Is not the difference between species chemical? If larvæ so transferred react as in the experimental work, new [4] phytophagous races or species must arise, isolated by their attachment to a special foodplant, and induced to vary from the type from which they were derived by the influence, exerted chemically, of that foodplant. Of insects so related to one another, even in our own restricted fauna, we have many; for example, the moth *Cerura biscuspis* is purely an alder feeder, whilst its congener *C. furcula* takes sallow, the Aleurodid *Tetralicia vaccinii* feeds on bilberry, and *T. ericae* on *Erica tetralix*, the gallgnat *Loewiola centaureae* parasitises *Centaurea nigra* and its relative *L. serratulae*, *Serratula tinctoria*, and so the list could be extended to all insect groups.

[3] Turesson, "The Plant Species in Relation to Habitat and Climate," *Hereditas*, vol. 6, 1925.

[4] As demonstrated by me in the case of the Gallmaking sawflies of the genus Pontania in a paper now in the press.

Electro-deposition of Rubber.

FROM recent announcements in the press it would appear that some considerable changes are likely to take place in the technology of rubber as the outcome of patented developments in the process of rubber electro-deposition. So promising have been the results obtained that the American rights in the various patents concerned have been transferred from their original owners, the Anode Rubber Co. of Great Britain, the B. F. Goodrich Rubber Co., and the Eastman Kodak Co., to a new company called the American Anode, Inc., for independent exploitation. The British rights, it is understood, have just been acquired by the Dunlop Rubber Co. and its associated concerns. It is perhaps too soon yet to estimate the commercial value of the whole process, for it can only be regarded as emerging from the experimental stage; but the fact that strong financial support is already forthcoming furnishes presumptive evidence of its value.

The possibility of rubber electro-deposition dates back to 1906, when Henri observed that in rubber latex, which is a colloidal suspension of rubber particles in a serum, the particles are negatively charged and migrate to the anode under the influence of a direct electric current. The observation found early practical application in Cockerill's process, patented in 1908, for removing rubber from latex by depositing it electrically upon a moving anode; but as this process led only to the production of crude rubber—in fact it was only intended for the coagulation of rubber from latex prior to shipment—its commercial scope was limited. The importance of the recent developments in this field arises from the discovery, made independently in 1922–23 by Klein in Hungary and by Sheppard and Eberlin in the United States, that all the ingredients essential to the production of finished rubber articles, namely, the sulphur required for vulcanisation purposes, many fillers and other compounding ingredients, as well as organic dyes and vulcanisation accelerators, can be admixed in a finely divided state with rubber latex or even with an artificial dispersion of rubber, and that the whole adsorption compound produced can be electrically precipitated as a homogeneous

layer on the anode which serves as a mould. It then only remains to vulcanise the deposit in the usual way, either after separation from the metallic surface or while still adhering thereto. Of course it may not be desirable to add the vulcanising agent to the bath, but to effect a cold vulcanisation after deposition. In fact, as may be gathered from the patent literature on the subject, the process is capable of many modifications.

It will be evident that the process which has been outlined eliminates many of the cumbersome mechanical methods at present associated with the rubber industry. The operating conditions can be precisely controlled, whilst by maintaining them constant the process can be made continuous or even automatic; moreover, being a cold process throughout, the original quality and structure of the starting material are retained in the product. Against these advantages must be set the fact that, since rubber is a non-conductor, it is possible to obtain only comparatively thin sheets of rubber product, though further investigation will doubtless remove this limitation. The oxygen liberated by electrolysis at the anode gives rise to a further difficulty, inasmuch as it leads to the formation of a spongy deposit; already, however, many proposals have been made for overcoming this defect, such as the use of porous moulds surrounding the anode or the addition of reducing agents to the bath. When the technique of the process has been perfected, a reduction in the cost of manufacture of sheet rubber goods and rubbered fabrics may be anticipated; not only that, but important developments may be expected in the direction of the coating of metal and other surfaces with rubber.

Obituary.

Sir John Scott Keltie.

SIR JOHN KELTIE seemed endowed with perpetual youth. He regulated his activities so nicely to his increasing age that, even when well advanced in his eighty-seventh year, he was able in one day to lunch at his club, attend a long committee meeting and the Council of the Royal Geographical Society, conduct a dinner of the Geographical Club, sit through a long evening meeting of the Society, seeing and hearing everything as clearly as when a boy, and, after returning home, sit up until midnight talking over the past and planning the future for a year or two ahead. He found life so full of interest and satisfaction that there seemed no reason why he should not live to celebrate the centenary of the Royal Geographical Society in 1930, and that of his own birth in 1940. He was happy in being spared the suffering of long illness and the dulling of his physical powers; he died of bronchitis on Wednesday, Jan. 12, at work almost to the last day.

Keltie was born in Dundee on Mar. 29, 1840, inheriting from his ancestors, who dwelt in Glendevon, a store of bodily health and mental fitness, but nothing more. Unaided and self-supporting, he made his way through several sessions, first at the University of St. Andrews and then at that of Edinburgh, though without taking a degree. The choice of a career seemed to lie between the dominie's desk and the preacher's pulpit, and he qualified himself for the latter in the United Presbyterian Church. But the narrow theology of the time repelled Keltie, and he used to tell how many years later he looked up the "Year-Book" of his old Church and found his name branded with the curt comment, "Lapsed into literature."

Keltie's literary work began in 1861 with Messrs. W. and R. Chambers in Edinburgh, who were then publishing the first edition of their famous "Encyclopædia," and at this period he produced many pieces of work in various fields, including a "History of the Highland Clans." He married in 1865, and soon found life in Edinburgh too narrow for his ambition. The southing instinct of his race brought him to London in 1871, when he joined the editorial staff of Messrs. Macmillan and Co., Ltd., and remained in association with that firm to the end of his life. He acted as sub-editor of NATURE from 1873 until 1885, and as editor of the "Statesman's Year-Book" from 1880 until his death, this being the last of his literary activities and that of which he was most proud. In 1873 he wrote an article on the island of Socotra and sent it at a venture to the *Times*, which accepted it, and thus began a lifelong association with that journal. It was probably this chance which turned his attention seriously to geography in time to share in all the stirring episodes of the opening up of Africa, the penetration of central Asia, and the polar expeditions of forty remarkable years. His work on NATURE similarly developed in him a wide knowledge of the literature of science and a keen though unspecialised interest in its advances.

Keltie joined the Royal Geographical Society as a fellow in 1883, and in the following year when the Society was roused, at the instance of Mr. D. W. Freshfield, to deal with educational aspects, he was appointed inspector of geographical education and commissioned to inquire into the methods of teaching in Great Britain and abroad. On this service Keltie travelled through the principal countries of Europe and brought home a very large collection of text-books, maps, and teaching appliances which he exhibited and lectured upon in London, Edinburgh, and other places. He produced a valuable report setting forth the deplorable state of geographical teaching in the British Isles as compared with France, Germany, and Italy. From this report sprung directly the revival in teaching geography which has culminated in the training and appointment of professors or readers in every British University and the institution of a geographical tripos at Cambridge. In 1894 the librarianship of the Royal Geographical Society became vacant and Keltie was appointed to the

post, then a part-time occupation, which afforded great opportunities for the pursuit of private literary work. Keltie soon became the indispensable helper of the assistant secretary—the great naturalist H. W. Bates, whom he succeeded in the secretaryship in 1892. From this time onward the administrative work of the Society engrossed his attention and could well have filled the whole time of a less untiring worker than Keltie; but it only stimulated his literary and journalistic powers and, at a time when the science of publicity was still imperfectly developed, his connection with the press did much to enhance the prestige and popularity of the Society and the fame of the great travellers and explorers with whom he was in daily contact.

Throughout his work at the Royal Geographical Society Keltie was on the side of progress, always encouraging those who were striving after more scientific methods in exploration or discussion and always interposing a moderate but unwavering opposition to reactionary tendencies. The confidence which successive presidents and councillors reposed in his judgment made him a power in the Society and in the geographical world even in his days of silent service as secretary. After he retired from the secretaryship in 1917, he was elected to the Council and latterly acted as vice-president.

Keltie was long connected with Section E of the British Association, in which he was recorder for several years and president at the Toronto meeting of 1897; afterwards he served on the Council of the Association. He bore the lion's share of the organisation of the great International Geographical Congress of London in 1895 and was one of the secretaries at the meeting. He also supported the Geographical Association from its day of small things and helped it forward to its present splendid maturity.

Although most of his work is likely to be forgotten as journalism, much of it ranks as literature and is of more than ephemeral interest, especially his "Partition of Africa"—a study of political geography in the making — and his "Applied Geography." He initiated and edited several important series of books on travel and exploration either alone or in collaboration. In 1893 he reconstructed the serial publications of the Royal Geographical Society and made its monthly *Journal* the most popular as well as the most widely circulated paper of its kind in Europe, while at the same time maintaining to the full its scientific character and the high standard of its cartography. His skill as an editor was of a high order, and he excelled in the art of inducing difficult contributors to follow the rules.

Though no explorer and little of a traveller, Keltie exerted a powerful influence on exploration in every quarter of the globe by his close personal relations with travellers of every nationality during the last quarter of the nineteenth century and the first quarter of the twentieth. He had the quick intuition of the Highlander combined with the slow caution of the Lowlander and balanced by a tact and generalship peculiarly his own. While faithful to his superiors and to his subordinates alike, he never failed in the duty of giving sound even if unpalatable advice to the former, and he always treated the latter as fellow-workers and was scrupulously just in giving them credit for good intentions as well as good work. He attained great success in organising public ceremonial functions, and his private hospitality, aided by the charm of his daughter Mrs. T. L. Gilmour, will long be remembered.

The appreciation in which Sir John Keltie's work is held by those best qualified to judge it may be estimated from the honours he received. These include gold medals from the Geographical Societies of London, Edinburgh, Paris, and New York, the honorary membership of nearly all the geographical societies in the world, the honorary degree of LL.D. from St. Andrews, the companionship of several Scandinavian orders, and finally the honour of knighthood, which he received in 1918.

HUGH ROBERT MILL.

DR. C. L. WITHYCOMBE.

DR. CYRIL LUCKES WITHYCOMBE, lecturer in advanced and applied entomology, died at Cambridge on December 5, aged twenty-eight years. Born at Walthamstow, the son of a schoolmaster, he early developed a peculiar taste and power for the keeping and rearing of insects, and this indicated his career. He passed his Intermediate Science Examination from Birkbeck College, and then went on to King's College, where he came under the influence of the late Prof. Dendy and of Dr. Mackinnon, on whose advice, with the object of broadening his science, he took the ordinary degree in botany, chemistry, and zoology instead of honours in one subject. He then went to the Imperial College to work under the late Prof. Lefroy, who regarded him as by far the best pupil he ever had.

During these years Withycombe spent all his spare time in the field, and he kept and reared a large series of Neuroptera, on which group he published fourteen papers, the most important being on the biology of the group in reference to the phylogenetic significance of their immature stages (*Trans. Ent. Soc.*, 1923 and 1925). The phylogeny had already been discussed by Handlirsch on palæontological evidence, and by Tillyard and Comstock on external morphology and wing venation. While their work was fully considered, the result was a modestly written discussion of the relationships of the families together, summarised by the propounding of a new phylogenetic tree, based also on the mass of new facts discovered by the author; assuredly this paper marks a stage in the scientific history of the group. It is a pity that the task he had set himself of monographing the British species cannot be carried out.

In 1923 Dr. Withycombe went to Trinidad as lecturer in entomology at the newly founded Imperial College of Tropical Agriculture. He was happy in having agreeable colleagues, and in seeing the tropics and their produce. He described to me

how his first year almost daunted him with his realisation of the insufficiency of present knowledge. It was clear he was passing through his transition period, blending what he knew of three sciences into one harmonious whole. It was at this time he published his work on the bladders of Utricularia, which as a boy he had independently discovered as capturing their prey by active movement in response to stimuli. His thought henceforth was of his plant first, and this is well seen in his research on the sugar-cane froghopper blight in Trinidad. Here he was dealing with a pest not introduced but belonging to the forests of the island, only secondarily attacking the canes. Having studied his insects and his plant together as one entity, his advice to the planter is to attend with the greatest care to his cultivation, in particular to see that his canes have plenty of water physiologically available for their growth. "Canes do not necessarily show serious blight when froghoppers have been abundant, nor is an abundance of the insect a necessary condition for serious blight." Other research in Trinidad resulted in the discovery of a bollworm, *Sacadodes pyralis*, a moth, the life history of which was worked out, and much time was spent in studying and rearing successive generations of cotton stainers, Dysdercus, bugs which prefer cotton to their natural Malvaceous plants and stain and rot the cotton lint by the bacteria and fungoid spores they introduce.

Dr. Withycombe only came to Cambridge in August last, and he at once set to work on his material of froghoppers and Dysdercus. He had to prepare a course of advanced lectures, and he had a sub-department to get into order. As a lecturer he was almost conversational, as he had seen everything of which he spoke, and his class loved him. As a colleague we admired and loved him too, for he had a most lovable personality, quite extraordinary vision, and absolute devotion to research. J. S. G.

MR. CHARLES HARDING, formerly an assistant in the Meteorological Office, died at Eastbourne on Sunday, Jan. 9, in his eighty-first year. Mr. Harding entered the Meteorological Department of the Board of Trade in 1861, and was among those who transferred to the service of the Meteorological Committee when the Office was reconstructed in 1867 after the death of Admiral Fitzroy. He thus had experience of the Office under all the different forms of administration through which it had passed, with the exception of the most recent one of all under the Air Ministry. For some thirty years Mr. Harding was Principal Assistant in the Marine Division, and served under three Marine Superintendents, Captain Toynbee, Lieutenant Baillie, and Captain M. W. Campbell Hepworth. He retired in 1911, but returned during the War for part-time duty, and did not finally sever his connexion with the Office until 1920. His active career in the Office, therefore, extended over nearly sixty years. Mr. Harding became a fellow of the Royal Meteorological Society in 1874, and served on its council and as vice-president for many years. He was the author of a number of meteorological papers, dealing mainly with climatology or marine meteorology, published in the *Proceedings of the Royal Meteorological Society* and elsewhere. For some forty years he was a valued and regular contributor of notes and articles on meteorological subjects to the columns of NATURE.

WE regret to announce the following deaths:

Dr. Daniel Carhart, professor emeritus of civil engineering since 1908 at the University of Pittsburgh, on Dec. 8, aged eighty-seven years.

Dr. Forris Jewett Moore, until a year ago professor of organic chemistry at the Massachusetts Institute of Technology, on Nov. 20, aged fifty-nine years.

Sir Isambard Owen, from 1909 until 1921 Vice-Chancellor of the University of Bristol, who took a leading part in the establishment of the University of Wales (1891–93) and in the reconstruction of the University of Durham (1907–9), on Jan. 14, aged seventy-six years,

Mr. F. J. Stoakley, for some fifty years chief assistant to the professor of chemistry at Cambridge, and well known to many generations of men who have worked in the Chemical Laboratory there, on Jan. 16, aged sixty-two years.

News and Views.

IN connexion with the reprint elsewhere in this issue (p. 125) of Clerk Maxwell's own abstract of his great memoir on the electrodynamic field, our attention has been directed by Sir Joseph Larmor to the valuable group of Maxwell letters that were discovered in 1903 among Stokes's private papers. They have been made public in the "Memoir and Scientific Correspondence of Sir George Stokes," vol. 2 (1907), pp. 1-45, published by the Cambridge University Press. They are an intimate account, reporting progress in a personal way from time to time in most of his scientific activity throughout his life. These and like collections of letters, from many of the most prominent workers of the time, all preserved by Stokes, make the two volumes an almost indispensable prolegomena to the history of discovery in physical science during the latter half of last century. A very interesting account of Maxwell's early years is contained in an obituary notice written by Tait for the Royal Society of Edinburgh, and printed in NATURE, vol. 21.

PROF. G. ELLIOT SMITH has announced in the *Times* of Jan. 14 an interesting discovery which he says "should settle once for all the century-old controversy regarding the identification of certain elephant-like creatures represented . . . in Mexico, Central America, and elsewhere in the New World." Mr. J. Eric Thompson has just discovered in the Ayer Collection of the Newberry Library in Chicago unpublished

water-colour sketches made more than ninety years ago by M. Frédéric de Waldeck, a French artist, of four bas-reliefs in stucco found by himself on the floor of a subterranean room in the palace at Palenque, and also a drawing of a part of the wall in the same room. The drawings on the first of the stucco slabs show two elephant's heads drawn in a floral design which is said to be suggestive of motives of the Chinese T'ang period; the second shows anthropomorphised heads "of characteristic Maya style"; the third, a conventionalised tapir; and the fourth, an egg and Haliotis shell. The design on the sculptured wall represents an elephant's head, front face with open mouth, on a serpent's body, with a conventionalised macaw and tapir heraldically grouped on each side. Prof. Elliot Smith also publishes a photograph of a crudely modelled elephant from San Salvador and two views of a painted vase discovered in 1916 at Yalloch, Guatemala, the design on which is considered by Dr. Gann, the discoverer, to represent the long-nosed god B (the feathered serpent Cuculcan, the Aztec god Quetzalcoatl), but which Prof. Elliot Smith holds to represent the elephant in the conventionalised style of Java and Eastern Asia.

As readers of NATURE are aware, Prof. Elliot Smith, reasoning as a zoologist, has argued ably that certain Maya sculptures represent the Indian elephant; but is it possible in so highly conventionalised an art as that of the Maya to make any attribution at all with certainty? The varied interpretations — tortoise, tapir, macaw, and the like — which provoke Prof. Elliot Smith's amusement, are evidence of the ambiguity of the design rather than of the perversity of the attempts at interpretation. The Waldeck drawings would place the matter beyond question if they could be accepted as accurate. Prof. Elliot Smith quotes vindications of Waldeck's trustworthiness, which had been impugned; but the drawings themselves show the influence of the pseudo-classical Empire style of the French art of Waldeck's day rather than the true spirit of Maya art. It is admitted that Waldeck had a penchant for restoration. In the circumstances, it is perhaps not too much to say that a stylised reproduction of a subject already highly conventionalised needs careful verification by experts before it can be accepted as evidence beyond question.

THE Gold Medal of the Royal Astronomical Society has been awarded to Prof. Frank Schlesinger, of Yale University Observatory, for his work on stellar parallax and astronomical photography. Prof. Schlesinger has done excellent observational work in spectroscopy and the variation of latitude. Specially notable is his work on stellar parallax, in which he showed how a higher standard of accuracy was attainable and took a leading part in the organisation of a number of observatories in this work. He has recently established an observatory at Johannesburg for parallax observations in the southern hemisphere. He has also initiated the use of wide angle doublet lenses for determination of position. The great accuracy which he has attained has stimulated German astronomers to re-observe the Astronomische Gesellschaft Catalogue on these lines.

AT its last meeting, the Council of the Royal Photographic Society awarded the Progress Medal to George Eastman "in recognition of his inventions, researches, publications, and other work," moved partly to this step by the broad vision displayed in his founding and supporting, alike with rich endowments and active co-operation, the Eastman Research Laboratories. From this organisation, staffed by some of the most notable scientific workers that photography can claim, reports concerned with almost every aspect of the subject, from theories of light action to the commonplaces of dark-room practice, are circulated freely without other tangible reward than the gratitude of practical workers. Mr. Eastman's labours in his chosen field stretch so far back as to be barely realised by the photographer of to-day. Fifty years ago, while still a youth, he worked out from scanty data gleaned in journals of the period a method of producing dry plates (then a novelty wholly imported from Europe) and courageously started their manufacture. The same qualities led him later to devote large sums and his great practical experience to perfecting the roll-holder, and its natural sequel the daylight-loading film camera of to-day. The zest with which he interested himself in the new product celluloid, and the whole-hearted support afforded Edison in his early work in kinematography, are mainly responsible for the rapid progress made by the latter towards mechanical precision. Had Friese Greene and Le Prince, working in England, enjoyed like access to this invaluable help in their hours of difficulty, few of the film problems now puzzling British Government departments need have arisen.

THE friends and admirers of the late Dr. T. S. P. Strangeways are forming a memorial fund, of which the primary object will be the provision of scholarships for his five sons. The committee includes the Master of Christ's College, the Master of Gonville and Caius College, the Master of St. John's College, the Master of Trinity Hall, the Regius professor of physic, the professor of pathology, the professor of anatomy, Sir Otto Beit, Sir Walter Morley Fletcher, Sir Charles Walston, Lady Woodhead, Dr. Cassidy, and many other well-known names. Cheques should be crossed "c.a. Strangeways Memorial Fund," and may be sent to either of the hon. treasurers: Mr. G. F. C. Gill, Lloyds Bank, Cambridge, or Prof. Sir Humphry D. Rolleston, Bart., Southfield, Trumpington Road, Cambridge; or to Dr. L. E. Shore, Dr. Louis Cobbett, or Dr. G. P. Bidder. It is obvious that a large sum will be required; and towards this £1895 has been subscribed by the Committee and a few friends.

AMONG the men of science of the seventeenth century—a period made memorable by the work of Gilbert, Napier, Galileo, Wallis, Hooke, and Newton—the Hon. Robert Boyle will always occupy a prominent place. Born three hundred years ago, on Jan. 25, 1627, he might be called the Cavendish of his time.

Of noble birth, Boyle was left with ample means by a father who was one of the ablest of public men. The portrait of Boyle, however, is that of a thinker and not of a man of action. He was delicate and studious as a boy and owed much to his tutor, with whom he spent some years on the continent, while in after life he was influenced by his sister, just as Pascal was by his. It was in 1654 that Boyle, then twenty-eight years of age, went into residence at Oxford, and with Wilkins and others began those meetings which led to the foundation of the Royal Society. Six folio volumes tell of his industry, and contain the results of his experiments in chemistry and physics. Following in the footsteps of Torricelli and Otto von Guericke, he improved both barometer and air-pump, and it was in his "Defence of the Doctrine touching the Spring and Weight of Air," published in 1662, that he gave us the important law known by his name. He never held any appointment, though he might have been Provost of Eton and president of the Royal Society. His death took place on Dec. 30, 1691, just a week after that of his sister. They had long lived together in Pall Mall and were buried side by side "at the upper end of the south side of the chancel" of St. Martin-in-the-Fields; but thirty years later the church was rebuilt, and to-day no one can point to his grave and no monument recalls to the stranger that Boyle was buried there.

IN the *Sunday Times* of Jan. 2, Prof. H. J. Spooner directs attention to some of the notable centenaries which occur this year. Among the names of men of science which he mentions are those of Newton, Laplace, Fresnel, Volta, and Lister. The bi-centenary of the death of Newton will be celebrated at Grantham in March, while the centenary of the death of Volta is being recognised by the holding of an electrical exhibition at Como. The custom of commemorating such events should find general acceptance, for, as Fairbairn once remarked, "the smallest honour we can do the great benefactors of mankind is occasionally to bring them to our recollection." To the names mentioned many others might be added. Next in interest to mathematicians and astronomers, after Newton and Laplace, comes that of Robert Woodhouse (1773–1827), successively Lucasian professor and Plumian professor, to whom belongs the credit of introducing the calculus at Cambridge and who found earnest disciples in Babbage, Herschel, and Peacock. Another astronomer who died the same year was Calandrelli (1749–1827), once director of the Vatican Observatory, while going back four hundred years we have the birth of Stadius (1527–1579), a predecessor of Kepler as mathematician to the Emperor of Germany. A contemporary of Stadius who should not be overlooked was the famous Dr. John Dee, alchemist and astrologer, who was born in 1527 and died in 1608.

TO chemists and physicists the tercentenary of the birth of Boyle (1627–1691) and the centenary of the death of Augustin Jean Fresnel (1788–1827) will afford the greatest interest. Though Fresnel sank into an early grave he was one of the foremost students of optics, and it was only eight days before his death that Arago placed in his hands the Rumford medal of the Royal Society. Another physicist of note who died in the same year was Chladni (1756–1827), whose works on sound were translated into French through Napoleon. Henry Beaufoy (1764–1827) was both physicist and astronomer but is still better known for his experiments in naval architecture. The year 1827 saw the publication by Ohm of "The Galvanic Circuit worked out mathematically". Although no great chemist died in 1827, in that year were born Sir Frederick Abel (1827–1902), John H. Gladstone (1827–1902), Edward Nicholson (1827–1890), and, most distinguished of all, Marcellin Berthelot (1827–1907). In the same year the death occurred of Samuel Crompton (1753–1827), whose work as the inventor of the spinning mule will be the occasion of a gathering at Bolton, and also of George Medhurst (1759–1827), one of the inventors of the atmospheric railway. Among the great pioneers of last century was Sandford Fleming (born 1827), who was Engineer-in-Chief of the Canadian Pacific Railway from 1871 until 1880.

SOME considerable stir in the United States was caused in July 1925 by the trial of Mr. John T. Scopes, a science teacher of a Tennessee high school, for having taught the truth of evolution in defiance of the State law. The matter aroused widespread interest, and in our issues of July 11 and later, we published the views of a number of leading men of science and theologians on the desirability or otherwise of the control of university and school curricula by the State. It will be recalled that Mr. Scopes was found guilty, after a long trial, of breaking the State laws and was fined 100 dollars. The defence at once announced its intention to appeal against the decision of the judge and to raise the question as to whether a State law prohibiting the teaching of evolution was consistent with the constitution of the United States. The case came before the Supreme Court of Tennessee, and on Jan. 15 the verdict was given that the 'anti-evolution' law is constitutional, but that the lower court erred in fining Mr. Scopes 100 dollars. Mr. Scopes was guilty of a misdemeanour, for which the maximum penalty in Tennessee, it would appear, is 50 dollars unless the case is tried by a jury.

ON Dec. 4 of last year, the twenty-fifth anniversary of the establishment of the Bureau of Standards was celebrated at Washington. The Hon. Herbert Hoover, Secretary of Commerce, and "the only Engineer in the Cabinet," delivered the first address, in the course of which he remarked, "The Bureau to-day represents the greatest of all the world's physical laboratories. . . . I know of no laboratory, no effort of any Government that represents so liberal and so generous a support to science as is exemplified in the Bureau of Standards. To-day its appropriations approximate two and a quarter million dollars a year, a larger income than most of our universities." Referring to the Bureau and the maintenance of a

high standard of living, he said, "It is only through the support of agencies of this character, and hundreds of other institutions engaged in scientific research, that we may expect with confidence that as our population grows we can still add this increment of comfort and luxury which we have enjoyed in the last century." Addresses were also given by Dr. F. A. Wolf, who referred to the time when the quarters of the Bureau consisted of two basements in the Coast Survey building on Capitol Hill; by Dr. Stratton, a former Director of the Bureau, and by Mr. Cortelyou, a former Secretary of Commerce, who spoke of the hundreds of men of high scholarship found in the Bureau, and recalled a story of Edison who, being asked by an interviewer to name the four most useful men he knew, replied, "Oh, you wouldn't recognise them. They're working around in laboratories."

THE expedition to New Guinea of the Smithsonian Institution and the Scientific Research Society of the Dutch East Indies, which has penetrated 250 miles into the interior of Dutch New Guinea under the leadership of Prof. Stirling, has reached Singapore on its way back to the United States. According to a dispatch from the Singapore correspondent of the *Times* in the issue of Jan. 14, 8000 ethnographical specimens, a large botanical collection, and much information concerning the pygmy races has been obtained. It will be remembered that in the reports on the progress of this expedition which have been issued by the Smithsonian Institution from time to time, special stress has been laid on the value of the work in mapping and exploration which has been made possible by the use of the aeroplane. The mountain barrier was crossed and the entire upper reaches of the Bouffaer River, hitherto unknown, were mapped. The original intention of visiting Lake Habbema, at an estimated altitude of 12,000 ft., by flying was abandoned; but the expedition reached a height of 9000 ft. where three months were spent among the pygmies. These proved to be most hospitable and friendly, in contrast to the Papuans of the coastal area, who attacked the camps, the canoes, and the transport, when several of the natives were killed The expedition would appear to have been more fortunate than travellers in other parts of New Guinea in their relations with the pygmies, as it has usually been found difficult to establish contact with them.

AN appeal for contributions to a Maya Exploration Fund has been issued by Sir Frederic Kenyon, Director of the British Museum. As a result of the excavations carried out last year on the site at Lubaantun, an invitation has been tendered to the trustees of the British Museum by the Government of British Honduras to undertake the supervision of the archæological exploration of the Colony. The trustees are prepared to accept the responsibility if funds allow; but as the resources at their disposal are limited, they ask for the financial support of the British public in this undertaking, which promises results of exceptional importance. A capital sum of £40,000 to £50,000 is required to meet an annual cost of £2000 for exploration from year to year. British Honduras, though a small territory, contains remains of every phase of Maya civilisation. As explorations of the last two or three years have shown, it is impossible to place any limit to the extent and character of the material which may be forthcoming from this area to help in elucidating the fascinating problems which bear upon the origin and development of the prehistoric culture of Central America. At Lubaantun itself, in the course of two seasons' work, features unique in Maya art and architecture have been brought to light. That the continuous and systematic archæological exploration of the country should be undertaken at the request of the Colonial Government is in itself a gratifying mark of the recognition of the importance of these priceless monuments of antiquity, which hitherto have not only been utterly neglected by the authorities, but have not even been protected from the vandalism of any chance comer.

A BOOKLET entitled "The National Institute for Research in Dairying: Its Work and Needs," compiled by the staff, deals with the inception, development, and aims of the National Institute for Research in Dairying, which is now located (under the University of Reading) at Shinfield, near Reading. During the time that the Institute has been established—some fourteen years—it has overcome many of its initial difficulties and has tackled some of the pressing problems of dairying with vision and enthusiasm. In face of what has been accomplished, it is to be hoped that the question of finance, which still hinders the work, will receive attention. It is not only those directly connected with dairying who are indebted to the Institute, but also the general public for the benefits which arise from the Institute's campaign for clean milk. The work of the Institute is classed under the headings of (*a*) management and feeding of dairy stock, (*b*) the chemical constitution and other properties of milk and milk products, (*c*) the methods of handling and distribution of milk. In each of these sections, not only has attention been given to the practical aspect of the various questions, but also the underlying scientific problems have been thoroughly studied. This has necessitated a very large amount of chemical, physical, and bacteriological investigation.

FROM the beginning, the National Institute for Research in Dairying has placed the production of clean milk in the forefront of its programme, and it has succeeded in stimulating a very keen interest in this subject throughout England. At the present time there is a steady increase in the number of clean-milk competitions, which are mainly organised by the county authorities. In 1925 the number of these competitions totalled 35, and there is every reason to expect an increase in the future. Demonstrations of methods to be employed in producing clean milk on the farm are now a feature of many county and local agricultural shows, and the visits of the county dairy instructors or instructresses to the farms in their respective areas are spreading the knowledge which is so vital to success. Most of these dairy teachers have been to a special course of instruction at the National

Institute, so that, in addition to research, the Institute plays a very important part in training and stimulating those who are able to influence the farmer in this important question of clean, safe milk.

THE inaugural meeting of the Institution of Fuel Technology was held in London on Dec. 7 and 8 last. Sir Alfred Mond, in his presidential address, discussed the problem of fuel generally in an interesting and stimulating manner. He pleaded for more co-operative effort in the scientific development of fuel, and more optimism in industry as a whole. T. Hardie read a paper on modern practice in gas manufacture, based on the experience of the Gas Light and Coke Co. The thermal efficiency of carbonisation in modern vertical retorts has reached 85 per cent., and of carburetted water-gas manufacture nearly 70 per cent. Prof. R. T. Haslam, Massachusetts Institute of Technology, contributed a theoretical discussion on the combustion of carbon, and Sir Richard Redmayne a paper on the German brown coal industry, giving a very comprehensive account of the fuel itself and of the various processes to which it is now put; it emphasised the potential value of such a low-grade fuel when suitably exploited. A paper was contributed by W. E. Groume-Grjimailo, of Petrograd, on his theory, based on hydraulic analogy, of the flow of furnace and heating gases, and its application to furnace construction. S. McEwen discussed the economies of low-temperature carbonisation, with special reference to the supply of pulverised fuel and its use. Dr. J. S. Owens gave an account of modern views on smoke and public health. The *Fuel Economist* for December contains a full account of the papers and discussions, which are of considerable interest and value.

WE learn from the report for the past year of the British Photographic Research Association, which was presented to the Council by the Director of Research on Nov. 23, that the Association has now entered on the last year of its second period of grant from the Department of Scientific and Industrial Research, and is therefore obliged to consider the question of the future. The Association is supported financially by the subscriptions of its members, supplemented by a grant from the Department, and in this manner has been enabled to make a really good start and thoroughly to justify its existence during the last nine years. We wish we could add that it was thoroughly well established, but the obviously uncertain nature of its income must be a source of anxiety to every member of the staff, and now and then leads to the loss of valued assistants, who naturally are ready to pass to appointments of a more apparently secure character.

AT the last annual general meeting of the Association, a resolution was passed that "it is of great importance to the industry that the British Photographic Research Association should be continued, and that every effort should be made to secure its continuation on a sound financial basis." We sincerely hope that these efforts will be made, and that they will be crowned with a success that will enable the Association not only to feel that it is well established but also that it may look forward to a healthy growth. The last year has added eight to the total of its scientific communications published, and two others are in the press. In addition, four summaries of literature have been circulated, frequent meetings of the staff with members of the scientific staffs of manufacturing firms have been held, and three lectures have been given in response to "requests from outside circles." Assistance or advice given confidentially to the members of the Association is one of the other activities of the research staff, but its main work is to supplement and not to replace the research departments of the various manufacturing firms, by attacking fundamental problems rather than those immediately concerned with factory work. It is pleasing to note that a certain feeling of distrust that existed at first on the part of some manufacturers has now been replaced by one of confidence in the research staff of the Association and its Director.

THE Society for Experimental Biology met at Bedford College, London, on Jan. 10 and 11. At the first session Prof. A. E. Boycott described experiments to determine the cause of the local distribution of Planorbis and Bithinia in a group of ponds, Mr. R. E. Chapman showed the effect of bicarbonates on photosynthesis in water plants, Dr. W. K. Slater discussed the effect of anaerobic conditions on the metabolism of the cockroach, and Dr J. Needham communicated a paper on the carbohydrate metabolism of the developing egg. A number of demonstrations of plant and animal experiments were also made. The second session, which was devoted to a symposium on the relative growth of parts, in which Prof. J. S. Huxley, Miss M. Shaw, and Messrs. M. Perkins, John Hammond, J. T. Cunningham, and others took part, was characterised by lively discussion. In the third session Dr. C. M. Yonge described intracellular digestion in Metazoa and Mr. G. F. Marrian explained the inter-relationships of respiratory pigments. Mr. G. P. Wells summarised experiments on the action of cations on invertebrate muscle, and Mr. V. J. Clancy described recent work on the biochemistry of sclero-proteins which go to form skeletal and protective structures in animals and plants. At the annual meeting twenty-two new members were elected, and on the evening of Jan. 10 a dinner at the Florence Restaurant was attended by about fifty members and guests.

AT the fourth annual meeting of British zoologists in the rooms of the Zoological Society on Jan. 8, it was proposed by Prof. Stanley Gardiner, and carried unanimously, "That this meeting represents to the Trustees of the British Museum the desirability of equipping zoological expeditions for the purpose of obtaining as full a record as possible of the past and present fauna."

THE Research Association of British Paint, Colour and Varnish Manufacturers has made arrangements

to purchase a property at Teddington near to the National Physical Laboratory, to be used as its research station and laboratories. It is hoped that the premises will be ready for occupation by the end of March. A Technical Advisory Committee has been appointed to consider and draw up the preliminary programme of research, and a second member of the technical staff has been appointed, namely, Dr. J. O. Cutter.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant master to teach engineering science in the day junior Technical and Evening Technical Schools, Truro—The Principal, Technical Schools, Truro (Jan. 28). A secretary to the Royal Asiatic Society—The Secretary, Royal Asiatic Society, 74 Grosvenor Street, W.1 (Jan. 29). A lecturer in machine drawing and design in the department of engineering, University College, Nottingham—The Registrar (Jan. 31). An assistant editor of British Chemical Abstracts—B (Applied Chemistry)—The Secretary, Bureau of Chemical Abstracts, 46 Finsbury Square, E.C.2 (Feb. 4). A principal of the Teachers' Training College and professor of education in the University of Western Australia—The Agent-General for Western Australia, Savoy House, Strand, W.C.2 (Feb. 10). A test assistant at the Royal Aircraft Establishment for general assistance to the scientific staff of the wind tunnel section of the Aerodynamic Department—The Chief Superintendent, R.A.E., South Farnborough, Hants. (Reference No. A. 142).

Our Astronomical Column.

COMETS.—Mr. Blathwayt, who discovered his first comet a year ago, has now found a second one, which is of the ninth magnitude, being the brightest comet that has been in sight for several months. The place of discovery is Braamfontein, near Johannesburg, and the position on Jan. 13 at $1^h\ 28{\cdot}0^m$ is given as R.A. $15^h\ 44^m\ 0^s$, S. Decl. 29° 46′, daily motion $+12^s$, S. 50′. The comet is too far south for observation in England, but may come northward later.

Prof. J. Comas Sola, of Fabra Observatory, Barcelona, has discovered an object of doubtful character (comet or minor planet). Its place on Jan. 10 at $0^h\ 30{\cdot}0^m$ U.T. was $8^h\ 19^m\ 20^s$, N. Decl. 2° 22′, daily motion $-1^m\ 28^s$, S. 18′, magnitude 12·4. If it is a minor planet, it must have a fairly small mean distance and a high inclination, so that it is an object of interest in any case.

Dr. A. C. D. Crommelin has deduced the following orbit of comet 1926 f. (Comas Sola) from photographic observations by G. Merton and F. J. Hargreaves on Nov. 10, Dec. 3, Dec. 24:

$$\left.\begin{aligned} T &= 1927\ \text{Mar.}\ 22{\cdot}1992\ \text{U.T.} \\ \omega &= 38^\circ\ 27'\ 30''{\cdot}8 \\ \Omega &= 65\ \ 36\ \ 29{\cdot}2 \\ i &= 13\ \ 45\ \ 40{\cdot}0 \\ \phi &= 35\ \ 5\ \ 39{\cdot}5 \end{aligned}\right\} 1926{\cdot}0$$

$$\log q = 0{\cdot}248639$$

$$\text{Period} = 8{\cdot}51645\ \text{years.}$$

These elements indicate a close approach to Jupiter in May 1912, and are therefore compatible with the suggestion of identity with Spitaler's comet 1890 VII. Very large perturbations are required to make this possible, the aphelion distance having increased from 5·08 to 6·568, which latter is $1\frac{1}{3}$ units beyond the orbit of Jupiter.

EPHEMERIS FOR 0^h.

	R.A.	N. Decl.	log △.
Jan. 24	$2^h\ 39^m\ 46^s$	18° 40′	0·148
Feb. 1	2 49 52	20 26	0·166
,, 9.	3 2 10	22 14	0·183

The comet should be readily observable until May, which would be six months after discovery. It remains within a few degrees of Mars for some time.

THE MINOR PLANETS.—Prof. H. N. Russell gives in the *Scientific American* for January an interesting summary of our present knowledge on this subject. Keen visual scrutiny revealed 300 planets between 1847 and 1891; then the photographic method was introduced and led to a great increase in the rate of discovery, more than 1800 discoveries having been announced between 1891 and 1926. At present, 1046 planets have been well observed and have received permanent numbers; about 1000 more are known to exist, but their orbits are only roughly determined.

The search cannot be pronounced a waste of time, if only for the fact that it led to the discovery of Eros, which gives such an excellent means of determining the solar parallax. Albert, Alinda, and Ganymede resemble Eros in travelling partly within the orbit of Mars. The group of six Trojan planets, which make equilateral triangles with Jupiter and the sun, give an example in the heavens of a solution of the 3-body problem which Laplace had announced from theory more than a century earlier. Dr. Baade's remarkable asteroid Hidalgo, the orbit of which extends from Mars to Saturn and is more eccentric than many cometary orbits, also presents interesting features, and raises some puzzling questions in cosmogony.

It is satisfactory that international co-operation in observing the minor planets, which broke down during the War, is being established afresh. Prof. M. Wolf's first photographically discovered planet was lost for some thirty years, and was then recovered in America, though it needed a long series of observations to establish the identity.

SATELLITES OF MARS.—These satellites offer some interesting problems, owing to their close proximity to Mars, with resulting shift to their orbit planes, due to the planet's oblateness. There is also the possibility of some alteration of the mean motion of Phobos as a reaction of tidal friction. Hence the series of measures made in 1924 with the 26-in. equatorial at the United States Naval Observatory, Washington, by A. Hall, E. C. Bower, and Miss E. A. Lamson (*Astr. Jour.*, No. 873) is of interest. The corrections to the mean daily motions are:

	Deimos.	Phobos.
Hall . .	−0·000060°	+0·000099°
Bower . .	−0·000107°	+0·000097°

The deduced values of the reciprocal of the mass of Mars are:

	Deimos.	Phobos.
Hall . .	3,108,500	3,157,100
Bower . .	3,127,200	3,212,100

Giving Deimos double weight, owing to the larger arc subtended by its orbit, the weighted mean is 3,140,100. Thus the observed value of the mass is nearly 2 per cent. smaller than the accepted value, rather a large difference.

Research Items.

ANTHROPOMETRY OF THE ABORIGINES OF SOUTH AUSTRALIA.—Dr. T. D. Campbell and Dr. Aubrey J. Lewis have published in the *Transactions of the Royal Society of South Australia* for 1926 observations on 28 aborigines (11 males and 17 females) from the camp at Ooldea on the edge of the Nullarbor Plain. Most of them belong to the Alinjera group, a few to the Willoorara group. Individual measurements are given, the mean values working out as follows: Stature, 1593·4; cranial length, 187; cranial breadth, 135; nose height, 43·2; nose breadth, 44·8. The means of the indices are: Cephalic, 72·2; facial, 81·7; nasal, 104·6; ear, 53·1; radio-humeral, 81·5. The figures are compared throughout with those collected by Prof. Wood-Jones and Dr. Campbell on varying numbers of individuals, in one case—stature—more than three hundred, and are found to approximate to them fairly closely. They go to confirm the assertion that the aborigine of Central Australia belongs to a pure stock with well-defined and constant physical characters. He is dolichocephalic, platyrhinic, and dolichokerkid, the breadth of his ear is about half its length, while as to his jaw, the mean index is fairly constant though there is considerable individual variation.

EARLY RECORDS OF CALIFORNIAN INDIANS.—Although Bancroft, for the purpose of his "History of California," drew freely on most of the available sources, a re-examination of these, mostly diaries of Spanish priests who accompanied punitive or exploratory expeditions—records not generally available—has shown that they contain much supplementary material of archæological or ethnological value. Mr. E. W. Gifford and Mr. W. E. Schenk, who have already published material relating to the southern San Joaquin Valley in the *University of California Publications in American Archæology and Ethnology*, have now issued the data relating to the California Delta region in vol. 23, No. 2 of the same series. The records of the expeditions in question extend from the year 1772 to 1849. They throw an interesting light on the sources of food supply, comment being made on several occasions on the vast quantity of game. At Carquinez great mounds of fresh-water mussel shells were observed in the vicinity of a native village; but probably two different stages of culture were represented. Of the general conclusions which can be drawn, the most interesting is that based on evidence pointing to the infiltration of European influence. In 1819 the capture of forty-nine horses belonging to the Muquelemes near the Calaveras–San Joaquin confluence is significant, and the object of many of these expeditions was to recover escaped converts. The possible mixtures and modifications of physical types which resulted imposes great caution in the interpretation of skeletal evidence from certain groups or regions. Radical differences in cultures are difficult to note. Conclusions as to the numbers of the population require a large margin of error. In 1806 there may have been anything from 3,000 to 15,000 inhabitants. In 1870 the Indian population in this area had fallen to 5.

THE MANDSHURIAN TIGER.—The area inhabited by the tiger in the Far East is widely separated from the main area comprising India and southern China. The Mandshurian tiger, according to recent researches by Baikov, recorded in *Priroda*, Nos. 5-6, 1926, should be regarded as a species distinct from the southern tiger and more closely related to the fossil cave tiger of Europe. It differs even in its habits from the southern species, which lives in the jungle, for the Mandshurian tiger lives in *taiga*, *i.e.* in the dense forests peculiar to eastern Siberia, and it definitely dislikes heat, going up to the mountains in summer, while in winter it is perfectly comfortable even during the hardest frosts. The principal prey of the Mandshurian tiger is wild pig, but it is doing a great deal of damage to cattle, while it also often attacks men even in the day-time.

AGRICULTURAL MAP OF RUSSIA.—The Russian Institute of Applied Botany, in Leningrad, has just published a very interesting agricultural map of the country compiled by Prof. I. F. Makarov. The map itself is reproduced on a fairly large scale in colours, and shows, by the 'dot' method, the relative distribution and density of crops in the country, a single dot representing 1000 hectares of crops. This method makes the map exceedingly instructive, as even a superficial glance is sufficient to show the very irregular and peculiar distribution of cultivated land in Russian territory. Very concentrated dots indicate the highly cultivated areas of the Ukraine, of the northern Caucasus, and of the Volga region, while smaller in size but nearly as dense accumulations of dots indicate the numerous oases in the vast deserts of central Asia, which are otherwise quite devoid of dots. Of particular interest to every naturalist is the northern limit of agriculture, which is also shown on the map. The line drawn on the map shows the northernmost limits of actual cultivation of cereals during the last century; it does not coincide, however, with the northern limit of possible agriculture, or with the limit of a stable agriculture forming an economic basis of the population; it lies between these two lines. The course of the line on the map begins in European Russia at lat. 62° and runs eastwards more or less parallel to the White and the Polar Seas, but near the Ural Mountains it suddenly drops to lat. 60°. Having crossed the Urals the line runs across Siberia, now ascending, now descending again. An interesting point is shown in eastern Siberia, where the line forms an enormous loop embracing the lowlands of Yakutsk with the river Lena and its tributaries. The northernmost point in Siberia touched by the line is lat. 65° N., this being in the Yakutsk province; but in the Amur region, between the same meridian, the line comes down only to lat. 43° N., and reaches the Japanese Sea at lat. 45° N. Isolated outposts of agriculture occur in Siberia far beyond the line, and even well beyond the Arctic circle. Apart from the general map, this publication contains a number of regional maps, showing the distribution of crops in various parts of Russia in detail, as well as explanatory text giving much statistical information.

AN APPARATUS FOR CATCHING THE MICRO-FAUNA OF THE SEA-BOTTOM.—A new apparatus for this purpose is described by Dr. Th. Mortensen (*Saertryk af Vidensk. Medd. fra Dansk naturh. Foren.* Bd. 80, pp. 445-451). Recent investigations have indicated both the magnitude and importance of the micro-fauna of the bottom deposits in the sea, but it has always been difficult to obtain adequate samples of this, since it is very laborious to sift out microscopic animals from the mass of material brought up in the dredge or trawl, while the Petersen grab, though more satisfactory, gives but a small sample. Dr. Mortensen's apparatus, designed to remedy this, consists of a fine silk net attached to a rectangular iron frame, the whole being prevented from sinking into the bottom deposits by a pair of thin zinc plates which

are attached to the iron frame in front and to one another behind and at either side. They are bent upwards at the anterior end like the runner of a sledge and are almost as long as the net which lies between them. In use the net skims along the surface of the mud and collects an abundant sample of the micro-fauna from the surface layers. When used on a sandy bottom, an iron bar is attached a little distance in front of the mouth of the net so as to stir up the light organisms, which remain floating long enough to be caught in the pursuing net. Excellent results have been obtained in depths up to 94 metres with this net, abundant catches of nematodes, planarians, small annelids, ostracods, copepods, and many small molluscs having been secured.

CHROMOSOME MEASUREMENTS. — The accurate measurement of chromosomes is a difficult field in which little has yet been done. An extensive and laborious series of such comparative measurements has recently been made by Nesta Ferguson (*Phil. Trans. Roy. Soc.*, vol. 215 B, pp. 225-253) on the Aloinæ, a group of Liliaceous genera comprising Aloe, Gasteria, Apicra, and Haworthia. More than fifty species were compared as regards the chromosome content of their nuclei. In all these genera there are four long chromosomes and three short ones, but seven species and varieties were found to be tetraploid, having eight long and six short chromosomes. Tables of measurements and graphs of variation in chromosome length are followed by measurements of width in different stages of mitosis, and, finally, the average volume of the chromatin in the corresponding nuclei from nine different species is computed. In the genus Haworthia this volume is 40·4 μ^3 in *H. Cooperi*, 107·7 μ^3 in *H. radula*, and 208·6 μ^3 in the tetraploid *H. tesselata parva*. It is concluded that the last has arisen through a duplication of the complete chromosome set of the nucleus. Differences in the mean length of the long chromosomes from species to species are also found, which may be significant.

THE JAPANESE EARTHQUAKE OF SEPT. 1, 1923.— Broadly speaking, the origin of this great earthquake covers the whole of the land and sea-basin, which have undergone conspicuous topographical changes (NATURE, vol. 115, 1925, pp. 65-66), and especially the seismic focal zone that crosses the central part of Sagami Bay from north-west to south-east. From an analysis of the seismograms obtained at Tokyo and other stations (*Proc. Imp. Acad. Tokyo*, vol. 2, 1926, pp. 401-404), Prof. A. Imamura suggests that the great earthquake consisted of a group of earthquakes which originated successively at brief intervals in different parts of the focal zone. He distinguishes in particular three earthquakes, though there may have been others in the south-eastern portion of the zone—the first, not a violent earthquake, with its epicentre below the sea and about midway between Misaki and Manazura; the second, three seconds later, a very great earthquake, with its epicentre on land about 30 miles north-north-west of the other; and the third, a very sharp earthquake, about 4½ seconds later still, with its epicentre near the coast and due north of the first epicentre.

MIOCENE MOLLUSCA FROM FLORIDA. — Julia Gardiner has studied and discusses "The Molluscan Fauna of the Alum Bluff group of Florida" (U.S. Geol. Survey: *Professional Paper* 142, A-D). The Alum Bluff deposits comprise three distinct faunas, which characterise three formations known in descending order as the Shoal River, the Oak Grove Sand, and the chipola. The whole series is overlain by the Choctawhatchee Marl, and is referable to the Miocene age. The author briefly sketches the history of the Alum Bluff group and gives a map of the places of its occurrence, with tables of the distribution of the fauna and local distribution of the species. The systematic descriptions (occupying some 147 pages) follow, arranged according to Dr. Dall's classification, and include many new species, while the 27 plates of fossils are a delight to look at. Each of the four parts into which, for some occult reason, the paper is divided, is furnished with an index. One index to the whole would have been much more useful and satisfactory.

OIL SURVEYS IN NORTHERN ALASKA.—A recent bulletin of the United States Geological Survey (No. 783-E) by Messrs. P. S. Smith, J. B. Mertie, and W. T. Foran, is in the nature of a progress report of the extensive surveys being undertaken in this territory, more particularly the Naval Reserve of 35,000 square miles set aside by President Harding in 1923; the main object of this work is the location of possible oil deposits and, if successful, their development under Government administration. Oil has been definitely proved in the Reserve in the vicinity of Cape Simpson, where two distinct seepages occur, but under what conditions it originated and in what quantity it is available, are points as yet undetermined. The general interest of the report is that part of it which touches on the special problems of development which must necessarily arise when exploiting an oil-field near to or within the Arctic Circle. For example, climatic conditions make it impossible for ships to gain access to the Reserve by sea except in the period between August 1 and early September; "even during this short period they run the hazard of being caught in the ice and lost." Clearly any quantity of petroleum won from this region could not be moved by ocean-going vessels, especially as there is no harbour as yet suitable to ships of the tanker class. Alternatively, pipe-line transport from the Reserve to an ice-free harbour would probably have to be more than 1000 miles long. "Through half this distance even trails, on which all supplies and materials would have to be hauled, are lacking, and for a third of the distance there is not even timber enough to build shelters for the workmen." Similar circumstances apply to railway construction, the cost of which would be prodigious. A further serious factor in the present case is that if the oil in transit is to be used for purposes of national defence, the line of supply would have to be safeguarded; in fact, the whole region would demand protection in view of its remoteness from Government centres. Thus a very large oilfield and a commensurate production would be necessary before the cost of practical solutions to these problems could be economically justified. Save for the strategic factor, much the same reasoning applies to the development of oilfields in north-west Canada, concerning which we hear much from time to time.

ANTARCTIC METEOROLOGY.—The *Boletin Mensual* of the Argentine Meteorological Office, of which the issue for 1923 has now been published, contains a résumé of the observations taken at 8, 14 and 20 hours at 74 meteorological stations in the Republic, including two stations outside the Republic at South Georgia and the South Orkneys. These observatories are the only permanent ones existing in antarctic and subantarctic regions, and so have particular value. In spite of their low latitude, 60° 44′ south, the South Orkneys had only three months with a mean temperature above freezing point, and the highest mean, in February, was only 1·2° C. In midwinter the mean fell to more than 10° below freezing point. In South

Georgia conditions were more temperate, eight months having means above freezing point, and in the warmest month the mean rose to 6·1° C. Precipitation at the South Orkneys showed the low level for the year of 481 mm.; at South Georgia it was 1257 mm. These figures, which represent fairly well the average conditions, are of interest in relation to the heavy glaciation of both island groups.

VISCOSITY OF METALS.—Parts 1 and 2 of vol. 134 of the mathematical and physical division of the *Sitzungsberichte* of the Academy of Sciences of Vienna contains a paper by Dr. F. Hettwer, of the Physics Institute of the University, on the viscosity of metals. The specimens were cylinders 0·8 cm. diameter, 10-14 cm. long, with their axes vertical. The upper end was clamped in a fixed support, the lower in a support to which a given torsional couple about a vertical axis could be applied by means of weights. The temperature was kept constant by water circulation. The twist of the cylinder produced was measured by means of a circular scale, and its small changes by means of a mirror and scale. When first the torsional couple is applied, elastic fatigue affects the twist for some time, and the observations taken during the daytime for 10-14 days afterwards are used. The values of the viscosity obtained are: for lead 4·7, tin 24, aluminium 75, and zinc 330 multiplied by 10^{14}. For alloys the laws of viscous flow appear to be more complicated than in the case of pure metals, and the viscosity higher.

THE ELECTRICAL CONDUCTIVITY OF THE ATMOSPHERE.—The issue of the *Physikalische Zeitschrift* for Dec. 1 contains an account of the observations made on this subject during the past three years by Dr. Rose Stoppel, with the assistance of the Notgemeinschaft der deutschen Wissenschaft. The conductivity was determined by the leak from an insulated wire 150 cm. long, 0·2 cm. in diameter, which was charged every half-hour by contact for an instant with one pole of a battery of 200 volts, the other pole of which was earthed. The decrease of potential of the wire was recorded every two minutes by a Benndorf electrometer. The observations were made in a cellar in Hamburg and in a dark room in Akreyri in the north of Iceland. At each place of observation the conductivity has a daily period with a maximum between 4 and 6 in the morning local time, uninfluenced by the period of midnight sun, but much reduced at times of aurora. The variations of conductivity are not to be accounted for by changes of sunlight, of temperature, pressure, or degree of saturation of the air, and are probably due to cosmical radiation undetected up to the present time.

METHODS OF TESTING ELECTRIC LAMPS.—The very large number of incandescent electric lamps which have to be tested to stringent specifications each year by the Bureau of Standards for the American Government departments have made it necessary to invent new methods and auxiliary apparatus so as to speed up the tests and reduce the cost. An initial photometric test of the lamp in lumens per watt is first made. Fortunately the changes in life output and efficiency for changes in voltage are sufficiently consistent for lamps of a given type to permit of computation of the required voltage at which the lamp is to be run for a life test. This voltage is considerably higher than the manufacturer's nominal service rating, and hence, as the life is much shorter, a great saving in time and money is effected. All lamps are rated and tested on the basis of total light output in lumens and efficiency in lumens per watt. As the factors for deducing the mean spherical candle-power of vacuum tungsten lamps from the mean horizontal candle power are known, they are actually measured on a horizontal photometer bar. Other lamps are measured on an integrating sphere 30 inches in diameter, the test lamp occupying a fixed position within the sphere. Very large lamps are measured in an 88-inch sphere. These three photometers have special auxiliary devices by which the necessary computations are made in a semi-automatic manner at the time the observations are taken. Detailed descriptions of these devices are given in a paper, "Recent Developments in Lamp Life-Testing Equipment and Methods," published by the U.S. Bureau of Standards (No. 325). One great advantage of the methods described is that the scales employed may be easily and quickly read without eye-strain.

MAGNETISATION IN ALLOYS.—The Bell Telephone System in the United States maintains a very large research organisation called the Bell Telephone Laboratories Inc. In these laboratories G. W. Elmen discovered permalloy, an iron-nickel alloy with a permeability enormously greater than that of iron in low magnetic fields. This alloy is of the greatest importance in submarine telegraphy. In the *Bell Laboratories Record* for December, L. W. McKeehan writes an interesting popular paper giving what he calls a physical background to the properties of permalloy. In the new alloy, X-ray analysis shows that there is apparently nothing peculiar about the crystals. It exhibits a uniform solid solution of iron and nickel. A great deal of study has been devoted recently to magnetic measurements of elastically deformed specimens. It appears that permalloy acts in an entirely natural manner. It is known that magnetisation of iron, nickel, and cobalt is accompanied by changes in the interatomic forces. This is shown by the minute changes in overall dimensions. If these changes take place suddenly, energy ought to be expended, and this the author identifies with magnetic hysteresis losses. Magnetic hysteresis losses are abnormally low in permalloy. When its components iron and nickel are separately magnetised, the iron expands and the nickel contracts in the direction of the magnetic axis. It is probable, therefore, that somewhere in the region of iron and nickel alloys there will be neither expansion nor contraction on magnetisation. Two Japanese experimenters have reported that the critical composition where this phenomenon occurs makes the magnetic behaviour of permalloy most strikingly abnormal. The atoms of the iron and the nickel act together in groups and there are no sudden changes in their position. Hence hysteresis loss does not take place. This theory ought to be helpful in discovering other magnetic alloys of great theoretical interest and commercial importance.

ARTIFICIAL SILK.—The *Journal of the Royal Society of Arts* for Dec. 10, 1926, contains a paper on artificial silk, read before the Society on Nov. 17, by T. Brough, chief designer of Messrs. Courtalds, Ltd. Artificial silk possesses certain features which make it distinct from the natural substance, and for this reason its name is rather misleading, but the resemblance between the two fibres is seen from the description of the processes by which they are produced. Of the four processes now in use for the production of artificial silk, the viscose is the most important, about seventy-six per cent. of the world's supply being manufactured by this method. By judicious use of artificial silk, either alone, or with the assistance of other fibres such as cotton, worsted, or natural silk, a large variety of beautiful textures can be woven, and illustrations of examples of these fabrics are reproduced.

Paris Academy of Sciences.

PRIZES AND GRANTS AWARDED IN 1926.

MATHEMATICS.—The Bordin Prize has been awarded to Serge Bernstein for his "Leçons sur les propriétés extrémales et la meilleure approximation des fonctions analytiques d'une variable réelle"; the Poncelet Prize to Paul Montel for his mathematical work as a whole; the Francœur Prize to Gaston Julia for his works on the theory of functions.

Mechanics.—The Montyon Prize has been awarded to Kyrille Popoff for his book, "Les méthodes d'intégration de Poincaré et le probleme général de la balistique extérieure"; the Henri de Parville Prize to Antoine Alayrac for his work on the theory of flight; the Henri Bazin Foundation to Léo Escande and Marcel Ricaud for their researches concerning the mechanics of fluids.

Astronomy.—The Lalande Prize has been awarded to Armand Lambert for his catalogue of fundamental stars; the Damoiseau Prize to Joseph Renaux for the whole of his work; the Valz Prize to Frank Schlesinger, Director of the Yale University Observatory, for the whole of his work, particularly for his researches relating to the measurement of the parallax of stars by the trigonometric method; the Janssen Prize to Francisco Miranda da Costa Lobo for the whole of his astronomical work; the La Caille Prize to Gaston Fayet for the whole of his astronomical work.

Geography.—The Delalande-Guérineau Prize has been awarded to Jacques Hippolyte Grossard for his geodesic work in the Nile and Congo basins; the Gay Prize to Henri Michel for his studies on the improvement of tidal rivers; the Tchihatchef Prize to the late Jean Govin for his geodesic work; the Binoux Prize between François Roland for his work, "Les cartes anciennes de la Franche-Comté," and Jules Gaultier for his researches on surveying instruments.

Navigation.—The Prize of 6000 francs (in equal parts) has been divided between Émile Georges Barrillon, for his study on the waves produced by the motion of a ship, and André Apard for his work on the hygroscopic properties of the B powders; the Plumey Prize (2000 francs) has been awarded to Frédéric Marquet for his treatise on navigation.

Physics.—The La Caze Prize has been awarded to Charles Fabry for the whole of his scientific work; the Hebert Prize to Paul Bunet for his electrotechnical work; the Hughes Prize to François Croze for his work in spectroscopy; the Clément Felix Foundation to Georges Reboul for the continuation of his studies on badly conducting substances.

Chemistry.—Montyon Prize (Unhealthy Trades). A prize (2500 francs) has been awarded to Ernest Portier for his work as a whole on industrial hygiene, and an honourable mention (1500 francs) to Louis Chelle for his researches on gases used in warfare; the Jecker Prize is divided between André Wahl (6000 francs) for his work in organic chemistry and Gustave Vavon (4000 francs) for his researches on catalysis with platinum black; the La Caze Prize to André Job for his researches on the mechanism of oxidation; the Cahours Foundation between Raymond Delaby for his work on the homologues of glycerol, and Michel Samson for his work on glass; the Houzeau Prize to Louis Hackspill for his work in inorganic chemistry.

Mineralogy and Geology.—The Fontannes Prize has been awarded to Léon Moret for his "Contribution à l'étude des spongiaires siliceux du Crétacé supérieur français."

Meteorology and Physics of the Globe.—The Victor Raulin Prize has been awarded to Joseph Lacoste for his work in mineralogy and atmospherics.

Botany.—The Desmazières Prize has been awarded to Robert Kühner for his memoir entitled "Contribution à l'étude des Hyménomycètes et spécialement des Agaricacées"; the Montagne Prize divided between Georges Mangenot (1000 francs) for his memoirs on algæ, and Pierre Dombray (500 francs) for his work entitled "Contribution à l'étude des corps oléiformes des hépatiques des environs de Nancy"; the De Coincey Prize to Irénée Thériot for work on the analysis and specification of exotic mosses.

Anatomy and Zoology.—The Cuvier Prize has been awarded to Édouard Chatton for his work on the Protozoa; the Savigny Prize to Édouard Lamy for his work on molluscs; the Thore Prize to Rémy Perrier for his two volumes on entomology in his "Faune de la France."

Medicine and Surgery.—Montyon Prizes have been awarded to Maurice Blanchard and Gustave Lefrou (2500 francs) for their researches on the acute spirochætoses of French equatorial Africa, to Louis Fournier and Louis Guénot (2500 francs) for their work on the bismuthotherapy of syphilis, and to Étienne Burnet (2500 francs) for work on Mediterranean fever. Honourable mentions (1500 francs) to Jules Le Calvé for his work entitled "L'œdème, étude expérimentale et clinique," to W. B. Palgen for his essay on the biology of some bacteria, and to Alfred Weiss for his clinical and experimental researches on colectomy. Citations to Maurice Cuvigny, Leroux-Robert, Raymond Turpin, Marcel Sendrail, and Charles Dejean; the Barbier Prize to Jules Bridré and André Donatien for their work on the micro-organism of contagious agalaxy of the sheep and goat; the Bréant Prize between Yves Kermorgant (3500 francs) for his work, "Contribution à l'étude de l'étiologie des oreillons," and Charles Pérard (1500 francs) for his work on coccidioses of the rabbit; the Godard Prize to Christian Champy for his work, "Sexuality and Hormones"; an honourable mention to Jacques Benoit for his work, "Recherches anatomiques, cytologiques et histophysiologiques sur les voies excrétrices du testicule chez les mammifères"; the Mège Prize to Alberico Benedicenti for his work, "Malati, medici e farmacisti"; the Bellion Prize to Stefan Nicolau for the whole of his work; the Larrey Prize to Charles Spire and Pierre Lombardy for their work, "Précis d'organisation et de fonctionnement du service du santé pendant la guerre."

Physiology.—The Montyon Prize has been divided between Marcel Duval, for his physico-chemical and physiological researches on the internal medium of aquatic animals and the modifications produced under the influence of the external medium, and Auguste Quidor and Marcel Hérubel for their memoir on a new theory of visual perception and its applications; the La Caze Prize has been awarded to Georges Weiss for his work in biological physics; the Pourat Prize has been divided between Stefan Mutermilch (1000 francs) for his work on normal and artificial hæmolysins, and Albert Berthelot (1000 francs) for his work in bacteriology and medicine; the Martin-Damourette Prize between Henry Chabanier for his work on the rôle of the kidney in diabetes, and Maurice Chiray and Yon Pavel for their work on the contractility of the biliary vesicle; the Philipeaux Prize has been awarded to Henri Simonnet for his work on the liposoluble factor, with honourable mention to Émile Wagner for his memoir, "Le système nerveux de l'adrénalino-

sécrétion"; the Fanny Emden Prize to Louis Delherm and Albert Laquerrière for their work on the biological effects of various radiations.

Statistics.—The Montyon Prize has been awarded to the Institut de Statistique de l'Université de Paris for its contribution to the progress of applications of mathematics to statistics, finance, and political economy. Honourable mentions of 500 francs to Ernest Blin for his researches on the physical development of assisted children, and to Albert Ranc for his book, "Le budget du personnel des recherches scientifiques en France."

History and Philosophy of Science.—The Binoux Prize has been awarded to Henry de Varigny for his book, "La mort et la biologie."

Works of Science.—The Henri de Parville Prize has been awarded to René Legendre for his memoir on the concentration of hydrogen ions in sea water.

Medals.—The Berthelot medal has been awarded to Ernest Portier and to André Job.

General Prizes.—The Grand Prize of the mathematical sciences has been awarded to Eugène Bertrand de Fontviolant for his work on the resistance of materials; the Bordin Prize (physical sciences) to Auguste Pettit for his researches on serum for the treatment of infantile paralysis; the Lallemand Prize to Yvonne Sorrel-Dejerine for her work entitled "Contribution à l'étude des paraplégies pottiques," and a very honourable mention to Pierre Hillemand for his work, "Contribution à l'étude des syndromes de la région thalamique"; the Serres Prize to Charles Pérez for the whole of his work in embryology; the Vaillant Prize to Mme. Lucie Randoin for her researches on the physiology of nutrition, with special reference to vitamins; the Jean Reynaud Prize to Mme. Alfred Giard, in memory of the biological work of the late Alfred Giard; the De Joest Prize to Alain Quemper de Lanascol for his work on the geometry of compasses; the Houllevigue Prize to Jean Rey for his work on the physical properties of petrol vapours and their laws of flow; the Saintour Prize to Pierre Fauvel for the whole of his work on annelids; the Jules Mahyer Prize to Louis de Broglie for his studies on the quantum theory; the Lonchampt Prize to Charles Dhéré for his work on electrodialysis and the purification of proteids; the Wilde Prize (in equal parts) between Armand Renier for his studies of the Belgian coal measures, and Bruneau de Laborie for his African explorations; the Caméré Prize to René Feret for his researches on cement; the Jérome Ponti Prize to Maurice Fréchet for his work on the theory of functions; the Gustave Roux Prize to Pierre Chevey for his work in zoology; the Thorlet Prize to Adolphe Richard; the Albert I. of Monaco Prize to Jean Charcot to permit him to complete the equipment of his vessel the *Pourquoi pas ?*

Special Foundations.—The Lannelongue Foundation has been divided between Mmes. Cusco and Rück.

Prizes at the Grandes Écoles.—The Laplace Prize has been awarded to Georges Parisot; the L. E. Rivot Prize to Georges Parisot, Jacques Hémar, Louis Armand, and Louis Dherse.

Foundations for Scientific Researches.—The Trémont Foundation has been awarded to Edmond Marcotte for his work on internal combustion motors; the Gegner Foundation to René Baire for the whole of his mathematical work; the Hirn Foundation to Joseph Thoret for his researches on air currents; the Becquerel Foundation to Georges Bruhat for his work in optics and physical chemistry; the Bouchard Foundation to Maxime Ménard for his work on X-rays and radiations used in therapeutics; the Le Chatelier Foundation to Jean Cournot and Albert Roux for their studies on alloys by means of the X-rays.

The Geographical Association.

THE Geographical Association held its annual meetings on Jan. 6-8 at the London School of Economics. The address of the president, Sir Charles Close, on "Population and Migration," gave a statistical investigation of world population with special reference to the development of the British Dominions. The tendency of population growth, indicated by graphs of census returns, gives some foundation for a forecast of the future. Within three-quarters of a century from 1875, England will probably pass from the period of highest birth-rate—36 per 1000—to a stationary condition in which birth-rate and death-rate will balance. Any migration policy must take this tendency into consideration, as well as the absorption rate in the Dominions, estimated at 5 per 1000. This at present would give about 100,000 per annum, excluding the quota to the United States. It is a corollary of this population movement that the dissemination of geographical knowledge of the regions of the world must occupy an increasingly important position in education.

Maps constitute one of the most important groups of geographical documents. Even the significance of the 'Bactrian Triangle' of Bukhāra, Merv, and Samarkand, discussed by Dr. Eileen Power in relation to trans-Asian caravan routes, cannot be fully realised apart from a cartographical representation of the three great east-west highways in their physico-geographical setting. But the mapping of such regions prior to the coming of the aeroplane has been financially almost impossible. Air surveys open a new era. Already such regions as the lower course and delta of the Irrawaddy, and the coastlands of British Guiana, have thus been mapped. Some 100,000 square miles of Canada have been surveyed from the air. Even vegetation distribution, in certain circumstances, can be determined, the Katanga district in particular offering interesting possibilities. In the air survey about to be undertaken there, Major Heming thinks that the geologists will be able to locate copper ore deposits by the soil effect on vegetation, the distribution of which will be revealed by the air photographs.

Other possibilities of aircraft are under observation, as in the revision of the O.S. 1/2500, commonly called the 25-inch map, for south-east England. The Director-General of the Ordnance Survey, in discussing the official maps at present available to the public, indicated certain developments in the 1/1,000,000 map of England and Wales. Additional contours, a revision of the towns and certain other details, will enhance its value for general use, whilst the success of the map showing Roman roads encourages the Ordnance Survey to proceed with similar maps of an archæological and historical character. A special map has been prepared showing the track in Britain of the total solar eclipse which takes place on June 29 next, a phenomenon not to be repeated here until the year 1999. In this connexion Prof. H. H. Turner described, by means of photographs of previous eclipses and by ingenious mechanical slides, the formation and nature of an eclipse.

A visit to East Kent included an excursion to the Betteshanger Colliery and the housing schemes at Elvington and Aylesham. The latter, serving the needs of the Snowdown and Adisham Collieries, may

be taken as the best expression of an attempt to save the beauty of the Kentish countryside in face of a possible industrial development. In the valley below Aylesham Wood, Nature offers a site for a town of ten thousand inhabitants which gives the planner of towns, both in the form and the setting of the valley, his maximum opportunity. The collieries, though less than a mile away, are effectively hidden by rising ground, the summit of which, crowned by woods and spinneys, forms an effective horizon. This Aylesham scheme is a striking application of geographical science to the economic and social needs of our times. It is one in which the unconscious and empirical adjustment due to slow growth and lack of policy—illustrated by Mrs. Ormsby's regional survey of London—may be replaced by a sound but not too rigid plan of organised urban development.

The Proposed New Biological Station in Bermuda.

WE have recently received from Prof. Herbert W. Rand, of Harvard University, a statement setting forth the history of the Bermuda Biological Station and the steps which are being taken for its reorganisation with the view of placing it on a permanent foundation and of extending its usefulness.

The station was inaugurated in 1903 through the joint activities of Profs. C. L. Bristol (New York) and E. L. Mark (Harvard), and since that time about 250 workers have carried out investigations at the station, and 141 published papers have been issued.

In August 1925 a group of American biologists interested in the Bermuda Station met to consider its future, and proposed a scheme for its complete reorganisation on the same general lines as those which have proved so successful in the case of Wood's Hole. The first step was to communicate with biologists who had either worked in Bermuda or for other reasons might be expected to be interested in the work of the station, and replies from about 150 were received, and these biologists form the corporation. They were asked to nominate a committee of reorganisation, which met in New York in Nov. 1925. Recognising the importance of securing the co-operation and support of the Bermudians, this committee sent letters to the Governor of Bermuda, to former members of the Bermuda Natural History Society, and to several other residents of the island. The responses are stated to be most encouraging. The committee arranged for the election, by ballot of the members of the corporation, of a board of twelve trustees, and it was provided that four of these should be non-residents of the United States. These are Dr. E. J. Allen, Plymouth; Prof. J. H. Ashworth, Edinburgh; Dr. A. G. Huntsman, Director of the Atlantic Experimental Station for Fisheries, Halifax, Canada; and Dr. E. A. McCallan, Director of Agriculture, Bermuda. The American trustees are Prof. E. G. Conklin, Dr. E. V. Cowdry, Dr. C. B. Davenport, Profs. B. M. Duggar, R. A. Harper, R. G. Harrison, E. L. Mark, and H. W. Rand.

Papers of incorporation under the laws of the State of New York have been prepared and approved, so that the station is authorised to accept and hold funds to establish and maintain a station for scientific study in biology. A committee is investigating the possible sites for the new station and is drawing up the detailed plans for the station and its equipment.

It is hoped that the government of Bermuda may be willing to make some provision for the station, possibly in connexion with the new aquarium now in course of construction. The Royal Society of London has intimated its interest in the scheme to widen the scope and value of a station offering such exceptional advantages of position, which, though situated in British territory, has hitherto owed its existence and development to American enterprise, and the National Research Council at Washington has passed a vote approving the project.

We understand that, when the organisation is completed, there is every hope that funds to a substantial amount will be forthcoming from America to put the station upon a sound financial basis and to make it a first-class laboratory with thoroughly adequate equipment. British marine biologists will, we are sure, follow with sympathetic interest the efforts of the committee to this end. The advantages of the Bermudas for biological research are considerable; the semi-tropical fauna can be studied under reasonable conditions of living and of climate throughout the year, and the station will be readily accessible, being reached in about forty-eight hours from New York. A well-equipped station in the Bermudas will afford the opportunity for the proper investigation of the semi-tropical waters of the Atlantic, and in these studies it is hoped British and American scientific men will be associated. We cordially wish the committee success in its endeavours to provide the means for the furtherance of this important work in marine biology.

University and Educational Intelligence.

CAMBRIDGE.—A. R. Clapham, Downing College, has been appointed to the Frank Smart University studentship in botany.

DR. GEORGE MCOWAN, lecturer in chemistry in the United College of St. Salvator and St. Leonard, University of St. Andrews, has been appointed reader in chemistry at Raffles College, Singapore.

A REPORT on Higher Degrees has been issued by the Association of University Teachers as a supplement to the *University Bulletin*, vol. 6, No. 1. It represents the results of the labours of a committee of the Association appointed to inquire into the conditions under which higher degrees are awarded in the universities of Great Britain. Several years ago a similar inquiry was undertaken by the Universities Bureau of the British Empire, and summaries of the conditions have since been published in the "Universities Year-book." The committee of the A.U.T., however, has not rested content with recording existing conditions, but has fitted its record into a convenient tabular form, and has gone so far as to formulate general principles and even to suggest standard regulations which it commends to the careful consideration of the universities on the ground that, if some common agreement could be achieved, it would be to the great advantage of university study and research. The general principles recommended are: that the D.Litt. and D.Sc. should imply conspicuous ability and originality and distinguished and sustained achievement; the Ph.D., ability to study a problem systematically and to relate results to the general body of knowledge of the subject, and a definite contribution to knowledge or scholarship; and the degree of Master, the mastery of the technique of investigation. The suggested regulations include a *viva voce* examination for the Ph.D. and for the Master's degree. Standardisation is not a word to conjure with in university circles, but this report seems to deserve the consideration it asks for.

Calendar of Discovery and Invention.

January 23, 1710.—Johann Friedrich Böttger, the German alchemist, was born in 1682 and died in 1719. Apprenticed to a chemist of Berlin named Zorn, he experimented with zest with the view of the transmutation of metals into gold. From Berlin he went to Dresden, and it was while under the patronage of the Elector of Saxony that he accidentally discovered the process of making porcelain from the reddish clay found in the neighbourhood of Meissen, and on Jan. 23, 1710, the first European porcelain factory was opened at that place.

January 24, 1838.—During the voyage from Europe to America in the sailing vessel *Sully* in 1832, the American painter, Morse, then forty-one years of age, conceived the idea of signalling by electricity, using a code of dots and dashes. Six years later, on Jan. 24, 1838, he exhibited his electric telegraph in New York city, the *Journal of Commerce* stating: "Intelligence was instantly transmitted through a circuit of ten miles, and legibly written on a cylinder at the extremity of the circuit."

January 25, 1868.—Bishop Thirlwall, writing on Jan. 25, 1868, said: "I had a treat last night, which I would not have missed for any prize. Tyndall delivered the second (the first unhappily on the Friday before) of the lectures at the Royal Institution, 'On Faraday as a Discoverer.' . . . Tyndall said many fine things, not flowers of rhetoric, but springing out of the depths of their long intimate friendship. . . . He prized the honour of being Faraday's successor less than the happiness of having been his friend. The one was a mantle almost too heavy to bear, the other a memory full of the purest delight. He closed with the words, 'Let me die the death of the noble, and let my last end be like his,' and then rushed out of the room amidst a storm of applause. The attendance was just the largest that the room, with the addition of extra chairs, would hold. It was curious to see how, after it was over, people gave vent to their feelings by shaking hands, as if to congratulate one another on being present on such an occasion. It was indeed something to remember to the end of one's life. Faraday was a noble man, with heart, mind, and soul equally and healthily developed."

January 27, 1774.—One of the principal factors in engineering progress has been the development of machine tools. Among these the oldest is the lathe. A notable advance in workshop practice was made when John Wilkinson, on Jan. 27, 1774, patented his machine for boring guns in which the gun was rotated and the boring tool advanced down the bore. Called upon to make the cylinders for the engines of Watt, Wilkinson devised a machine in which the cylinder was fixed but the boring bar was supported at both ends while the cutter-head was moved along the bar, thus enabling the surface traced out by the tool to be reproduced in the work.

January 28, 1807.—Murdock in England and Le Bon in France were the pioneers of gas lighting, but its introduction for street lighting was due to the eccentric German, Winsor, through whose efforts Pall Mall was lighted by gas on Jan. 28, 1807. This was the first public thoroughfare in the world to be so illuminated.

January 29, 1886.—It was the invention of the light, high-speed spirit engine by Daimler which made the motor-car possible, but the first to apply such engines to carriages was Karl Benz. Benz's first motor-car, built in 1885, is in the Deutsches Museum, Munich; his patent is dated Jan. 29, 1886.

E. C. S.

Societies and Academies.

LONDON.

Royal Society, Jan. 13.—F. W. R. Brambell, A. S. Parkes, and Una Fielding: Changes in the ovary of the mouse following exposure to X-rays. Part i. Irradiation at 3 weeks old. Degeneration occurred of all oocytes in the ovaries of 47 female mice, exposed to full sterility dose of X-rays at 3 weeks old. Membrana granulosa and theca interna, in those cases where differentiated, degenerate also. Finally old follicles are only represented by small cavities containing zona pellucida remnants. Simultaneously with these changes, old inter-follicular tissue atrophies, and germinal epithelium proliferates epithelial cords. In adult animals ovaries are composed almost entirely of this first proliferation. In many cases a second proliferation follows. This consists of small spherical or slightly elongated cords. These cords resemble so-called spermatic cords described in ovaries of inbred rabbits and of free-martin cattle. They also resemble structures described as anovular follicles. They have no effect on œstrous cycle.

F. W. R. Brambell, A. S. Parkes, and Una Fielding: Changes in the ovary of the mouse following exposure to X-rays. Part ii. Irradiation at or before birth. Investigation of the ovaries of 6 mice X-rayed *in utero* and of 30 X-rayed at birth confirm the foregoing results. Of animals irradiated at birth, 24 were allowed to become adult. Cords of first proliferation constituted the bulk of all the ovaries. The cells of first proliferation appear to be responsible for production of œstrin and regulation of œstrous cycle. Production of œstrin stops at certain stage of differentiation into luteal-like cells.

A. S. Parkes: On the occurrence of the œstrous cycle after X-ray sterilisation. Part ii. Irradiation at and before birth. Further evidence is brought forward in support of conclusion that all normal cyclic œstrous phenomena except ovulation can occur in animals in which Graafian follicles of ovary have been totally destroyed at an early age by exposure to X-rays, and can occur, therefore, in the absence of organised corpora lutea and Graafian follicles.

R. M. Sargent: Recovery from vigorous exercise of short duration. Recovery from vigorous exercise of short duration is extremely rapid, especially in the first 10 minutes immediately after cessation of exercise. Rate of recovery varies somewhat with the subject and the severity and duration of exercise. It is inadvisable, in determining total recovery-oxygen after exercise, to measure the amount used during the period of incomplete recovery and apply a correction. As a result of exercise, oxygen consumption at rest was found to be increased, on average about 7 per cent. This change appears to result from genuine alteration in level of metabolism, and cannot be regarded as an integral part of recovery process as such.

R. G. Canti and M. Donaldson: The effect of radium on mitosis *in vitro*. It is possible to bring about cessation of mitosis in tissue cultures *in vitro* by means of radium irradiation. With the intensity of radium irradiation employed, mitosis ceases, but when the radium is removed after several hours' exposure, mitosis reappears. At commencement of irradiation, cells not only complete division when mitosis has already commenced, but some cells also actually begin mitosis and go through the process of division in apparently normal fashion. In no experiment was there any evidence of radium producing increase in the number of cells in mitosis.

R. J. Ludford and W. Cramer: Secretion and the Golgi apparatus of Islets of Langerhans. Appear-

ances in the cells of the Islets of Langerhans in normal animals indicate that the cells in the same animals are at different stages of functional activity. The condition in which the most definite and uniform change has been observed is during pregnancy, in which the Islet cells are particularly active. Similar but less uniform and definite change is found after exposure of heat.

M. Dixon: On the mechanism of oxidation-reduction potential. The phenomena of oxidation-reduction potential can be predicted from the work of Wieland, and a theory in accordance with Wieland's theory of oxidation is developed and extended in various directions. An explanation of the anomalous behaviour of the sulphydryl system is suggested.

Royal Meteorological Society, Dec. 15.—N. K. Johnson: Some meteorological observations made at sea. Readings were taken over a period of 24 hours on a ship steaming eastwards in the Mediterranean Sea. The observations were made on May 12-13, 1926, and the sky was practically clear throughout. Air temperature showed a diurnal variation of 1°·9 F. There are also indications of a small diurnal variation in the sea temperature. The vertical temperature gradient between heights of 5 m. and 22 m. was found to possess the dry adiabatic value throughout the day but exceeded this value during the night. This result, which is exactly the reverse of what occurs on land, probably represents the normal occurrence at sea.—N. K. Johnson and E. L. Davies: Some measurements of temperature near the surface in various kinds of soil. Measurements were made throughout 1925 of the maximum and minimum temperatures recorded at a depth of about 1 cm. below the surface of six kinds of 'soil'. In summer the maximum soil temperatures are considerably in excess of the maximum air temperatures recorded in a Stevenson screen. This excess is 37° F. in the case of tarmac, and 14° F. in the case of grass-covered soil. In mid-winter the soil maxima are all practically equal to the screen maximum. The minimum temperatures recorded in the 'soils' agree closely throughout the year with the minimum air temperature in the screen. The only exception is in the case of the grass-covered soil, in which the minimum averages about 5° F. higher than the air minimum. Using a value for soil conductivity, the temperature observations were extrapolated up to the actual surface of the soil. In this way it is found that the average summer maximum for the surface of tarmac is about 115° F., and for earth and sand about 100° F. The extreme maxima for these 'soils' are calculated as about 140° F. and 130° F. respectively. In the tropics an extreme maximum surface temperature for ordinary soils may be estimated as about 180° F.—A. N. Puri: Investigation on the behaviour of hair hygrometers. A study has been made of four types of hair hygrometers in which the total load on the hairs consists of a weight. These were taken through a series of humidity changes controlled by sulphuric acid–water mixtures. When the hair is loaded with a weight of two grams or more, it undergoes a slow extension which extends over a period of several weeks. Hair under a smaller load gives readings which can be reproduced to measure humidity within 2 per cent. Alterations in the length of the hair due to changes in humidity show a hysteresis effect which is apparently in the reverse direction to that observed when measurements are taken in terms of change in weight.

DUBLIN.

Royal Irish Academy, Dec. 13.—A. Farrington: The topographical features of the granite-schist junction in the Leinster chain. The zone of metamorphic rock which surrounds the Leinster granite is more resistant to weathering than the granite and tends to form high ground at the margin of the latter. This is particularly well shown in the basin of the Slaney river, where an undulating plain of granite is shut in on three sides by high hills of schist. The valleys of the streams which flow out of the granite area are constricted where they cross the schist belt, and as a result of this narrowing the glacially eroded glens of the eastern slope of the Leinster chain are much overdeepened in the schist, a well-marked step being formed near the granite-schist junction.

Royal Dublin Society, Dec. 21.—J. Reilly and Joan Sullivan: Studies on peat (Part ii.). Distillation under reduced pressure of certain constituents of peat.—J. Reilly and C. Boyle: The production of essential oils from fresh-grown plants (Part ii.). The cultivation of *Mentha piperita* and further experiments on the winning of lavender oil.—J. Reilly and J. Taylor: (Part iii.). Oil of pepermint.—J. Reilly and P. J. Drumm: (Part iv.). Note on oil of camomile.—W. R. Fearon: Colour reactions associated with liver oils. Two classes of colour reactions are frequent in liver oils: (1) those obtained directly on the addition of a powerful condensing agent, such as sulphuric acid, arsenic trichloride, or phosphorus pentoxide; and (2) those obtained indirectly on the addition of an aromatic phenol before treatment with the condensing agent. Reactions of the first class appear to be intimately associated with the growth vitamin A. Reactions of the second class are independent of the vitamin, and are due to a saponifiable component of the oil.

EDINBURGH.

Royal Physical Society, Dec. 20.—D. Guthrie: Tattooing and its significance.—D. J. Jackson: The life-history of a braconid parasite of Sitona.—A. C. Chaudhuri: The erythrocyte count in sexually normal and abnormal fowls. The count is higher in males than in females, and is lower in castrated individuals than in normal. It is exceptionally low in hens with an extra ovary, while in cases of sex reversal it approaches that of the male.

MANCHESTER.

Literary and Philosophical Society, Nov. 30.—Kenneth M. Smith: Observations on some insect carriers of potato virus disease. The so-called 'virus diseases' of the potato are becoming a serious menace to the potato-growing industry of the world. The causal organism, if such there be, of this group of disorders has not yet been isolated. The diseases, however, particularly in their 'leaf-curl' and 'mosaic' forms, are known to be infectious, and in Nature are transmitted by certain insects. A number of insects which attack the potato plant have been tested under controlled conditions as to their disease-carrying abilities. The insect is first itself contaminated with the disease, and later is placed upon a potato plant under an insect-proof cage. This plant is produced by one half of a known healthy tuber, the other half tuber being grown under a separate insect-proof cage as a control. So far as results of the experiments up to 1925 go, they indicate that the aphis or certain species of aphis are the most efficient carriers of the mosaic disease of the potato. Successful inoculation was also achieved with other species of insects, in two cases with a leaf-hopper and also with the greenhouse white-fly (Aleurodes). The capsid bugs have so far failed to transmit mosaic disease.

PARIS.

Academy of Sciences, Dec. 6.—H. Andoyer: The method of Delaunay.—F. E. Fournier: General laws, unpublished, of the formation of the vertical undulatory profile of the satellite wave of a ship in motion, calm sea.—J. Costantin: New experimental results on the culture of *Pleurotus Eryngii*.— — Piquier: The general integration of the partial differential equation $s=f(x, y, z, q)$.—Bertrand Gambier: The deformation of surfaces and the Gauss-Codazzi equations.—Paul Montel: The domains corresponding to values of analytical functions.—G. Vranceanu: The absolute differential calculus for non-holonome varieties.—J. Delsarte: The study of certain integral equations which generalise those of Fredholm.—H. Mineur: The absolute differential calculus.—E. M. Antoniadi: Changes observed on the planet Jupiter. Details of further results obtained in 1926 at Meudon with the 83 cm. telescope. Illustrations of the appearances on Nov. 27, 1923, and July 1, 1913, are given. The conclusion is drawn that while in certain cases the sun may have an effect, the phenomena presented by Jupiter are for the most part inherent in the planet itself and are due to its high temperature.—P. Helbronner: Results of the direct geodesic junction of Corsica to the French continent.—Jean Chazy: The formula of the Doppler-Fizeau effect in the universe of de Sitter.—Jean Rey: The industrial utilisation of the energy of a warm liquid in a steam turbine. An account of an actual application in 1904 of the recent suggestion of G. Claude (*C.R.* 1926, p. 924).—V. Posejpal: The resonance absorption and yield of fluorescence in the domain of the X-rays.—Edgar Pierre Tawil: The variations of the optical properties of piezo-electric quartz submitted to high-frequency currents.—Albert Pérard: Study of the monochromatic cadmium radiations in Michelson and Hamy lamps from the point of view of their metrological applications.—Paul Mondain-Monval: The heats of mixing of partially miscible pairs (of liquids). The system methyl alcohol–cyclohexane. The heat absorbed per gram of mixture is shown graphically as a function of the percentage of cyclohexane. Curves for the temperatures 18°, 29°, 40°, and 52° C. are given, the latter being above the critical miscibility temperature.—René Delaplace and Neda Marinesco: Some physico-chemical properties of cæsium eosinate. Data are given for the number of dipoles of solvent fixed on the molecule, *p*H of aqueous solution, electrical conductivity, and molecular weight.—Eugène Pérot: The cementation of mild steel by cyanogen and by cyanamide. Curves are given showing the influence of temperature, time, and pressure (of the cyanogen).—Georges Darzens: A method of preparation of α substituted valerolactones. Alkylalkylacetic acids, a general method for the preparation of which is given, on heating to 90° C. with double their weight of 90 per cent. sulphuric acid, are converted into the α alkylvalerolactones.—M. Tiffeneau and Mlle. J. Lévy: The reality of the semipinacolic transposition: the comparative stability of the secondary and tertiary hydroxyl groups. The work of Daniloff on the transposition of trisubstituted aldehydes into ketones by the action of concentrated sulphuric acid throws some doubt on the reality of the semipinacolic transposition. Experiments on the dehydration of phenyldibenzl-, anisyldibenzyl-, and phenylethyl methyl-glycols, however, prove that there are real cases of semipinacolic transposition.—R. Fosse: The presence of allantoic acid in *Phaseolus vulgaris*. The presence of allantoic acid and the absence of uroxanic acid in this plant has been proved.—L. Longchambon: The constitution of chalcedonies and quartzines.—René Souèges: The embryogeny of the Papaveraceæ. The last stages of the development of the embryo in *Papaver Phocas*.—A. Demolon and E. Natier: The action of potassium chloride upon non-calcareous soils.—M. Doyon and I. Vial: The remarkable activity and nuclear origin of an anti-coagulating substance extracted from the mesenteric ganglia.—Raymond Hamet: The antagonism of atropine and adrenaline.—P. Portier and Mlle. de Rorthays. Researches on the load supported by the wings of Lepidoptera of different families.—Maurice Azema: The formation of the renal vesicles and the development of the kidney in *Ascidia mentula*.—Edouard Chatton and André Lwoff: The Synophrya, infusoria internally parasitic in crabs. Their evolution and place in the Fœttingeriidæ.—J. Wolff and J. Loiseleur: The biochemical oxidation of ferrous malate.—Gabriel Bertrand: Observations on the nature of ferrase and of certain oxydase systems with reference to the preceding paper.—A. Philibert and J. Risler: The action of neon light on bacteria.—E. Brumpt: The transmission of *Treponema crocidurœ* by two species of Ornithodorus (*O. moubata* and *O. Marocanus*).

CALCUTTA.

Asiatic Society of Bengal, Dec. 6.—T. V. Ramakrishna Aiyer: Notes on some Indian Lepidoptera with abnormal habits. Examples of moths or butterflies living in association with other insects seem comparatively rare. Some examples, mainly from South India, are: Butterflies—*Spalgius epius*, West; moths—various species of the noctuid genus Eublemma; family Epipyropidæ.—D. N. Majumdar: (1) The bigonial breadth of some Hos of Kolhan; (2) Death and connected ceremonies of the Hos of Kolhan and Singbhum.—Rev. H. Hosten, S.J.: (1) Fr. N. Pimenta's Annual Letter, Goa, Dec. 21, 1599. The history of contemporary events drawn from the early missionary reports. (2) Fr. N. Pimenta, S.J., on Mogor, Goa, 1st Dec. 1600. (3) Fr. N. Pimenta's Annual of Margaõ, Dec. 1, 1601. (4) Three letters of Fr. Joseph de Castro, S.J., and the last year of Jahāngīr, Aug. 24, 1626–Aug. 15, 1627. (5) Eulogy of Father Jerome Xavier, S.J., a missionary in Mogor, 1549–1617. (6) Some letters of Fr. Jerome Xavier, S.J., to his family, 1593–1612. (7) Some notes on Bro. Bento de Goes, S.J., 1583–1607.—Mohini Mohan Chatterji: (1) Brahmanism in Bengal. Gauda or Bengal from remote antiquity to modern times has contributed a distinct religious note, that of the combination of loyalty to Brahmanism with tolerance and universalism. (2) A study of some Bengali customs: (i) Survivals of group-marriage; (ii) Mock-marriage.

VIENNA.

Academy of Science, Nov. 25.—R. Weiss and P. Fastmann: Benzalaryl-phthalane and -naphthalane and the transformation of the former into di-substituted indone.—E. Späth and A. Burger: Opium alkaloids (vii.). Synthesis of laudanin and laudanidin.—R. Seka, O. Schmidt, and K. Sekora: Condensation products of pyro-mellithic acid anhydride.

WASHINGTON.

National Academy of Sciences (*Proc.*, vol. 12, No. 11, Nov.).—Leonard B. Loeb: Gas ion mobilities in ether-hydrogen mixtures. Measurements were made over the whole range of mixtures, 0–100 per cent. ether. At concentrations greater than 30 per cent. of ether the mobilities of both the positive and the negative ions follow the theoretical law of mixtures; with smaller concentrations the mobilities of the positive ions are abnormal, possibly suggesting the formation of labile clusters of ions.—Roy. J. Kennedy:

A refinement of the Michelson-Morley experiment (*v.* NATURE, Jan. 8, p. 64).—Paul S. Epstein: (1) On the evaluation of certain integrals important in the theory of quanta. A convenient expression is obtained for the integral which determines the matrix of the hydrogen atom, considering only the simple closed Kepler motion and neglecting relativity effect and spin of the electron. (2) The new quantum theory and the Zeeman effect.—R. M. Langer: The dispersion of atomic hydrogen. (1) A measure. A powerful discharge was passed through one tube of a pair constituting an interferometer containing hydrogen through which 'white-light' fringes were being observed. The shift of fringes at a given wave-length, together with the concentration of atomic hydrogen and index of refraction of molecular hydrogen, enables the dispersion of atomic hydrogen to be calculated. At about $\lambda = 6000$ Å.U., $\mu = 1{\cdot}000068$. The method involves certain assumptions, but is regarded as giving results of the right order. (2) A calculation. Attempts to adjust earlier dispersion formulæ to give the proper frequencies for anomalous dispersion lead to values of the index of refraction different from that obtained above.—H. B. Goodrich: The development of Mendelian characters in *Aplocheilus latipes*. There are four homozygous types of this Japanese freshwater fish: wild, yellow, white, and variegated. The colours are produced by three kinds of pigment cell, melanophores and brown and yellow chromatophores, which appear to be present in similar numbers in all four types and at the earliest stages of growth. The Mendelian gene appears to function by controlling the amount of melanin elaborated in cells which are always present.

Official Publications Received.

BRITISH AND COLONIAL.

Indian Problem and its Solution: a Letter by the Head of the Ahmadiyya Community to His Excellency the Viceroy and Governor-General of India. Pp. 31. (London: The London Mosque, Southfields, S.W.18.)

Transactions of the Buteshire Natural History Society (1925). Pp. 60+48 plates. (Glasgow and London: The Mann Publishing Co., Ltd.)

Aeronautical Research Committee: Reports and Memoranda. No. 1023 (M. 39): Some further Experiments on the Behaviour of Single Crystals of Aluminium under Reversed Torsional Stresses. By H. J. Gough, S. J. Wright and Dr. D. Hanson. Work performed for the Engineering Research Board of the Department of Scientific and Industrial Research. (B.1.a. Metals, 47.—T. 2166.) Pp. 13+8 plates. 1*s.* 3*d.* net. No. 1033 (Ae. 226): On the Advantages of an Open Jet Type of Wind Tunnel for Airscrew Tests. By H. Glauert and C. N. H. Lock. Pp. 10+3 plates. 9*d.* net. (London: H.M. Stationery Office.)

Address on 'The Dangers of Contraception,' delivered by Frederick J. McCann at the Caxton-Hall, London, on October 29th, 1926. Pp. 16. (London: League of National Life.) 6*d.*

The Marine Biological Station at Port Erin (Isle of Man): being the Fortieth Annual Report of the former Liverpool Marine Biology Committee, now the Oceanography Department of the University of Liverpool. Drawn up by Prof. Jas. Johnstone. Pp. 39. (Liverpool: University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd.) 1*s.* 6*d.* net.

The British Mycological Society. Transactions, Vol. 11, Parts 3 and 4, December. Edited by Carleton Rea and J. Ramsbottom. Pp. 169-311. (London: Cambridge University Press.) 15*s.* net.

New Zealand. Department of Lands and Survey: Scenery-Preservation. Report for the Year ended 31st March 1926, together with Statement of Accounts and Schedule of Lands Acquired and Reserved during the Year under the Scenery Preservation Act. Pp. 8. (Wellington, N.Z.: W. A. G. Skinner, 1926.) 6*d.*

Western Australia: Geological Survey. Bulletin No. 88: Palæontological Contributions to the Geology of Western Australia. Series 7, Nos. 13, 14 and 15. By Rex. W. Bretnall, F. Chapman and Ludwig Glauert. Pp. 72 (4 plates). Bulletin No. 91: The Auriferous Lodes of the Gibraltar District, Coolgardie Coalfield. By F. R. Feldtmann. Pp. 29+7 plates. (Perth: Fred. Wm. Simpson.)

Memoirs of the Department of Agriculture in India. Entomological Series, Vol. 9, No. 6: Studies on Indian Thysanoptera. By H. H. Karny. Pp. 187-239+plates 16-23. 1.8 rupees; 2*s.* 6*d.* Entomological Series, Nos. 7, 8, 9. No. 7: New Species of Indian Gall Midges (Itonididæ), by Dr. E. P. Felt; No. 8: New Indian Geometridæ, by Lewis B. Prout; No. 9: Description of *Laspeyresia stirpicola*, n.sp. (Lepidoptera), by E. Meyrick; with a Short Note on the Life-History and Status, by Rai Bahudur C. S. Misra. Pp. 241-260+plate 24. 5 annas; 6*d.* (Calcutta: Government of India Central Publication Branch.)

Proceedings of the Royal Society of Edinburgh, Session 1925-1926. Vol. 46, Part 3, No. 28: Researches into the Characteristic Numbers of the Mathieu Equation (Second Paper). By Dr. E. L. Ince. Pp. 316-322. 9*d.* Vol. 46, Part 4, No. 29: On the Cardinal Function of Interpolation-Theory. By W. L. Ferrar. Pp. 323-333. 1*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Proceedings of the Thirteenth Indian Science Congress (Bombay, 1926). Pp. xxiii+405. (Calcutta: Asiatic Society of Bengal.)

Records of the Botanical Survey of India. Vol. 9, No. 5: Mosses collected in Gilgit, etc., by J. Garrett and W. Lillie. By H. N. Dixon. Pp. 303-313+1 plate. (Calcutta: Government of India Central Publication Branch.) 8 annas; 10*d.*

FOREIGN.

Proceedings of the United States National Museum. Vol. 69, Art. 12: New Land and Fresh-Water Mollusks from Central and South America. By William B. Marshall. (No. 2638.) Pp. 12+3 plates. (Washington, D.C.: Government Printing Office.)

Instituto Geográfico y Catastral. Anuario del Observatorio Astronómico de Madrid para 1927. Pp. 528. (Madrid.)

The Rockefeller Foundation. Annual Report, 1925. Pp. xi+521 (43 plates). (New York City.)

Department of Commerce: Bureau of Standards. Technologic Papers of the Bureau of Standards, No. 325: Recent Developments in Lamp Life-Testing Equipment and Methods. By J. F. Skogland and R. P. Teele, Jr. Pp. 681-702+5 plates. (Washington, D.C.: Government Printing Office.) 15 cents.

Smithsonian Institution: United States National Museum. Bulletin 100, Vol. 6, Part 2: Contributions to the Biology of the Philippine Archipelago and Adjacent Regions. Additions to the Polychætous Annelids collected by the United States Fisheries Steamer *Albatross*, 1907-1910, including one New Genus and three New Species. By A. L. Treadwell. Pp. 181-193. (Washington, D.C.: Government Printing Office.)

Proceedings of the United States National Museum. Vol. 69, Art. 8: Crustaceans of the Orders Euphausiacea and Mysidacea from the Western Atlantic. By Walter M. Tattersall. (No. 2634.) Pp. 31+2 plates. Vol. 69, Art. 23: Cymbidium, a New Genus of Silurian Pentameroid Brachiopods from Alaska. By Edwin Kirk. (No. 2649.) Pp. 5+1 plate. (Washington, D.C.: Government Printing Office.)

New York Academy of Sciences. Scientific Survey of Porto Rico and the Virgin Islands. Vol. 4, Part 1: Geology of the Virgin Islands, Culebra and Vieques. Introduction and Review of the Literature, by James F. Kemp; Physiography, by Howard A. Meyerhoff. Pp. 141. (New York City.)

Appendix No. 2 to the Annual Report of the Chief of the Bureau of Navigation, 1926: Annual Report of the Naval Observatory for the Fiscal Year 1926. Pp. 19. (Washington, D.C.: Government Printing Office.)

Journal of the Faculty of Science, Imperial University of Tokyo. Section 2: Geology, Mineralogy, Geography, Seismology. Vol. 2, Part 1: The Tazima Earthquake of 1925. By Dr. Bundjirô Kotô. Pp. v+75+8 plates. (Tokyo.) 2.50 yen.

CATALOGUES.

The Book: its Authors, Printers, Illustrators and Binders; also a Selection of Memoirs and Autograph Letters of Literary Personalities. (No. 490.) Pp. 60. (London: Francis Edwards.)

Classified List of Second-hand Scientific Instruments. (No. 89.) Pp. vi+58. (London: C. Baker.)

Heat Treatment Bulletin No. 37: Theory and Practice in the Hardening Shop. Pp. 5. (London: Automatic and Electric Furnaces, Ltd.)

Diary of Societies.

SATURDAY, JANUARY 22.

BRITISH MYCOLOGICAL SOCIETY (in Botanical Department, University College), at 11 A.M.—W. Buddin and Miss E. M. Wakefield: Studies on *Rhizoctonia Crocorum* and *Helicobasidium purpureum*.—E. W. Mason: On the Naming of a Dark Spored Hyphomycete.—J. Ramsbottom: Fragmenta Mycologica V.—Miss K. Sampson: Anthracnose Diseases of Red Clover.—R. C. Woodward: Studies on Apple Mildew.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. W. Tristram: English Medieval Wall-Painting.

PHYSIOLOGICAL SOCIETY (at National Institute for Medical Research, Hampstead), at 3.30.—Demonstrations by Prof. L. Hill: Measurement of Capillary Pressure in the 3rd day Chick-Embryo.—J. A. Campbell: Chamber for Continuous Exposure to High and Low Percentage of Oxygen.—T. Angus: Apparatus for Studying the Arc-lamp as a Source of Ultra-violet Radiations.—H. W. Dudley: Apparatus for Working up Tissue-extracts on an Intermediate Scale.—Dr. H. H. Dale and A. N. Richards: Continuous Record of Oxygen Absorption by Small Animals.—W. Feldberg: Histamine Vasodilatation in the Rabbit.—R. Bodo and H. P. Marks: Aseptic Perfusion of Isolated Heart.—Papers by Prof. H. S. Raper: Indole Derivatives from Tyrosine.—Dr. G. V. Anrep and R. Kinosita: The Influence of Mechanical Factors of the Circulation upon the Diastolic Volume of the Ventricles.—Prof. R. J. S. McDowall: The Relation of Alkali to the Parasympathetic (Preliminary Communication).—M. A. Battie and Prof. R. J. S. McDowall: The Effect of Alkali on the Blood Sugar.—K. Furusawa and P. M. T. Kerridge: The Buffering Power of the Uterus of the Cat.—J. A. Campbell: Effects of Exposure to Low Tensions of Air and Oxygen.—C. H. Best, Dr. H. H. Dale, H. W. Dudley, and W. V. Thorpe: Histamine, the Vasodilator Principle of Extracts from the Lung.—Dr. H. H. Dale and A. N. Richards: The Vasodilator Action of Small Doses of Adrenaline.—Prof. L. Hill: The Biologically Active Rays of Sunlight.—Dr. G. A. Clark: The Immediate Effect of Vagus Section on Blood-Sugar Level.—E. M. Boock, J. H. Burn, and

J. W. Trevan: The Accuracy of the Assay of Strophanthus and Squill by Different Methods.—J. H. Burn and J. M. Ellis: The Amount of Specific Alkaloid in Different Samples of Ergot, assayed by Clark's Method.

HULL ASSOCIATION OF ENGINEERS (at Hull Municipal Technical College), at 7.15.—G. F. O'Riordan: A Two Years' Retrospect.

MONDAY, JANUARY 24.

ROYAL IRISH ACADEMY, at 4.15.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—A. R. Normand, J. D. Ross, and E. Henderson: The Distribution of Intensity in the X-Ray Spectra of the Normal Saturated Dicarboxylic Acids, their Diethyl, and Mono-Ethyl Esters.—W. J. McCallien: The Geology of Gigha.—Prof. H. Briggs: Rock-Faulting from the Engineering Standpoint.

INSTITUTION OF AUTOMOBILE ENGINEERS (Loughborough Graduates' Meeting) (at Loughborough College), at 7.—Mr. Short: Carburettors.

INSTITUTION OF ELECTRICAL ENGINEERS (Informal Meeting), at 7.—M. Whitgift and others: Debate on The Electricity Bill.

INSTITUTION OF ELECTRICAL ENGINEERS (Mersey and North Wales (Liverpool) Centre) (at Liverpool University), at 7.—J. Firth and F. Buckingham: The Electrical Equipment of Large Buildings.

INSTITUTION OF ELECTRICAL ENGINEERS (North-Eastern Centre) (at Armstrong College, Newcastle-upon-Tyne), at 7.—Col. E. Mercier: Notes on the 60,000-Volt Underground Network of the Union d'Electricité.—P. Dunsheath: 33,000-Volt Cables with Metal-Sheathed Cores, with special reference to the S.L. Type.

INSTITUTION OF MECHANICAL ENGINEERS (Graduates' Section, London), at 7.—Major A. R. Valon: Mechanical Engineering in the Army in Relation to the Duties of an Ordnance Mechanical Engineer (Lecture).

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—H. H. Price: Mill's Theory of the External World.

ROYAL SOCIETY OF ARTS, at 8.—Dr. L. C. Martin: Recent Progress in Optics (Cantor Lectures) (2).

BRITISH MEDICAL ASSOCIATION, at 8.—Sir Berkeley Moynihan: Cancer and how to fight it (Hastings Lecture).

ROYAL SOCIETY OF MEDICINE (Odontology Section), at 8.—Dr. J. H. Maclean: The Bacteriology of Dental Caries.—Prof. H. P. Pickerill: Non-eruption of Teeth.

MEDICAL SOCIETY OF LONDON, at 8.30.—Pathological Evening.

ROYAL GEOGRAPHICAL SOCIETY (at Æolian Hall), at 8.30.—J. M. Wordie: The Cambridge Expedition to East Greenland.

INSTITUTE OF CHEMISTRY (Leeds Area Local Section).—Prof. J. W. Cobb: The Training of a Fuel Chemist.

TUESDAY, JANUARY 25.

ROYAL SOCIETY OF ARTS (Dominion and Colonial Meeting), at 4.30.—B. H. Morgan: The Sugar Resources of the British Empire.

ROYAL SOCIETY OF MEDICINE (Medicine, Surgery, and Laryngology Sections), at 5.—Dr. L. S. T. Burrell, Dr. F. Chandler, Dr. G. Marshall, and Dr. K. D. Wilkinson (*Medicine*), T. Edwards, J. E. H. Roberts, and H. S. Souttar (*Surgery*), G. E. Martin, C. A. S. Ridout, and V. E. Negus (*Laryngology*): Special Discussion on The Treatment of Chronic Non-tuberculous Infection of the Lungs.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—Prof. R. Whytlaw Gray: Smokes as Aerial Disperse Systems (2).

INSTITUTION OF ELECTRICAL ENGINEERS (North Midland Centre) (at Hotel Metropole, Leeds), at 7.—Prof. W. M. Thornton: What is Electricity? (Faraday Lecture).

INSTITUTION OF ELECTRICAL ENGINEERS (North-Western Centre) (Informal Meeting) (at Engineers' Club, Manchester), at 7.—J. H. Reyner: Recent Developments in Radio Reception.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN (Scientific and Technical Group), at 7.—Exhibition and Demonstration of Apparatus used in the Testing of Photographic Products, etc.:—Dr. F. C. Toy: A New Photo-electric Photometer.—S. O. Rawling: (*a*) An Electrode Vessel Jacketed for Use at Various Temperatures; (*b*) Method for Coating Photographic Emulsions as Single Layer Plates Without Dilution.—A. S. Newman: (*a*) A New Design of Microscope; (*b*) Apparatus for General Laboratory Use; (*c*) Sundry Workshop Appliances.—F. F. Renwick: A Turbidimeter for Use with Photographic Emulsions.—B. Farrow: An Apparatus for Determining the Relative Exposures with Various Light Filters.—R. Davies: A Selenium Cell Photometer Adapted for the Determination of Reflection Densities with an Automatic Curve Plotting Device.—T. Thorne Baker: Apparatus for the Telegraphic Transmission of Photographs, at Work over an Artificial Line Equivalent Electrically to Paris-London.—W. A. Balmain and L. F. Davidson: An Intensity Scale Apparatus Improved so as to render it possible to Expose Several Strips of Plates Simultaneously.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND (at 39 Elmbank Crescent, Glasgow), at 7.30.—Rev. R. R. Hyde: The Development of Industrial Welfare Work.

ROYAL ANTHROPOLOGICAL INSTITUTE (Anniversary Meeting), at 8.30.—H. J. E. Peake: The Beginnings of Civilisation (Presidential Address).

WEDNESDAY, JANUARY 26.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (in Demonstration Room, A 1, Science Museum, South Kensington), at 5.30.—A. Titley: Trevithick and Rastrick and the Single Acting Expansive Engine.—Rhys Jenkins: A Note on Newcomen's Handwriting.

INSTITUTION OF AUTOMOBILE ENGINEERS (North of England Centre) (at Engineers' Club, Manchester), at 7.—Prof. W. Morgan: The Optical Indicator as a Means of Examining Combustion in Internal-Combustion Engines.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (Graduate Section) (at Newcastle-upon-Tyne), at 7.15.—J. E. Conner: The Erection of a Rotary Portland Cement Kiln.

INSTITUTION OF AUTOMOBILE ENGINEERS (Wolverhampton Centre) (at Engineering and Scientific Club, Wolverhampton), at 7.30.—G. Rushton: The L.G.O.C. Methods of Repairing Motor Omnibuses.

SOCIETY OF CHEMICAL INDUSTRY (South Wales Section) (at University College, Swansea), at 7.30.—Capt. J. R. Green: Quantitative Spectrographic Analysis in Metallurgy.

ROYAL SOCIETY OF ARTS, at 8.—F. W. Spencer: British and American Practice in Hot and Cold Working of Metals.

FARADAY SOCIETY (at Chemical Society), at 8.—J. B. O'Sullivan: The Behaviour of the Quinhydrone Electrode in Solutions of Neutral Copper Sulphate.—W. Taylor: The Actinic Absorption of Chlorine Gas with Respect to the Hydrogen Chlorine Reaction.—W. Taylor and A. Elliott: The Residual Effect in the Actinic Absorption of Chlorine.—W. R. Harrison and E. P. Perman: Vapour Pressure and Heat of Dilution of Aqueous Solutions. Part II.—N. A. de Bruyne and R. W. W. Sanderson: The Electrostatic Capacity of Aluminium and Tantalum Anode Films.—G. A. Elliott, S. S. Joshi, and R. W. Lunt: On the Velocity of Chemical Reaction in the Silent Electric Discharge.—G. A. Elliott: The Activation of Hydrogen in the Electric Discharge.—C. C. Tanner: The Soret Effect.—H. I. Downes and E. P. Perman: An Improved Method of Measuring Vapour Pressure by Air Bubbling.

BRITISH PSYCHOLOGICAL SOCIETY (Medical Section) (at Royal Society of Medicine), at 8.—Dr. T. S. Good: An Attempt to Investigate and Treat Cases of Psycho-neuroses and Psychoses at an Out-Patient Clinic; followed by a discussion by Dr. E. Mapother, Dr. H. Crichton Miller, Dr. J. Rickman, and others.

EUGENICS SOCIETY (at Royal Society), at 8.30.—H. Macdonald: Social Distribution of Intelligence.

INSTITUTION OF MECHANICAL ENGINEERS (Sheffield Branch) (at Sheffield).—E. W. Tipple: Machine Tools.

THURSDAY, JANUARY 27.

ROYAL SOCIETY, at 4.30.—L. A. Harvey: The History of the Cytoplasmic Inclusions of the Egg of *Ciona intestinalis* (L.) during Oogenesis and Fertilisation.—S. Dickinson: Experiments on the Physiology and Genetics of the Smut Fungi. Hyphal Fusion.—Dr. J. W. H. Harrison: Experiments on the Egg-laying Instincts of the Sawfly *Pontania salicis* Christ. and their Bearing on the Inheritance of Acquired Characters, with some Remarks on a New Principle in Evolution.—S. A. Asdell and Dr. F. H. A. Marshall: The Effect of the Ovarian Hormone in producing pro-Œstrous Development in the Dog and Rabbit.—E. Ponder: The Measurement of Percentage Haemolysis. II.

ROYAL INSTITUTION OF GREAT BRITAIN, at 5.15.—J. R. H. Weaver: Romanesque and Early Pointed Architecture in Spain (2).

SOUTH LONDON ENTOMOLOGICAL AND NATURAL HISTORY SOCIETY, at 7.—Annual Meeting.

INSTITUTION OF AUTOMOBILE ENGINEERS (Luton Graduates' Meeting) (at Luton), at 7.30.—G. L. Ensor: A Practical Experience of the Single Sleeve Valve Principle.

FRIDAY, JANUARY 28.

ROYAL SOCIETY OF ARTS (Indian Section), at 4.30.—Sir Leonard Rogers: The Forecasting and Control of Cholera Epidemics in India.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (at Newcastle-upon-Tyne), at 6.—G. S. Baker: The Economy of Tank Testing of Ship Forms and Research in Ship Propulsion.

INSTITUTION OF LOCOMOTIVE ENGINEERS (Manchester Centre) (at College of Technology, Manchester), at 7.—S. Symes and others: Discussion on Mass Production as applied to the Repairing of Locomotives.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—H. Lambert: Lighting in Portraiture.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE (at Royal Technical College, Glasgow), at 7.—Sir William Larke: Address.—Prof. A. L. Mellanby and Prof. W. Kerr: Use and Economy of High Pressures in Steam Plants.

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—C. E. Atkinson: The Design of High Tension Sub-stations.

ROYAL SANITARY INSTITUTE (in Small Town Hall, Reading), at 7.30.—Discussion on Cancer:—Sir Stewart Abram: From the Point of View of the Physician and the Public Authority.—Dr. T. S. Keith: Cancer Research To-day.—J. L. Joyce: The Present Position of the Treatment of Cancer.

ROYAL INSTITUTION OF GREAT BRITAIN, at 9.—Prof. E. P. Cathcart: The Physique of Women employed in Industry.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY (Chemical Section).

SATURDAY, JANUARY 29.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (at Neville Hall, Newcastle-upon-Tyne), at 3.—P. F. Hope: Steam and Electric Locomotives for Colliery Purposes.

ROYAL INSTITUTION OF GREAT BRITAIN, at 3.—Prof. E. W. Tristram: English Medieval Wall-Painting (2).

PUBLIC LECTURES.

SATURDAY, JANUARY 22.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Mrs. H. M. Dunn: Benares, the Sacred City.

SUNDAY, JANUARY 23.

GUILDHOUSE (Eccleston Square), at 3.30.—S. N. Mallik: Hinduism.

MONDAY, JANUARY 24.

UNIVERSITY COLLEGE, at 6.—Dr. H. D. Jennings White: Science and Poetry.

THURSDAY, JANUARY 27.

KING'S COLLEGE, at 5.30.—Dr. F. A. P. Aveling: The Mind: Psychology.

NORTHAMPTON POLYTECHNIC INSTITUTE, at 7.—R. Genders: Steel and its Thermal Treatment: The Heat Treatment of Carbon Steels.

FULHAM CENTRAL PUBLIC LIBRARY, at 8.—A. S. E. Ackermann: Popular Fallacies.

SATURDAY, JANUARY 29.

HORNIMAN MUSEUM (Forest Hill), at 3.30.—Miss M. A. Murray: Some Invasions of Ancient Egypt.