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The Protection of Nature in Britain.

THE conscience of the people is gradually awakening to the full value of Britain's natural possessions. It is beginning to be realised that, beyond the sphere of commercial values, there is to be reckoned an æsthetic value, an appraisement of beauty and of the springs of spiritual uplift; that in her Nature monuments, in her native animals and plants, Britain possesses an unique and priceless heritage. But so much of this great heritage has already been dissipated, through lack of foresight rather than through ill-intent, that a grave duty lies upon our generation to see that the forces of destruction are restrained and replaced by a wise policy of conservation. We are glad, therefore, that the British Association has taken up the matter, and has recently brought together representatives of a number of learned societies and other bodies to discuss the need for further protection of sites of historic or scientific interest, or of natural beauty, against disfigurement or obstruction (see NATURE, March 29, p. 476).

In Britain the awakening to a sense of the æsthetic values of Nature has been a slow process. It is true that the law as a rule lags behind public opinion, but even so it is surprising to find that, while animals have been protected for sport or for their commercial value almost from time immemorial, it was not until 1880 that Britain took legal steps to protect creatures "attractive in appearance or cheerful in song," as the Nebraskan law puts it; and the law of 1880 protected only birds. Many nations have outstripped Britain in this respect. The International Convention for the Protection of Birds useful to Agriculture was subscribed in Paris, in 1902, by Austria-Hungary, Germany, Belgium, Spain, France, Greece, Portugal, Sweden, Norway, and Switzerland, but the Government of the United Kingdom held aloof from this treaty, in spite of its declared economic purpose.

In June 1923 a further International Congress was held in Paris, "pour la Protection de la Nature (Sites et Monuments Naturels)" (see NATURE, July 21, 1923, p. 115), and the more general protection of Nature advocated at that gathering suggests a cursory examination of the steps taken by British law for the conservation of the people's natural heritage.

Almost the only body of law specially concerned with the protection of Nature in Britain is to be found in the Wild Birds Protection Acts of 1880 to 1908. With the detailed aspect of these we do not propose to deal; it is sufficient to say that, while they have produced many excellent results, the present laws (nine in number) are cumbersome, often ineffective, and in their application sadly lacking in uniformity. A fresh Bill, to take the place of the old Acts,

successfully passed through the House of Lords, under the guidance of Viscount Grey of Fallodon, in 1923, but it did not reach the House of Commons. May we express the hope that this democratic measure, a fair compromise between utilitarian and non-utilitarian interests, aiming at the protection of the bird-life of Britain for the people, may speedily be taken in hand by the legislators now in office?

There is one aspect of the Wild Birds Acts, however, to which attention should be directed, for it set in force a method to the development of which Nature-lovers look as the most promising means of preserving a representation of the native fauna. By the Acts of 1894 and 1896, the law empowered the central authority to specify particular areas where all birds and all birds' eggs were to be absolutely protected. The Government, at the request of a county council, was prepared to delimit a bird sanctuary, but it was not prepared sufficiently to protect it. The result was often deplorable. The Chief Constable of Lancashire stated before the Departmental Committee of 1913, that the County Council "made a sanctuary [at Formby], and as soon as that was done every hunter went there and, naturally, tremendous damage was done—far more than if it had been left alone." It would appear that so long as the greed of collectors outruns their sense of public duty, the creation of sanctuaries must entail a serious financial obligation, which so far has been met by private generosity and by the praiseworthy efforts of organised bodies, such as the Selborne Society, the Royal Society for the Protection of Birds, and the Society for the Promotion of Nature Reserves. Each of these has spent very considerable sums of money in purchasing or leasing, and afterwards protecting, areas suitable for somewhat limited Nature reserves, or in providing watchers to guard special bird-breeding areas during the nesting season. But this is very different from the state of affairs in the United States of America, or in Canada, South Africa, and other British colonies.

Recently the Government has taken a further, welcome but timorous, step. It has created several sanctuaries of its own, setting aside ponds and shrubberies in certain of the London Royal Parks for the accommodation and nesting of native birds. Such areas in populous centres may preserve the commoner birds for the delectation of the public, but they can do little for the protection of the rarer birds the safety of which is most in jeopardy. A more promising area, Duddingston Loch, in the King's Park, within the bounds of greater Edinburgh, has recently been handed over to the Government for the purposes of a sanctuary, through the generosity of a private donor. These are excellent steps, full of promise, but they fall far short of the action already taken by many governments throughout the world, for the preservation of native animals and for the pleasure and education of the present population and their successors.

Curiously enough, practically all the legal efforts made in Britain for the protection of native creatures have been directed to the preservation of birds. Yet many British mammals stand in equal need of protection. At the present moment the wild cat, the pine-marten, the polecat, and the grey seal all stand perilously near the brink of the precipice of extermination. It is true that in 1914 an Act for the protection of the grey seal was passed, creating a close season from October 1 to December 15, the period when the females are on shore with their cubs. But if the reports that reach us regarding the slaughter still carried on, for the sake of a few poor pelts and a little oil, are correct, the species in Britain is being driven headlong to destruction. As for the other mammals, no hand has been raised to stop a persistent trapping and slaughter, which ere long will deprive the country of almost the last relics of the larger representatives of the ancient native fauna of the land.

We have said nothing about the preservation of the lower creatures, such as butterflies, of the native flora and of Britain's "Nature sites and monuments." But is there anything to be said? So far as we know, the law takes no interest in the matter, and rare plants may be stripped from their haunts and the haunts themselves may be destroyed (as has recently happened through the quarrying of road metal at Blackford Hill near Edinburgh) in spite of the appeals and protests of local scientific societies and others.

This is not as it should be. Destruction of this kind can never be made good—the disappearances, however much they may be regretted in later years, can never be replaced. Something has been done for the ancient monuments of man, and the official Ancient Monuments Commission is to be congratulated on the success of its efforts to preserve for future generations the architectural relics of the former inhabitants of Britain from the Stone Ages downwards through time. But the ancient monuments of Nature are left unguarded. Our suggestion is that a Commission, with powers equivalent to that of the Ancient Monuments Commission, should be appointed to watch over the welfare of the Nature monuments of Britain and its native fauna and flora—a "Nature Monuments Commission." The Wild Birds Advisory Committees, recently appointed to advise the Home Secretary and the Secretary for Scotland, are a step on the way, but they deal only with birds; and there are other members of the fauna and of the flora, as well as "sites et monuments naturels," in equal jeopardy.

The Visioning of Science.

The Story of a Great Schoolmaster: being a Plain Account of the Life and Ideas of Sanderson of Oundle. By H. G. Wells. Pp. vi+151+3 plates. (London: Chatto and Windus, 1924.) 4*s.* 6*d.* net.

IN his interpretative biography of Sanderson, the "great schoolmaster" who made Oundle, for his generation, what Rugby was to that of Thomas Arnold, or Uppingham to that of Thring, Mr. H. G. Wells, with his customary penetration and lucidity, disentangles the main problem that emerges from this latest phase of progressive education. The last two or three years of Sanderson's life were increasingly directed towards conceiving and building a Hall of Scientific Vision. He imagined it as the culminating edifice of all the secular buildings that house the everyday life and work of the school world. It was to pair with the School Chapel as crown and completion of those symbolic structures that link youth and age in the flowing generations. The scientific vision and the religious vision were to unite in the fullness of life perfected for boyhood and youth. How to fashion a new temple of science, true and worthy of its own tradition, yet harmonious with all that is ennobling in the vision of the old faith? To this issue Sanderson gave his last years, and his tragic death in full career left it as a legacy to those concerned with the advancement of ideals through education.

The problem of integrating the facts of science with the "values" of religion implies a prior solution of many puzzling enigmas; and above all, it implies the correlation of science with history, as Sanderson increasingly saw and stressed. But in his busy life at Oundle, he remained isolated from those newer schools of evolutionary doctrine, which are assiduously at work upon this and related problems. Let us try to sketch, in barest outline, their possible contribution to Sanderson's task of conceiving, planning, furnishing, a Hall of Vision, at once scientific, historic, futurist.

These newer evolutionists begin to glimpse, from their synthetic view-point of science and history, a whole Pageant of Vision, and, moreover, one shadowed forth in well-ordered sequence. For them there is, first, the ever-widening tale of evolution, and its procession of Nature's energies, as it were a world-play or cosmodrama.[1] Therewith unfolds a further tale of ever-opening secrets, those of the application of Nature's resources and energies to man's use; this is, as it were, the great play of labour, or technodrama. With these two approaches towards unity, more commonly described as sciences physical and natural, pure and applied, not a few, even amongst men of science, remain satisfied, and so tend to stop short of real vision. There is, of course, also the story of life's struggles, in hunger and beyond, to sex and dawning love and care of offspring: hence man's rise from the brute, to higher groupings; first of family, gens, and tribe, of cavern and hut-group to village; then to town and city, to nation and empire, in a word to ordered civilisations. Here is the life-play, or biodrama; at least its first chapter, that of the play of selfdom, or autodrama, and with much of psychodrama, or soul-play, as well.

This psychodrama, or soul-play, does not end here: it begins anew; it takes lead and command, and henceforth no longer merely obeys natural conditions and simply natural impulses, but strives to control and direct them. Under this new imperative and guidance the autodrama, with its interests profoundly centred upon self and kin, however combined in an enlarging and more corporate self, deepens its primal impulses and motives, of nutrition and reproduction, hunger and love, self-regarding and species-regarding, but transposes that order of them. Henceforth in the individual life and its pairings, through offspring and race, the emphasis becomes transformed: love now overpowers hunger, to the subordination, and, if need be, even the sacrifice, of the individual life itself.

It follows that ethics is not, as it seemed to Huxley, something external to life; and to be super-induced artificially so far as may be. The other-regarding instinct, the altruist impulse, is thus seen as the very secret of life, plain within the evolution of animal life, the mammals for conspicuous instance; and deep within the flower, the sex secret of which, though seemingly so obvious, yet remains unpopularised, and inadequately emphasised in most theories of organic evolution. To this more intimate understanding of flowers even Darwin himself never really came, despite all his loving observation of their external aspects and relations in field and garden. Through such limitations his great theory, and with it most current biology, has remained but that of an autodrama of life, and has fallen short in discernment of that other-regarding factor, which is the profounder guiding secret of life's evolution, organic, human, and social. Out of this deep source, this transposition of the urge of life-impulses from the fundamental needs of simple nutrition to the supreme call of reproduction and sex, come the flower's beauty, the bird's song, the lover's lyric. From this elemental and organic process of real metamorphosis, or, as one might say, of true conversion, issues the universally human impulse of religion with its mystic and prophetic chants, of love, of faith, of

[1] The concept of science as presenting a dramatic interplay of three correlated unities—the World-process, the Life-process, the Social-process—has been vividly worked out by Prof. Patrick Geddes, as his many students know. It is as one of those students that the writer here sketches the visioning of science.

hope, life triumphant over death. Autodrama is fundamentally but of the creeping and caterpillar phase of life, in hunger and struggle and danger, in growth and development, individual and alone; yet its chrysalis-sleep and transformation, up to its emergence as winged Psyche with the life of mating predominant over nectar-seeking, is also a natural process. Thus the evolutionary sciences, at once organic and psychic, meet the religions in mutual interpretations. Already, indeed, they are rising together, into what is at once science and religion. Their joint process, at once intellectual and emotional, we may call ethodrama.

But the autodrama and the ethodrama, as we see (and share) them in the world, are so far at strife. Their views of the cosmodrama differ, their grasps upon the technodrama also, indeed yet more. Hence, fresh struggles for existence, new tragedies in evolution. In the simpler world of life around us, we call this interplay (with Hæckel) "ecology," or (with Ray Lankester) "bionomics," each word but derived, though at opposite ends, from the "economics" of man's own toil and effort, day by day. Given such evolutionary outlook, it naturally comes about that all active schools of social thought increasingly combine their economics with history; and see the social process not as a succession of catastrophes and escapes, but with a uniformitarianism as of the geologist, a product of everyday life and labour.

The chequered pages of history become but the material of a further and yet more difficult interpretative vision. They have thus once again suggested great yet imperfect philosophies of history; which now are seen more and more as the stuff of a needed science of history. Not merely as annals, nor as an empiric and encyclopædic recording of events, nor even as psychologic readings of individual and incidental motives, a science of history interprets all these annals and stories as a mighty tree of becoming. Its modes of growth and branching are increasingly discerned; and even set forth, in their essential progressions, as the *arbor sæculorum*.

A philosophy of history, yet of no mere philosophic abstractions, like those metaphysical philosophies which have passed away, but of scientific character and verifiability, has indeed been in progress since the beginnings of sociology. But, as yet, insufficiently do these initiatives of science and history move forward in unison. They need to grow together, alike in clearness and unity, yet in vivid presentment as well. Presentment how? As essential history. The pageants of civilisations and their religions, of their cities, nations, empires, for the halls and avenues of state; and the miracle plays of religions and their cultures for temple-courts and cathedrals—all these renewals of evocative ritual are preparing. The newer evolutionists are labouring towards great issues. They foresee, and would get ready for, a time when the stately procession of philosophies, the varied masques of learning, the quests of the sciences, the anthologies of muse-inspired literatures, the joyous triumphs and mysteries of the arts, will be schemed not only in our universities and rehearsed in our cloisters, but also replanned in our studios and enacted in our theatres. For staging of these great spectacles and their due expression in song, and dance, and music, pioneers are emerging; and Sanderson was type and protagonist of this militant order. As they come into power, these evolutionary educationists will train up affirmative personalities eager and skilled to set forth, and before the people, in home, school, and street, in park, amphitheatre, and temple, the pageant of man and his world, in their origins, being, and becoming. Yet all these histories and mysteries, these tragedies and comedies, are only partial visions; they are still but the material for that fuller ideal vision, which every man in measure may reach, yet none but the gods fully attain, that of the chronodrama, the comedy divine yet human, of which the whole evolution of humanity, so far, is but the earnest and the beginning.

Here we touch the transcendences. For further advance in the visioning of fulfilments we need the collaboration of the orchestrated arts. For we have passed beyond the limits of history. We are no longer in the toil and effort of life, with its unrehearsed struggles, unpremeditated sacrifices, unorganised victories. We celebrate anew the explorations and adventures of the spirit creative, and now with skilled foresight and resolute hope. Our chronodrama, and with it all the preceding dramas of Nature and labour, of selfdoms and their transformation, have thus been uniting into the drama of creative art. For this climax of his vision the newer evolutionist needs a Greek term to round off the nomenclature of his sixfold synthesis. Terms like æsthetodrama, temenodrama, symbolodrama, all suggest themselves, but without conclusive appeal.

Clearly at this point it is for poet and artist to take up the tale of unfolding vision, and with them, their quondam ally the priest. Return then to our opening text. Towards solving that problem which, for Sanderson, was the supreme issue in education, men of science will contribute in measure that they sympathetically understand, and so make ready to co-operate with, not only poet and artist, but also priest and prophet. Yet a traditional barrier stands in the way. In his would-be rôle of seer, the man of science suffers a disabling handicap. He lacks as yet any adequate theory of evil, and its devastating part in arresting the

evolution of man, and checking, even reversing, his ascent. This defect of science is more than merely negative. The failure of science, so far, to develop a social pathology is accompanied by a great refusal. Pride and prejudice have hitherto debarred the man of science from serious study of the central processes of religion. He has scornfully ignored the religious conception of sin as pollution of the inner life, and has explained away the purificatory rites of the sacramental office, with its consequent liberation of creative energies joyously militant. It was no romantic or sentimental attitude towards this central tradition of religion, but experience and grasp of its vital efficacy, that impelled Sanderson to labour for integration of his School Chapel and Hall of Vision. The underlying problem of synthesis baffled him, for the sufficient reason that, as yet, official science is devoid of vision, and ecclesiastical vision is empty of science. V. B.

Planck's Law and its Present-day Significance.

Vorlesungen über die Theorie der Wärmestrahlung. Von Prof. Dr. Max Planck. Fünfte, abermals umgearbeitete Auflage. Pp. x+221. (Leipzig: J. A. Barth, 1923.) Grundzahl: 7 marks.

THE fifth edition of Planck's "Wärmestrahlung" differs essentially from the fourth only in the almost complete expulsion of what is known as Planck's "second form" of the quantum theory. According to the second form, energy was absorbed continuously but emitted discontinuously. It was a kind of half-way house between the classical theory and the theory of the actual existence of stationary states. From its nature the second form of the quantum theory could scarcely be disproved by any phenomena involving radiation, however unlikely it might be that the facts of line spectra could be reconciled with it; for in such phenomena the stationary states only manifest themselves at the instant of their metamorphosis into different stationary states. But the fundamental experiment of Gerlach and Stern, in which silver atoms deflected in a non-uniform magnetic field were found to assume definite spatial orientations, showed that at least in one case stationary states are realised in Nature, and it is specially with regard to this evidence that Planck has now abandoned the second form. Such a step, made by its founder, marks the complete emergence of the quantum theory from its period of adolescence.

The main change in the successive editions of Planck's famous treatise occurred from the third edition (1912) to the fourth edition (1921). It is fair to say that that change in the formal development of the law of black radiation, with its shedding of inessentials and its closer association with the ideas of Bohr and Einstein, is insufficiently appreciated in Great Britain. The deduction necessarily consists of the same two parts, thermodynamics and probability on one hand and a study of the actual mechanisms of the interchange of energy on the other. But the former is considerably more systematised, and the latter is now a development of Einstein's deduction of the radiation law, refined so as to provide a precise evaluation of a certain coefficient by imposing an agreement with the classical theory for large quantum numbers.

In the thermodynamic part, the determination of the relative probabilities of systems represented by different parts of the phase-space involves the identification of a certain parameter with the temperature. Here it is possible to criticise Planck's procedure, in accordance with the work of Darwin and Fowler. Planck identifies entropy with the logarithm of the nebulous "thermodynamic probability" on somewhat mystical grounds, and uses this to introduce the temperature. All that is really necessary, when the probabilities have been calculated, is to observe that a certain integrating factor which discloses itself is defined by classical thermodynamics to be the reciprocal of the temperature. We may then, if we like, construct a "Zustandsumme" and show that this has the properties of the free-energy function of thermodynamics, but neither it nor entropy play any part in the subsequent analysis.

In the second part of the deduction Planck gives parallel treatments for ideal linear oscillators and ideal rotators, and sketches the treatment for ideal Bohr atoms. According to the classical theory, a certain number of the systems of any of these kinds which at any instant lie inside a given region of the phase-space will at any subsequent moment have moved into any other given region, partly in virtue of their own loss of energy by radiation and partly in virtue of the radiation incident on them from outside; and the number doing so can be calculated. On the quantum theory, the number doing so cannot at present be calculated, and only certain special regions of the phase-space are concerned. For a steady state of affairs, an equation of continuity must be satisfied, by which certain of the gains and losses of any relevant region of the phase-space are equal to certain of the losses and gains of some other region of the phase-space. For large quantum numbers, the equation of continuity must become identical with that calculated on the classical theory, in which the coefficients are known. Certain limiting relations thus found to hold, for large quantum numbers, between the unknown numbers of systems undergoing the different kinds of transitions,

are assumed to hold also for all quantum numbers, and the equation of continuity in its general form then gives immediately the law of black radiation, with all the coefficients determined.

Planck assumes that for oscillators and rotators interchanges occur only between stationary states characterised by consecutive quantum numbers, "in order that for large quantum numbers the jumps shall transform into continuous changes." This is scarcely adequate; nowadays such an hypothesis must be regarded as part and parcel of the general correspondence principle. Einstein's own deduction involved an appeal to Wien's displacement law. But it compensates for its lack of precision by its greater generality, for it is concerned with transitions between any stationary states, not merely between those of consecutive quantum numbers.

Planck's law of radiation can be deduced purely from probability considerations, by applying statistical quantum-mechanics to the degrees of freedom of the ether. It is therefore on the same footing as any other distribution law—such as Maxwell's law or the laws of dissociative equilibrium. At present, uncertainty attaches less to these laws than to the mechanisms of interchange of energy which set them up. In so far as the laws are confirmed by experiment, any assumed mechanism of interchange which does not lead to them can be ruled out, and the laws in effect impose restrictions on the types of mechanism it is possible to assume. The significance of deductions of the law of black radiation has thus come to be reversed. What is known concerning the partition of energy already conditions one of the main problems of the future, namely, the precise formulation of the laws of interaction of matter and radiation. It is in this other problem that Planck's researches may now be regarded as the pioneer investigations. E. A. M.

The Science of Crystallography.

(1) *The Natural History of Crystals.* By Dr. A. E. H. Tutton. Pp. xii + 287 + 33 plates. (London: Kegan Paul and Co., Ltd., 1924.) 15*s.* net.

(2) *Elementary Crystallography.* By Dr. John W. Evans and George M. Davies. Pp. vii + 134. (London: Thomas Murby and Co., 1924.) 9*s.* 6*d.* net.

SINCE the application, in 1912, of X-rays to the investigation of the minute structure of crystals and crystallised matter, a great impetus has been given to the study of crystallography. The foundations of the subject were, at the end of the eighteenth century, based on a study of the external forms of minerals; and for this reason it has long been regarded as a branch of mineralogy. Now, however, it has a much wider circle of adherents amongst chemists, physicists, metallographers, etc. All the chemical elements and, with few exceptions, all definite chemical compounds are capable of assuming a distinctive and characteristic crystalline structure, which is a direct expression of their atomic grouping. Further, the crystalline state of any of these compounds is much more frequent than the colloidal state, though, of course, the crystals met with may not always be so conspicuous as those found in Nature as minerals. The physical properties of many substances have been determined only on confused aggregates of minute crystals, and their true directional values are not known.

At the present day crystallography is in rather an unfortunate position. It is claimed by mineralogists, who are sometimes parcelled out with geologists, by chemists, now by physicists, and to some extent also by metallographers. Ultimately, it will no doubt rank as a distinct science, towards which it is being brought by the increased activities displayed in such varied directions. This, of course, leads to an increased output of literature, including text-books. At one time, notions on crystallography were to be found only in books on mineralogy, but recently we have had good text-books on the subject written in English by a chemist, a physicist, a metallographer, and a geologist, and many more are evidently to come.

The two books before us differ widely in their character and scope. Dr. Tutton writes for the general reader with the view of instilling a wider interest in the subject and bringing to notice its important bearings. Dr. Evans and Mr. Davies aim at giving the beginner a thorough grounding in the first principles of geometrical crystallography. The first, with its wealth of excellent illustrations, is an attractive and readable book; whilst the second gives a first impression of being a dull and dry text-book. Both, however, have their uses; and after a reader has developed sufficient interest by the perusal of the first book, with a wish to proceed further, he must begin with the alphabet of the subject as presented in the second book. This (like the Russian alphabet) often seems to be a stumbling-block; but it comprises only quite simple geometry of three dimensions, which to an ordinary three-dimensional student should present no more difficulty than geometry of two dimensions.

(1) Dr. Tutton's book is really a second edition of his popular work entitled "Crystals," published in 1911 as a volume in "The International Scientific Series," and based on his British Association lecture at Winnipeg in 1909. It appears, however, in a larger and better format, and it has been completely

revised and much enlarged. The special chapter on X-ray methods and results is of course quite new, and the elucidation which these afford of crystal and atomic structures has its effect throughout the book. The author expresses satisfaction that the results of his own researches, especially those relating to the crystallographic constants of the long series of isomorphous double sulphates and selenates, have been amply confirmed by X-ray methods; and he would appear to attach greater importance to the results given by the new method. We venture to think, however, that his own results, which have been most carefully and more directly determined by the goniometric measurement of the interfacial angles on crystals, will have a more lasting value as the fundamental crystallographic constants for the several salts. The several chapters cover a wide range of the subject, more especially in its bearing on chemical crystallography, and many interesting historical details are well told. The book concludes with a useful glossary of technical terms and a list of the thirty-two crystal classes.

(2) The second book, by Dr. Evans and Mr. Davies, is a text-book for elementary students. It explains very clearly and concisely the external forms and symmetry of crystals, taking in detail only eleven of the more important of the thirty-two classes, and commencing with the orthorhombic system. These classes are very simply named after the minerals which they represent, namely, spinel, tetrahedrite, pyrite, beryl, calcite, tourmaline, quartz, zircon, olivine, augite, and albite. The numerous outline figures, drawn by Mrs. G. M. Davies, are simple and clear, but unfortunately Fig. 1, representing a space-lattice, lacks the strict parallelism so essential for crystals.

So far, the student should have no difficulty; but in the last two chapters on "Twin-crystals" and "The thirty-two classes of crystal symmetry," Dr. Evans in his enthusiasm for the subject gives the substance of two of his profound papers which appeared in the *Mineralogical Magazine*. The tabular arrangement for the thirty-two classes as devised in the original paper is improved upon for the book, and the notation has been in part changed, *e.g.* for the clinohedrite class, his "IIUk" now becomes "IIMv." The student might make an effort to learn these symbols by heart, but very likely they would be unknown to the external examiner. One great hindrance to any advance in crystallography is the large number of different notations that are in current use and have been used in the past, and the consequent difficulty in comparing and correlating the work of different authors. The present elementary text-book is unique in so far that it proposes still another new notation. L. J. S.

Our Bookshelf.

Building for Peace. II.: International Letters. By William Albert Noyes. Pp. 78. (Cambridge: W. Heffer and Sons, Ltd.; New York: The Chemical Catalog Co., 1924.) 1*s.* 6*d.* net.

THE first volume of "Building for Peace" has led to some correspondence between university professors, French, German, and American. Their international letters are here published. It seems an honest attempt to verify facts and remove misunderstandings. If all the professors in Europe are engaged in similar correspondence so much the better.

One writes: "The fate of the world is not controlled by men who think, or at least try to think, scientifically and objectively." Another replies: "I believe, on the contrary, that it is just such men who can and *will* rescue Europe from her present chaos." A third: "You follow without discouragement the high but difficult purpose of international reconciliation."

At present, public men are like schoolboys baffled by the false scents at the beginning of a paper chase. They are bothering about reparations and poison gas and who caused the War, and whether Germany has to pay because she lost the War or did part of the damage or only because she can afford it. When they find the right track they may go fast and far.

For example, the presence of Americans at the British Association meeting at Toronto in August next might provide an opportunity for considering the restoration of a Scientific International. The Americans can also tell how the Pan-American Scientific Congress led to the Pan-American Union and the organisation of the common interests of the republics of the west.

The penetration of the scientific spirit into the realm of politics will be of untold benefit to humanity. Many people seem to be groping towards some form of thought, criticism, and logic by which truth may be distinguished from propaganda which attempts to make a fraction of the truth look like the whole. We need an unambiguous language with definitions of truth, justice, and peace as clear as those of ohm, ampere, and volt. HUGH RICHARDSON.

Introduction to Medical Biometry and Statistics. By Prof. Raymond Pearl. Pp. 379. (Philadelphia and London: W. B. Saunders Co., 1923.) 25*s.* net.

PROF. RAYMOND PEARL has had many years' experience in teaching the principles of biometric methods to biologists and medical men, and the present book is essentially an account of the mode of treatment of this subject which he has found most successful in the School of Biometry at Johns Hopkins University. It is the result of an attempt to make available a simple exposition of the elementary principles of the subject for those biologists and medical men who have had no special mathematical training, and yet find it necessary to use modern biometric methods in their work.

After an interesting account of the historical development of the science of vital statistics and biometry, Prof. Pearl contributes chapters on the tabular presentation and graphical representation of statistical data, on rates and ratios, on standardised death-rates, on

life-tables, on the elementary theory and some special problems of probability, on the probable error, on the measurement of variation and correlation, and on simple curve fitting. The mathematical explanations that he has introduced in each special section are treated in a simple and logical manner, and should be followed without much difficulty by the average medical man. To each chapter is attached a short list of the books and papers which he regards as most suitable for reading, to provide more detailed information on the subject-matter therein.

While there are already available one or two well-known books on the elementary principles of statistics, there would appear to be a place for a book like the present one, which is specially designed for medical readers. It should prove a trustworthy guide to such in the legitimate use, in their work, of the simpler of the modern biometric methods, the practice of which is rapidly becoming more general and more essential in the field of medicine.

Handbuch für das mikroskopisch-zoologische Praktikum der wirbellosen Tiere. Von Prof. Dr. Paul Deegener. Erste Lieferung. Pp. 160. (Berlin und Leipzig: Walter de Gruyter und Co., 1923.) 8*s*.

THE first instalment of this "Handbuch" deals with Protozoa, Porifera, Cœlenterata, and Turbellaria, and the complete work will consist of six or seven parts, that is about 1000 pp. A brief definition of each phylum, *e.g.* Protozoa, is followed by a statement of the principal characters of the subclass, *e.g.* Sarcodina, and of the order, *e.g.* Lobosa, and the latter is then the subject of a fairly general account, with illustrations of the more important examples, dealt with from the point of view of structure, life-history, etc. For each subdivision—class, subclass, or order, according to convenience—suggestions are given for obtaining the more typical examples, and suitable methods are indicated for examination in the living state and for preservation, staining, and mounting of the organisms or their parts. As a whole, the work seems to accomplish its purpose satisfactorily, and some parts of it are excellent in treatment. The author gives no account of a siphonophore or of a ctenophore, and of the Sporozoa only the gregarines receive consideration. Other teachers will no doubt expect in a volume of this size, as did the reviewer, to find at least a short treatment of the Siphonophora and the Ctenophora, and perhaps also of a Coccidium and of malaria, as material of both but especially of the former is by no means rare.

The figures, with few exceptions, are well chosen, but the legends of certain of them require revision, *e.g.* the author has reproduced Kent's old figure of Dendrosoma, and has retained the reference to "external buds" for bodies which have been shown to be epizoic Acinetaria of the genus Urnula.

Birds in Legend, Fable and Folklore. By E. Ingersoll. Pp. v+292. (London: Longmans, Green and Co., 1923.) 12*s*. 6*d*. net.

IN this work Mr. Ernest Ingersoll leads us along an attractive byway of ornithology. One chapter deals with birds as national emblems, and traces the symbolic eagle, not omitting dicephalous varieties, from 4000 B.C. on the shores of the Persian Gulf to the bald-headed species honoured to-day in the United States. Others deal, for example, with Noah's messengers and parallel legends, with the folklore of bird migration, with birds in Christian tradition, with birds in ancient augury and modern popular weather-lore, and with birds of ill omen at all times and in many lands. Historical legends also have a place, from the Capitoline geese to the feathered disciples of St. Francis of Assisi which form the subject of the frontispiece. Purely fabulous species, such as the phœnix and the rukh, are likewise dealt with.

Mr. Ingersoll is an American, and we note that the folklore of the white and black peoples of the United States is relatively poor, as one would expect in populations without long traditions: Red Indian beliefs and stories, however, figure largely in the book and will be new to many readers in Great Britain. For the rest, the author has drawn his information both from antiquity and from the present time, and from very many parts of the world. The material he has collected is varied in nature and very large in amount, but even so it is not exhaustive. We find, for example, in the chapter on migration, only a bare mention of hibernation under water and no account of the views on that subject expressed by such writers as Olaus Magnus of Upsala. A better index would have been an advantage.

The Properties of Engineering Materials. By W. C. Popplewell and H. Carrington. Pp. xii+546+34 plates. (London: Methuen and Co., Ltd., 1923.) 28*s*. net.

THE volume before us is divided into two parts, the first of which deals with the mathematical theories of stress from the engineer's point of view, and the second includes matter descriptive of the properties of materials and methods of testing. The book is well written, and will be of service both to students and engineers in practice, who will find in the second part a great deal of information regarding the results of tests. It is an open question, however, as to whether both sides of this subject can be treated adequately in one volume, and on examination of Part I., we frequently find that the authors have stopped a discussion just when it had begun to be interesting, obviously through limitations of space. This is somewhat unfortunate, since the book is intended to meet the needs of the final years of university courses. Thus at the end of chapter x., which deals principally with resilience, curved bars, and flat plates, we find four pages on earth pressure (Rankine's theory), and the stability of dams. Both of these subjects might have been omitted, or, if included, both deserve much fuller treatment. The index requires revision also, since we can find no reference either to Rankine, or to earth pressure.

Nature and Human Nature: Essays Metaphysical and Historical. By H. B. Alexander. Pp. x+529. (Chicago and London: The Open Court Publishing Co., 1923.) 15*s*. net.

A COLLECTION of contributions to popular and philosophical journals. The writer has a picturesque style and reveals a striking personality. His essays are not original researches, but for the most part reflections on spiritual values.

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.*]

Induced Asymmetry of unsaturated Radicals in optically active Compounds.

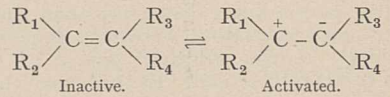
1. THE development of absorption bands in organic compounds is generally recognised as being due to the chromophoric properties of certain unsaturated groups, the electrons of which have a lower "absorption-frequency" (compare Darwin, "A Quantum Theory of Optical Dispersion," Proc. Amer. Nat. Acad. Sci., 1923, 9. 25) than those of saturated groups. Modern physical theory also suggests that optical activity depends on the specific influence of a limited number of asymmetrically-disposed electrons (see, for example, Born, *Physikal. Zeitschr.*, 1915, 16. 251-258; *Ann. Physik.*, 1918, (iv.), 55. 177-240). Apart from the optically active co-ordination-compounds of Werner, the chromophoric groups are usually quite distinct from the asymmetric centres; but recent work on rotatory dispersion has shown that they may nevertheless be linked together very intimately, since the dispersion-equations are often dominated by the absorption-frequencies of the chromophoric groups. These frequencies are usually in the ultra-violet region of the spectrum; but, if they fall within the visible region, the well-known Cotton effect can often be observed when the measurements of optical rotatory power are carried through the part of the spectrum which includes the absorption-band.

The extraordinary influence of chromophoric groups on optical rotatory power has usually been explained on the ground that, since optical activity is distributed over the whole of the asymmetric molecule, it may be expected to respond to the influence of vibrations having the natural frequency of any of the constituent groups of atoms. This view is, however, not in harmony with current physical ideas, which tend to limit the domain of optical rotatory power to certain electrons only in the molecule; it is, moreover, difficult to reconcile with the fact that the chromophoric groups are sometimes quite inert. A consideration of the experimental evidence, from two distinct aspects, has therefore led us independently to adopt the converse view that, instead of the asymmetric centres being made to adopt the absorption-frequencies of the chromophoric groups, these groups can exhibit an "induced asymmetry," as a result of which they may themselves become optically active, when coupled sufficiently closely to an asymmetric complex. The terms in the equations of rotatory dispersion which contain the characteristic frequencies of a chromophoric group will then represent a direct contribution by this group to the optical rotatory power of the molecule, and not merely the indirect influence of a substituent on the rotatory power of the asymmetric carbon atoms. This influence, which obviously exists, and may sometimes be important, can probably be transmitted, like acidity or reactivity, through chains of atoms, either as a "general" unidirectional effect, or by the mechanism of an "induced alternate polarity"; [1] but it is more likely to influence the extent of the electronic movements than their characteristic frequency.

2. The view that unsaturated chromophoric groups can be made asymmetric by induction from a fixed asymmetric centre, and thus develop optical activity, can be justified both on experimental and on theoretical grounds.

(*a*) Chemists have long recognised that a double bond is not the equivalent of two single bonds. It has, however, generally been assumed that the two links of a double bond are identical with one another, since equal quantities of the two possible products are usually obtained when one of the links is broken, *e.g.* in the formation of addition-compounds. This condition does not prevail, however, when the molecule is asymmetric. Thus in the camphor series, two stereoisomeric products may be formed in the ratio of 8 : 1 instead of 1 : 1. The hypothesis of the equality of the two links of a double bond is therefore not merely unproved, but, in the case of asymmetric compounds, is directly opposed to the experimental evidence.

(*b*) There are good reasons for thinking that the activation of a double bond leads ultimately to a complete rupture or ionisation of one of the two links, and therefore to a final disappearance of symmetry in the bond. This polar conception of the mechanism of activation, which finds expression in a scheme such as



has already been criticised on the ground that activated unsaturated molecules should be, but are not found to be, asymmetric. In ordinary cases this criticism is met by the fact that the two enantiomorphous forms must necessarily be produced in equal quantities, and would, moreover, be interconvertible, so that the activated product would always be a racemic mixture and therefore inactive. In asymmetric molecules, however, this equality need no longer exist, and the polar form of the chromophore might very well exhibit optical activity. In our opinion, this induced optical activity would not be likely to vanish, even if all the molecules should return to a resting-state, since the electrons of the two links of the double bond would still be in an unsymmetrical electric field, and being unequally energised would be capable of contributing to the electronic dissymmetry which gives rise to optical rotatory power. From the present point of view, it is a matter of indifference whether, in the resting state of a symmetrical molecule, the double bonds are actually symmetrical, or oscillate symmetrically between two unsymmetrical phases, since in neither case could optical activity be developed.

3. Although Bohr's theory of atomic structure has been generally accepted by chemists, it does not appear to have been realised that it assigns to the carbon atom a configuration which is of a much lower order of symmetry than the regular tetrahedron of le Bel and van't Hoff. Thus, if the four orbits of a 2-quantum sub-group are all either clockwise or counter-clockwise as viewed from the corners of a regular tetrahedron, the identity of the four trigonal axes is maintained, but two enantiomorphous configurations are possible, exactly as in the tetrahedral cubic system of symmetry, the asymmetry of which leads to optical activity in crystals of sodium chlorate. On the other hand, if two of the orbits are clockwise and two counter-clockwise, a figure is obtained which cannot exist in enantiomorphous forms; but this is of the lowest order of tetragonal symmetry, in which

[1] Dr. H. G. Rule has directed our attention to the existence of a relationship between optical rotatory power and the polarity of the substituents, especially in the derivatives of active amyl alcohol and in the menthyl esters of substituted benzoic acids.

nearly all the elements of symmetry of the regular tetrahedron have been suppressed. Bohr's atom then clearly provides new possibilities for the development of asymmetry, *e.g.* in saturated groups, such as $>CH_2$, $>CMe_2$, or $>CBr_2$, as well as in unsaturated groups, such as $>CO$ or $>C=C<$, if placed in an asymmetric environment. Two enantiomorphous configurations are even more obviously possible in systems such as $-CH_3$ or $-CMe_3$, containing three similar radicals, than when the radicals attached to the carbon atom can be grouped in two pairs and might therefore tend to assume the tetragonal rather than the tetartohedral cubic type of tetrahedral symmetry. Optical activity could, of course, only appear under conditions which would lead to the production of unequal quantities of the two enantiomorphous forms; and if these conditions were removed, the optical activity would probably disappear as a result of the racemisation of the active product. Moreover, since the experimental evidence shows that only a very modest optical rotatory power is developed in molecules which contain no unsaturated atom or group of atoms, it is clear that induced asymmetry can only give rise to important developments of rotatory power when applied to unsaturated or chromophoric groups.

4. Induced asymmetry need not lead to an optical rotation of the same sign as that of the fixed asymmetric groups by which it is controlled. Since these will usually have a lower dispersion than the chromophoric groups, anomalous rotatory dispersion may be developed if the rotatory power of the fixed groups is sufficiently great. In that case, the anomalous dispersion of the menthyl dixanthogenides examined by Tschugaeff may be due to the same cause as in the case of his menthyl camphorsulphonate, the principal difference being that the second radical has only an induced asymmetry in the former case, as compared with a fixed asymmetry in the latter case.

T. MARTIN LOWRY.
E. E. WALKER.

Specific and Latent Heats of Iron and Steel.

THE phenomenon of recalescence in iron and steel is well known, but the fact that the rate at which heat is lost for a given change of temperature, above and below the point of recalescence, does not seem to have been noticed. That this is so, however, is clearly shown by experiments made by me, and described in part in Proc. Roy. Soc. (A, vol. 103, p. 1 and A, vol. 105, p. 129). In these experiments iron and steel wires were heated and cooled in two different ways, in both of which the variation of length with temperature was automatically recorded in terms of time. In the first, the wire was slowly heated and cooled in a tubular furnace, the temperature at the same time being recorded. In the second, the heating was effected by passing an electric current through the wire, which was then allowed to cool in the open. In both experiments the wire was surrounded by an atmosphere of nitrogen. Using the first method, the temperature of the wire was to all intents, at all times, that of the furnace, whereas in the second it depended on the supply of heat contained in the wire itself.

The difference in the cooling-curves obtained in these ways was very striking. The contraction-curve recorded during cooling in the furnace was an ordinary cooling-curve, which can be expressed throughout as an exponential function of the time, and showed no trace of any peculiarities at the temperatures of recalescence. The air cooling-curve, on the other hand, consisted of three separate parts, namely, (*a*) that from the highest temperature to the temperature of recalescence, (*b*) from the beginning to the end of the duration of the recalescence, (*c*) from the end of recalescence to ordinary temperature. Both of the curves (*a*) and (*c*) can be very closely represented as exponential functions of the time, but with different constants in the exponent.

The accompanying diagram (Fig. 1), which is traced from the automatic cooling records, shows at a glance the general character of the results for the four specimens of metal examined, and it will be seen at once that as the carbon-content of the steel increases, the temperature at which recalescence occurs is lowered; but further information also may be obtained from the diagram. The rate of cooling in the furnace was just about one-hundredth of the rate in air, and when the time scale of the furnace curve is divided by a hundred the curve CC becomes identical with the branch (*c*) of the cooling-curve in the figure, over the whole range of furnace temperatures—from somewhat above 1000° C. downwards.

If the constants for the (*a*) and (*c*) curves are computed, and the curves themselves extended, as shown

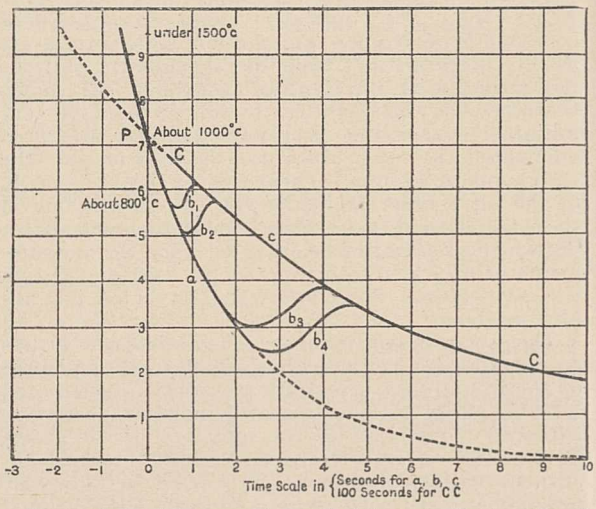


FIG. 1.—Copies of the automatic records of the contraction in cooling of four specimens of steel wire. Length of wire 10 in., diameter of wire 0·02 in. Scale for ordinates 0·012 in. per division.

The automatic records are shown by the full curves a, b_1, b_2, b_3, b_4, c, and CC.

The dotted extensions of a and c are calculated from the complete values of k_a and k_c.

The carbon content of the steel giving curve b_1 is 0·05 per cent.
" " " " b_2 " 0·08 "
" " " " b_3 " 0·50 "
" " " " b_4 " 0·80 "

The curve CC is the automatic record given by slow cooling in the furnace. It is the same for all four wires and is identical with c.

by the dotted lines, and if also the abscissa of the point of their intersection P is taken as the origin of the time scale, and $t_1 t_2$ as the times at which recalescence begins and ends, it will be found that t_2/t_1 is very nearly equal to 3.

Taking y_a and y_c as the ordinates of the (*a*) and (*c*) curves respectively, y_0 being the ordinate of P, then

$$y_a = y_0 e^{-k_1 t} \text{ and } y_c = y_0 e^{-k_2 t}.$$

Since at both t_1 and t_2, y_a and y_c have the same values, $k_1 t_1 = k_2 t_2$, so that $k_1/k_2 = t_2/t_1$. For bodies of the same dimensions and with the same quality of surface, the rate of cooling in the same surrounding condition is inversely as their specific heats, since k_1 and k_2, which give a measure of the rate of cooling, are also inversely proportional to the specific heat of the metal as it exists when in the high and low temperature states. Or, in other words, the specific heat of iron and steel at ordinary temperature is about three

times as great as at temperatures above the point of recalescence.

Were the extensions of the metal directly proportional to the temperature, the area contained between the cooling curve and the axis of time would, when multiplied by an appropriate constant, represent the total heat given out in cooling. The heat lost from $t=o$ to $t=t_1$ and from $t=t_2$ to $t=\infty$, which is proportional to the areas bounded by the (*a*) and (*c*) curves, depends on the fall of temperature, but the area under the (*b*) curve measures the heat which is rendered latent, while the metal changes from the low to the high temperature state, and is equal to $(t_2-t_1)\times$ the mean temperature during the change.

The constants k_a and k_c are of dimensions T^{-1}, and may be replaced by $1/t_a$ and $1/t_c$, *i.e.* the reciprocals of the times in which the extension is reduced in the ratio of $e/1$; so that the areas under the three curves are respectively $t_a(y_0-y_1)$, $y_1(t_2-t_1)$, and $t_c y_2$. These expressions would be exact only if the extension were proportional to the temperature, but this is not strictly true, since the temperature record on the curve obtained by furnace-cooling shows that the coefficient of expansion diminishes gradually as the temperature rises. It is, however, sufficiently near the truth for the temperature at which recalescence occurs.

The latent heat, measured by $y_1(t_2-t_1)$, increases with t_1, and has a maximum when $t_1=t_a$.

It would be interesting to trace out what really happens when the iron is free from carbon and other impurities, and whether, as the cooling-curves seem to indicate, at the temperature corresponding to the point P the change of state would be instantaneous. If that were so, no heat would be rendered latent, and the only change would be in the specific heats.

Samples of pure iron would be required to answer these questions, and the preparation of pure iron seems to be surrounded with difficulties. I am informed by the authorities of the National Physical Laboratory that they, with all their facilities, have not yet succeeded in producing the pure metal.

I understand that X-ray experiments have indicated that at a temperature slightly below the melting-point (*i.e.* more than 1400° C.) iron again changes its state, but, though in some of my cooling-curves the temperatures at which cooling began were very close to 1500°, no feature in the curves suggests any sudden change in the coefficient of expansion or specific heat. It may be, however, that on the very short length of curve lying between 1500° and 1400° C. a small change might escape notice.

A. MALLOCK.

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March 1.

Binding of Electrons in the Nucleus of the Mercury Atom.

SINCE we described in NATURE of March 29, p. 459, the relation between the satellites of mercury lines and the isotopes, we have found that the structure of the line 3131·84 does not satisfy the relation given by the formula therein used. The differences in wave-lengths are all too small. To explain this anomaly, we assume that in atoms of elements consisting of several isotopes, the binding of positive and negative protons is not simple, but shows various features. It is usual to introduce an hypothesis for explaining the compactness of the nuclei, that the law of electric action is modified at distances comparable with the dimensions of the nuclei, in such a way that there is attraction between like charges and repulsion among the unlike. We can thus conceive of a case in which the electrons are bound together into one mass and the positive protons into another. The two particles oppositely charged will repel each other at nuclear distances, but this action will cease as they are separated to a certain distance and will become attractive. In this state, the negatively charged particle will be quasi-elastically connected with the positive, and can make coupled vibrations. Such seems to be the case, when the above-mentioned line is excited.

Let the integral number of atomic weight in H-units be A, the atomic number N, the mass of an electron m, and that of H-proton m_H; then the mass of the negative particle is $(A-N)\frac{m}{m_H}$ in H-units. The formula we have given for the difference of isotopes A_i and A_j then becomes

$$\delta\lambda=(A-N)\frac{m}{m_H}\frac{\lambda}{2}\left(\frac{1}{A_i}-\frac{1}{A_j}\right).$$

For mercury, take the mean value $A=200$, $N=80$, $\frac{m}{m_H}=\frac{1}{1847}$; then

$$\delta\lambda=0{\cdot}06507\,\frac{\lambda}{2}\left(\frac{1}{A_i}-\frac{1}{A_j}\right).$$

Putting for $A_j-A_i=2$, 4, 5, 7 respectively and for the product A_iA_j simply A^2, we find the position of the satellites of 3131·84 almost exactly as shown below.

Intensity.	δλ (obs.) (*mA*).	δλ (calc.) (*mA*).	Obs.−calc.	A_j-A_i.
5	18·0	17·9	0·1	7
8	5·7	5·1	0·6	2
10	0	0	0	..
1·5	5·1	5·1	0	2
5	9·9	10·2	0·3	4
1	12·8	12·8	0	5

The differences between the observed and the calculated values are quite within the error of observation. Considering the difference in A_j-A_i given in the table, the isotopes emitting the satellite lines are perhaps 197, 200, 202 and 204, as other combinations evidently give rise to a greater number of satellites.

We would remark that in the immediate neighbourhood of the above line there is a strong line only shorter by 0·3 Å. This line has eight components, which approximately fulfil the condition that the nucleus makes coupled vibration with a detached H-proton. The line above discussed must consequently belong to a singular case of the binding of the positive and negative protons.' An interpretation of the appearance of the singular line is the coincidence in the period of coupled vibration of the nucleus and the particle of electrons with that of the line 3131·84. Otherwise the presence of such a particle will affect the period of nuclear vibrations corresponding to other lines, and affect the position of the satellites given by the formula put forward in our previous communication.

The law of action between two charges e, e' is given by

$$\frac{ee'}{r^2}\left(1-\frac{c}{r}\right),$$

c being the distance at which Coulomb's law ceases to hold. At a distance nearly c from the centre of the nucleus, the negatively charged particle above discussed is neither attracted nor repelled from the centre, but a minute displacement calls forth enormous

force both from the positively charged nucleus and from the electron cloud surrounding it, if we consider c to be comparable with nuclear dimensions. If the vibrations take place about this position of equilibrium, it is not difficult to conceive of the existence of the line.

We can also introduce an hypothesis that the quantum relation still holds in the neighbourhood of the nucleus; then the particle can move in stationary orbits. The perturbations in such a state will also give rise to vibrations, but in this case there may be many lines having similar character.

Perhaps there are lines showing similar behaviour in atoms of different elements, but the above is the only one which has come to our notice. A single line is insufficient to prove definitely that the electrons within the mercury nucleus can exist as one mass, but it may be looked upon as an experimental fact for supporting the hypothesis as regards the change in the law of electric action within the nucleus, as 120 electrons apparently form a particle near the core of mercury atom.

H. NAGAOKA.
Y. SUGIURA.
T. MISHIMA.

Institute of Physical and Chemical Research,
Komagome, Hongo, Tokyo,
February 18.

Intense Magnetic Fields and the Disturbance of Electronic Orbits in Magnetic Materials.

IN recent years a great deal of attention has been centred on the problem of permanent magnetism, and some remarkable developments in the manufacture of permanent magnet steels have taken place, results having been obtained which, ten years ago, would have been considered unbelievably good. For example, steel made in accordance with Prof. Honda's specification gives a remanent induction density of 11,600 lines per square centimetre and a coercive force of 226 gauss.

In a paper read before the Institution of Electrical Engineers in 1920, S. Evershed gave a general idea of the magnetic intensity due to the electronic currents in the atoms of a substance, and he showed that, in order to reduce this current by one per cent., an impressed magnetic intensity of 1,500,000 gauss is necessary.

It has appeared to the writer that an attempt to produce magnetic fields sufficiently powerful to influence the electronic orbits might form a very fruitful line of investigation, and it would appear that one of the new permanent magnet steels might be expected to be specially favourable for this work. Means have now been devised by the writer for doing this, and it is hoped that it will be possible to publish at an early date a preliminary account of the results obtained.

The root idea of the method adopted is briefly as follows: If a current is passed through a coil for a sufficiently short time, the strength of the current may be almost indefinitely large. If, therefore, a magnetic specimen is provided with an exciting coil in which this very large current is allowed to pass, extremely high values of the magnetic intensity will be produced in the specimen under test. The easiest method of producing and controlling a very large current for this purpose is to use a large capacity condenser charged to a high potential and to discharge it through the exciting coil of the specimen. For example, suppose a short tube of magnetic material is provided with an exciting coil of 100 turns, and let the mean length of the magnetic circuit be 3 cm. If a current of 3000 amperes is passed through this coil, the intensity of the magnetic field so produced along the mean magnetic circuit will be 125,700 gauss.

Now it is true that a magnetic field of this intensity is small relatively to that required to produce an appreciable effect on the electronic orbits, and any influence which this field intensity may have on the orbits can be only a very minute one. *If, however, this field intensity be repeatedly applied to the specimen, a cumulative effect will be produced*, and it is expected that this cumulative effect will be easily measurable. The effect will be detected by an examination of its influence on the B-H curve of the specimen.

In Fig. 1 is shown a diagrammatical sketch of the general arrangement of the apparatus.

Condensers are used having a total capacity of 600

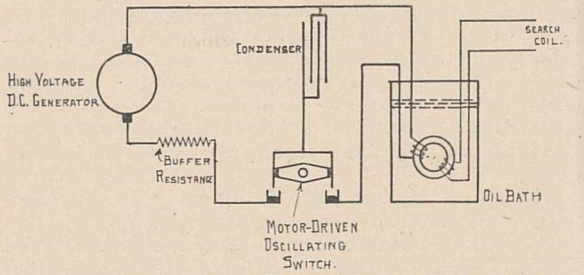

FIG. 1.

microfarads and capable of standing a pressure of 2000 volts. The condensers are charged from a high-voltage direct-current dynamo and then discharged through the exciting coil of the specimen, the charge and discharge operation being controlled by means of a motor-driven oscillating switch with mercury cup contacts. The rate of oscillation of the switch may be controlled between wide limits as found necessary, down to about one oscillation in 5 minutes.

The magnetic specimen is wound with a search coil in addition to the exciting coil, and the whole is deeply immersed in a large oil bath to allow the heat which is generated in the exciting coil to dissipate as quickly as possible.

The routine of the observations made is as follows: (1) The B-H curve of the specimen is taken. (2) The exciting coil of the specimen receives a large number of discharges of the condenser, say 1000 such discharges, and an oscillogram of the current for a representative discharge is taken. The interval between successive discharges is so regulated that the exciting coil remains sufficiently cool. (3) The B-H curve of the specimen is again taken. (4) A further series of condenser discharges is passed through the exciting coil. (5) The B-H curve of the specimen is again taken. This procedure will be continued so long as may be reasonably necessary to obtain some indication of the effect that is being produced.

It may be of interest to note that the central idea of the above experimental arrangement has found one immediately practical application, as was described by the writer in *Engineering* for March 7, in which a method is given for the magnetic testing of small samples. This method permits of the determination of the B-H curves up to values of the magnetic intensity of about 2000 gauss, the sample being in the form of a closed magnetic circuit of only two or three ounces weight.

T. F. WALL.
Carr Bank House, Fulwood, Sheffield,
March 24.

The Encouragement of Medical Discovery.

THE article on medical research in NATURE of April 5 hits the nail on the head. Great Britain is now spending, I suppose, something like a quarter of a million pounds a year on subsidised medical researches; but as you say, "Research and original investigation of the highest kind are the work of the individual, and first-class researchers occur sporadically but a few times in a generation"—and the nation does nothing at all to encourage these men at present. I have no doubt that the subsidised workers are all doing their best, but we as a nation do not seem quite to understand the fact that discovery—which is the final crown of research—is rarely achieved except by people who possess a very specialised order of intellect. In the past the men who have actually made the most important advances in medical science have been volunteers, and often, like Harvey, Jenner, Pasteur, Lister, Laveran, Koch, and many others, were not subsidised or paid at all, at least when they began their labours. In my opinion, out of 30,000 or more medical men in Great Britain, there may be many or several potential Harveys and Jenners, but owing to the absence of any payment whatever, even for the most successful but privately made discoveries, such potential workers do not allow themselves to indulge in the pleasures (or pains) of scientific investigation.

My opinion is that the money which we are now giving for subsidised researches should be supplemented by some form of national payment for unsubsidised discoveries already completed. We are now paying large sums for prospective discovery but nothing at all for discovery already achieved. In 1920 the British Science Guild proposed an excellent scheme for pensions for achieved results in medical science, costing, I suppose, less than a tenth of the money which the nation now pays for subsidised research; but our scheme was turned down by the Government of that day for reasons which appeared to me to be quite trivial and unsound. Would it not be advisable, now that we have a Government which is supposed to appreciate the value of labour, to attempt to resuscitate this scheme, and thus to persuade the nation to pay honourably for professional benefits received by it in the line of medical discovery?

RONALD ROSS.

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London, S.W.1.

Mendelism and Evolution.

IN his review of Morgan's "The Mechanism of Mendelian Heredity" Mr. Huxley refers to my letter in NATURE of January 12, saying, that if he reads me aright I approve of the idea, expressed as a mere suggestion by Johannsen, etc. I have read my letter again and I must say that it seems to me to be perfectly straightforward and to offer no excuse whatever for reading into it anything that I did not write. Consequently, there is no need for me to reply to the questions that Mr. Huxley puts to me. However, his remarks about the hostility of Darwinians to Mendelism, their refusal to make use of it, etc., lead me to think that it may perhaps be worth while to make my own position clear.

In a study of the structure, classification, and geographical distribution of fishes, carried on for more than twenty years, my method, whether I was engaged with orders and families, or with genera and species, was always the same; this was, from a consideration of all the available data, to form conclusions as to relationships, and to try to express these in classification. After comparing my own results with those obtained from other groups, and after considering the evidence from palæontology and embryology, I think that I have good reason to believe that evolution has been a slow and gradual process, that in its main lines it has been adaptive, and that changes of structure have been intimately related to and even determined by changes of function; further, that as a rule the first step in the origin of a new species is the formation of a community with a new or a restricted environment, or with new habits; in other words, that some form of isolation, either localisation or habitudinal segregation, is a condition of the development of a new species.

In many instances the evidence is clear as to what has happened, and when and where it has happened; there are even indications why; but the problem that remains to be solved is how!

I have read several books by eminent Mendelians, which contain some very definite statements as to the methods of evolution and some strong criticisms of Darwin; but the impression left on my mind is that Darwin knew the nature of the facts that had to be explained, and gave us a theory that explained them, and that his Mendelian critics are not acquainted with the real nature of the problem. But this is not hostility to Mendelism. Surely one may admire the results obtained by Mendelian research, results of great theoretical interest and practical value, even if one has to admit that this work in a very special and limited field cannot be expected to give us a complete theory of evolution.

Evolution has been such a long and slow process that we may well doubt whether experiments made by man will ever succeed in repeating, except to a slight extent, what has happened under natural conditions. But we may at least hope that experiments of the right sort may perhaps lead to something. A thorough comparison of the structure and the life-history of two related species should reveal the meaning of some of their specific characters in relation to habits and environment, and thus show the lines on which experiments should be conducted in the attempt to produce modifications of the same nature.

C. TATE REGAN.

I AM sorry to have misinterpreted Mr. Tate Regan, but I assumed, I think not unnaturally, that what he quoted, he quoted with approval. In the circumstances, my criticisms fall only upon the quoted statement and its author.

As an example of what I meant by the failure by workers in other fields of zoology to take account of genetic methods and results, and the failure even to attempt experimental solutions, I may refer to two recent papers by Annandale (Annandale, Proc. Roy. Soc. B, 1924, 96, p. 60; and Annandale and Hora, Rec. Ind. Mus. 1922, 24, p. 505) on molluscs and aquatic vertebrates respectively, in which, on the basis of field observations (often of the most interesting nature), certain evolutionary theories are put forward.

Of Dr. Annandale's work in the faunistic and geological fields, it is unnecessary, and would be impertinent, for me to speak; every one knows its soundness and brilliance. But to attempt to raise any theory of the *method* of evolution on observational data alone, is so unthinkable to the experimentalist that he scarcely knows where to begin his criticisms.

When we remember that Dr. Annandale does not know (and cannot, for he records no experiments) what part of each character he deals with is due to germinal influence, and how much it is capable of being modified by environment; that he does not know whether he is dealing with a homogeneous or a mixed population; nor whether possible hereditary

differences are due to one or many factor-differences; and when one remembers the initial difficulty in some of the most carefully-controlled experiments, even in Drosophila itself, of distinguishing between the effects of "nature" and "nurture," one can only feel that to lay down on such evidence, whether or not the inheritance of acquired characters has been operative, is a temerity the magnitude of which the author has probably not realised.

I have mentioned Dr. Annandale because I have just happened to read and be interested in his ecological observations: but similar instances abound. *Per contra*, as mentioned in a recent number of NATURE, Dr. F. M. Chapman (Bull. American Museum of Natural History, vol. 48, 1923, No. 9) has recently been attempting to utilise Mendelian conceptions in the taxonomy of birds. It is a useful exercise to compare the two methods. J. S. HUXLEY.

New College,
Oxford.

The Late Lord Rayleigh's Scientific Papers.

I HAVE at disposal separate copies of the majority of the scientific papers of my father, the late Lord Rayleigh. I shall be glad to entertain applications for any specified individual papers from scientific workers or students who may really need them. The stock of copies is of course limited, and I cannot promise to deal with the applications very promptly.

RAYLEIGH.

Terling Place, Chelmsford, Essex,
April 4.

The Continuous Spectrum of Hydrogen.

I NOTE with great interest in NATURE of February 23 a letter by Dr. F. Horton and Miss A. C. Davies referring to their paper in the *Philosophical Magazine* of November 1923 entitled "Critical Electron Energies in Hydrogen." I wish to acknowledge their undoubted priority in the publication of the description of the continuous spectrum of hydrogen in the visible region. As this reference was buried in the text of this paper, it was overlooked in a rather cursory first reading of their work.

More recent work has fully confirmed the interpretation which Dr. Horton and Miss Davies give to our results in so far as it refers to the essential condition for the production of these spectra being a matter of voltage. We have reproduced all the effects described in our paper by variations of voltage between filament and plate. We cannot altogether agree with some of the inferences which they make as to the origin of this radiation, particularly with reference to their associating the minimum voltage for its production with 12·6 instead of 13·5, and their interpretation that it is due to re-combination of neutral atoms into molecules.

One additional experimental fact needs emphasis, which is the following: After the lines of the Balmer series have ceased to be visible altogether and when the secondary spectrum also is almost entirely gone, there are two lines in the latter spectrum which remain very much more intense than all the rest of the secondary. These are in the orange at wave-lengths approximately 6032 and 6021. These lines also fade completely when the continuous spectrum is well developed, but their persistence after the rest of the secondary spectrum is virtually eliminated seems not to have been noted either in the experiments of Richardson and Tanaka, described in the issue of NATURE for February 9, or in those of Dr. Horton and Miss Davies. HARVEY B. LEMON.

The University of Chicago,
Ryerson Physical Laboratory,
March 24.

John Harrison.

I TRUST that you will allow an admirer of John Harrison to be a little indignant with your reviewer, "R. A. S.," of Lt.-Comdr. Gould's book (NATURE, March 22, p. 417). "To some he [Harrison] appears . . . incurably clumsy. His taste for making clocks of wood, his complications, his retrograde inventions like the grasshopper escapement and the gridiron pendulum . . . stand to his debit." These are surely strange words for a man who (unless I misinterpret the initials) has been president of the Royal Astronomical Society, in the house of which stands that exquisite piece of mechanism, the Harrison clock, lovingly restored and enthusiastically described by Mr. E. T. Cottingham (Monthly Notices, R. A. S., lxx. 25, Nov. 1909). Harrison, it must be remembered, was the son of a carpenter, and brought up to that trade, whence his early clocks with wooden wheels. Harrison taught himself to be a clockmaker, and having a horror of friction, devised the delicately beautiful grasshopper escapement to be very nearly frictionless. Harrison invented the gridiron compensation, and applied it not only to pendulum-clocks but also to his first chronometers, to which Graham's mercury compensation was not suitable. Harrison was not alone among inventors in doing things at first in too complicated a way, learning simplicity by experience. It is common knowledge that most of Harrison's methods were almost immediately discarded—and something the same may be said of Isaac Newton—but it is extraordinary that any one who has seen the Harrison clock at the Royal Astronomical Society, or his fourth chronometer which won the prize, can call him incurably clumsy and retrograde!

"All Harrison's ideas," says your reviewer, "were of the nature of misdirections"; and this of the man who had the imagination and courage to tackle and eventually to solve the problem which was so important that the British Government offered 20,000*l.* for a solution, and so difficult that neither George Graham nor any other master of his craft—British or foreign—made any attempt to compete. The prize was offered in 1714. Harrison first came to London about it in 1728, finished his first machine in 1735, his second in 1739, his third in 1757, and his fourth, the prize-winner, in 1759. He received the last instalment of his reward in 1772.

What were the whole profession of clock-makers doing all this time? They were doing practically nothing at all until the voyage of No. IV. to the West Indies in 1764 showed that the problem was solved; and then there was such an outburst of competition and invention that by 1780 the chronometer had become almost standardised in its present form. "Opinions differ somewhat as to Harrison," says your reviewer, and proceeds to call him clumsy, retrograde, and misdirected! It is a sad piece of criticism. ARTHUR R. HINKS.

I TRUST that Mr. Hinks's energetic remarks will cause many readers to turn to Lt.-Comdr. Gould's fascinating volume. That author's admiration for Harrison is as great as could be wished; but in comparing him to Le Roy, he writes (on p. 91): "The difference in their machines is fundamental—Harrison built a wonderful house on the sand; but Le Roy dug down to the rock."

With regard to the interesting Harrison clock in the rooms of the Royal Astronomical Society, which Mr. Hinks's energy and Mr. Cottingham's skill succeeded in setting in motion, the last few times I inquired about it I learned that it had returned to that state of repose that so well befits its years. R. A. S.

The London Zoological Society's Aquarium.

THE aquarium at the Zoological Gardens, Regent's Park, which has been in course of construction for the past eighteen months, is now complete, and was opened by His Grace the Duke of Bedford on April 5. Mr. E. G. Boulenger, who has been Curator of Reptiles at the Gardens for the past twelve years, has been appointed Director, and has himself superintended the construction down to the smallest detail.

The building, which is situated under the hills of the Mappin Terraces, is divided into three large halls. The first of these is devoted to the exhibition of temperate fresh-water fishes, and there are twenty-five tanks of varying size. Among the most noteworthy exhibits in the Fresh-water Hall are the American gar-pike (*Lepisosteus tristoechus*) (Fig. 1), the bowfin (*Amia calva*), the Central European catfish (*Silurus glanis*), and the sterlet (*Acipenser ruthenus*).

The catfish is about 3 feet long and was presented by the Duke of Bedford, who has several very large specimens living in his ponds at Woburn. It is the largest European fish found in fresh water, with the exception of the sturgeon, and is known to attain the length of 10 feet.

The sterlet, which is also found in the rivers of Central Europe, never attains the large size of the sturgeon, but is extremely active and forms an interesting exhibit. Although it has been stated that this fish does not live for more than ten years, the specimen on view at present was given by Capt. J. A. M. Vipan, who has had it in captivity with several others for thirty-six years in his aquarium at Stibbington Hall. It is not kept in the main fresh-water circulation, which has a temperature of 55° F., but in a special tank of colder water at 40° F.

Photo] [*F. W. Bond.*

FIG. 1.—View of fresh-water tank containing American gar-pike (*Lepisosteus tristoechus*), N. America.

Most of the British fresh-water fish are represented, trout, perch, gudgeon, bream, rudd, salmon, carp, etc. Chub, dace, and grayling do not live well in aquaria, the two former being particularly susceptible to a fungus (Saprolegnea) and a protozoal disease known as Ichthyopthirius, while the latter is generally infested with a species of endoparasitic Acanthocephala which is liable to penetrate the intestinal wall and cause death. The rainbow trout, which arrived early in February, spawned immediately, and some of the young trout were observed to be hatched and feeding in the tank six weeks later.

In addition to the fish exhibits, certain amphibians are shown. One of the most interesting is a Giant Salamander which was brought from Hong Kong last year by the Marquess of Sligo; this proved to be new to science, and has been recently described by Mr. E. G. Boulenger as a new species, *Megalobatrachus sligoi*.

The Sea-water Hall is the largest of the three halls, and occupies the centre of the building. It is surrounded by twenty-five large tanks, in which, with the exception of the turtle and Limulus tanks, are shown all the common objects of our shores and the fish which inhabit British waters.

Many of the fish were obtained with the assistance of the Marine Biological Laboratory at Plymouth, and the Society is much indebted to Dr. E. J. Allen, the Director, for the assistance he has rendered and the advice he has given not only in the stocking, but also in the construction of the Aquarium.

The other main localities from which the sea-water tanks have been stocked are Brighton and Lowestoft. Dr. E. S. Russell, of the Fisheries Laboratory at Lowestoft, has also given assistance in the stocking of the sea tanks, and the specimens of the wolf fish which are shown were obtained by him from the North Sea. The fish seem to stand the long railway journey from Plymouth (about 8 hours) very well. They are sent in wooden tubs specially constructed with a ledge about 6 inches wide round the lid. These are filled with water to within about 3 inches from the top, and the jolting of the train is sufficient to aerate the water by causing it to lap against the ledge. If the train stops more than ten minutes the tubs are aerated by means of a small air compressor.

All the edible sea fish are shown with the notable exception of the herring and the mackerel, both of which are extremely difficult to keep in captivity at any distance from the sea, owing to the way in which they succumb to the slightest injury in transit. It is hoped that this difficulty may in time be overcome.

The habits of the hermit crab and the commensal anemone (Adamsia) may be studied in a special tank; there are also tanks for the octopus, pipe fish, sea anemones, crabs, lobsters, crawfish, and the commoner British molluscs. Some very fine specimens of the king crab (Limulus) have been presented by the New York Aquarium; the largest of these measures 2 feet in length. In the turtle tank are shown Loggerhead and Hawksbill turtles.

The sea-water is stored in two of the three large concrete reservoirs which lie under the floor of the Sea-water Hall, and was obtained from the Bay of

Biscay by a number of tank steamers from which it was discharged into barges at the London docks. From the docks it was brought to the Gardens by the Regent's Canal and pumped directly into the reservoirs. Each reservoir holds 60,000 gallons, and only one reservoir is in use at a time; after the water from one reservoir has been in circulation for a month, it is allowed to stand and settle, and the water from the other reservoir is used. From time to time it is necessary to add a little fresh water to make up for loss by evaporation and the concentration of the salts. There is also in time a certain loss of some quality analogous to vitamins, but this may be remedied by the occasional addition of a few gallons of fresh sea water. At the New York Aquarium the same sea water has been in circulation since 1907 with the addition of a few gallons annually. The sea water is kept at a more or less constant temperature of 55° F. with the exception of the turtle tank, which is heated to 75° F. The circulation is so arranged that the water in each show tank is changed once every twelve hours; this is also the case in the fresh-water and tropical tanks.

The Tropical Hall is devoted entirely to fresh-water fish from the Tropics. There are ten large and thirty-five small tanks, and the water in these is kept at a temperature of from 70° to 80° F. Among the most interesting exhibits are the Australian lung fish (Ceratodus) and the South American lung fish (Lepidosiren); besides these, there are a number of other species remarkable for their brilliant colouring and curious breeding habits.

With the exception of the four largest tanks, which are made of reinforced concrete, and the smallest of the tropical tanks, which are entirely of glass, all the tanks are made of 2-in. slate. The glass fronts of the tanks vary in thickness from ¼ in. in the small tropical tanks to 1¼ in. specially annealed plate glass in the larger ones. The glass in the small tanks is bedded in a mixture of red lead and gold size which sets hard, whereas the large sheets of plate glass are floated against an iron frame-work in a soft mastic putty. The decorative rock-work in the tanks has been copied in natural stone in accordance with models made to scale in plasticine by Miss Joan B. Procter, the Curator of Reptiles. The lighting of the tanks on the outer side of the crescent is by daylight; for foggy days and dark evenings artificial light can be added. The lighting on the south side, which is under the mountains of the Mappin Terraces, is entirely artificial. Special blue glass electric bulbs are used which cut off certain rays and produce a "daylight" effect.

The building is heated entirely by steam. It is very important that the temperature of the water in the tanks and the air in the various parts of the building should be the same. To ensure this a ventilating system has been installed and the air is circulated by electric fans in conduits which run throughout the Aquarium. In the summer the air can be cooled. The roof of the service passage (Fig. 2) on the north side is of double reinforced glass with an air space between the layers so that the air in the passage is maintained at a more or less constant temperature.

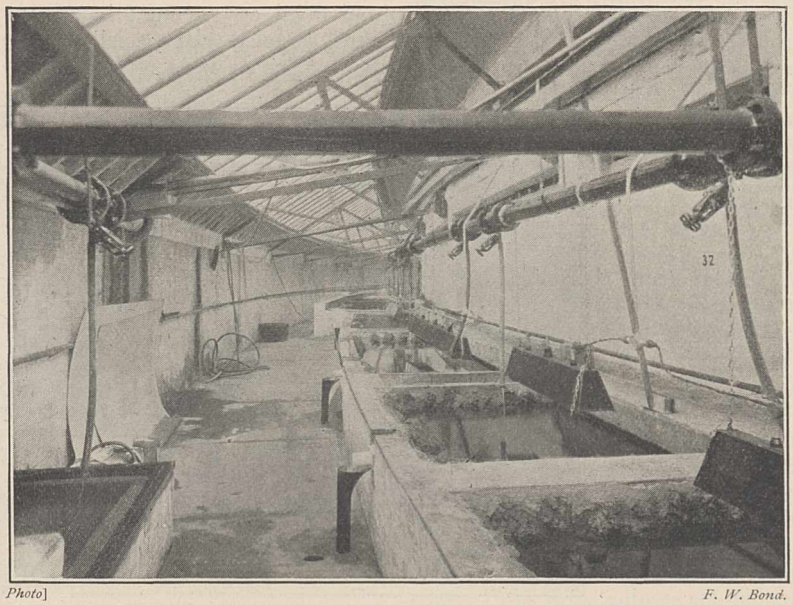

Photo F. W. Bond.

FIG. 2.—Service passage behind the sea-water tanks, showing arrangement of lighting, circulation, aeration, and overflows.

The centrifugal pumps which circulate the water and the aerating apparatus are electrically driven. All the electrical plant has been duplicated in case of a breakdown.

The Aquarium is provided with good research facilities. A number of experimental tanks has already been provided in the service passage at the back of the show tanks, and there is a well-equipped laboratory over the entrance hall. Work on the helminth parasites of fishes which have died during the stocking of the Aquarium has already been started by Prof. R. T. Leiper and Mr. G. S. Thapar. It is hoped that, in the near future, researches will be undertaken on many of the other problems relating to food fishes, which are of the greatest economic importance.

G. M. V.

Destructive Distillation of Coal.[1]

OF the many important industries which are tending to rely more and more as time progresses on the guidance of science with regard to their future development, that of the gas industry forms no exception. Apart from the numerous independent workers outside the industry who have been untiring in their efforts to enlighten us in some measure as to the constitution of coal—that most complex of all raw materials—and its behaviour under heat, facilities are to-day being afforded within the industry itself for obtaining a clearer understanding of the fundamental scientific principles underlying carbonisation. The last few years have witnessed a mild revolution in the methods of gas legislation and accountancy, and the technical unit of heat—the therm—has now generally supplanted the unit of volume—the cubic foot. This innovation has not benefited merely the consumer by conferring on the product with which he is supplied a definite hall-mark of quality, but it has also served an equally useful purpose in enabling the gas technologist to appreciate much more clearly some of the more scientific aspects of his process.

It is to be regretted that the introduction of the thermal basis of manufacture and sale has been so long delayed. Prior to its introduction, many investigators directed their efforts almost entirely to the production of a good yield of gas of high illuminating power, but devoted insufficient attention to the tar and coke produced in the process. There has thus been a lack of appreciation of the close inter-relationship that exists between the therm bearing products of coal distillation, and consequently in the majority of cases investigators have not troubled to give the necessary information concerning the yields and characteristics of these important by-products. Naturally the chief responsibility of a gas undertaking is to make gas, but, in future, this will be no excuse for neglecting to give due consideration to the other important products of carbonisation. The only truly scientific way of computing results is in terms of the distribution of the potential heat energy of the coal between the three main products, gas, tar, and coke. Even to-day there are still many workers who fail to realise this. It is in this way only that a true comparison may be made of the many different processes and proper attention paid to the conservation of the energy available in the coal.

In his recent Cantor Lectures on coal carbonisation, Mr. Evans described some laboratory experiments showing the influence of the rate of heating of the coal in high temperature carbonisation. The results indicated that the total yield of therms in the form of the three products (excluding the heat required to effect the distillation process) was practically the same under all conditions, but the distribution of the available heat units between the gas, tar, and coke varied considerably. In general it was concluded that to obtain the maximum thermal yield of gas, the coal must be heated as rapidly as possible. Slower and more careful distillation resulted in greater yields of tar but less gas, and must be regarded as a tar-conserving process, while exceedingly slow distillation gave much poorer yields of tar, but high coke yields.

Under the most rapid heating conditions practised in these experiments, the thermal yield of volatile products was considerably greater than that obtainable under ordinary working conditions of carbonisation in horizontal retorts. Whereas only 90 therms were obtained in normal practice, as many as 100 therms were yielded in the laboratory when carbonising at the maximum rate. Although at present it is impossible to effect carbonisation so rapidly on the large scale as in the laboratory, it is very clearly indicated that increased thermal yields of gas and tar will result from any acceleration of the process. To-day the tendency in horizontal retort working is to speed up the process by raising the temperature of the setting, and better gaseous thermal yields are being obtained in consequence. Improvements in this direction, however, are limited not only by the conductivity and fire-resisting properties of the retort material, but more especially by the poor heat transmission within the coal substance. Besides, in the production of the highest gaseous thermal yields, gas is formed at the expense of tar, and it may readily be conceived that with excessively high temperatures at the walls of the retort, this decomposition of tar may take place to such an extent as to render the resultant tar valueless as an industrial commodity. Moreover, excessive "cracking" gives rise to tar containing so much free carbon that its viscosity begins to become a source of trouble; stopped pipes and similar technical difficulties are the result.

The principal impediment to more rapid heating on the technical scale, as already indicated, is the resistance to the passage of heat offered by the coal substance itself, and it is most important that in some way or other its conductivity should be increased. When bituminous coal is heated at a moderate temperature, it is a well-known fact that it assumes a pasty condition, probably owing to partial decomposition with the formation of tarry products. The slow transmission of heat through the coal charge has been connected with the formation of a plastic layer of this pasty coal enveloping the interior of the charge. This semi-fluid layer offers considerable resistance to the escape of gaseous decomposition products from within, and is itself all the time undergoing decomposition and becoming more and more viscous. As a result it becomes greatly distended with the bubbles of gas, and finally, as it loses its plastic nature and becomes carbonised, it leaves behind the familiar cellular structure of ordinary gas coke. It is this cellular structure which is responsible for the slow heat penetration, and the problem of increased conductivity is bound up with the means of preventing the formation of the plastic layer.

When coal is powdered and intimately mixed with some inert porous material such as coke or coke-breeze, the latter, during the heating of the coal, tends to absorb the tarry products, and in this way assists in keeping the way clear for the free escape of gaseous decomposition products. It has been shown by a

[1] Synopsis of three Cantor Lectures delivered at the Royal Society of Arts on February 25, March 3 and 10, by Mr. E. V. Evans, chief chemist, South Metropolitan Gas Co.

number of investigators that the formation of the plastic layer and the consequent expansion of the coal may be almost entirely avoided by these means, provided that sufficient inert material be used. A method is thus available for attaining the desired object, and technical experiments on a large scale using coal-coke mixtures have confirmed the expectations of a more rapid carbonisation. Using briquettes made from a suitable mixture of finely powdered coal and coke, the rate of distillation was materially greater than had coal been carbonised under ordinary conditions. The thermal yield of volatile products was also found under these conditions to be increased by as much as 10 per cent.

The origin of the additional thermal yield of volatile matter obtained as the result of rapid carbonisation provides an interesting speculation. A plausible theory is that the additional volatile matter is obtained at the expense of the binding material which cements together the cellular structure of the coke. It is supposed that this binding material originates from the decomposition of the first formed tarry products, and it is not improbable that the proportion of these substances volatilised will be greater the more rapidly they are heated. Thus, in an ultra-rapid carbonisation, the binding material left in the coke would be very small in quantity, while in an exceedingly slow process the amount might be fairly considerable. The rate of heating would, therefore, be expected to have a marked effect on the nature of the coke produced, and this is clearly indicated in the normal volatile matter test. In this test the coal is heated so rapidly that there remains a deficiency of binding material, and a friable and useless coke is obtained in consequence. It is necessary, therefore, that conditions should be so adjusted as to give the minimum amount of binding material compatible with the formation of a firm and satisfactory coke. This quantity will be the least when the particles to be cemented together are in the closest proximity to each other, so that here again it is the coal-coke mixture which promises the best results.

The coke remaining after the carbonisation of coal-coke briquettes and its claims as a fuel have received a considerable amount of attention during the last few years at the hands of several investigators. Compared with ordinary gas-works coke it is much firmer and more compact, a better conductor of heat and more easily burned, leaving an ash practically free from carbon. An increased thermal yield of volatile products is, therefore, not the only advantage accruing from this method of carbonisation.

A very important fact in connexion with the carbonisation of coal-coke briquettes which has been brought to light is that, if the process be arrested after the completion of the first few hours of the carbonisation, the remaining volatile matter is found to be fairly uniformly distributed throughout the briquettes. The maximum rate of gas evolution takes place in the initial stages, and this gas is also of high calorific value; during the last hour or so there is obtained a comparatively small quantity of gas of low calorific value. Probably the cost of production of gas per therm during the initial period will be appreciably less than in the final stages, and it is not improbable that, from a consideration of the economics of the process, it may be possible to interrupt the carbonisation at such a stage that the gas lost is more than compensated for by the enhanced value of a coke containing a small percentage of volatile matter uniformly distributed. The incompletely carbonised coke obtained in this manner burns freely on the ordinary household fire, and is perfectly smokeless. It is thus possible by this means to achieve under high temperature conditions of carbonisation the main object of the low temperature process, namely, the production of a satisfactory smokeless fuel for household purposes.

The reduction of coal to a finely powdered form before carbonisation opens up an attractive vista of possibilities. Not only may chemical treatment be applied prior to briquetting with the view of increasing the thermal yield of volatile products, but also various substances may readily be included in the briquettes for the same purpose. It facilitates the operation of de-ashing—a very desirable process if a smokeless household fuel is to be one of the required products—and finally, different coals might be so blended as to give from every carbonisation a gas of constant quality, so obviating the present troublesome variations in working results.

The Cantor Lectures which have here been briefly summarised constitute a very important contribution to our picture of the probable lines of development in the gas industry in the more immediate future. It must not be forgotten, however, that our present lack of knowledge of the constitution of coal itself is a very real impediment to progress, and it is necessary that every encouragement should be given to the industrious army of workers who by their united endeavours are gradually amassing a store of information on this subject.

Obituary.

PROF. JACQUES LOEB.

BIOLOGY in the broadest sense of that broad term has suffered a grievous loss in the death of Jacques Loeb—one of those rare minds who seem not to grow old, but continue capable throughout life of turning to ever-fresh types of problem, mastering them, and fertilising them with new facts, new methods, and new ideas.

Loeb was born in Germany in 1859. He studied medicine at Berlin, Munich, and Strasbourg, taking his degree in 1885. He became an assistant in the physiological laboratory of the University of Würzburg in 1886, in that of the University of Strasbourg in 1888, but was enabled to spend a considerable portion of the years from 1889 to 1891 at the Zoological Station at Naples.

In 1891 Loeb left Germany for the United States, a step partly dictated by his dislike of the autocratic and imperialistic tendencies he saw in his native country. This anti-militarist spirit never left him, and during the War he wrote a number of articles stressing the stupidity and waste of nationalism and of the wars that spring from nationalism.

In 1891 Loeb was appointed associate professor of biology in Bryn Mawr College, and in the same year married the American lady to whom the sympathy of a multitude of those who never knew her husband, as well as all those who did, is now being offered. In the next year he was offered a position in the University of Chicago, the home of many eminent biologists, which he held for ten years. He then migrated to the University of California, where he was professor of physiology, and thence, in 1919, he removed to become head of the division of general physiology in the Rockefeller Institute for Medical Research in New York, a position which he held until his untimely death.

In 1890, five years after he had taken his degree, Loeb published his first book, on the heliotropism of animals and its identity with that of plants. In this volume, thus early in his career, he showed characteristics which he never lost. He preferred broad problems of general application; he aimed at reducing physiological to physico-chemical processes; he pursued a materialistic (or, as he, perhaps not quite accurately, preferred to say, a mechanistic) explanation of life in general and of animal behaviour in particular.

Scientific papers were always pouring from Loeb's pen; his restless mind was not content with the practical, personal side of research, but demanded to treat the theoretical aspects of large questions as a whole; and the book on heliotropism was only the first of a long succession of books which speedily put him in the front rank of professional biologists. A mere enumeration of their titles will show how varied were his interests: "Physiological Morphology" (1891–2); "The Comparative Physiology of the Brain and Comparative Psychology" (1900); "Studies in General Physiology" (1905); "The Dynamics of Living Matter" (1906); "The Mechanistic Conception of Life" (1912); "Artificial Parthenogenesis and Fertilisation" (1913); "The Organism as a Whole" (1916); "Forced Movements, Tropisms, and Animal Conduct" (1918); "Proteins and the Theory of Colloidal Behaviour" (1922).

As will be seen, some of these are books which summarise the state of knowledge in particular problems; these, however, were never mere compilations, but always represented the point of view to which he had attained after busying himself (and never without success) with the practical business of research in the subject. The rest, on the other hand, are of a more general character; "The Dynamics of Living Matter," for example, or "The Mechanistic Conception of Life," or "The Organism as a Whole," although arising directly out of his work and embodying many of its fruits, are of the widest scope.

In addition, it was Loeb who was chiefly responsible for the launching of the *Journal of General Physiology*, which is playing a considerable rôle in fostering the more physico-chemical aspects of physiological biology in America.

For some years before this, Loeb had been becoming more and more interested in what may perhaps be called rather biophysics and biochemistry than in biological problems analysed with the aid of physics and chemistry. This led eventually to his immersion in research on the proteins, with the remarkable results set forth in his latest book—results which every chemist as well as every physiologist, whether they agree with them or not, will have to take into account.

This rare capacity of passing from subject to subject Loeb shared with great men like Helmholtz and Pasteur. Once, when on a visit to England, he was asked by one of our zoologists how he found time to acquire sufficient knowledge of a new subject before venturing to embark upon research in it. His answer was characteristic: "I don't: all that is quite unnecessary. The knowledge comes as one works."

It was not to be expected that such an unusual type of mind should not have the defects of its qualities. It was a mind which had the capacities of analysis and of generalisation in a rare degree. *Per contra*, it lacked something of the qualities denoted by Bergson in his much-abused term intuition—the seeing of many sides to a question simultaneously, the synthetic grasp of an idea or a problem in the same way as a work of art is apprehended, as a unitary thing, an individual whole. It was doubtless this which led to his taking such extreme and sometimes untenable views on a number of general questions—on the mechanistic interpretation of life; on the problem of consciousness, which he treated with a smiling epiphenomenalism impervious to argument; to his insistence on "organ-forming substances" as explanatory in regeneration and experimental embryology, as against less tangible, apparently less material hypotheses, such as those of gradients and differences in metabolic activity; and outside the purely scientific domain, to his firm belief—worthy of the finest flower of eighteenth-century rationalism—that, given knowledge of the facts, reason alone would and must suffice to place and keep humanity in the right path.

However, Loeb was not a statesman, nor yet a philosopher, but a biologist; so that his defects remain irrelevant and amiable, while his positive achievements remain in perpetuity, as achievements in themselves, and living and vivifying in the work of others.

If we are to single out those parts of his work which are of greatest importance, we should choose, first, his researches on tropisms and forced movements in animals, which have laid a permanent foundation for all future investigation of animal behaviour along physiological lines; then, his far-reaching investigation of artificial parthenogenesis and fertilisation—again pioneer work, again a notable contribution towards a physico-chemical account of one of the most striking of biological processes; next, his work on the antagonism of various ions in regard to processes of growth and development; and finally, his work on the proteins. In addition, the way in which he laid all branches of both the animal and the plant kingdoms under contribution as material for his work was in itself a lesson in method. One day he was studying the heliotropism of a hybrid; the next, the regeneration of a flowering plant; then the fertilisation of sea-urchins; the development of fish; the effects of brain-lesions on vertebrate behaviour; the temperature-coefficients of different phases of the life-cycle of a fly . . . and never without reference to some central idea and plan of advance.

It is sad that Loeb should be cut off in full vigour, and that we shall not see whither his biophysical work was leading him; it is sad for all those who have met

him, at his New York home or, still pleasanter memory, in his summer laboratory at Wood's Hole, to think that they will not again see his cheerful, friendly smile and face acute yet simple; but at least he has lived and achieved, and has left a notable monument in his work, and in the gratitude and in the work of the numberless younger men whom he helped with his never-failing kindness and resourcefulness of suggestion.

PROF. CARL F. O. NORDSTEDT.

CARL FREDRIK OTTO NORDSTEDT died in Lund on February 6, aged eighty-six. A long obituary notice is printed in the recently issued part of the *Botaniska Notiser*, from which the following account is taken.

Nordstedt was born at Jönköping on January 20, 1838, and was descended from Samuel Linnæus, the brother of the great Swedish naturalist, Carl von Linné. Educated in his native town, he proceeded to the University of Lund in 1856, studied under the celebrated algologist, Jakob Georg Agardh, and in 1862–63 acted as assistant physician in the military hospital in Stockholm, but abandoned medicine for botany. Before this, Nordstedt had helped to found the Lund Botanical Club, the oldest of the Swedish associations in that science. From 1873 to 1875 he officiated as amanuensis in the Botanical Institution, and at the end of 1878 he became permanent amanuensis, a post which he retained for more than forty years, to the beginning of 1921.

The post of conservator was established at the close of 1870, upon the gift of the younger Agardh to the University of 40,000 phanerogams, and Nordstedt became the first to occupy that position; the extent of the collection increased under his energetic direction. When in 1901 Agardh bequeathed his rich and extensive library to the University, Nordstedt was appointed its first keeper, and he remained keeper for twenty-two years, without salary. Four days before his death he was seen in the library, intent on his duties.

The oldest Swedish botanical periodical, *Botaniska Notiser*, was established in 1839, and under various editors had a chequered career, until Nordstedt in 1870 undertook its conduct, which he continued for fifty-one years; in 1921 the direction of this journal was taken over by the Lund Botanical Club.

Nordstedt's work in the issue of exsiccata of Charophyta and fresh-water algæ was energetic and constant; he was the first of his nation to study the plankton of his country's inland waters, and the outcome of his labours was his well-known and admirable "Index Desmidiacearum" of 310 pages, published in 1896, with a supplement in 1908. He was present at the botanical congresses at Vienna in 1905 and Brussels in 1910, and he was constituted a member of the committee to draw up a formal system of nomenclature for cryptogams, which he presented to the latter gathering.

The oil-portraits of Carl von Linné's father and mother and Samuel Linnæus were given by Nordstedt to the collections preserved at Linné's Hammarby, seven miles to the south-east of Uppsala; they are well known by their reproduction in T. M. Fries's monumental life of Linné.

Nordstedt travelled in Norway, Germany, Switzerland, Italy, Tyrol, the Netherlands, Belgium, was at least twice in England, the latter time at Cambridge in 1909 for the Darwin celebration, and in Denmark many times. He was a Knight of the Vasa Order in 1900 and of the Polar Star in 1906; he was an honorary member of many societies abroad, and a foreign member of the Linnean Society of London from 1895. He had a good constitution and splendid health, and suffered but little from age until a few months before his death. To those who had the pleasure of his hospitality in his modest home in Lund, the remembrance of his delightful company will always be cherished. A full bibliography of his works will be found in the *Botaniska Notiser*, as previously cited. B. D. J.

MR. ARNOLD T. WATSON.

BY the death of Mr. Arnold T. Watson, of Sheffield, at the age of seventy-seven, marine zoology loses a well-known investigator who has made many valuable additions to our knowledge of the anatomy and habits of the tubicolous Polychæte worms. Mr. Watson belonged to that admirable class of workers who do so much for the advancement of science though not professionally engaged in it. For the last thirty-five years he devoted practically the whole of his leisure time to the investigation of the tube-building marine annelids, on which he has long been an acknowledged authority.

The results of Mr. Watson's labours have from time to time been published in various scientific journals, including the Journal of the Royal Microscopical Society, the Proceedings of the Royal Society, the Journal of the Linnean Society, the Proceedings of the Liverpool Biological Society, and the Reports of the British Association. Prof. M'Intosh's monumental "Monograph on the British Marine Annelids" also bears testimony to the importance of Mr. Watson's researches. He was a member of the Liverpool Marine Biology Committee, and paid numerous visits to the Port Erin Biological Station for research purposes connected with his work. For the last twenty years he rarely missed attending the meetings of the British Association, and frequently contributed accounts of his discoveries to the Zoological Section. His circle of friends included Sir William A. Herdman, Prof. W. C. M'Intosh, Prof. Fauvel (of Angers), and Prof Gilson (of Louvain), all of whom were ever ready and willing to help him in his work, which he deeply appreciated.

As one who for many years had the privilege of his friendship, the present writer can speak with sincere admiration of his unassuming and genial character, his perfect sincerity, and the high ideals by which he regulated his whole life. A. D.

WE regret to announce the following deaths:

Dr. T. N. Annandale, Director of the Zoological Survey of India and Superintendent of the Indian Museum, Calcutta, on April 10.

Dr. A. L. Smith, Master of Balliol College, Oxford, on April 12, aged seventy-three.

Current Topics and Events.

The lecture given by Prof. H. E. Armstrong at the Royal Institution on April 7, under the auspices of the Society of Chemical Industry, was cordially appreciated, and was in many respects noteworthy. It was intended to direct the attention of chemists to the need for co-ordination of their observations and theories with those of physicists. With characteristic zest, Prof. Armstrong warned these scientific workers not to cling too long or too tenaciously to ideas imposed upon them by custom. Youth had fondled a calf, and age, he declared, still cuddled the animal, forgetful that it had become an ox. He confessed that he had been led to revert to the study of the relationship of physics to chemistry by contemplating a thunderstorm. What explanation had chemistry to offer of phosphorescence, for example, of the phosphorescence of ozone? This, and kindred phenomena, naturally reminded chemists and physicists alike of the classic experiments performed by Sir James Dewar at the Royal Institution, and Prof. Armstrong expressed the thanks of the Society of Chemical Industry to the Institution for enabling those experiments to be witnessed. With the skilful aid of Mr. Heath and Mr. Green, about twenty of the Dewar experiments were then successfully repeated, to the delight of the audience, and of the veteran professor, who manipulated the tubes, the flasks, the models, and the lantern-slides in a manner that recalled many a victory over the perversity of matter. To illustrate another phase of his theme, a demonstration was given of the method employed by Mr. G. L. Addenbrooke to investigate the effects of desiccation of the dielectric in Faraday's ice-pail experiment. Prof. Armstrong also insisted upon the necessity for studying the forces that manifest themselves at surfaces of contact between electrodes and dielectrics or partial conductors.

To see again so many of the brilliant experiments of Sir James Dewar in a single group, directed to the purpose of indicating in what manner chemistry may be linked to physics, was at once a privilege and an object-lesson. It is only possible here to summarise a selection of them. Charcoal cooled by liquid-air is able to absorb air in a closed vertical tube dipping into mercury, and to form a vacuum sufficiently near to perfection for a barometer, or for a radiometer. With hydrogen the absorption is slight. Liquid oxygen is attracted to the poles of a magnet, and is held in place between them. Dry air admitted through a spark-gap into the top of an exhausted glass tower, as a jet, descends through the tower in a stream with a luminous glow. This occurs only with oxygen compounds, and pure oxygen increases the effect. Low temperature stiffens metal springs and hardens substances like india-rubber. Iodide of mercury changes colour by being dipped in liquid air. An egg-shell cooled in liquid-air exhibits phosphorescence—a blue glow. A candle behaves similarly. When cooled in liquid-air, ice from impure water is brilliantly phosphorescent, and ice from pure water is only feebly phosphorescent. The spectrum of liquid oxygen shows absorption bands. Bromine vapour sealed into an inverted flask with slightly cupped base, is condensed upon the interior of the cup when liquid-air is poured into the cup at the top, and the interior of the flask becomes clear: similarly with chlorine. Certain waves of ultra-violet light from a quartz-faced mercury-vapour lamp are absorbed by liquid oxygen and the energy is utilised in the production of ozone. A Nernst filament burning in liquid oxygen produces ozone. Particles of naphthylamine sulphonic acids and derivatives dropped into water capture ultra-violet light from a carbon arc and transform it into colours—sky blue, carmine purple, and green. By what interpretation is all this to be brought into harmony?

A general impression has been fairly prevalent of late that the past winter has been exceptionally severe. Taking Greenwich Observatory as a representative centre for England and using the observations supplied by the Astronomer-Royal and published in the Registrar-General's "Weekly Return of Births and Deaths," the idea of the unusual severity of the winter is scarcely supported. Without doubt the cold extending into April is prolonging the wintry conditions, and it will be remembered that exceptionally severe frost was experienced in November last. The mean temperature (using the Fahrenheit scale) at Greenwich for the six winter months ending March this year was 41°·4, which is 1° below the average for 60 years. So recently as the winter of 1916–17 the mean was 40°·6, which is 0°·8 lower than last winter; but there is no equally cold winter previously since 1901–2. In the last 50 years there have been 9 winters with a lower mean temperature than last winter; the coldest was 1878–79 with a mean temperature of 39°·4, while in 1885–6 it was 39°·8. During the winter which has just closed, 4 of the 6 months had a mean temperature below the normal; the coldest month was February, but November had the greatest deficiency from the normal. In March there were at Greenwich 28 frosts registered by the radiation thermometer, and in February 26, giving a total of 54 frosty nights in the two months out of a total of 60 nights. Sunshine has been unusually abundant recently; on 7 days ending March 14 the sun at Greenwich was shining brightly for 64 hours, and the average per day for the whole month was 4·7 hours, while the normal is only 3·4 hours. Rainfall has been very deficient for the last two months, and a drought occurred at Greenwich from March 7 to 21. Similar conditions to those at Greenwich have occurred in most parts of England.

It is satisfactory that the future of main line electrification on British Railways is now being discussed by traction engineers. On March 27 Col. O'Brien, of the London, Midland, and Scottish Railway, read a paper on this subject to the Institution of Electrical Engineers. He strongly advocated main line electrification. He pointed out that the modern electric locomotive is superior as a tractor to the steam locomotive. It will reduce operating

costs appreciably. No movements are required for turning, coaling, or watering. Only one man will be required for shunting-engines. The elimination of reciprocating parts and the boiler will reduce repairs to about one-third their present cost. The number of electric generating stations in Great Britain is now very large. Energy, therefore, could easily be purchased by the railway companies. Extensive systems of electrification would not be dependent on a single generating station. The figures given in the paper indicate that, after paying all fixed charges on capital expended, the railway companies would obtain a further net profit representing from 5 to 10 per cent. on the capital expended. In the subsequent discussion it was made clear that the amalgamation of the railway companies, instead of promoting electrification, had actually retarded it, as certain schemes decided on had been dropped. Sir Philip Dawson pointed out the great progress that has been made abroad, especially in Germany, in electric traction.

THE president of the Institution of Mechanical Engineers, Mr. William H. Patchell, delivered his address on Friday, March 21, and had a good deal to say about modern developments in electrical generation. The total of 200 million units sold by the Glasgow Corporation, Dalmarnock Station, is dwarfed by the totals of 1127 millions and 2265 millions sold by the Detroit, Mich. and Chicago, Ill., stations respectively. The American consumption of electricity per head of population per annum would never have been 500 to 700 kw.-hr. if it had been left to the consumer to go out and buy it. The figures quoted by Mr. Patchell set one thinking what British mechanical engineers might be doing if our electricity supply authorities stimulated a demand. Mr. Patchell discussed the question of the generation of steam at high pressure. Makers are willing to offer turbines and boilers for 1200 lb. pressure, and say 750° F. steam temperature, but much more knowledge of what may happen is wanted to ensure a feeling of security to those who have to operate such a plant, and the material of which boilers are in future to be constructed is by no means settled. The drums for the 1200 lb. steam pressure Babcock-Wilcox boilers, with 19,743 square feet of heating surface, now in hand for the Boston Edison Company and elsewhere, are forged steel cylinders, 48 inches inside diameter, 56 inches outside diameter, and 34 feet long. Mr. Cox, of the Midvale Company, Philadelphia, which is making the drums, lately stated that they are perhaps the largest hollow forgings ever made. The weight finished is 162,000 lb. The billet was cut from a 78-inch octagon ingot weighing 262,000 lb. It was stood on end and upset to about 96 inches in diameter, then had a 23-inch core removed with a hollow punch, was expanded to about 50 inches inside diameter, drawn on a mandrel to 45 inches inside and 58½ inches outside diameter, annealed, tested, machined inside and out, and after closing in the ends for manholes, is to be reannealed. This scarcely sounds like boiler-making, and the manufacture of such drum forgings can only be undertaken by a few selected masters of their trade.

THE second reading of the Summer Time Bill was agreed to in the House of Commons on April 11. The main object of the Bill is the permanent establishment of a six months' period of summer time, from the first Sunday in April to the first Sunday in October. This is the period recommended at the recent conference held in Paris between representatives of Great Britain, France, and Belgium. It will certainly be an advantage for the changes to summer time, and back to standard time, to be made on the same days in these countries, and as the duration of daylight varies with the latitude, the dates of transition are purely a matter of agreement. In the discussion of the Bill in the House of Commons, many points in favour of, and against, the operation of summer time were presented, but no member seems to have referred to the different effects of the same period at different latitudes, as, for example, Paris and Edinburgh. As, however, no one period can be equally suitable for all latitudes, the permanent establishment of summer time between fixed dates is much more satisfactory than the varying dates adopted in different years in Great Britain and neighbouring countries.

AGRICULTURAL engineering in Great Britain has, in the past, had no definite Department of Research, but this has now been rectified by the Ministry of Agriculture and Fisheries, which has offered to the University of Oxford the necessary funds to create an institute definitely concerned with this form of investigation. This offer the University of Oxford has gratefully accepted and has appointed Capt. B. J. Owen to the post of Director. No doubt Capt. Owen will have his own ideas as to the forms of research that he will pursue, but it is probable that the work he has hitherto been doing for the Ministry of Agriculture will be continued. His activities have been directed along the lines of investigations into sub-soil ploughing, hay-stack drying, mole draining, and the generation of electricity by wind power, and in these departments he has already produced important results. Capt. Owen has travelled widely in the United States of America, Denmark, Sweden, Norway, and other countries, where he has studied the methods of research pursued there. It is believed that there is a great field awaiting investigations in connexion with engineering as applied to agriculture, and it is hoped that the new departure will have far-reaching influence on the farming of Great Britain.

THE earth-shake felt on the night of April 4 in the border districts of Nottinghamshire and Derbyshire was one of the strongest of the type known in England, several chimneys having been thrown down at Hucknall Torkard and South Normanton. The disturbed area appears to have been about 20 miles long and 12 miles wide and contains about 190 square miles, its centre being about 10 miles north-north-west of Nottingham. The Pendleton earth-shake of November 25, 1905, was slightly less strong and was felt over an area of 144 square miles. As the average area disturbed by English earthquakes strong enough to damage chimneys is about 71,000 square miles, it

is clear that the focus of the Nottinghamshire earth-shake must have been close to the surface. As in most other earth-shakes in mining districts, the recent shock was probably due to a superficial fault-slip caused by the loss of support from the removal of the coal-seams up to the fault.

THE Le Blanc Medal of the French Chemical Society was presented to Prof. T. M. Lowry on March 28, at a joint meeting of the Société Chimique de France and of the Société de Chimie Physique.

THE anniversary meeting of the Royal Geographical Society will be held at the Æolian Hall, New Bond Street, W.1, on Monday, May 26, at 5 o'clock, when the presidential address will be delivered and the presentation made of the gold medals and other awards of the society.

DR. R. E. STRADLING, head of the Department of Civil Engineering, Architecture, and Building in the Technical College, Bradford, has been appointed Director of Research of the Building Materials and Construction Research Board of the Department of Scientific and Industrial Research, London.

WE learn from *Science* that Prof. F. Paschen, professor of physics in the University of Tübingen, has accepted an invitation of the University of Michigan to be in residence during the first semester of the year 1924–25. He will lecture and direct research in the field of spectroscopy.

THE Faraday Medal of the Institution of Electrical Engineers will be presented to Dr. S. Z. de Ferranti on Thursday, April 24, at 6 P.M., on which date Mr. G. Semenza, of Milan, will deliver the fifteenth Kelvin Lecture, taking as his subject "Kelvin and the Economics of the Generation and Distribution of Electrical Energy."

ACCORDING to the *Chemiker Zeitung*, Messrs. Schott and Co., the Jena glassmakers, have placed on the market filter plates of sintered glass. It is pointed out that these have many applications in all branches of chemistry, examples in analytical, preparative, and electro-chemistry being quoted. Series of filters of different stopping powers are marketed.

APPLICATIONS are invited by the Indian Central Cotton Committee for the post of cotton research botanist at Lyallpur, Punjab. The person appointed will pursue investigations with the view of improvements in local and American cotton schemes. Candidates should possess high qualifications in cotton-breeding and plant physiology, and must apply for the position by May 31, at latest, to the Secretary to the High Commissioner for India, 42 Grosvenor Gardens, S.W.1.

A CORDIAL invitation is again extended to Farmers' Associations and Clubs, Chambers of Agriculture and Horticulture, Students' Societies, and other bodies interested in agriculture or market gardening, to inspect the Rothamsted experimental plots during the coming summer. Mr. H. V. Garner will be available to demonstrate the plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting. All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden.

A GENERAL discussion on fluxes and slags in metal melting and working is to be held on Monday, April 28, by the Faraday Society and the Institute of Metals, with the co-operation of the British Non-Ferrous Metals Research Association and the Institute of British Foundrymen. The meeting will be held from 3 P.M. to 7 P.M., with an interval for tea, at the Institution of Mechanical Engineers, Storey's Gate, S.W.1. A general introduction will be given by Prof. C. H. Desch, and there is a programme of some fourteen papers intended to initiate discussion on the various aspects of the subject. The papers deal primarily with the uses of fluxes and slags in the smelting and refining of the non-ferrous metals, but there will be one section dealing with fluxing problems in arc and oxy-acetylene welding. The subject of slag inclusions will also be dealt with. The complete programme may be obtained from the Secretary of the Faraday Society, 10 Essex Street, London, W.C.2.

THE twenty-ninth annual congress of the South-Eastern Union of Scientific Societies will be held at Guildford on May 28-31, under the presidency of Sir Richard Gregory, who will deliver his presidential address on "Science in Civilisation" on the first evening of the meeting. Sectional presidents will address their sections as follows: Dr. A. B. Rendle (botany) and Mr. G. W. Young (geology) on May 29; Sir Francis G. Ogilvie (regional survey) on "The Educational Value of Regional Survey," and Prof. E. B. Poulton (zoology) on "Some Modes of Protection in the Pupal Stages of Butterflies and Moths," on May 30. Other papers to be read and discussed at morning sessions are by Mr. C. H. Grinling on botanical survey work, by Mr. Ray Palmer on bumble-bees, and by Rev. S. O. Ridley on deep-sea life. Evening lectures will be delivered by Dr. A. F. Tredgold, on the influence of modern civilisation in producing degeneracy, and the antidote, and by Mr. F. C. Elliston-Erwood, on the Pilgrims' Way, while Dr. W. Martin will lecture on the morning of May 31 on the kinematograph film as an educator. Archæological, botanical, and geological excursions to local places of interest have been arranged for the afternoon sessions. The honorary general secretary of the Union is Mr. H. Norman Gray, 334 Commercial Road, London, E.1.

THE after-Easter session at the Royal Institution will commence on Tuesday, April 29, when Prof. J. Barcroft begins a course of four lectures on the effect of altitude on man. The Tyndall Lectures will be delivered this year by Major M. S. Tucker, Director of Sound Ranging in the Army, on acoustical problems. On Wednesday, April 30, and Thursday, May 8, Mr. F. Balfour Browne will give two lectures on social life among insects; on the succeeding Thursday afternoons, Dr. E. V. Appleton will deliver two lectures on atmospheric interference in wireless telegraphy, and Dr. C. G. Seligman two lectures on (1) divine kings and rainmakers of the Sudan, and (2) the Veddas of Ceylon. Saturday afternoon lectures, beginning on May 3, will include two lectures

by Dr. F. A. E. Crew on heredity and sex. The Friday evening meetings will be resumed on May 2, when Sir Alexander Kennedy will deliver a discourse on Petra. Succeeding discourses will probably be given by Prof. V. F. K. Bjerknes, Dean Norris, and Lord Rayleigh, among others.

THE preliminary programme of the fourth International Conference on Soil Science to be held at Rome in the International Institute of Agriculture, on May 12-19, has recently been issued. As this is the first such meeting since the War, one studies the programme with interest to see not only what main subjects are down for discussion, but also to what extent the Conference is international. Taking the latter point first, one finds that practically every European country engaged in soil research is represented, with the regrettable exception of France. Although the bulk of the papers are by Italian and German authors, there are many contributions from Holland and the Scandinavian countries, a fair number from Austria, Hungary, Switzerland, Poland, Czecho-Slovakia, and several from Russia. There are very few papers from British sources, but it is pleasing to note that Great Britain is at last taking an official part in this important Conference, and that papers are also forthcoming from Egypt, the Sudan, and Rhodesia. The United States is, as usual, well represented. Turning now to the subjects to be discussed, they fall under the main headings of soil physics and chemistry, soil survey and classification, soil biology. The main interest centres in the first of these sections. Several papers deal with improved methods of measuring the physical properties of soil, and special attention is being given to the newer methods of mechanical analysis of soil. Soil acidity, its experimental determination and its cause, will be discussed in detail, and the allied subject of base exchange in soil will receive similar treatment. Finally, some aspects of plant physiology and bacteriology of especial interest in their relation to soil are to be discussed. The meeting, which promises to be very interesting, will conclude with a short tour of regions of especial agricultural interest in Italy.

Our Astronomical Column.

THE END OF THE JULIAN CALENDAR.—M. Milankovitch, who was the delegate of Serbia and Croatia at the Congress on the Julian Calendar that assembled in Constantinople last May, gives in *Astr. Nach.*, No. 5279, a full account of the resolutions that were then adopted: they are as follows:

(1) 13 days were dropped; the day following Sept. 30, 1923, was called Oct. 14.

(2) The dropped feast-days were celebrated *en masse*.

(3) No change was made in the number of days in each month.

(4) As hitherto, all years divisible by 4 are leap-years except those mentioned in (5).

(5) Years ending in 00 are not leap-years unless the remainders on dividing by 900 are 200 or 600.

(6) No alteration in the dates of the "Fixed" feast-days.

(7) The movable feasts to be at fixed intervals from Easter as hitherto. Easter is the first Sunday after the first full moon after the spring equinox.

(8) The full moon and equinox are both to be reckoned by astronomical tables, not by the previous method of epacts and golden numbers. The time used is that of the meridian of Jerusalem (civil reckoning).

(9) The astronomical professors of Athens, Belgrade, Bucharest, and Pulkovo were invited to prepare the dates of Easter under Nos. 7 and 8 for a sufficient number of years in advance.

(10) These changes are to be no obstacle to further calendar reforms that may meet with universal assent.

The most interesting resolutions are (5) and (8). (5) will give the same leap-years as the Gregorian one up to the year 2799 inclusive, so there is ample time to consider its general adoption. It gives one leap-year less than the Gregorian in a period of 3600 years, and is much more exact than the latter, the mean annual error being 2 seconds instead of 25.

Many people will consider that astronomical tables are now sufficiently perfect to warrant the substitution of the astronomical full moon for that hitherto used in finding Easter. There are 6 cases in the next 50 years where the new method gives a different date for Easter from the old. The new dates are March 23, 1924; April 24, 1927; March 28, 1943; April 25, 1954; March 25, 1962; April 2, 1967; as compared with April 20, April 17, April 25, April 18, April 22, and March 26, in the present reckoning.

ELEMENTS OF REID'S NEW COMET, 1924 *a*.—The following elements have been telegraphed from the Cape:

$$T = 1924 \text{ Feb. } 22{\cdot}78 \text{ G.M.T.}$$
$$\left.\begin{aligned} \omega &= 260^\circ\ 40' \\ \Omega &= 111^\circ\ 18' \\ i &= 72^\circ\ 22' \end{aligned}\right\} 1924{\cdot}0.$$
$$\log q = 0{\cdot}23350.$$

These elements negative the suggestion, made in this column last week, of identity with De Vico's Comet, 1846 IV. Unfortunately, they give no prospect of the comet becoming visible in England. It will be south of the sun, setting before sunset, for several months; it may possibly be still within reach of large instruments in the autumn, but it will be too faint for ordinary observers. The high inclination of the axis of the orbit makes periodicity unlikely. It will be noticed that the perihelion point is outside the orbit of Mars.

ROTATION PERIODS OF MERCURY AND VENUS.—Schiaparelli's values for these periods—88 days and 225 days respectively—find a strong supporter in M. A. Danjon, of Strasbourg Observatory. He gives in *L'Astronomie* for March reproductions of drawings of Mercury made with the 50-cm. equatorial of the Observatory by himself and by M. A. Couder: the two observers agree in the positions of the brighter regions on the disc, and both accord well with Schiaparelli's map (*Astr. Nach.* No. 2944). M. Danjon further notes that the markings are as well defined as those of Mars, and that he followed them for several hours without noting any shift, which is sufficient to dispose of any rotation period in the neighbourhood of 24 hours.

M. Jarry Desloges and his assistants at Sétif, Algeria, announced the same conclusion about Mercury in the last annual volume of the Observatory. Thus practically all the observers who have good climate and instrumental means are now agreed about the rotation of Mercury; there is less accord about Venus, the markings of which are both elusive and temporary. Mercury is now well placed for observation in the evening sky. It transits the sun on May 7.

Research Items.

THE PITCH INDIANS.—Interesting evidence bearing upon a primitive type of social organisation among the Indians of California has been rescued from oblivion by Mr. P. Earle Goddard when it was in imminent danger of being lost entirely. In vol. 17, No. 4 of the University of California Publications in American Archæology and Ethnology, he describes the habitat of the Pitch Indians, a Wailaki division, many of whose ruined villages he visited in 1922 in company with one of the four surviving members of the tribe, an old man of seventy. The Pitch Wailaki were the extreme south-eastern extension of the Athapascan stock on the Pacific coast. Politically they were a separate group of the Wailaki, and in a region where there was general enmity between neighbouring peoples they were especially noted for their hostility to others. They comprised four small political groups or sub-tribes living in villages averaging as nearly as possible five houses each. Taking the number of villages as a basis of calculation, the population must have numbered between 650 and 800. These have practically disappeared within the memory of a man still living.

SYNTHESIS OF ETHEREAL SULPHATE IN THE BODY.—Since Baumann in 1876 first isolated potassium phenyl sulphate from horse's urine, there has been controversy as to the mode of origin of these ethereal sulphates in the body. Recent experiments by Dr. T. S. Hele (*Biochem. Journ.*, vol. 18, 1924, p. 110) have thrown some light on the question. A dog was fed on a standard diet, the total sulphur content of which was known, and the sulphur and nitrogen of the excreta were investigated. Over part of the experiment guaiacol was administered daily in amount more than sufficient to combine with all the sulphate produced in the body in the course of metabolism. In addition to this, on certain days there was administered either sodium sulphate or bisulphite, or cystine. Sodium sulphate was also given alone. The results showed that when sulphate and guaiacol were given together, about 66 per cent. of the sulphate was excreted in combination with the guaiacol: similarly, of sulphur administered as cystine, 47 per cent., and of sulphur given as bisulphite, 19 per cent. was excreted in the form of an ethereal salt. It therefore seems as though guaiacol, and therefore presumably other phenols, will unite with sulphates in the body, under certain conditions. The synthesis takes place in the liver in all probability, but not all the available phenols are subjected to it: part is combined with glycuronic acid, part is excreted unaltered, and some of it is destroyed by oxidation.

FAT METABOLISM IN PLANTS.—Relatively little is known concerning the fat metabolism in plants, and Prof. J. H. Priestley (*New Phytol.*, vol. 23, No. 1) has written a useful summary of that knowledge and made some additions to it. After discussing the nature of fats, oils, waxes, and lipins, he describes the distribution of fatty substances in the plant, pointing out their presence particularly in the protoplasm of apical meristems, in young cell walls, in protective tissues and assimilating tissues. They appear to be synthesised in the photosynthetic centres, and chloroplasts may turn their activities from starch formation to the accumulation of fatty substances. There is some physiological evidence that the synthesis of fats starts from carbohydrates. Suggestions are made as to how, beginning with glycolaldehyde and ammonia, the phosphatid cephalin could be obtained, and the importance of methylation in connexion with these and other transformations in the plant is emphasised.

A EUCALYPTUS "SCRUB."—The *Victorian Naturalist*, vol. 40, No. 10, February 1924, contains a very readable account by D. J. Paton, with map and list of species, of a very unusual plant formation, covering a dry arid hilly region, in which occur uncertainly the auriferous quartz formations which about 1850 made Bendigo, lying just south, suddenly famous and populous. Pushing north from Bendigo this area is characterised by a dense growth of shrubby eucalypts with slender stems, intertwined with thick tangles of parasitic creepers, and early received the name of "whipstick scrub." In some places areas have been partially cleared by the eucalyptus distiller, *E. polybractia* and *E. viridis* being particularly sought for their high oil content; in such places dense growth of *Melaleuca uncinata* is found. Parasitic on all the plants of the scrub, but especially upon *E. viridis*, is the climber *Cassytha melantha*, forming impenetrable tangles and often breaking down its unfortunate host plants by its weight. The dominant plants of the main scrub and of the lower strata of scrub and shrubby undergrowth are listed and the distribution of the more localised species analysed. It is interesting to learn that in this "whipstick scrub," which the author regards as a formation that used to cover a much larger area of northern Victoria, about one-eighth of the plants are oil bearing, whilst only eight representatives of five genera of Papilionates are present.

ORTHAULAX FROM THE TERTIARY DEPOSITS OF THE WEST INDIES.—Among the large number of Tertiary molluscs collected in Haiti under the supervision of the United States Geological Survey during the winter of 1920–21, the most striking and one of the commonest in the upper zone of the Thomonde formation (Miocene) was the strange *Orthaulax aguadillensis*, Maury. Mr. W. P. Woodring, in a recent paper (Proc. U.S. Nat. Mus., lxiv., art. 1), discusses the genus, which is intermediate between Rostellaria and Strombus, and confined to the Middle and Upper Oligocene and Lower Miocene of the West Indies, Central America, Mexico, and the south-eastern United States. He further describes and figures the two species *O. aguadillensis*, Maury, and *O. conoides*, n.sp., met with in Haiti.

EVOLUTION OF SHELL-SCULPTURE IN THE VIVIPARIDÆ.—In 1918 Dr. Annandale established the genus Taia for certain sculptured Viviparidæ met with in the Inlé Lake, which he remarked at the time had some resemblance to those of Haldeman's North American genus Tulotoma (*melius*, as emended by Fischer, Tylotoma). He has now (Proc. Roy. Soc. Lond., B., vol. xcvi.) instituted a comparison between them and the similarly ornamented forms of Margarya of western China and the yet more interesting Pliocene series from the Isle of Cos and from Slavonia and Dalmatia. These European fossils Neumayer had also compared to Tulotoma, but it was Sandberger, we believe, who first, in 1875, definitely transferred them, without justification, we think, to the existing American genus, which, if White be correct, was represented by a single species so far back in time as the Laramie beds. Dr. Annandale, however, supports this determination and goes so far as to say that, judging by the shape of the mouth, the Cos shells must have been provided with an operculum similar to that of Tulotoma, which of course is quite

different from that of his own Taia. By careful investigation of living Taia, Dr. Annandale is able to show that the modifications in the ornamentation of the shell are brought about entirely by changes in the shell-secreting margin of the mantle, and are not correlated with any profound anatomical changes in the animal. Concerning these interesting cases of convergence, though he does not apply that term to them, Dr. Annandale remarks: "They provide additional evidence . . . that in certain regions . . . there is or has been some influence at work which has produced a similar collective peculiarity in the shells of the Viviparidæ on diverse occasions and in different parts of the world," and hazards the suggestion "that it had something to do with a peculiar chemical stimulus in the water . . . affecting the germ-plasm as well as the soma of the molluscs." The corresponding case of the *Tanalia aculeata* (Gmelin) of Ceylon should now receive attention, for concerning this snail H. F. Blanford wrote in 1862 that specimens from the same stream and collected at the same spot presented perfect graduation between the extreme forms from smooth to ornamented and proceeded to demolish the twenty-four other specific names founded on those variations. A new subgenus and new genus are established by Dr. Annandale in the course of his paper that run the risk of being overlooked because the editor left them buried in the text instead of seeing that due prominence was given to them.

THE PERIODS OF EARTHQUAKE-WAVES.—Whether any variations occur in the periods of earthquake-waves as they radiate outwards from the origin has for some time been doubtful. It has recently been considered in some detail by Mr. J. B. Macelwane (Bull. Seis. Soc. America, vol. 13, 1923, pp. 13-69). A single earthquake—the Californian earthquake of January 31, 1922—was selected and more than fifty seismograms or photographic reproductions of them were examined, with the following results. The period of a long wave at the beginning of the first preliminary waves was found to decrease, and that of a very short superposed wave to increase, as the distance from the epicentre increased. No relation could be discovered between the periods of the second preliminary waves and the epicentral distances. The periods of two maxima in the shorter waves of the principal portion showed a rapid increase with the distance, that within the first quadrant being approximately a linear function of the epicentral distance.

CANADIAN IRON ORE.—The Honorary Advisory Council for Scientific and Industrial Research of the Dominion of Canada has issued a report (No. 14) on the utilisation of the low-grade iron ores of Canada. It is pointed out that the iron industry of Canada is developing and reaching important dimensions, but that the bulk of the iron is produced from imported ores, the ironworks of Nova Scotia drawing their ores from Wabana, Newfoundland, and those of Central Canada from the Lake Superior mining district of the United States. It is admitted that Canada contains no deposits of iron ore capable of competing with these on equal terms, but it is pointed out that Canada does possess very large reserves of low-grade iron ores which are capable of concentration and sintering, and, treated in this way, produce an iron ore of the highest possible character, which could be used advantageously to replace the imported ores. On the other hand, it is freely admitted that the cost of the ore thus artificially produced from low-grade Canadian ores cannot compete commercially with the imported ores, which require no such special treatment. The marginal difference is, however, not very great, and the present report suggests that this difference should be made up by the payment of a Government bounty to the producers of such artificial ores from the native Canadian material. It is estimated that a bounty of one cent per ton per unit of iron in the product would be sufficient for this purpose, and would enable the Canadian product to compete successfully with imported ores. It is pointed out that the payment of such a bounty would save the expenditure of 5,000,000 dollars per annum, which goes out of the Dominion in payment for foreign ore, that it would to that extent stimulate the development of the resources of Canada, would give employment to Canadians, and would benefit the railways of the Dominions by supplying them with freight.

TEMPERATURE OF MEXICO.—A translation from the Spanish text has been made by Mr. W. W. Reed, of the U.S. Weather Bureau, of an important discussion of the temperature in the Republic of Mexico by Jesus Hermandez, and is published as Supplement No. 23, 1923, to the U.S. *Monthly Weather Review*. Data from 70 meteorological stations have been used, and the work contains numerous tables and 75 diagrams or charts. Observations are for the epoch 1901–1910. Mexico, although mainly within the tropical zone, experiences great diversity of climate, from severe cold to extreme heat, the differences of temperature being due largely to the varied topography of the country. The graphical results showing the month to month variations in temperature are of extreme interest, these variations being largely dependent on elevation and distance from the sea. The lowest temperatures occur generally in December or January, and the annual maximum is experienced some time from May to August. Nearly all regions have a general fall of temperature after September. Surface isotherms are controlled chiefly by elevation above sea-level. The temperatures are generally highest along the coast, while the minimum temperatures are grouped about the elevated regions, latitude having but little effect. For daily temperature the minimum occurs about sunrise, while the maximum is reached at 2 P.M. from May to September and at 3 P.M. during the remainder of the year. The mean temperature for the year in the city of Mexico, derived from the 24-hourly observations, is 59°·6 F.: the maximum monthly mean is 64°·5 F. in May, the minimum 52°·8 F. in January. The discussion is of great scientific value, and, with the results emanating from the United States and Canada, practically completes our knowledge of temperature for the North American continent. The Supplement is published at 10 cents, a remarkably low price considering the large number of tables and charts contained in the discussion.

UNITED STATES SURVEY WORK.—The Report of the United States Coast and Geodetic Survey for the year ending June 30, 1923, contains the record of a great deal of valuable work in American waters. One of the many projects to which particular attention was paid was the charting of the Alaskan coast line and water routes. In view of the greatly increased volume of tonnage frequenting Alaskan harbours in recent years, this work was long overdue. The provision of suitable survey vessels has permitted it to proceed rapidly. Coastal topography has now been surveyed in most parts of south-eastern Alaska, much of Prince William Sound, Cook Inlet and Kodiak Island, Kuskokwim Bay and Norton Sound. Detailed surveys of several important harbours, notably Kachemak Bay, have been completed. Equally important are the wire-drag surveys of the coastal waters. This work has now been completed

on the main routes in south-eastern Alaska. Another useful achievement during the year was the completion of an arc of precise triangulation through Dry Strait. This gives a continuous chain of triangulation from Dixon Entrance to the head of Lynn Canal, and will eventually co-ordinate all Alaskan surveys with those of the United States proper and of Canada. A beginning has also been made on the precise triangulation of western Alaska by parties working north from Cook Inlet. It is hoped that in a few years' time the material will be available for an accurate map of Alaska.

NEW USES FOR RUBBER.—The Journal of the Royal Society of Arts, volume 72, for Friday, March 14, 1924, contains an interesting paper by Mr. P. J. Burgess, chairman of the Rubber Growers Association, in which he explores the possibilities of new methods of utilising rubber. The motor industry apparently absorbs some 70 per cent. of the world's rubber output in the manufacture of tyres, and in view of the fact that the new cord fabric in the tyre is so much more durable, it would seem essential to find new outlets for the surplus yield of the rubber plantations. Mr. Burgess's paper and the interesting discussion that followed should therefore perform good service in focussing attention on a problem of considerable practical importance. Of particular interest perhaps is the emphasis he lays upon the possible development of methods for using the raw latex. In Great Britain raw latex has been used for paper-making by the Kaye process, but a more important development would seem to be taking place in the United States, where cotton fabric is being impregnated with preserved latex for use in tyre-making. Raw rubber as it leaves the plantation in the East is almost exclusively in the form of smoked sheet or crêpe. The finest qualities of the crêpe rubber appear to possess extraordinary properties as a soling material for boots and shoes, being resilient and quite exceptionally durable. Although only introduced for the purpose in Great Britain in 1921, it is estimated that in 1923 some 2000 tons of rubber have been absorbed for this purpose alone. The problem of the utilisation of rubber, compounded and vulcanised, as a surface material for roads and pavements, was discussed, and in this connexion Mr. Burgess suggested that the size of the block could be materially increased with advantage, now that the wood base could be replaced by a compounded rubber material.

X-RAY MEASUREMENT.—The inadequacy of the milliammeter and spark gap as means of measuring the quantity and quality of the radiations from X-ray tubes of different types and under various conditions of excitation has been felt by all radiologists, but no more trustworthy methods which were at the same time convenient have been substituted. An investigation of the behaviour of a Coolidge tube by Prof. J. A. Crowther which appears in Part 1 of Vol. 22 of the Proceedings of the Cambridge Philosophical Society affords some explanation of the failure of the two instruments to give a satisfactory account of the output of the tube. By means of an electrostatic oscillograph of his own design and a current oscillograph of the Duddell type, the electromotive force applied to the tube and the current through it were recorded on a falling photographic plate. On the same plate a narrow horizontal beam of the X-rays produced by the tube was allowed to fall and in its path an aluminium wedge was placed, so that the intensity and quality of the beam could be estimated from the blackening of the plate. The resulting photographs show that it is possible to send current through a tube without exciting any X-rays, and that a Coolidge tube and an induction coil are an unsuitable combination.

PERMALLOY.—The invention of "permalloy" last year in the laboratories of the Western Electric Co. of New York has had a notable effect in the design of submarine cables. The new metal permalloy is composed of about 80 per cent. pure nickel and 20 per cent. pure iron. Very slight magnetic forces can magnetise and demagnetise it. This property gives it special value in submarine cable work where large magnetic effects are desired and only feeble currents are available. If a thin permalloy tape be wrapped round the copper wire beneath the guttapercha insulation of a submarine cable then we get a "uniformly loaded cable" which will have a traffic capacity of three or four times that of the same cable without this tape. This is the most radical improvement that has taken place in transoceanic telegraphy since the first cable was laid fifty years ago. The new cable which will connect New York with the Azores is to be loaded with permalloy. It will be laid by the Western Union Telegraph Company, and is expected to have a traffic capacity four times that of existing cables of the same size. This new permalloy cable will not make existing cables obsolete, but it will divert the direction of much of the world's communication. Its use will also make clearer the relative fields of radio and submarine telegraphy.

THE PHOTOGRAPHIC ACTION OF CANAL RAYS.—An investigation of the photographic action of the canal rays of hydrogen is described by Dr. M. Jabobson in the *Annalen der Physik*, February 1924. Glass plates were employed, five or six of which could be introduced into an upper receptacle of a vertical evacuated vessel, lowered one by one into the position in which they were exposed to the action of the horizontal canal rays from a side tube, and again lowered into a receptacle at the bottom of the vertical vessel. The plates were affected by the impact of the canal rays, and also by the light given off by the hydrogen atoms. The former can be cut off by reversing the plate, so that they are absorbed by the glass and do not reach the photographic film, and it is shown that when they fall directly on the gelatin for a short time, they blacken the plate considerably more than the accompanying light would do by itself. This blackening, however, proceeds more slowly than that caused by the light alone with increased exposures, and, when both act, the combined action is, with such exposures, less than that caused by light alone. Three stages are observed: (1) with small exposures blackening occurs, increasing with prolonged exposure up to a certain point, where it is much weaker than that produced by the light involved alone; this indicates that the canal rays only penetrate to a small depth, and that they inhibit the action of the light rays throughout the film. (2) With longer exposures a very white patch appears in the middle of the blackened patch, where the beam is most intense. (3) With still longer exposures small black spots appear inside the white spot on development; these show a crystalline structure, which is covered with a very thin layer of gelatin. Apparently in the second stage the upper layer of the gelatin is broken up by the impact of the H atoms; on development this is washed away, and is unable to hold the silver particles, a slight hollow being formed. In stage (3) a more prolonged bombardment consolidates the surface film, and causes the silver atoms to unite into crystals, which are held beneath it.

British University Statistics.

THE University Grants Committee's Returns for 1922–23 from universities and university colleges in Great Britain in receipt of Treasury Grants are of special interest and importance. For the first time they include returns from Oxford and Cambridge, and now embrace nearly all important institutions other than theological and training colleges in which teaching of university standard is carried on. Another circumstance which makes the returns unusually interesting is that 1922–23, being separated from the War by three complete academic years—the duration of an ordinary undergraduate course—may fairly be regarded as the first "normal" post-War year. Comparison with pre-War statistics is thus admissible, though even in 1922–23 there were still 3646 university students who had been assisted under the Government scheme for the higher education of ex-service men.

The total number of full-time students shown in the returns is 44,930. In the following table they are grouped according to localities and faculties. The figures in brackets show percentages.

	Pure Science.	Medicine, including Dentistry.	Technology.	Other Faculties.	Total.
Oxford .	435 (10)	147 (3·5)	52 (1)	3,578	4,212
Cambridge .	1247 (24)	382 (7·5)	529 (10)	3,008	5,166
London .	1637 (18)	4,075 (44)	1130 (12)	2,335	9,177
Midlands and North England (*a*) .	2191 (21)	2,844 (28)	1972 (19)	3,259	10,266
West and South (*b*) .	460 (20)	267 (12)	199 (9)	1,332	2,258
All England.	5970 (19)	7,715 (25)	3882 (12·5)	13,512	31,079
Wales .	752 (28)	217 (8)	166 (6)	1,546	2,681
Scotland .	1041 (9)	3,934 (35)	1519 (14)	4,676	11,170
Great Britain	7763 (17)	11,866 (27)	5567 (12·5)	19,734	44,930

(*a*) Birmingham, Leeds, Liverpool, Manchester, Sheffield, Durham, and Nottingham.
(*b*) Bristol, Exeter, Southampton, Reading.

The "other faculties" comprise arts (including theology, fine art, law, music, commerce, economics and education) and agriculture (including forestry, horticulture, and dairy work).

It will be seen that the percentage of students of pure science was relatively high at Cambridge and the Welsh colleges, and low at Oxford and in Scotland; London and the Scottish universities are conspicuous for the number of their medical students; and the midlands and north of England had the largest proportion of students of technology. The agricultural students were at Cambridge (272), Oxford (258), Armstrong College (51), Leeds (48), Reading (155), Welsh colleges (80), and Scottish universities (328).

A considerable part of the University Grants Committee's report is devoted to a comparison of the statistics of 1913–14 and 1922–23, with the object of ascertaining the general direction in which the balance of university studies seems to have been moving since the outbreak of War. The comparison is limited to institutions which were receiving grants from the Board of Education in 1913–14. Attention is directed to an increase from 17·1 to 21·2 in the percentage of students of pure science in England and Wales. It is suggested that this is attributable to the emergence of a general feeling that the country was inadequately supplied with men and women of scientific training, and that this factor would have been more strongly reflected in the statistics but for a simultaneous awakening to the dangers arising from ignorance of foreign countries and of their business methods, and a resultant increase in the popularity of modern languages, commerce, and certain other subjects falling within the arts group. The percentage of medical students increased from 28·3 to 31·6, owing to the unprecedented demands upon the medical profession for the fighting forces, the revelation through the examination of recruits of an unsuspected amount of physical disability, and the losses of the profession in the field. (Next year the returns will show a substantial decrease in the number of medical students, the number of entrants in 1923 being small in comparison with the number of students completing their course in that year.) A decline in the relative popularity of technology is attributed to the depressed state of industry, the relatively high cost of technological courses, and the improvement in salaries in the teaching profession.

The returns provide answers to the following among other questions concerning full-time students: (i.) Whence did they come? (ii.) Where did they reside while pursuing their studies? (iii.) At what ages were they admitted? (iv.) How many were preparing for a first degree or diploma, and how many were advanced students?

(i.) Forty-seven per cent. came from homes less than thirty miles distant from the institution, 44 per cent. from other parts of the British Isles, 6 per cent. from other parts of the British Empire, and 3 per cent. from foreign countries. Those from other parts of the Empire were chiefly at London (834), Edinburgh (419), Oxford (402), Cambridge (379), and Glasgow (164); most of those from foreign countries were at London (361), Oxford (282), Cambridge (221), Birmingham (96), Glasgow (79), and Edinburgh (69).

(ii.) Of women students, 34 per cent. resided in colleges and hostels, 48 per cent. at home, and 18 per cent. in lodgings; the corresponding percentages of men students were 17, 41, 42, or, if Oxford and Cambridge are excluded, 6, 54½, 39½.

(iii.) The ages on admission of students entering for the first time in 1922–23 were: 19 and over, 51 per cent.; 18 and under 19, 34 per cent.; 17 and under 18, 13 per cent.; under 17, 2 per cent.

(iv.) Of 32,255 men and 12,675 women students, research and other "advanced students" numbered 1991, of whom 285 were women. The expression "advanced students" is defined for the purposes of the return as those either working for a higher degree or taking courses of a standard appreciably higher than that for a first degree in the subjects which they were studying. Of the total number (1991), 582 were at London—chiefly at the Imperial College and University College,—368 at Cambridge, 245 at Oxford, 176 at Manchester, 90 at Edinburgh, 88 at Birmingham.

In the tables of income and expenditure, Oxford and Cambridge are not yet included, as accounts for these universities are not yet available in a form which would enable them to be properly analysed for this purpose. The total incomes of the other institutions were as follows:

	£ (1000).
London: The University and its incorporated Colleges (University College 168, King's 105)	447
Manchester: University (183), and College of Technology	316
London: Medical Colleges	279
Glasgow: University (209) and Royal Technical College	271
Edinburgh University	231
Liverpool University	199
London: Imperial College of Science and Technology	196
Leeds University	171
Birmingham University	158

	£ (1000)
London: various schools of the University—Economics (53), East London (39), Birkbeck (35), Oriental Studies (23)	150
Bristol: University (109) and Merchant Venturers' Technical College	133
Newcastle-on-Tyne: Armstrong College (94) and College of Medicine	124
Sheffield University	123
London: Women's Colleges	102
Aberdeen University	98
St. Andrews University	90
University Colleges, Reading, 81; Cardiff, 81; Aberystwyth, 74; Nottingham, 55; Bangor, 52; Swansea, 39; Southampton, 32; Exeter, 23; Durham, 22.	
University of Wales, 22; University of Durham, 11.	

In the aggregate these incomes amounted to 3,582,891*l.* and were derived as follows: endowments (11 per cent.), donations (2 per cent.), grants from local authorities (12 per cent.), parliamentary grants (35·5 per cent.), tuition and examination fees (34·5 per cent.), and other sources (5 per cent.).

Comparable statistics for 1913–14 are available for England and Wales, but not for Scotland. They show that there has been an increase of 153 per cent. in the total of the incomes and a notable increase in England in the proportion to the total of the income derived from parliamentary grants. The following table shows the variations in the percentages of income derived from various sources:

	England.		Wales.	
	1913–14.	1922–23.	1913–14.	1922–23.
(*a*) Endowments	12·3	10·0	6·5	6·6
(*b*) Donations	3·3	2·5	3·3	0·9
(*c*) Grants from local education authorities	15·9	13·8	5·9	20·5
(*d*) Parliamentary grants	33·2	36·9	55·3	50·6
(*e*) Tuition fees	31·0	30·4	27·2	16·5

The Committee, in its report, groups the income under the first three heads as "local assistance," and points out that whereas the percentage of income under these heads decreased in England from 31·5 to 26·3, the contribution from parliamentary grants increased from 33·2 to 36·9. There are, however, encouraging signs that "once financial conditions improve the universities and colleges may look with confidence for additional help both from public bodies and from private firms and persons in the localities which they principally serve; indeed one great County Local Authority in England came, we understand, to the courageous decision some months ago to raise its annual subsidy to university education in its area to the produce of a 1*d.* rate." It is almost entirely owing to the adoption in 1921 by the Welsh local education authorities of a scheme for contributing the produce of a 1*d.* rate to the national university that the large increase shown against heading (*c*) took place. The Committee does not dwell, in this connexion, on the answers provided by the returns to the question, "Whence do the students come?" although these answers have an obvious bearing on the question whether the "local assistance" ought to be increased. It has already been pointed out that 47 per cent. of the full-time students came from homes less than 30 miles distant. If Oxford and Cambridge were excluded, the proportion would be nearer 60 per cent. At the same time, it must not be overlooked that in proportion to the efficiency of the teaching at a university, the services of its graduates will benefit communities far distant from the homes whence they came. It would be lamentable, moreover, if the universities were to become involved, as have so many technical colleges maintained by local education authorities, in highly intricate and debatable adjustments as between the various contributing authorities of the net costs of maintenance.

Comparative statistics of university student enrolment and degrees conferred in 1912–13 and 1922–23 in all parts of the British Empire are given in the 1924 issue, just published, of the Universities Yearbook.

Plant Ecology in Switzerland.[1]

IT is appropriate that the trend of botanical investigation in Switzerland, a mountainous country with considerable areas of natural vegetation, should be largely in the direction of plant ecology. A flourishing school of plant sociology (to use their own term) has arisen, inspired to a great extent by the veteran Carl Schröter. The latest of the series of vegetation monographs already published by members of this school is one on the Grimsel region, by Dr. E. Frey, of Bern. About half the entire surface of this region, which lies on the eastern slopes of the Finsteraarhorn massif, is either sparsely vegetated or else consists of bare detritus or rock. Moreover, in some cases the glaciers are steadily retreating, thus exposing a virgin surface for colonisation by plants. The comparatively unstable state of the vegetation resulting from these conditions naturally led the author to regard the vegetation primarily from the "genetic-dynamic" point of view. Hence nearly half the monograph deals with the colonisation of, and plant succession in, the various rock, detrital, and alluvial habitats. It is in this part of the work that the chief interest lies.

Dr. Frey presents well-thought-out classifications of the plant habitats afforded both by compact and disintegrated rock. His careful observations show that in the case of solid rock the direction and angle of slope, the nature of the rock surface, the presence and breadth of crevices, altitude, and other factors play a part in determining the plant population. Similarly in moraines, glacial alluvium, and other accumulations of debris, the size of the rock fragments, position with regard to the water-table, and so on, are important. The plant successions in these diverse habitats are well worked out, and the great importance of the pioneer work of cryptogams, especially lichens, is emphasised. Convergent successions appear to be not infrequent, as when the originally independent successions of lichens on a rock surface, and of vascular plants in neighbouring crevices, finally become merged in a single closed association dominated by higher plants.

The author distinguishes a large number (about 50) of plant-associations and sub-associations, a number of which are cryptogamic. In delimiting his associations he made use both of the *characteristic species* of Braun and of the *constants* employed by other ecologists. Relative frequency was determined by a method of estimation. He defends his choice of methods against the criticisms of the Uppsala school, suggesting, with some justification, that the value attached by the Scandinavians to constants as the

[1] "Vegetationsverhältnisse der Grimselgegend." By Ed. Frey. Mitteilungen der Naturforschenden Gesellschaft in Bern, 1922. 197 pp.

criterion of an association may be attributed to the relative paucity of the northern floras, rather than to the minute accuracy of their quadrat method. With the richer flora of the Alps other methods may be desirable, for different types of vegetation often require different methods of study. It is the opportunity afforded to workers from different countries of discussing and comparing such methods under field conditions, which constitutes one of the chief benefits to ecology of periodic international conferences such as the Phytogeographical Excursion which took place in Switzerland last summer.

In the discussions of recent years regarding the status of the "plant-association" as the primary unit of vegetation, and the methods of recognising and delimiting associations, there has been perhaps some tendency to lose sight of the physiological significance of the fact of association. It is customary to speak of "open" and "closed" plant-associations; but association in the strict sense can only be said to begin when the associated organisms exercise some influence on one another. In this sense some so-called open associations are not associations at all, at least in the initial pioneer stage. From the loose chance relations obtaining in the earlier stages, association gains in definiteness and importance as the vegetation becomes more and more closed. In other words, physical factors have a predominating influence in the earlier phases of development of vegetation, biotic factors becoming increasingly important in the later stages. While in general recognising these principles, Dr. Frey, dealing as he does mainly with vegetation of an open character, might have brought them out more clearly. For example, while agreeing in part with Oettli that association plays a less important rôle in the rock flora than elsewhere, he states that the occurrence of vascular rock plants is so sporadic that only the total list of species found in a wide region can represent the association. This usage, not at all uncommon, of the term association to denote something from which the element of real association is, to all intents and purposes, absent, can scarcely be justified.

Considerable attention was devoted to the study of succession on recent soils below the ends of glaciers, in the hope that light might be thrown on the problem of the relations of vegetation during the Glacial Period. The author finds the evidence somewhat conflicting, and exercises commendable caution in drawing conclusions. The most definite result arrived at is that apparently the unfavourable influence of the proximity of glaciers extends to a greater distance in a humid than in a dry climate. So far as it goes, this affords some support to Brockmann's hypothesis, which seeks to correlate the phenomena of the Glacial Period with an oceanic type of climate.

Dr. Frey's monograph is a good example of the thorough vegetational surveys which are being carried on so effectively at the present time in Switzerland. It is illustrated by well-reproduced photographs, and by transects and a coloured map. In the transects an effective mixture of symbols and initial letters is employed; the clearness of the map is somewhat interfered with by shading. Not the least useful feature is the very full and clear explanation in chap. iv. of the terms used. R. H. Y.

The Radiation of Light by Excited Atoms.

PROF. G. MIE, in a paper in the *Annalen der Physik* for January, continues the development of a theory of the radiation process, which he outlined in the same journal in 1921. On the Rutherford-Bohr theory of atomic constitution, radiation takes place when an electron "falls" from an outer stationary orbit to an inner one, and several authors have regarded the emission of light by the atom as an almost instantaneous process, the energy being suddenly transferred to the ether, forming a radiation centre from which it travels out in waves, the frequency of which is given by $E = h\nu$. The facts of interference make it necessary to assume that this ether centre goes on vibrating several million times before it comes to rest, which means, of course, an appreciable time interval, during the greater part of which the atom is supposed to be in the lower stationary state, *i.e.* the electron is revolving in the lower stationary orbit.

Prof. Mie supposes that the radiation is gradually given out by the atom to the ether while the alteration from one stationary state to another takes place. Thus the atom passes in a finite time through a constant succession of non-stationary states, the orbit of the electron altering gradually in a kind of contracting spiral from the outer to the inner Bohr orbit.

In the case of a freely radiating atom, Prof. Mie assumes that the fading out of the radiation (*Abklingung*) follows an exponential law; he formerly assumed that when the atom leaves the higher stationary state the radiation begins weakly, reaches a maximum at a certain distance from that state, and then drops exponentially; he now considers that it is quite possible that the intensity starts at once with a high value, and drops exponentially from the start. The essential difference between the non-stationary electron orbits and the stationary is that in the former energy is given up by radiation; the non-stationary movements are not periodic, and they do not obey the simple laws of classical mechanics.

In explaining the statistical equilibrium of a heated gas, it is necessary to assume the existence of two kinds of collisions between atoms, or between atoms and electrons. In collisions of the first kind the atom passes suddenly from a lower to a higher stationary state, the energy needed being derived from the kinetic energy of the colliding bodies; in a collision of the second kind, the atom passes from a higher to a lower state, and the energy given up is converted into kinetic energy. It is necessary to assume that similar collisions of the first and second kind may take place when an atom is in a non-stationary state, the essential condition being that the final result is always a stationary state of the atom.

Prof. Mie investigates the experimental results of R. W. Wood and of G. Cario on the decrease of light emission in a metallic vapour, excited by optical resonance or by an electron stream, when a neutral gas is added. Cario explained this by assuming that the time V (*Verweilzeit*) during which the atom remains in the upper stationary state is finite, while Mie shows that the same result follows if $V = 0$, and the time A (*Abklingungszeit*) during which the atom passes through the non-stationary states, is finite. He also shows that it is possible to assume that both the times V and A are finite, and takes into account a second possibility of sudden alterations in the atom, due to absorption of radiation. The photoelectric emission of electrons, when light of short wave-length and X-rays are absorbed, cannot be explained by a continuous absorption process,

and Prof. Mie assumes, in order to get over the difficulty, that a kind of latent energy can be stored up in the atoms, or perhaps in the electrons, when suitable radiation falls upon them. It is shown that Planck's formula for "black" radiations follows from the theory on certain assumptions, using Einstein's method of proof.

L'Enrégistreur Gueugnon.

IT is possible that there is a considerable amount of optimism in the declaration of M. Gueugnon, ". . . le graphique frappe les yeux de tous et non de quelques privilégiés. Chacun *sait lire un dessin.*" It is nevertheless a fact that the use of graphical methods as a means of making more real the results of analytical investigations is universally invoked by teachers, and even by the serious researcher when he desires to see concretely what his calculations lead him to. Most of us, however, are contented with rough-and-ready graphical presentations. When we have to show the effect of, say, two oscillations in different directions with various relationships between the periods, we just sketch the results roughly: the teacher who aims at greater clearness gives perhaps some detailed account of the way to plot the actual

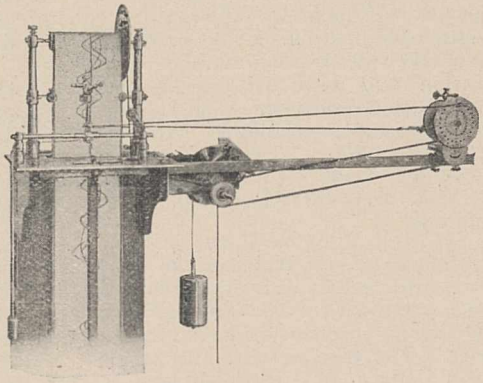

FIG. 1.—The Gueugnon curve-tracer.

curves, and even instructs his pupils to draw a few for themselves. The results are not always encouraging.

M. Gueugnon is of opinion that the accurate drawing of the curves obtained in this or in any other type of problem is of great importance, as being the best means of obtaining at a single glance a view of all the variations involved. But he goes further and affirms that the student should have at his disposal a mechanical means of studying graphically the effects produced by all sorts of combinations of motions. It is for this reason that he has devised the instrument (Fig. 1) which is the subject of this note. The principle is very simple, and one that the student will easily appreciate. A roll of paper F (Fig. 2) moves on a horizontal axle AB, while a platform TT′ can be made to move horizontally, carrying a style at S, which marks the paper. By giving different types of motions to the paper and to the platform carrying the style, we get various kinds of relationships between the x and y co-ordinates indicated in the figure. The style is also connected with a pendulum so that it can be made to oscillate and register uniform time intervals. It is clear that if the style swings with the pendulum while the platform is at rest, and the axle carrying the paper is made to move as the result of unequal loading on the two sides of the pulley attached to the axle, then we get an Atwood's machine with all the facilities for studying at first hand the formulæ of uniformly accelerated motion. If the style is not in oscillation, but the platform is made to move with uniform speed, then we get the study of the projectile.

Without going into details, it is sufficient to state that each of the rectangular co-ordinates x and y can be made to change uniformly, or with uniform acceleration, or periodically. It will be at once appreciated that in this way a very large number of varieties

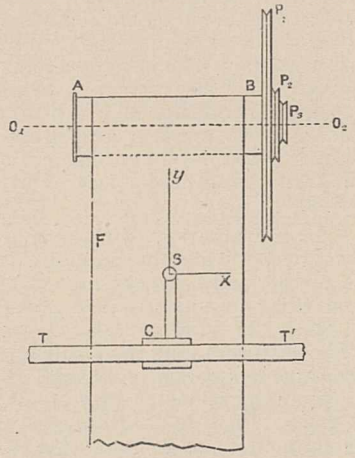

FIG. 2.

are obtained for the relation between x and y, and the curves thus drawn can be made to illustrate most of the equations in the ordinary courses of pure mathematics and of mechanics and physics.

The writer has had the opportunity of inspecting a considerable number of curves thus obtained. The curves come out very clearly and neatly. One such curve is reproduced here (Fig. 3) as an illustration.

The enrégistreur has aroused the interest of the French Government, and a committee appointed by the Minister of Commerce and Industry in 1918 to report on the apparatus gave a unanimous verdict of approval and commendation. The Committee con-

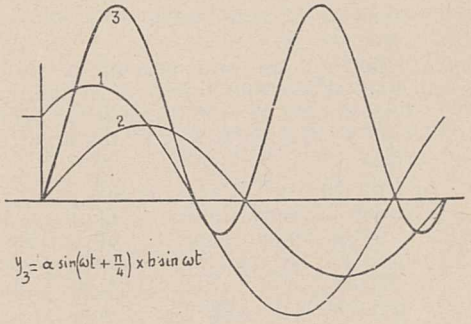

FIG. 3.

sidered that M. Gueugnon's apparatus is superior to those used hitherto, and that it facilitates and simplifies the study of mechanics, physics, and electricity. The apparatus has been actually introduced into the French National Schools of Arts and Crafts, into many institutions for scientific study in both France and Belgium, and into some universities.

The apparatus is manufactured by M. H. Morin of 11, rue Dulong, Paris. The price is given as 2200 francs. The variations in the exchange rates make it difficult to translate this into English money with any accuracy, but it seems that the cost is something like 25*l*.

S. B.

University and Educational Intelligence.

BELFAST.—At the meeting of Senate of the Queen's University held on April 9, it was reported that the Ministry of Agriculture of Northern Ireland is prepared to contribute a sum of 31,000*l.* towards the cost of erecting and equipping new buildings for the Faculty of Agriculture. The University is providing a site and contributing 6000*l.*, and the late Miss Eliza Riddel gave 5000*l.* for this purpose (making a total estimated cost of 42,000*l.*). The University will be responsible for the erection of the buildings, which will be their property. The designs and sketch plans are being prepared. The Northern Government will defray the salaries, bonuses, and superannuation of the professors and lecturers in agriculture, and will make an annual grant for maintenance, equipment, subordinate staff, examiners' fees, and necessary scientific books.

LONDON.—In continuation of the course of public lectures given at the School of Economics during the past term, a further series, on the history and present position of the British Commonwealth, are to be given at King's College on Wednesdays, commencing on April 30. The lecturers and their subjects are: Sir William Beveridge (economic problems); Sir Halford Mackinder (communications); Prof. C. G. Seligman (racial problems); Prof. L. T. Hobhouse (religions); Prof. A. J. Sargent (trade); and the Right Hon. L. C. Amery (defences), the last lecture being at the London School of Economics. Among the other lectures at King's College arranged for next term are a course of four lectures on May 15, 16, 19 and 20 by Prof. T. H. Bryce, professor of anatomy in the University of Glasgow, on the development of the human embryo up to the appearance of the primitive segments, and a course of three lectures on April 24, May 1 and May 8, by Señor Don José Castillejo, of Madrid, on education in Spain. The lecture hour is in each case 5.30 P.M.

A free public lecture in ophthalmology will be delivered at 5 o'clock on Friday, May 9, at the Charing Cross Hospital Medical School, by Prof. J. van der Hoeve, of Leyden, who will take as his subject "Accommodation." The lecture will be in English, and no tickets will be required.

APPLICATIONS for the principalship of the Edinburgh and East of Scotland College of Agriculture are invited. They should be sent to reach the Secretary of the College, 13 George Square, Edinburgh, before the end of May.

THE post of director of the National Poultry Institute (Harper Adams College Section) is open. Particulars of the appointment are obtainable from the Principal of the Harper Adams Agricultural College, Newport, Salop. The latest date for the receipt of applications is May 6.

APPLICATIONS will be received from graduates of the University of Manchester in medicine and surgery for the Dickinson Travelling Scholarship in medicine, which is of the value of 300*l.*, and tenable for one year. The regulations governing the scholarship may be obtained from the Secretary to the Trustees, the Manchester Royal Infirmary. The trustees of the Dickinson Pathology Scholarship are also inviting applications. Its value is 75*l.* for one year, and it is open to students who have received instruction in pathology, medicine, and surgery at the University of Manchester and the Royal Infirmary. Applications for either of the scholarships must be received by the Secretary to the Trustees, the Royal Infirmary, Manchester, by, at latest, May 1.

IT is proposed by the Royal Society to appoint a second Foulerton research professor whose duties will be to conduct such original researches in medicine or the contributory sciences, on lines approved by the president and council of the Society, as shall be calculated to promote the discovery of the causes of disease and the relief of human suffering. Copies of the regulations governing the professorship can be obtained from the Assistant Secretary of the Royal Society, Burlington House, W.1. Applications for the professorship must be received by, at latest, September 30 next.

THE British Empire Exhibition will not include an education section, but many conferences arranged by educational associations will be held in the Exhibition conference halls: May 7, National Home Reading Union; May 9 and 10, The New Education; May 10, Universities of the United Kingdom; May 14-21, Eugenics Education; May 26, 28, 29, Imperial Studies; June 9, 13, 14, Parents' National Education Union; Sept. 2-4, Spiritual Values in Education; Sept. 10, 17, College of Nursing. The conference on May 9 and 10 on "The New Education: from Childhood to Citizenship," has been arranged by the following associations working together: Dalcroze Society, Dalton Association, King Alfred School Society, League of Nations Union, Montessori Society, New Education Fellowship. The programme includes co-education, eurhythmics, the speaking of poetry, the Montessori method, the Dalton plan, education and international co-operation (with a demonstration lesson on "The League of Nations"), and analytical psychology. Among those taking part will be Sir J. Crichton-Browne, Miss Lena Ashwell, Dr. C. W. Kimmins, Prof. James Findlay, Dr. C. G. Jung of Zurich, and other well-known authorities.

UNDERGRADUATE training for scientific research was the theme of an address delivered on December 28 by the president of the Zoological Science Section of the American Association for the Advancement of Science. The speaker, Dr. Maynard M. Metcalf, of Oberlin College, presented his ideas in the form of a description of the organisation, educational policy and methods of an imaginary college founded with the object of promoting research by leading a large proportion of its ablest pupils to adopt research (or "productive scholarship" or "creative scholarship"—which he regards as almost synonymous) as their life work. He insists that in the face of the ever-increasing specialisation necessitated by the growing ramifications of the tree of knowledge, it is essential that the prospective research workers' equipment should be marked by breadth of knowledge and catholicity of interest, and that these can most surely be established during the undergraduate years. This is also the period during which the mind is most receptive to inspiration such as is needed for a life of fruitful scientific research. It is therefore by the improvement of the quality of undergraduate work that we may hope to obtain an increasing supply of properly trained research workers to meet the ever-growing need for them. The main conditions of such improvement are: the number of students in the college to be limited (in the ideal college, to 500); the college teachers to be so numerous that effective close personal touch with the students can be maintained; each teacher to have half or more of his time free for research. In the ideal college all the teachers are of professorial rank except a very few appointed with the view of promotion to that rank after two years of probation.

Early Science at the Royal Society.

April 20, 1664. Dr. Charleton proposed an anatomical administration to examine Dr. Willis's observation of the brain, and to fit a skeleton, in order to consider the articulation and motion of the bones. It was ordered, that the operator take care to demand a body; and that in reference to it, the amanuensis draw up the copy of the warrant for such a demand, and attend the president to sign it.

April 21, 1670. Thomas Willisel brought in some plants gathered by him in Norfolk & Suffolk, which were recommended to the care of Mr. Charles Howard.

1686. Sir Cyril Wyche obliged the Society with an account of the Roman abacus.

April 22, 1663. Mr. Boyle showed a box, with figures carved on it very deep, done by an art of softening wood, which the artist could harden again. He was desired by the society to let the artist know, how well they were pleased with this skill of his, and that they were willing to assist him in procuring a patent for him, in order that he might enjoy the benefit of his art, upon condition that he should acquaint them with the secret.

1685. Dr. Slare proposed a person for a chemical operator to the Society who should attend their meetings and be content with a moderate salary.

April 23, 1662. Mr. Winthrop showed a tin lamp, called a bladder's lamp, burning high like a candle, continually feeding itself; of which a diagram was ordered to be made and registered.

1673. An experiment was made with aquafortis and pulverised oister-shells in a bolt-head, tied close about at the open end with a flaccid bladder, in order to see, what it would produce; and it was found after a little while, that the bladder was swelled. It was then ordered, that it should be put, as it was, into the trunk of the Society, and left there, locked up till the next meeting, to see, whether these exhalations would prove permanent air.

April 24, 1679. Sir Jonas Moore took the chair; and as soon as Dr. Grew had read his observations *De Homine*, without at all entering into the debate of the matters, the Society rose.

April 25, 1666. Mr. Oldenburg was desired to write to Sir John Finch, to request him, that he would procure for the society some good load-stones in Italy: as also that he would communicate the observations made upon the famous magnet in the palace of the Great Duke at Florence.

1667. Mr. Hooke proposed a way of measuring the circumference of the earth with a twelve foot glass and three stakes, to be practised in St. James's Park in a calm day.

1678. A long discourse was occasioned concerning the motion and fabric of muscles.

April 26, 1665. Sir Robert Moray affirmed, that he had known a man, who could take two or three pipes of tobacco into his stomach before he let out any smoke; and then let it out afterwards all together. . . . This was seconded by Mr. Evelyn, who remarked that he had seen a person, who, after taking tobacco would discourse a while before he let out the smoke.

1682. The whole time of the meeting was employed in entertaining the Morocco ambassador, by showing the repository and library; with which his excellency seemed well pleased, but more particularly with a very fair Alcoran written in Arabic. After his excellency's return into the meeting-room he inscribed his name in the charter-book among the Fellows of the Society in a fair character in Arabic, and so was waited upon to the gate [of Gresham College] where he took coach and returned.

Societies and Academies.

LONDON.

Royal Society, April 3.—Sir Charles **Sherrington**, and E. G. T. **Liddell**: Reflexes in response to stretch (myotatic reflexes). In the knee-extensor (decerebrate preparation) a stretch applied to the muscle evokes contraction in it. This is reflex and purely proprioceptive, its receptors lying in the fleshy region of the muscle. A stretch less in extent than 0·8 per cent. of the total muscle-length suffices to evoke the reflex. Slow stretches evoke the reflex as well as do quick. The latency of the reflex is short. When augmentation of the stretch ceases, augmentation of the reflex contraction also ceases, and the reflex usually declines, merging into long-lasting plateau-like contraction. The reflex is readily diminished and annulled by reflex inhibition provoked from the sources recognised as regularly inhibitory for the knee-extensor. Under this inhibition the muscle's reaction to stretch resembles indistinguishably, in our records, that yielded by the muscle after complete paralysis from severance of its motor nerve. Among receptors in the muscle there are, in addition to those excitable by stretch and provoking reflex contraction in the muscle, others which provoke reflex inhibition of the muscle.—H. M. **Carleton** and G. C. **Robson**: The histology and function of certain sex-limited characters in the cuttle fish (*Doratosepion confusa*). This cuttle fish, obtained from South African waters, is sexually dimorphic, there being present in the male only an apical prolongation of the fins which forms a long "tail." On the latter are situated paired *lateral organs*, which are masses of intercellular "hyaline" tissue or "hyaline degeneration," a substance recognised in human pathology and associated in mammalian tissue with morbid conditions. In the case of Doratosepion it is not pathological. It is derived from the transformation of connective tissue fibres of collagen type, the stages in the "hyaline" metamorphosis of which have been traced. In the absence of living animals (which are unobtainable) an attempt is made to interpret the function of the *lateral organ* and "tail" from their structure; and it is suggested that there is in *Doratosepion confusa* a mode of coitus and insemination different from that usually found in Cephalopoda.—J. G. Dusser **de Barenne**: Experimental researches on sensory localisation in the cerebral cortex of the monkey (Macacus).—T. H. **Havelock**: Optical dispersion and selective reflection, with application to infra-red natural frequencies. With the optical dispersion formula in a form suitable for the neighbourhood of an isolated region of absorption, an exact equation is found for the wave-length of the maximum of selective reflection; further, a simple approximate solution is given which does not involve the coefficient of absorption. This is applied to the infra-red region in rock-salt, sylvin, and fluorspar. Certain formulæ for infra-red frequencies derived from theories of crystal structure are examined in view of the correction to be applied when comparing the results with residual rays.—J. H. **Jones**: The quantum theory and the dielectric constant. The change in the potential energy of an atom of hydrogen when submitted to an electric field of strength F, consists of terms in the first and second degree in F. In the normal state, the first term vanishes and the term in the second degree, when taken over unit volume of the gas, is identical with $\left(\frac{K-1}{8\pi}\right)F^2$, where K is the dielectric constant of atomic hydrogen and the following expression is deduced for K:—

$$K - 1 = 4\pi N (a_1)^3,$$

where N is the number of atoms per unit volume and a_1 is the radius of the first Bohr circle. The method is applied to more complex gases on the assumption that the law of force is of the form $\frac{(Z-s)e^2}{r^2}$, where Ze is the nuclear charge and "s" is the screening number. The term of the first degree in F has again the value zero when averaged over a large number of atoms. An expression is obtained for the dielectric constant based on purely a quantum hypothesis.—A. M. **Mosharrafa**: Half-integral quantum numbers in the theory of the Stark effect and a general hypothesis of fractional quantum numbers. By permitting half-integral orbits in the Epstein theory of the Stark effect, it is possible (i.) to account completely for the deficiency in Sommerfeld's tables of components as compared with Stark's results, and (ii.) to solve some of the existing difficulties in connexion with the physical reality of the orbits. A slightly generalised form of the Wilson conditions is proposed where the quantum numbers are assumed to be rational fractions. This form possesses the special merit of including the law of least action as a limiting case, and may therefore prove easier to reconcile with classical conceptions.—E. A. **Fisher**: The discontinuity of the drying process. As a rule, very characteristic drying curves are obtained which are essentially similar for all capillary systems, both colloidal, *e.g.* wool fabrics, clays, etc., and non-colloidal, *e.g.* quartz sand.—S. F. **Grace**: A spherical source in a rotating liquid. The initial relative disturbed motion is irrotational; the subsequent disturbed motion is symmetrical with respect to the axis. The motion of the liquid along the axis is always away from the sphere; at a particular point the velocity oscillates with constant amplitude about a value equal to the velocity of discharge and the amplitude increases from zero at the sphere to the magnitude of the velocity of discharge at infinity. The period of the oscillation decreases from an infinitely large value at the sphere to zero at infinity. The liquid has no motion across the equatorial plane. The motion in this plane depends only on the distance from the centre of the sphere and tends rapidly to zero away from the sphere; the paths of particles tend to become concentric circles, the centre being at the centre of the sphere. The results indicate that the flow of liquid is drawn out along the axis. The solution is one applicable for a restricted interval of time from the generation of the source.

Physical Society, March 14.—Mr. F. E. Smith in the chair.—U. A. **Oschwald** and A. G. **Tarrant**: (1) A new photo-electric and ionisation effect. For the discharge in a neon lamp to start, a certain minimum voltage is necessary, which is affected very considerably by light or other ionising agents external to the lamp. The light effect is produced by illumination of any intensity above a very low value (0·01 foot-candles producing an appreciable effect). It is caused by rays of a broad wave-band in the visible spectrum, with a maximum effect in the orange, and the seat of the effect is located on the surface of both the metal electrodes, irrespective of polarity. A similar effect, but probably of different mechanism, is caused by rays from uranium oxide and from an X-ray tube. It is possible to detect by this means X-rays from a very feeble tube at a distance of 90 feet.—(2) Notes on some electrical properties of the neon lamp. By means of a special, accurately timed switch, a neon lamp was thrown into the "oscillating" state, and its voltage measured after any predetermined interval (from 0·005 to 0·5 seconds). Thus the voltage-time curve of the "oscillating" lamp was plotted. Very close agreement with theory is found. A neon lamp was made to oscillate at its highest possible frequency, which was measured by a tuned circuit. Measured frequencies did not agree well in this case with theory, but a maximum frequency of about 95,000 is observed. A neon lamp was also run at such a voltage that if the discharge were interrupted for any considerable time it would not restart, the voltage being below the minimum starting voltage for the lamp. The circuit was interrupted by a special high-speed interrupter for separate single intervals down to 5×10^{-8} seconds. In no case did the discharge restart, showing an ionisation persistence of less than this interval.—J. H. **Shaxby** and E. J. **Evans**: Certain properties of the Osglim neon-filled lamp. The characteristic (voltage and current) curve of the Osglim neon-filled lamp illustrates many of the properties of the discharge of electricity through rarefied gases. The identity of the sparking potential with that necessary to produce a minimal current through the gas, pointed out by Townsend, is clearly confirmed. Part of the characteristic is negative, and this results in the lamp discharge becoming intermittent on a direct current supply, over a certain range of external resistance, independently of any external condenser in the circuit. This tendency appears, whatever the current through the lamp, when any change is made in the circuit, and produces instability at the moment of switching on the lamp. In the case of A.C. supply, it causes an intermittent discharge during that part of the cycle, when, so far as the supplied volts are concerned, one would expect a continuous glow. The lamp can be used as an indicator in a commutator method of measuring the frequency of alternating currents.—J. **Taylor** and W. **Clarkson**: The critical resistance for flashing of the low-voltage neon discharge tube. There is a critical value R_c, for the resistance in series with the neon tube, below which no flashes can be obtained. This value is given by

$$R_c = \frac{E - v}{k\,(v_B - v_A)}$$

where E is the charging voltage, v_B the lower critical voltage, v_A the cathode fall of potential (approximately), and k the conductance of the discharge tube.

Aristotelian Society, March 17.—Prof. A. N. Whitehead in the chair.—C. **Pellizzi**: The problems of religion for the Italian idealists. The two great philosophical schools in Italy towards the end of the eighteenth century were idealism and sensism. Both held their own until, in the middle of the nineteenth century, positivism seemed to overthrow all other traditions. Positivism was a sort of crusade against the Catholic Church, partly prompted by political motives, and it brought a large majority of the educated class to free itself from dogmatic and traditional ideas about religion. Croce and Gentile are the heralds of a new era in Italian thought. Croce came to philosophy late in life, and apparently almost by accident. He read Hegel when thirty years old and when much of his mentality was already formed. Gentile started in the university and was the pupil of Jaja, one of the few survivors of the old school of Italian idealists. Croce assumes the all-inclusive mind and sets himself to discover its pure forms and universal categories. Gentile is more of a metaphysician, setting himself to discover what mind itself is and why and how it can live as it actually lives. The historic life of the mind being given, Croce wants to know what are its pure forms and how they work. For Gentile nothing is given, not even spirit. Mind is life, not existence. In regard to religion, the Catholic creed approaches most closely his ideal. He and many who follow him would like to join *as idealists* a positive religion which unfortunately disclaims and disapproves their theories.

Geological Society, March 26.—Dr. J. W. Evans, president, in the chair.—K. S. **Sandford**: The fossil elephants of the Upper Thames basin. In the Summertown-Radley Terrace the accompanying fauna lies above a cold fauna consisting of *Rhinoceros tichorhinus*, *Bison priscus* (rare), with *Elephas primigenius* (Ilford type) poorly represented and apparently dying out, and *E. primigenius* (Siberian type) prolific. In the Sunk Channel a single tooth of *E. primigenius* has been reported; this has been rediscovered, and is a rare case of *x27x* in a third upper molar, with a lamellar ratio of 9·5 and frequency of 10·5: that is, the ridges are very narrow and closely set. The tooth is in excellent preservation, and lay apparently at the bottom of the channel. This suggests a return of the Siberian mammoth; the Sunk Channel is probably of the Reindeer Age: that is, Upper Palæolithic (by inference only). Reindeer has not been identified in any of the terrace-deposits of the Upper Thames Basin (that is, west of the Chiltern Hills).—H. P. **Lewis**: Some Upper Viséan Caninid corals. One species, having a wide distribution in the D_2 beds of North Wales, the Midlands, and the North-Western Province, may be referred to *Caninia* (*Campophyllum*) *juddi* Thomson. Associated with *C. juddi* Thomson in its distribution is a new variety of that species. In the other species studied (which is new) the most interesting specific feature is the extrathecal zone, which, as seen in transverse section from an early stage onward, appears to be intermediate in character between the corresponding zones of *C. cylindrica* Scouler, Salée, and *C. juddi* Thomson *emend.*

Royal Anthropological Institute, April 8.—Prof. C. G. Seligman, president, in the chair.—J. H. **Hutton**: The use of stone in the Naga Hills. The uses of stone for the purposes of this paper were divided into utilitarian, ceremonial, and magical, though consistency is not entirely possible, *e.g.* stone axes (or hoes ?) were presumably utilitarian when in use, but are now of purely magical value. Stone is used for pestles, hammers, nut-crackers, *coups de poing*, and, when heated, for drying paddy. The stone hammer is of the same type as one found in the Philippines. The use of stone for building houses and the retaining walls of terraces is virtually forced upon the Angami Naga by the nature of the soil occupied. Slate is used for roofing by the Kālyo-Kengyu tribe, and the Angami use wooden shingles, attached just like these slates by a single hole, for the roof of persons of high social status; but the villages using slates do so without, apparently, any social restriction and only in default of thatch. The Angami also use stone for fortification. Between the utilitarian and ceremonial uses come stone stair-ways in the Angami, stone causeways in the Kŏnyăk country, also stone watering-places principally in the Angami country. The ceremonial use of stone is principally to be observed in the Angami country, though the Kŏnyăk tribes use stone, as also wood, for the thrones of their chiefs, a tabu lying, not on the use of the same material by others, but on the use of the actual seat. With the erection of stones on graves or cenotaphs for the soul of the dead to enter into, and dwell in, the use of stone merges into the magical. The menhir erected for the habitation of the soul of the dead cannot be clearly distinguished from the phallic menhir erected for the fertilisation of crops, animals, and men, a use to which a dolmen form is also put. There is no association of the use of stone with a sun cult.

Royal Meteorological Society, April 9.—Dr. C. Chree, vice-president, in the chair.—I. D. **Margary**: Glaisher stand *versus* Stevenson screen: a comparison of 40 years' observations of maximum and minimum temperature as recorded in both screens at Camden Square, London. For the years 1881–1920, and if the values of D (max.) and D (min.) = S − G (Stevenson − Glaisher), D (max.) shows a very regular seasonal variation from −1·3° in July to +0·5° in December. The values are positive (S > G) in November to February, and negative (S < G) in April to September. This effect is closely parallel to, but does not seem dependent upon, the change of maximum temperature. D (min.) shows little variation throughout the year, and the values are nearly always positive (S > G). Until 1905 it averaged +0·8°, but owing, probably, to a re-arrangement of the instruments in the Stevenson screen, the value then changed abruptly to +1·3°. Northerly winds seem to cause abnormal values of both D (max.) and D (min.), apparently by depressing the Glaisher readings. No relation between D and other elements can be traced.—R. **Hill**: A lens for whole sky photographs. The representation of a view of 180° within the limits of a photographic plate is aimed at. R. W. Wood used a pinhole camera filled with water. The same effect can be accomplished by using a lens suitably placed in relation to a stop; a concave surface was found to give the best result. A system of three uncemented lenses, rapid enough for cloud photography, was described which gave a nearly equidistant projection over the whole 180°, zenith distances therefore being represented by proportional lengths on the photograph. Probably a comparatively rapid objective can be produced on similar lines.—F. J. W. **Whipple**: The significance of regression equations in the analysis of upper air observations. The assumption that a regression equation can show which of two contemporary phenomena is cause and which effect is criticised.

Paris.

Academy of Sciences, March 24.—M. Guillaume Bigourdan in the chair.—M. **Mesnager**: Observation concerning a note by M. Pitois on the differentiation of steels by examining the sparks caused by grinding.—P. A. **Dangeard** and Pierre **Dangeard**: Researches on the vacuome of the lower Algæ. Application of the method of staining with neutral red or cresyl blue. In this type of plant the existence of a vacuome in the plant cell is as constant as that of the nucleus.—M. **d'Ocagne**: The mechanical description of the ellipsoid.—Pierre **Weiss** and R. **Forrer**: The magnetic isotherms of nickel. Two diagrams are given representing the specific magnetisation σ (moment of unit mass) of nickel as a function of the field H, for numerous temperatures between 20° C. and 405°·7 C. These form materials for the equation of state of ferromagnetism $\sigma = f(H_1 t)$.—Norbert **Wiener**: A necessary and sufficient condition of possibility for the problem of Dirichlet.—Henri **Lebesgue**: Remarks on the preceding communication.—Georges **Bouligand**: Infinite domains and the exceptional case of the problem of Dirichlet.—A. **Marchaud**: Differences and derivatives.—E. **Fichot**: The topographical characters of the surface of the tidal wave in open seas.—R. **Dugas**: The movement of a material point of mass variable with the kinetic energy, submitted to the action of a field of force with equipotential surfaces of revolution.—Jousset de **Bellesme**: The differences between the flight of insects and that of the aeroplane.—A. **Danjon**: The photometric study of the eclipse of the moon of February 20, 1924. A discussion of the changes in the density of the shadow shown by these photometric measurements: periodic changes in the

opacity of the earth's atmosphere are regarded as probably the cause of the differences.—L. **Royer**: Mesomorph states and magnetic double refraction. The mechanism of the phenomenon would appear to be the same in both cases: magnetic double refraction is due to the orientation of anisotropic molecules by the external magnetic field; the mesomorphic state is due to a spontaneous mutual orientation of the molecules by a molecular field.—Georges **Déjardin**: The production of the spectra of argon, krypton, and xenon. The spectra were obtained by the action of electrons in a tube of three or four electrodes, the source of the electrons being a wire of incandescent tungsten. The first spectrum (ionisation potentials 15·2, 12·7, 10·9 volts) is that emitted by the neutral atom, the arc spectrum. The second spectrum is made up of three groups, which can be identified with the three spectra given by the method of oscillating discharge in a tube without electrodes.—Mlle. M. **Hanot**: The width of the lines in the spark spectrum of hydrogen.—Louis G. **Stokvis**: The decomposition of triphase systems not satisfying the condition that the sum of the representative vectors is zero.—L. J. **Simon**: The viscosity of mixtures, taken in pairs, of sulphuric acid, potash, and soda. The neutralisation of sulphuric acid in aqueous solution by alkalies can be followed in the viscosimeter: sodium stands apart from the other alkali metals in the form of the curves obtained.—A. **Marcelin**: Superficial solutions and the law of gases.—V. **Auger**: A new method for the volumetric estimation of ammonium salts.—V. **Agafanoff** and W. **Vernadsky**: The product of the dehydration of kaolin. After losing water below 550° C., kaolin gives a homogeneous product $Al_2Si_2O_7$, and not a mixture of Al_2O_3 and SiO_2. This conclusion is drawn from the results of comparative experiments with the mixture $Al_2O_3 + 2SiO_2$ and anhydrous kaolin, including behaviour with bromoform, microscopic appearance, and absorption of methylene blue.—Louis **Dangeard**: The presence of the lower Nummulitic in the region of Gâvre (Morbihan).—Jacques **Bourcart**: Observations on the nature of recent movements in Western Albania.—Albert **Baldit**: Some cases of transformation of clouds into parallel waves.—A. **Lebediantzeff**: Increase in fertility by desiccation of the soil in air under natural conditions.—M. **Lemoigne**: The mechanism of the production of β-oxybutyric acid by the biochemical method. Bacteria of the *Bacillus subtilis* group have been found to contain 10 per cent. of a crystalline insoluble substance; this on alkaline hydrolysis gives salts of α-crotonic and β-oxybutyric acids.—E. **Roubaud**: The physiological equivalence of anhydrobiose and athermobiose in the reactivation of heterodyname organisms.—Georges **Mouriquand**, Paul **Michel**, and M. **Bernheim**: The sensitising of the organism towards defective diets. Scurvy was set up in guinea-pigs by a defective diet, and then cured by administration of a full regime and lime juice. These animals were then again put on a scorbutic diet along with control animals not previously attacked by scurvy. The latter developed scurvy about the fifteenth day, the former from the second to the fifth day. The first attack of scurvy would thus appear to increase the sensibility to a second attack.—P. **Lasareff**: The physico-chemical cause of the absence of fatigue in the nerve centres in the course of their action.—Albert **Nodon**: Researches on the radioactivity of living cells. Positive results were given by an insect (Pœcicoloris) and a green leaf by the photographic method.—P. Lecomte du **Noüy**: The dimensions of the molecules of certain colloidal substances.—Odon de **Buen**: The migrations of the tunny fish (*Orcynus thynnus*) on the Atlantic coasts on the south of Spain.—André **Lwoff**: Experimental infection with *Glaucoma piriformis* in *Galleria mellonella*.

Official Publications Received.

Department of Agriculture, Ceylon. Bulletin No. 67: A Preliminary List of the Pests of Cultivated Plants in Ceylon. (Compiled by the Staff of the Division of Entomology.) Pp. 68. Bulletin No. 68: Yield and Growth in *Hevea Brasiliensis*. By Dr. G. Bryce and C. H. Gadd. Pp. 74. (Colombo: Department of Agriculture.) 40 cents each.

Transactions of the Royal Scottish Arboricultural Society. Vol. 38, Part 1, March. Pp. vi+68+26. (Edinburgh: Douglas and Foulis.) 3s. net.

New South Wales: Legislative Council. Report of the Director-General of Public Health, New South Wales, for the Year 1922: including a Report on an Outbreak of Plague at Sydney, September 1921–July 1922. Pp. v+139. (Sydney: Alfred J. Kent.) 6s. 9d.

The British Mycological Society Transactions. Vol. 9, Part 3, March 31. Edited by Carleton Rea and J. Ramsbottom. Pp. 129-188. (London: Cambridge University Press.) 15s. net.

Fifth Annual Report of the Governors of the Imperial Mineral Resources Bureau. Pp. 24. (London: 2 Queen Anne's Gate Buildings, S.W.1.)

The Journal of the Royal Anthropological Institute of Great Britain and Ireland. Vol. 53, 1923, July to December. Pp. xi+263-488+16+27. (London: 50 Great Russell Street, W.C.1.) 15s. net.

Report on the Operations of the Department of Agriculture, Madras Presidency, for the Official Year 1922-23. Pp. 30+4. (Madras: Government Press.) 8 annas.

Madras Agricultural Department. Year Book, 1923. Pp. ii+67. (Madras: Government Press.) 8 annas.

Department of Agriculture, Madras. Bulletin No. 86: List of the Important Insects injurious to Cultivated Crops in South India. By T. V. Ramakrishna Ayyar. Pp. 45. 6 annas. Bulletin No. 87: The Ground, Earth, or Pea-Nut (*Arachnis hypogœa*). Pp. ii+35. 4 annas. (Madras: Government Press.)

Royal Asiatic Society (North China Branch). Extra Volume 3: Social Organization of the Manchus; a Study of the Manchu Clan Organization, By S. M. Shirokogoroff. Pp. vi+194. (Shanghai: 5 Museum Road.) 4 dollars.

United States Department of Agriculture. Department Bulletin No. 1222: Growth and Feeding of Honeybee Larvæ. By James A. Nelson, Arnold P. Sturtevant, and Bruce Lineburg. Pp. 38. (Washington: Government Printing Office.) 10 cents.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 480: A Directive Type of Radio Beacon and its Application to Navigation. By F. H. Engel and F. W. Dunmore. Pp. 281-295. (Washington: Government Printing Office.) 5 cents.

Carnegie Institution. Annual Report of the Director of the Laboratory for Plant Physiology. (Extracted from Year Book No. 22, for the Year 1923.) Pp. 43-66. (Washington.)

Agricultural Census of the Colony and Protectorate of Kenya for 1923. Fourth Annual Report, November 1923. Pp. 20. (Nairobi: Department of Agriculture.)

Report on the Anophelinæ of Mauritius, and on Certain Aspects of Malaria in the Colony, with Recommendations for a new Anti-Malaria Campaign. By Malcolm E. MacGregor. Pp. 48+24 plates. (London: Printed by Waterlow and Sons, Ltd.)

Final Report on Geological Investigations in the Falkland Islands. By Dr. H. A. Baker. Pp. 38+6 plates+1 map. (London: The Crown Agents for the Colonies.)

Diary of Societies and Public Lectures.

WEDNESDAY, APRIL 23.

ROYAL MICROSCOPICAL SOCIETY (Industrial Applications Section), at 7.—J. E. Barnard: Lecture Demonstration.—Miss Annie D. Betts: The Practical Use of the Microscope in the Bee-keeping Industry.—S. R. Wycherley: Fibres, Analytical and Economic.—Exhibits by J. W. Atha and Co. and W. Watson and Sons, Ltd.

THURSDAY, APRIL 24.

INSTITUTION OF ELECTRICAL ENGINEERS, at 6.—G. Semenza: Kelvin and the Economics of the Generation and Distribution of Electrical Energy (Kelvin Lecture).

FRIDAY, APRIL 25.

ROYAL PHOTOGRAPHIC SOCIETY OF GREAT BRITAIN, at 7.—F. L. Wills: The Commercial Application of Aerial Photography (Lantern Lecture).

JUNIOR INSTITUTION OF ENGINEERS, at 7.30.—H. G. Williams: Aluminium Electrical Conductors for Overhead Power Transmission.

INSTITUTION OF ENGINEERING INSPECTION (at Royal Society of Arts), at 8.—Dr. V. E. Pullin: Radiology in Inspection.

ROYAL SOCIETY OF MEDICINE (Electro-Therapeutics Section), at 8.30.—Prof. S. Jellinek: Some new Observations and Experiments in Electricity.

PUBLIC LECTURES.

THURSDAY, APRIL 24.

KING'S COLLEGE, at 5.30.—Prof. José Castillejo: Education in Spain. (Succeeding Lectures on May 1 and 8.)—Prof. A. J. Toynbee: Outlines of Byzantine, Near Eastern, and Modern Greek History (378–1841 A.D.). (Succeeding Lectures on May 1, 8, 15, 22, 29, June 5, 12, 19, and 26.)