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The Universities and International Peace.

THE third Congress of the Universities of the British Empire, which is to be held at Cambridge next month, is an event of more than academic interest and significance. It proves that universities differing widely from one another in origin, traditions, constitution, organisation, and even the mother-tongues of the majority of their members, and some with the thick of the earth between them, are capable of friendly co-operative effort, sustained over a period extending now to fourteen years, in pursuit of common aims. Further, it shows that such co-operation is possible without external stimulus, pressure, or aid; above all, and in this it is characteristic of the forces which hold the British Empire together, in absolute independence of State inspiration, guidance, or subvention. The question suggests itself whether universities of other countries, outside the British Commonwealth of Nations, might not similarly co-operate internationally and thereby contribute more effectively than they do at present to international peace.

There is a peace that passeth all understanding, and when it shall prevail generally in the hearts of mankind, and especially in the hearts of politicians, high financiers, trade union leaders, and newspaper proprietors, humanity will have finally emerged from the jungle, and war will be a thing of the past. But peace in our time is largely conditioned by understanding, and whither should we look for help in the promotion of understanding if not to those foci of intellectual light—the universities? These do already, beyond question, give such help, but by independent and, to a great extent, unco-ordinated effort rather than by concerted action.

At Gex last August was held the fourth annual conference of the "Entr'aide Universitaire" (World Federation of Christian Student Associations). In the course of the proceedings a striking address was given by Dr. A. E. Zimmern on "The Contribution of the Universities to International Comprehension and, thereby, to International Peace." The League of Nations, Dr. Zimmern pointed out, was created to introduce more intelligence into international relations. What divides the nations at the present time is not hatred but ignorance, folly, and intellectual sloth. International relations are no longer confined to diplomatists and great financial and mercantile houses, but exist also between multitudes of ignorant people whom the progress of science in its applications to means of transport and communication have brought close together as in no previous period of the world's history. This approximation and this multiplication of points of contact implies increasing potential causes

of friction. Hence an urgent need of promoting by all available means the development of a true citizenship of the world, such as can be brought about, not by travellers' tales, novels, and plays designed to gratify an idle curiosity, not by trade or by missionary enterprise, not even by collaboration of specialists—the internationalism of science, so highly developed and esteemed in the nineteenth century—but by full and frank and generous interchange of ideas between personalities determined to comprehend each other's attitudes and points of view and the modes of working of each other's minds. What, then, should be the contribution of the universities ?

Universities have two aims ; namely, the fullest and finest development of the national character, and the search for truth. In the pursuit of these they contribute to international peace, first, by providing a *milieu* most suitable for enabling a foreigner to learn to understand the national character, and, second, by research in the field of international problems and the bearing thereon of national temperaments and attitudes. Dr. Zimmern does not believe in the idea of an " International University," and holds that no good can come of diluting distinctive national characteristics with an insipid cosmopolitanism. On the subject of international university congresses he offers no opinion. Within a limited field, including such questions as co-operation in scientific research and facilities for visits by university professors and lecturers and advanced students of one country to universities in other countries, such congresses, suitably organised, might afford opportunities for just that personal intercourse, that full and frank and generous interchange of ideas of people determined and competent to comprehend each other, which are so urgently necessary. A handbook of international organisations, compiled by the League of Nations, gives particulars of some 350. Several of these, such as the International Research Council and the International Academic Union, are indeed closely concerned with university activities, and others, such as the International Federation of University Women, bring together students and graduates of universities of different countries, but universities themselves are conspicuous by their absence. Groups represented by 350 organisations have thought it worth while to devise machinery for cultivating international relationship, but the universities of the world have not thought it worth while or, if they have, lack the energy to embody the thought.

The subject will no doubt be explored by the Section of University Relations of the International Institute of Intellectual Co-operation recently established by the League of Nations at Paris. It may be surmised that in any further development in this direction that may take place due weight will be assigned to a principle the importance of which has been proved by the experience of one of the most effective of international organisations, namely, the Comité Maritime International. This is the principle of continuity of the *personnel* of the delegations : " The leading persons who attend the Conferences," says a report by Sir Leslie Scott, the senior British delegate, in the *Times* of April 16, 1926, " are to a great extent the same. But for the mutual confidence engendered through personal contact with the same men, it would never have been possible to reconcile many apparently irreconcilable differences. A spirit of trust and friendship has grown up, which continual changes of *personnel* would have prevented. . . . There is no better preventive of misunderstandings [than this plan of personal continuity in representation], and in order to overcome the inherent difficulties of different language, temperament, and outlook, it is perhaps an essential condition of successful progress."

In 1918, on the invitation of the Government of the United States, the universities of the British Isles sent a representative mission to America, and in the following year similar university missions were sent to France and Belgium. Much good feeling was generated by these friendly official visits, but the precedents thus set have not been followed. The Atlantic no doubt presents a formidable obstacle, but it is not clear why such missions should not be undertaken from time to time as between countries comparatively near to one another. The visits paid on such occasions as the celebration of a jubilee or a centenary commemoration of the founding of a university, valuable as they undoubtedly are, are generally very brief and ceremonious, and the hosts and guests have not much time or opportunity for exchange of ideas. On the initiative of the University of Basle in 1922, the universities of Great Britain and Switzerland experimented with another kind of international intercourse. Delegates met together at Basle as the guests of the university, and discussed in sessions extending over several days a number of subjects of common interest. This venture, like the missions to America, France, and Belgium, appeared to meet with the approbation of all concerned, but likewise has not, so far, been imitated.

The younger generation is in this matter giving a lead to those responsible for university policy. The Confédération Internationale des Étudiants, founded at Strasbourg in 1919, has now affiliated national unions of university students in almost every country of Europe and several countries in other parts of the world. Regional groups of students in the United

States are being organised with the view of affiliation. "The time has come," says a leaflet issued by the National Union of Students of England and Wales, "for the young men and women of the universities to undertake to a much greater extent than before the organisation of activities among themselves, linking up the life of each university much more closely with that of other universities, and providing facilities for themselves (such as tours, congresses, etc.) which will give them that wider experience so essential to the education of those who are to become the leaders of to-morrow. Such activities by no means impair the quality of academic work; rather they enrich and supplement it. For example, the N.U.S. arranges for its members faculty tours. . . . Each year medical, agricultural, engineering, theological, and art students visit the leading hospitals, laboratories, farms, factories, art galleries, etc., of the different countries of Europe." In the past it has been customary to look upon university student organisations only as appertaining to particular universities, and not as having national or international activities. In the changed conditions of to-day it behoves the universities to consider whether it is wise to leave the cultivation of the international field so largely to their undergraduate and youthful graduate members and, it may be added, university women, whose International Federation, though not rivalling the Confédération Internationale des Étudiants in membership, is rapidly extending its influence.

More effective than such missions or conferences are, perhaps, academic institutes in foreign countries, a subject which was discussed at length at the annual conference of universities of Great Britain and Ireland in 1925. In this direction the Office National des Universités et Écoles Françaises has been very active, and there are now French Institutes in London, Florence, Naples, Madrid, Barcelona, Prague, Sofia, and Buenos Aires. The United States has, since the War, undertaken a peaceful penetration of universities on the eastern side of the Atlantic by means of the American University Union in Europe, with divisions at Paris and London. The establishment of branches of the Union in Rome, Berlin, and Vienna has been suggested, an American Institute has been founded at Prague, and there are at Geneva an International Educational Institute and an International Students' Union, both financed from America, whilst an American committee of the Geneva Institute of International Relations maintains an office for the reception of English-speaking visitors who come to Geneva to study international co-operation. This office was visited during the summer of 1925 by about 5000 Americans. The newly constituted Comité d'Administration of the European centre of the Carnegie Foundation for International Peace contemplates the formation of American Institutes at Berlin, Warsaw, Madrid, Rome, and in the Balkans as well as in the Far East, South America, and Mexico. All these American enterprises differ from the French Institutes in that they are entirely independent of State control. The same applies to the only comparable British Institute—that at Florence—but not to the Pan-American Union, which, through its Educational Section, keeps the Latin American universities in touch with one another.

Among other institutions through which universities exert an important influence on international relations by promoting international comprehension are university fellowships tenable in foreign countries for advanced study and research, and university vacation courses for foreigners. But, after all, the greatest contribution the universities can make to the cause of international peace is one which Dr. Zimmern seems to have overlooked. As Mr. Stanley Baldwin explained with admirable force and lucidity in his address entitled "Truth and Politics" on his inauguration as Lord Rector of the University of Edinburgh, the most important task of a university student is to learn to think clearly, to learn habits of precision in statement, honesty in handling evidence, fairness in presenting a cause—in a word, to be true in word and deed, and it is truth and the habit of truth alone that will "destroy the face of the covering cast over all people, and the veil that is spread over all nations" (Isaiah xxv. 7).

Science and the Modern World.

Science and the Modern World: Lowell Lectures, 1925. By Prof. Alfred North Whitehead. Pp. xi+296. (Cambridge: At the University Press, 1926.) 12*s.* 6*d.* net.

IT is fortunate that in the twentieth century, science and philosophy are beginning to be united in the same person as they were in the seventeenth century before their fatal divorce occurred. Prof. Whitehead's latest book cries out to be read and re-read and meditated upon (and to that end if possible possessed) by every man of science who is not content to live merely in his own special 'groove of routine' and is concerned in the trend and tendency of science as a whole; and by every philosopher who desires, as he must, to keep himself in contact with the thoughts of science. It is a work not only of the first importance but also of great beauty. Apart from the vivid writing, the reader's delight arises from two sources: in the first place, from the rapid characterisation of the various epochs into which Prof. Whitehead divides the history of modern scientific thought; and secondly, from his method of pointing out in each epoch just how the central thought

of the epoch bears, in the way of contribution or of defect, upon the central thought of the present as the author conceives it. The poet prefiguring him wrote: 'and as he works, the industrious bee computes *his* time as well as we.' One result of this procedure is that while the bulk of each historical chapter is simple and luminous reading, each chapter contains a few pages which demand the closest attention, but work with cumulative preparation towards the dramatic outcome.

The plan of the book is to begin with the origins of modern science out of the Middle Ages, and then after a sketch of the history and nature of mathematics, to take in succession the outstanding movements of thought—the seventeenth century, which Prof. Whitehead calls the century of genius, the eighteenth century, the romantic reaction of the earlier nineteenth century, and then the nineteenth-century science, which is followed by an account of the theory of relativity and the quantum theory. Certain chapters follow, to which I shall return presently. The historical surveys—if I may call them so—are distinguished not so much by any learning which would cause surprise in reading an author whose wide cultivation and breadth of human interest are so well known, as by the freshness and originality with which the salient features are seized. With all its rebellion against the rationalism of the Middle Ages and its appeal to Nature as the fountainhead of knowledge, and submission to "irreducible and stubborn facts" (as he quotes from William James), modern science owes to the medieval rationalism its belief in natural order; and to its insistence on 'the rationality of God conceived as with the energy of Jehovah and with the rationality of a Greek philosopher,' its 'belief in the connexion of every occurrence with its antecedents in a perfectly definite manner, exemplifying general principles.'

The service of Bacon to the new learning is acknowledged with a cordiality and discrimination which contrast refreshingly with the recent meagre and grudging commemoration of his anniversary, in an age which forgets his scientific inspiration because he was a disagreeable person and exaggerated the reach of his inductive methods, though even there it might be remembered that he taught the importance of negative instances. Berkeley is singled out as perhaps the most fruitful mind of the eighteenth century, though he affected little the course of science. The chapter on the Romantic Reaction contains a striking study of Wordsworth and Shelley as supplying, one in antagonism to science, the other, Shelley (as he urges in a very interesting passage), in full sympathy with science, the feeling for the æsthetic concreteness of Nature, as a whole and in its parts, which the 'materialism' of science lacked. (In interpreting 'the light that never was on sea or land' as the eternal objects of philosophy, Prof. Whitehead has overlooked Sir Walter Raleigh's exposure of that general misunderstanding, "Wordsworth," pp. 107 ff.) The greatest invention of the nineteenth century he declares was 'the invention of the method of invention.' But these chapters are packed with illuminating aphorisms.

The greater part of the book consists of Lowell Lectures given at Boston, and is, therefore, a hemi-semi-popular version of Prof. Whitehead's philosophy of Nature as approached from the history of science. It has thus the advantage of insinuating into the scientific reader's mind by a study of science itself the conceptions already reached. But it does much more. It presents the main drift of the author's former work with a clearness not before exhibited and perhaps not before completely attained; and it makes new and important additions. Prof. Whitehead's chief interest is to substitute for the hitherto prevailing 'scientific materialism,' as he calls it, or 'mechanism,' with its underlying conception of individual bits of matter in motion, the conception of 'organism.'

The first conception became fixed in thought with Descartes. Its immense service for science Prof. Whitehead does not, of course, deny, but it is an abstraction which has broken down in the history of science itself. Through the influence of biology and physiology, and now of psychology, the notion is imposing itself that the enduring things are organisms, and the present condition of physics itself he compares to the condition of astronomy when people began to help themselves with the introduction of epicycles—a sure sign of the need for change. He puts the difference this way (p. 81): On the current theory a bit of matter has *simple location*, that is 'in expressing its spatio-temporal relations it is adequate to state that it is where it is, in a definite region of space, and throughout a definite duration of time, apart from any essential reference of that bit of matter to other regions of space and to other durations of time. The organic theory asserts not only internal relatedness within the enduring thing, but interaction between all things.' He goes so far as to deny that even spatio-temporal relations between things, generally regarded as external, are so (p. 174). When it is more fully analysed, this means that each thing in Nature mirrors all the rest, or is what he calls a 'prehension' of them; a modification of Leibnitz's doctrine (in which he agrees with writers like James Ward and others), by which the entities in relation are not windowless but are in communication with all others, as it were by tubes of force.

This thoroughgoing interrelatedness of events is part and parcel of Prof. Whitehead's concrete treatment of

Nature, only he has never expressed it so explicitly as in this book. Space-time is for him no mere framework into which things fit; but Nature, which is essentially passage or transition, consists of events, and events are slabs or 'durations' (or portions of such) in this passage presented in sense, in which what he calls 'objects' (or what others have called 'universals') are 'ingredient' and have 'situation.' In this book there are introduced at least two new conceptions, that of 'endurance' or 'reiteration,' and that of 'value.' Enduring objects are the persisting patterns in which complex eternal objects (like yellow, hard, soluble in nitric acid, etc.) are actualised in union—not necessarily unchanging patterns, but it may be a pattern which is realised in succession like that of a musical melody.

The other notion of 'value' is that which is yielded by the suggestion of the romantic poets. Value is the intrinsic reality of an event, and realisation is in itself the attainment of value. It is, in other words, what an event counts for in the whole and therefore varies in degree. But always the wholeness or concreteness of events is given fact, and an 'æsthetic attainment is interwoven in the texture of realisation' (pp. 131-2). (I do not know if this meaning of value coincides with the ordinary use of value in speaking of goodness, truth, and beauty as values; but I incline to think it does.)

Finally, going beyond Prof. Whitehead's previous work into what must be supposed to underlie Nature as a whole and its parts, we have the notion of an eternal activity, which takes the place on this theory of Spinoza's 'Substance' (a notion tainted, of course, with the static conception of the seventeenth century), which realises itself in a hierarchy of emerging entities, themselves 'structures of activity' which are evolved, whereas on the mechanistic theory there is but material which endures.

These necessarily brief and condensed outlines might gave the impression that the book largely moves among attenuated conceptions. The reverse is the fact; it is always a man of science using philosophy as a critic of abstractions. The physicist in particular may find discussions of pending physical problems in the highly suggestive interpretation in Chap. ii. of the strange discontinuity in the paths of electrons within the atom, so that they occupy a series of isolated dots rather than a continuous line; and in the treatment in Chap. viii. of the quantum theory on the lines of the organic conception. These suggestions I must content myself barely to refer to.

The most difficult part of the book concerns Prof. Whitehead's differences from the orthodox treatment of relativity and in particular his conception of time. Time is distinguished from duration. In a duration we have measurable or, as Prof. Bergson says spatialised, time. Time itself is denied to be extensive (and indeed it is fairly clear that as a dimension of the spatio-temporal nature time cannot be of the same sort as the dimensions of space). But we are then met with the doctrine that time is a sheer or atomic succession of 'epochal durations'; the time within the duration being needed to secure the realisation of the enduring objects. These are stiff considerations, and I confess that I have not yet been able to get inside them completely. In other words, I cannot at present find room for any time except what is implied in the spatio-temporal process. All the more reason for myself and others to penetrate them, for they are an essential part of Prof. Whitehead's speculations. They are intimately related with some other features of the doctrine, the suggestion (p. 131) of a wider evolution beyond Nature itself, and within which Nature is but a limited mode, the hint here and in earlier work of a transition from Nature to what is left unexplained under the designation of 'mind' (for when Prof. Whitehead speaks of perceiving or a percipient event, this is but a bodily event, the functioning of which is consciouness, and he very forcibly observes *à propos* of some interpretations of relativity as an affair of the mind, that what we are concerned with is not the observer's mind but his body); finally, the whole relation between the world of eternal objects and the actual world.

As to the rest of the book, I can barely mention the last two chapters, one on religion and science which is quite admirably done, and the last on requisites for social progress, which largely turns on the correction of our specialised education by the cultivation of sense for concrete organic wholes, that is in the widest sense of 'art.'

Two other chapters, x. and xi., on 'Abstraction' and 'God' do not belong to the original Lowell lectures, and though they are a completion of the conception of the book and necessary to Prof. Whitehead's thought, and from the philosopher's point of view the most important novelty of the book, do, to some extent, interfere with the artistic unity of the work. They are an exquisite piece of metaphysical work, as if one were hearing a new Plato expound the relation of 'forms' (ideas) to actual reality, and the intercommunion of 'forms.' But they are too condensed to bear reproduction, and they will be of less interest to the purely scientific reader. For the same reason I omit any attempt to affiliate Prof. Whitehead with other, living or recent, philosophers—a subject of great interest. We may hope that we shall not have to wait long for fuller exposition of these matters and more light upon some of those difficulties to which I have referred. Meantime we must be thankful for the present book, which is without any exaggeration one of immense significance.

Against a second edition I note a few trifling misprints: p. 20, line 10; p. 101, line 13; p. 105, line 10; p. 160, line 7; p. 177, line 9 from foot; and add a query as to whether there is not some mistake in the second 'impassible' (p. 11). A misprint on p. 117, 'thoughts too deep for terms,' is too poignant for tears.

S. ALEXANDER.

The History of Electrical Communication.

Board of Education. Catalogue of the Collections in the Science Museum, South Kensington; with Descriptive and Historical Notes and Illustrations. Electrical Communication. 1: Line Telegraphy and Telephony. Compiled by R. P. G. Denman. Pp. 55+12 plates. (London: H.M. Stationery Office, 1926.) 9*d*. net.

TO derive the full educational benefit from a science museum, it is necessary to read a good descriptive and historical catalogue of the exhibits before visiting it. This section of the catalogue of the Science Museum, South Kensington, describing line telegraphy and telephony excellently fulfils this purpose. As the exhibits described are typical of the various stages of the development of the art, it will prove very helpful to every student of applied electricity, whatever his age may be.

In the introduction the earliest attempts at electric signalling are described. It is related how in 1730 Stephen Gray demonstrated by means of frictional electricity that a down feather could be moved at a distance of 800 feet. A few years later the Abbé Nollet formed a ring of Carthusian monks, 1800 yards in length, holding on to iron wires which connected them in series. He then discharged a battery of Leyden jars round the loop. The simultaneous leap made by each monk proved the rapidity of the discharge, and that its intensity was practically the same at all points. Desaguliers repeated some of Stephen Gray's experiments in 1738. It is interesting to remember that the Royal Society gave the first Copley medal to Gray and the second to Desaguliers. The latter received no less than three Copley medals, thus beating Faraday, who only received two. Cawthorn, in his "Vanity of Human Enjoyments," thus relates his end.

> "Can Britain . . .
> . . . permit the weeping muse to tell
> How poor, neglected Desaguliers fell?
> How he, who taught two gracious kings to view
> All Boyle ennobled, and all Bacon knew,
> Died in a cell, without a friend to save,
> Without a guinea and without a grave."

The last of the frictional electricity systems was developed by Sir Francis Ronalds in 1816. After this, inventors turned their attention to the much more convenient voltaic systems. Wheatstone and Cooke took out their first patent in 1837 for a method for giving signals by means of electric currents. A few years later a telegraph was working between Paddington and Slough, a distance of 18 miles. In 1843, with funds granted by Congress, Prof. Morse constructed a line between Washington and Baltimore. The armature on the receiving instrument moved backwards and forwards printing zigzag lines on a moving strip of paper. This instrument was later supplanted by the 'sounder,' operators finding it easier to listen to the clicks of the armature against the upper and lower stops than to read the slips. Messages with this instrument can be sent at the rate of 40 words a minute. Cooke and Wheatstone's revolving disc telegraph of 1840 reminds one of some of the apparatus used in modern automatic telephony. Hughes's type printing telegraph still survives.

Exhibit No. 2 shows Ronalds's 1816 telegraph and gives a vivid picture of science at that date. The invention was brought to the notice of the Admiralty, who thought it "wholly unnecessary." Ronalds therefore never proceeded with it. No. 7 shows Cooke's original electric alarum. Finding that this instrument did not work satisfactorily, Cooke consulted Wheatstone. This resulted in one of Wheatstone's greatest inventions—the relay—developments of which are in use in practically all modern telegraph systems. Wheatstone's five needle instrument (exhibit No. 9), made in 1837, consisting practically of five galvanometers, shows some of his methods of overcoming difficulties. No. 30 shows the Fullerphone, an instrument used extensively in the War. By means of this instrument both telegraph and telephone services can be worked simultaneously over the same wire.

There is an excellent exhibit of Murray automatic printing telegraph apparatus, a system which may be extensively used in the future. The submarine cable exhibits are very interesting. A specimen of the first cable laid between Dover and Calais in 1850 is shown. We always understood, however, that it was the anchor of a French fishing smack that broke the cable and not the action of the tides. One of the first mirror galvanometers, designed in 1858 by Lord Kelvin, then Prof. W. Thomson, is shown (No. 60). Then we have the siphon recorder and specimens of early Atlantic cables.

Varley's carbon lightning protector (No. 88), patented so far back as 1866 by the brothers Varley, consists of two copper points nearly touching one another in a small box filled with powdered carbon. It is supposed to be a non-conductor up to a definite voltage and a conductor for a higher voltage. Something similar to this was invented by the French electrician Thury some years ago for use on his high-tension direct-current

system. It seems to the writer that if something thoroughly trustworthy of this nature were invented it would perform admirably the functions of an electrical safety valve and a lightning protector.

There is a good exhibit of telephone transmitters and receivers. The Strowger automatic telephone sets and the working model of the automatic telephone system for the London area will interest many. The model is probably for its size the most complex mechanism extant. Six exchange switching centres are represented; access to these can be obtained by a number of automatic telephones included in the exhibit. Visitors may make test calls with these instruments and trace the progress of their call through the successive pieces of apparatus. They can also see how the call proceeds from one automatic exchange to another or a manually operated exchange. The telephone call meter (No. 136), which registers the number of effective calls made by a subscriber, is of general interest.

An interesting exhibition of telephotographs (No. 140), presented by the International Western Electric Co., shows the degree of technical excellence to which the transmission of pictures over long telephone lines has now been carried. This application of science has been rendered possible by the grouping of many modern inventions together. The thermionic valve, the carrier current transmission system, and the photo-electric cell are all used in the system. The method is a trustworthy one. A positive transparency prepared by any photographer can be sent, even although still wet, over telephone lines of any length in a few minutes, and after the usual photographic development of the received picture it can be produced in a newspaper.

A. R.

Nitrogenous Derivatives of the Sugars.

Hexosamines and Mucoproteins. By P. A. Levene. (Monographs on Biochemistry.) Pp. x + 163. (London: Longmans, Green and Co., 1925.) 10*s.* 6*d.* net.

DR. LEVENE'S monograph deals with an important group of natural compounds, closely related to the simple sugars. Some of the properties of the parent-compounds are described briefly in the first chapter, in which the existence of ring-systems of different size is referred to; but Haworth's proof that even glucose itself contains a 6-atom instead of a 5-atom ring calls for a further revision of formulæ which have been accepted for a generation without any foundation of experimental proof. The remarks of the author, in reference to chitosamine, that "much of the chemical structure of the sugar was formulated correctly rather by instinct than by experimental evidence," appears to be capable of a much wider application, but with a reservation as to the necessary correctness of the 'instinctive' formulæ.

The following chapters of the book deal with the hexosamines and their derivatives, with the hexosaminic and aminoheptonic acids and with the anhydrohexoses. Important sections are devoted to the configuration of these sugar-derivatives, and the study of this problem has led the author inevitably to the problem of the Walden inversion in the sugar series, on which he is now undertaking experimental work with the view of determining whether a change in polarity of a group attached to an asymmetric carbon atom does or does not change the direction of rotation.

The later part of the book deals with mucoproteins. These are complex proteins, in which the protein part varies widely from tissue to tissue and from species to species, whilst the carbohydrate group is always linked with sulphuric acid, the group being built up from equimolecular proportions of sulphuric acid, acetic acid, hexosamine, and glucuronic acid. These complex compounds have been made the subject of an intensive chemical investigation, in the course of which new ground has been broken in the preparation of sulphuric esters of simple carbohydrates. The field for investigation is a very wide one, and there are many difficulties to be overcome; but the author has given an admirable review of the present position. His chapters on 'Methods' describe the basic chemical operations which must precede any further investigations in this direction.

Bird Life and Natural Selection.

Indian Bird Life: or the Struggle for Existence of Birds in India. By Douglas Dewar. Pp. xv + 276. (London: John Lane, The Bodley Head, Ltd., 1925.) 7*s.* 6*d.* net.

WE congratulate Mr. Dewar in having written the best of the very numerous books which he has brought out. In his introduction he rather frightens us when he hints that he is going to show us to what extent Darwin was right or the reverse in his theories. As we read, however, we find that this apparently is not his object, and that all he intends to do is to quote examples of how natural selection may be influenced by environment or, in some cases, how neither natural selection nor environment can, in his opinion, account for what happens. The author's quotations are well selected but his theories are quaint. There are but few scientific workers who will agree with Mr. Dewar's theory that much of what occurs in life is due to 'luck.' On p. 260 he remarks, "the struggle for existence of birds results in the weeding

out of the unlucky rather than the less fit." We hope that when Mr. Dewar has again perused his own work and the excellent examples given therein of the survival of the fittest, he will feel in a position to change his mind. The book consists of a compilation of facts and statements recorded by others, but Mr. Dewar has done an excellent piece of work in bringing these same facts and statements together and in arranging them in so readable and interesting a form. The reader can draw his own conclusions from what is written, and, even if these conclusions do not agree with those of the author, he will be none the less indebted to him.

Mr. Dewar's observations on the extraordinary mortality amongst young birds and upon the small percentage of eggs which ever hatch are most interesting although very far from complete. The chapter on competition for nesting sites is not so good, for we have more of the author's deductions and fewer facts from other people, whilst in some places he undoubtedly goes astray both in his facts and in his conclusions. This is especially the case when he dilates on the life history of some of the parasitic cuckoos, for he has apparently not read certain recent papers in the *Proc. Zool. Soc.* showing how over-production of the eggs of cuckoos, where these birds become too common, works out their own destruction.

We think Mr. Dewar will also have some difficulty in convincing his readers that his conclusions as to breeding behaviour are correct. Thus we notice that he considers lapwings and other birds which try to draw intruders from the vicinity of their eggs or young by feigning injury, are merely the victims of unbalanced minds. Those who have seen birds behaving in this manner and not merely read articles referring to them, know well that such birds show most conclusively in many ways that they are acting for the definite purpose of saving their property. Whether, however, we agree with Mr. Dewar's conclusions or not, every one interested in the question of evolution and environment should read his book, and we may end as we began by congratulating him on having compiled a work which is a desideratum for all naturalists.

Our Bookshelf.

Health and Environment. By Leonard Hill and Argyll Campbell. Pp. xix + 208 + 8 plates. (London: Edward Arnold and Co., 1925.) 12*s.* 6*d.* net.

THIS handbook deals in the space of two hundred pages with subjects of so personal and intimate a character that there is not a single individual who could fail to be interested by a very large portion of it, especially as it contains a good deal of straight talk on clothes, food, light, and open air. The subject matter, though presented in non-technical language, is based on sound scientific investigations which may be examined more fully in the Medical Research Council's Special Report Series, Nos. 32 and 52 dealing with "The Science of Ventilation and Open-air Treatment," Parts I. and II., and No. 73 "The Kata-thermometer in Studies of Body-heat and Efficiency," written by Prof. Leonard Hill. These two authors have rendered a social service in presenting to the individual a rational method of 'keeping fit' and in laying down the guiding principles for the heating, lighting, and ventilation of factories, schools, public and other buildings where large numbers of people congregate. In this connexion the book is of especial value to employers of labour and public health bodies.

Our daily papers have recently shown the only too frequent outbreaks of fire in country houses. Here we see the installation of modern systems of lighting and heating in old structures, never intended for them, followed by a very obvious and expected result. Results not quite so obvious must accrue from the present-day practice of designing of houses by architect's draughtsmen without the co-operation of sanitary engineers from the outset; the latter are called in only when new houses are nearing completion. The book establishes a plea for the designing of suitable systems of heating and ventilation before the foundations of buildings are laid.

One of the present authors was the first to stress the importance of the tonic effect of moving-air upon the human body, and it is in the correlation of this with a sense of comfort and general well-being that the kata-thermometer designed by Prof. Hill has been of such great use. Diagrams illustrating the use of this instrument and the results obtained with it are given. These are very clear, with the exception of Fig. 13, which has suffered in reproduction.

Employers of labour will be specially interested in the inexpensive improvements suggested in their trades, whereby the comfort and efficiency of the worker are enhanced and the output consequently increased.

To physicists, the description of the kata-thermometer designed by Prof. Hill and its recording pattern evolved by E. Schuster may not be new, but the results of its applications are likely to prove interesting. A detailed account of these instruments is given at the end of the book specially for the information of ventilating engineers.

Insulated Electric Cables. By C. J. Beaver. In Two Parts. Part I. Materials and Design. Pp. 264. (London: Ernest Benn, Ltd., 1926.) 36*s.* net.

ALTHOUGH the manufacture of electric cables is a comparatively recent industry, the progress that has been made in their design and method of manufacture is most satisfactory. In the early days of electric lighting it was common to use bare conductors laid in pipes filled with oil, the wrappings of the conductors being used simply as spacing materials. In the Edison system, for example, the conductors consisted simply of copper rods wound over with jute rope and drawn into iron pipes. The Crompton system also, which consisted of bare strip conductors in a culvert, was extensively used in the early days, and some of it is in use to-day after thirty years' service. The great improvements that have recently been made in cables

are mainly due to the great encouragement given by the manufacturers to mathematical and physical research. In this volume Mr. Beaver discusses the materials used in the manufacture and the design of electric cables. An excellent résumé is given of the latest practice and the most modern theories which are used in design.

So far as conductors are concerned, aluminium seems to be coming to the front. A very careful comparison is made of the relative properties of conductors. It is pointed out that for conductors of equal resistance, aluminium conductors are only half the weight of copper conductors. Hence as the price of aluminium per pound is less than double the price of copper, aluminium conductors are indicated for many purposes. During the War, Germany was very short of these metals and so invented a method of producing zinc in the form of a ductile wire, but its low melting-point renders the soldering of joints with this material a very difficult operation. The increasing use of high pressures has made very elaborate researches on the properties of dielectrics necessary. The author describes many of these problems. Reference is made to the use of vulcanised bitumen as an 'ozone-proof' covering for rubber dielectrics. We can recommend this book.

Rambles in Vedânta. By B. R. Rajam Aiyar. Being a Collection of his Contributions to the *Prabuddha Bhârata*, 1896–98. Pp. xlvi+888. (London: George Allen and Unwin, Ltd., 1925.) 12*s.* 6*d.* net.

RAJAM AIYAR, scholar, poet, and philosopher, was born in 1872 at Batlagundai, a village in the Madura district. He entered the Christian College, Madras, in 1887, graduating in 1889, and attended the Law College for three years. He then devoted himself for a time to letters, but later turned to philosophy and religion. After a period of preparation he took up what can only be described as the rôle of an evangelist. He founded a monthly magazine, *Prabuddha Bhârata*, which ran for two years with some success, but was brought to an end by his premature decease at the age of twenty-eight years. This brief sketch of his career is necessary for a just appreciation of this reprint of some of his work. In "Rambles in Vedânta" we have a number of the articles, poems, aphorisms, essays, and tales which he contributed to the magazine, both under his own name and under various pseudonyms. He himself describes them as an exposition of the principles of the ideals of the Vedânta which he aimed at presenting in their purest and simplest form, removing the misconceptions and mysticism which had gathered round them. He had studied arduously the Upanishads, the Gita, and the work of Sankara to this end. But his interpretation was peculiar and individual; and his work shows that he had been strongly influenced by his reading in English literature, of which he had a real and keen but critical appreciation. If, therefore, his guidance in Hindu philosophy and religion can be accepted only with some reserve, the book is none the less valuable to Western readers as affording an insight into a personality which could perhaps have been produced nowhere but in the India of the end of the nineteenth century.

The Pathology of Tumours. By Prof. E. H. Kettle. Second edition. Pp. viii+285+4 plates. (London: H. K. Lewis and Co., Ltd., 1925.) 12*s.* 6*d.* net.

THE second edition of Prof. Kettle's book is arranged on the plan of the first, with the addition of many new diagrams and some revision of the text, particularly in the section on the general biology of tumours. The substitution of drawings for many of the photographs contained in the previous edition is a welcome improvement, since to the student entering on the study of pathology photographs are rarely satisfactory. The inclusion of a chapter on treatment is unusual in a volume of this type, but it is not altogether out-of-place, and a correlation of pathology and therapeutics enables the student more readily to grasp the general principles of both these branches of medicine.

Prof. Kettle's brief summary of the experimental study of cancer is excellent. He recognises fully the value of research work on the tumours of fowls and animals, considering it proved that the criteria by which we recognise a malignant tumour in mankind hold good in the mouse and other creatures. The work of W. E. Gye raises questions of the first moment, and "the parasitic nature of, at any rate, one form of malignant growth would seem to be proved."

The book is very well illustrated and indexed, and for medical students is ideal as an introduction to the subject of neoplasms and to the study of pathology in general.

A Text-Book of Inorganic Chemistry. Edited by Dr. J. Newton Friend. Vol. 3, Part 1: The Alkaline Earth Metals. By Dr. May Sybil Burr (*née* Leslie). (Griffin's Scientific Text-Books.) Pp. xxvi+346. (London: C. Griffin and Co., Ltd., 1925.) 20*s.* net.

THIS part of Dr. Friend's "Inorganic Chemistry" deals with the triad of alkaline earth metals (calcium, strontium, barium) and with radium and its compounds. It contains an immense amount of detail, as is indicated by the fact that the footnotes include on the average at least one reference for every three or four lines in the text; but for this very reason the book is much more suitable for use as a work of reference than for continuous reading. In accordance with general policy, illustrations have been restricted to half-a-dozen equilibrium diagrams, and no figures are given of the plant used to manufacture products such as calcium carbide, cement, or glass. Special attention has been paid to agricultural questions arising out of the use of calcium cyanamide and of calcium phosphates as fertilisers.

La lumière et les radiations invisibles. Par Prof. A. Boutaric. (Bibliothèque de philosophie scientifique.) Pp. 284. (Paris: Ernest Flammarion, 1925.) 10 francs.

THIS book gives a somewhat popular and non-mathematical survey of the theories of light and the phenomena of radiation. It embraces a very wide range of phenomena, including, for example, the colour of the night sky, the pressure of light and its cosmic importance, and the behaviour of a ray of light passing through a gravitational field. The final chapter deals with the ether and is very well written; the more difficult experiments associated with the ether are described in an appendix.

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.*]

On Prof. Miller's Ether Drift Experiment.

SOME time ago I was told (I think by Prof. R. W. Wood) that the late Prof. Morley had expressed himself as anxious about the immense superstructure that had been built on the null result obtained by Prof. Michelson and himself during a comparatively few very careful experiments. He was anxious that the experiment should be repeated under different conditions and the result confirmed. We now know that such repetition has been undertaken, at first in connexion with Prof. Morley, by Prof. D. C. Miller of Cleveland, for whose zeal, enthusiasm, and enterprise we must feel high admiration. Not six or a dozen repetitions, but thousands of them, have now been made, on the tops of mountains, on plains, with frames of different materials, and with a sufficient length of light path to give a result of 1 part in 1000 million. The undoubted result of these repetitions has been to confirm the null result of Michelson and Morley, so far as regards the orbital motion of the earth, and thereby establish one of the foundations on which the theory of relativity was at first based, up to what at that date had seemed to be the probable errors of experiment.

Whether there is anything more to be deduced from Prof. Miller's results (he clearly thinks there is) is a matter which is manifestly *sub judice*. His first *reported* claim, that the result on the top of a mountain was much greater than on a plain, could scarcely be accepted. If that had been true, the ideas involved would have been extremely difficult and revolutionary. It is a relief to know that that, at any rate, is no longer urged. The place at which the experiment is performed seems to matter not at all; and that is a great simplification, for it enables us to open our minds to see whether there is anything that can be admitted in his present claim. Prof. Miller has studied and plotted all his results in an admirable manner; and the only question is whether the outcome should be considered as practically zero, or whether (as he believes) there is a real residual effect which has to be accounted for.

What Prof. Miller now claims to have detected is a drift of the solar system in a direction approximately normal to the plane of the ecliptic, a drift which could not have been observed under the conditions of the early experiments. But the pressing question is whether such a drift has been observed now. That it is contrary to the main postulate of the theory of relativity, namely, that no effect due to motion through the ether can ever be observed, or, in other words, that everything goes on as if the ether did not exist, cannot be cited in opposition. For that is just the postulate which is under examination, and it has never been finally proven; though it has been made plausible by the verification of deductions made by its aid.

The argument of Prof. Miller, as I understand it, is that there is a slight residual effect due even to the earth's orbital motion, but so small that it comes within the limits of what is possible to observe. The effect is by no means of the full magnitude, but is, as it were, diluted down to (say) one-fifth of its theoretical value by some unknown cause, which he conjectures may be the FitzGerald-Lorentz contraction. It seems just possible that the FitzGerald contraction, though shown by Lorentz to compensate, does not compensate completely. Whether the compensation is complete or not, however, is a theoretical matter of some difficulty, which has not yet been thoroughly gone into, so far as I know, though reference may be made to a short paper by Sir Joseph Larmor in the *Phil. Mag.* for June 1904. If any good reason can be adduced for an outstanding discrepancy, that would strengthen Prof. Miller's position enormously; but until such reason is forthcoming the discrepancy must be doubted.

Assuming for the moment that the orbital motion does show a very slight and imperceptible or barely perceptible residual effect, Prof. Miller claims a larger effect, even ten times as large, which, plotted in accordance with sidereal time, could be accounted for by a cosmic drift of considerable magnitude if that too were diluted down by the same unknown cause and in the same ratio. He does not claim that the main drift of the solar system is observed, but only a residual fraction of it; and unless some reason can be given why there should be this residual fraction, and why the compensation should not be complete, it is dangerous to accept the result as certain, in spite of the skill with which Prof. Miller disentangles it from his multitude of observations and presents it as a small but recognisable and definite result.

The great importance of such a result, if it can be established, must make us very wary in accepting evidence for it, especially in view of the many disturbing causes. Hitherto the observations have been plotted with the view of displaying the reality of this supposed ether drift. But suppose they were plotted with some other object in view. For example, suppose they were plotted on the hypothesis that the south side of the housing of the instrument was slightly warmer than the north side. How would the average curve agree with that? An interferometer with so long a length of light path is a terribly sensitive instrument. The heat of the source of light, the warmth of the body of the observer, the exposure to radiation from the sun on one side and into space on the other, have all to be carefully considered. It is rather surprising that the readings were made by a peripatetic observer, with the instrument in constant and not very slow rotation. Under those conditions even the rotation of the earth might have a gyrostatic influence, and one would have thought that a stoppage of the frame and a reading of the fringes by a seated observer in many azimuths, would have been more satisfactory. It must be admitted as unlikely that an ether drift has been discovered by optical means; but the unlikely is not the impossible.

Assuming that the operations have been made with the cold-blooded and skilled accuracy of a Greenwich observer without regard to any theory whatever, and that the residual effect is genuine, then some result ought to be deduced; whether it be the important one claimed by Prof. Miller, or some more commonplace explanation. Meanwhile, one undoubted result does emerge from all this labour, namely, that the certain motion of the earth in its orbit fails to give any but a minute residual and doubtful effect—which is just the conclusion put forward by Michelson and Morley, a conclusion hitherto accepted by the scientific world. Beyond that there remains a residual effect to be discussed, and either established or negatived. The history of science has constantly shown that small residual effects *may* contain the germ of important discoveries. I hope that it may turn out so in the present instance, though I cannot say that I hope it with any confidence. OLIVER LODGE.

Photograms of Auroræ in Southern Norway.

SINCE 1911 photograms of aurora have been taken systematically from my stations in southern Norway, and many hundred photograms and ordinary photographs have been measured and calculated in order to find the height and situation of aurora in space. A detailed report of the results from 1911 to 1922 has recently been presented to the Academy of Science in Oslo, and it is to be hoped that the publication will not be very long delayed. During the years 1923, 1924, 1925, and 1926 the work has been continued, with six stations at work, and more than 250 successful photograms have been taken, and several hundred photographs. This material, which has not yet been completely measured and calculated, will be a very valuable supplement to that mentioned above.

Especially this spring, during the splendid auroras of January 26 and March 5 and 9, a long series of interesting photograms has been taken. On January 26 I first saw the aurora from my house at Bygdø near Oslo, at 17 h. 40 m. Greenwich time, as a green-yellow arc under the Great Bear. Some minutes later a reddish to violet coloration appeared in the north-west, which had a quite diffuse character without visible rays. I took a series of photographs of it, and on the plates *thin small rays are visible which could not be detected visually*.[1] (Plates Sonja E.-W., Herzog, Bremen.) About 18 h. 30 m. the aurora was splendid. Two arcs stretched over the heavens, from west to east; the northern was red and the southern was green. I am sorry to say that I did not get photograms of these arcs; visual observations from Denmark and from central Norway show that the red arc had an altitude much greater than the green one. About 19 h. the red arc had dissolved into long red rays which formed a beautiful corona. Of this I succeeded in taking a series of photographs which showed that the point of radiation had a somewhat abnormal situation: height above the horizon 72°, azimuth ÷3° to ÷4° (mean from 61 photographs during the period 1911 to 1922, are 70° and ÷9·7° respectively).

Soon afterwards the first period of activity ended, and it was not until about 21 h. that a new period of great activity began. The red coloration was sometimes exceedingly intense, in spite of the full moon, especially in the north-east. About 22 h. 30 m. the aurora was again quiet, but the third period of activity occurred about midnight to 1 h. in the morning, when the observations ceased. As the long series of photograms (about twenty) have not yet been calculated, we will content ourselves with this short report.

On February 24 the aurora appeared again with fine yellowish-green curtains at 18 h. 15 m. to 18 h. 50 m. in the north up to the polar star, and I saw the green aurora line in the zenith and to the south. But clouds all over the sky rendered photographic work impossible.

The next great aurora appeared on March 5. Long rays on the northern sky and in the zenith were observed already at 18 h. At 18 h. 30 m. I got into telephonic connexion between my station at Bygdø and my station at Tømte (48 km. to the N.N.W. of Bygdø), where the Antarctic explorer Carsten Borchgrevink took photographs simultaneously by instructions through the telephone. We succeeded in taking about 48 photograms, 30 of which were successful. One of these is reproduced in Figs. 1 and 2.

The measurements and calculation of this photogram showed that the altitude of the lower border was unusually high; four points at the feet of the rays gave the altitudes of 135, 132, 131, and 137 km. above the earth. The summits of the rays reached at least 350 km. Of this interesting curtain we took a series of photograms which showed that the lower border was continually descending and increasing in brilliancy, but the detailed computations have not yet been made.

The first period of activity ended about 20 h. 10 m. A new one began at about 21 h. 10 m. with a diffuse arc in the north. This grew successively stronger, and changed at about 21 h. 27 m. into rays and curtains which lasted until about 22 h. In the meantime

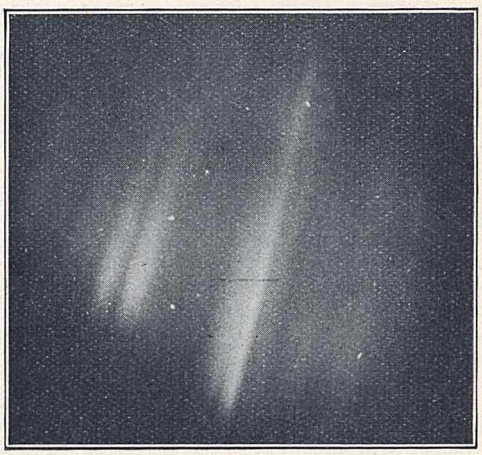

FIG. 1.—Auroral curtain, photographed at Bygdø at 18 h. 36 m. The stars γ, δ, ϵ, ζ and η of the Great Bear are seen very well on the picture.

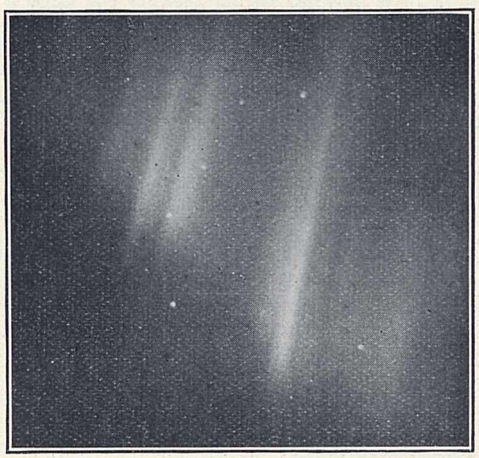

FIG. 2.—The same curtain photographed simultaneously by Carsten Borchgrevink at Tømte. Notice the great parallax referred to the same stars.

the station in Kongsberg had been ready for work and five interesting photographs were taken simultaneously from the stations Bygdø, Tømte, and Kongsberg (mutual distances 48, 64, and 105 km.). Also my two stations Oslo and Oscarsborg were now in action and obtained five successful photograms. After 22 h. the aurora retired to the north and remained stationary as a low diffuse arc near the horizon.

The third great aurora appeared on March 9. I am sorry that I was absent from my station during the maximum activity of the aurora. Nevertheless, some photographs of the corona were obtained, and a few photograms, none of which have yet been calculated. Other auroræ, but not so brilliant, were observed and photographed from my stations on February 10, 11,

[1] I have seen an analogous phenomenon previously (see *Naturwissenschaften*, 1923, p. 338).

13, 23, on March 3, 10, 11, 12, 13, 14, 16, 19, 21, all on April 10, and on May 3.

In connexion with these phenomena, Mr. Boldermo in Hemnesberget, Ranen, Norway, has made an interesting observation. In a letter to me dated March 12 he says: "About three weeks ago I observed that the northern lights influenced my wireless set. I observed that every time the northern lights appeared against the zenith and on the southern heavens, there was heard a cracking noise in the telephones.[2] I uncoupled the antenna from the apparatus and the latter appeared to have static charges. Against earth these ran over to a distance of up to 15 mm. about three times a second. As soon as the northern lights decreased, the charge by degrees disappeared. The night was almost clear with a slight wind. I have observed the same phenomenon twice later on."

In a subsequent letter he gave me a drawing of his antenna, which shows that the top of it is about 12 metres above the ground. From this it seems that the aurora sometimes modifies enormously the potential gradient in the atmosphere, and this phenomenon should be verified by other observers.

CARL STØRMER.

Propagation of a Single Harmonic Wave in a Medium in which the Group Velocity and Wave Velocity are the same.

IT is, I believe, held by many physicists that it is impossible to initiate or transmit a single wave in which the displacement is a simple harmonic function of time and space throughout.

The object of this note is to show that, given certain initial conditions, single waves or finite trains of waves which from beginning to end are of the simple harmonic type can be initiated and will travel unchanged in form; and further that, with slightly modified conditions, fractional parts of such waves can also be propagated unchanged, and will travel with the same velocity as the complete wave of which they would form a part.

Consider first an infinite train of waves in which the displacement referred to the axis XX, Fig. 1, is

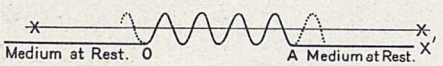

FIG. 1.

given by $y = a \sin pa$, where a is the amplitude and $p = 2\pi/\lambda$.

At each maximum and minimum value of y the medium is at rest and the displacement velocity is zero. If the curve is referred to an axis OX′, touching the maxima or minima with the origin at O, the equation becomes $y' = a(1 - \cos px')$. At $x' = 0, \lambda, 2\lambda$, etc., the displacement velocity is 0, and the acceleration ap^2.

Now suppose (*a*) that all the waves except those included between O and A are removed and that the medium outside these limits is at rest. Then the conditions for the continued propagation of the remaining waves are fulfilled, for the velocities and accelerations within the series remain unchanged, and the terminal accelerations are supplied by the excess of pressure (proportional to a/λ) within the series over that in the medium outside, which is at rest.

(*b*) If it is required to propagate an odd number of half wave-lengths the medium on either side of the wave series must be at rest, but having pressures differing by a quantity proportional to $2a/$wave-length. When (*c*) fractional parts of a wave are to be propagated, not only must the pressures on either side of that part be different, but also the two parts of the medium separated by the wave must have a relative velocity, determined by the displacement velocities at the limits of the propagated fraction.

Case (*a*), where a single wave or a whole number of waves is under consideration, can easily be made the subject of experiment.

Let a tube of unlimited length and of any diameter (Fig. 2) be provided with a piston on which a harmonic

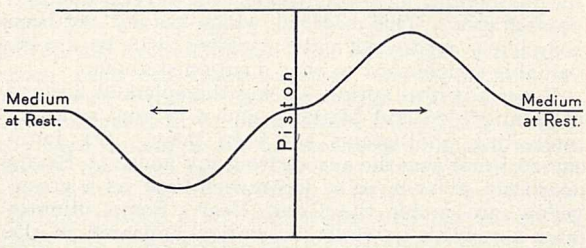

FIG. 2.

motion can be imposed. Let the air in the tube be at rest and the piston at the position of maximum displacement. If now the piston is caused to make one complete oscillation and to return to rest at its original position, the result will be that a simple harmonic wave will travel along the tube from each side of the piston, and that in one of these waves (namely, that in which the air is at first compressed) the mean pressure will exceed the still air pressure by a quantity proportional to a/λ, while in the other there will be a defect of pressure of the like amount. A barrier, therefore, placed in the tube will experience an average force during the action of the wave in a direction away from or toward the piston, according as the initiation of the wave starts with an increase or decrease in the air pressure. If the barrier is such as completely to absorb the wave motion, the magnitude of the force will be measured by a/λ, or by $2a/\lambda$ if the wave is completely reflected.

In cases (*b*) and (*c*), where an odd number of half wave-lengths or fractions of wave-length are concerned, it would be more troublesome to reproduce experimentally the required conditions. In the latter the motion is analogous to, though not identical with, the progress of a 'bore' in a river where the boundary between deep and shallow water travels as a wave with an accompanying change of stream velocity.

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Barlow's Tables.

REQUIRING recently the square roots of the numbers from 1 to 100 to ten figures, or one more place of decimals than is given in Barlow, I was led to the discovery that his last figure for numbers above 1250 is not to be depended upon for its accuracy. It is true that De Morgan, in issuing a reprint of Barlow's Tables in 1839, admitted that his method of checking Barlow's entries by differencing left "remaining a possibility of any of the last figures being a unit wrong in the columns of square and cube roots."

The purpose of this note is not to criticise a work that must ever remain a monument to the industry and zeal of an enthusiastic computer at a time when calculating machines were not in existence, but merely to place on record what must, I am afraid, be a very

[2] That noise was also heard by engineer Max Rich. Hennig in Ångermanland, Sweden, during the aurora on March 9.

incomplete list of errata, all the more important because Barlow is a standard work, and the constant companion of the practical man. By the very nature of my original inquiry, I only examined one entry in each double page of Barlow, that is, one out of a hundred. These were 1300, 1400, 1500, etc. Out of 87 entries examined after 1250, 19 are wrong by one in the last place. A little further investigation, too, soon showed that in certain parts of the table the error is continued throughout a series of consecutive entries.

The conclusion is irresistible that in no case throughout this portion of the table can the last figure of the square root be depended upon. Of course the average man feels very happy if he has the perseverance to push his results to five, six or even seven figures. But there are some who have need of all the figures that existing tables give them, who sometimes wish, indeed, that more were available. For such the warning conveyed by this note is intended. It is a matter for surprise that 5000, 7200, 7500 and 9800, in particular, are in error, since the figures of the roots are those of $\frac{1}{\sqrt{2}}$, $6\sqrt{2}$, $5\sqrt{3}$ and $7\sqrt{2}$ respectively, and $\sqrt{2}$ and $\sqrt{3}$ have long been known to a very large number of places. The list of errata is subjoined, the correct result being in each case given.

Number.	Square Root.	Number.	Square Root.
1400	37·4165739	6100	78·1024968
2000	44·7213595+	6600	81·2403840
4300	65·5743852	6900	83·0662386
4697	68·5346628	7100	84·2614977
4698	68·5419580	7200	84·8528137
4699	68·5492524	7500	86·6025404
4700	68·5565460	7800	88·3176087
4701	68·5638389	8600	92·7361850-
4702	68·5711310	8700	93·2737905+
4703	68·5784223	9100	95·3939201
4704	68·5857128	9800	98·9949494
4705	68·5930026	9896	99·4786409
4998	70·6965346	9897	99·4836670
4999	70·7036067	9898	99·4886928
5000	70·7106781	9899	99·4937184
5001	70·7177488	9900	99·4987437
5600	74·8331477	9901	99·5037688
5700	75·4983444	9902	99·5087936

+ or − after final 5 or 50 means that the correct square root is greater or less than the result exhibited. Such a convention minimises the risk of error when the decimal is curtailed.

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Can Portuguese Oysters be produced on English Oyster Beds by Artificial Fertilisation in the Sea?

DURING a visit to the Blackwater oyster beds in the summer of 1925, I had reason to open 100 Portuguese oysters (*Ostrea* (*Gryphæa*) *angulata*), and found them, as on previous occasions, practically all sexually mature. It occurred to me at the time to try an artificial fertilisation in the sea with the view of increasing the stock of oysters on the beds. As, however, the beds were private ones, it was thought inadvisable to take the risk without consulting the owners, and the opportunity of trying the experiment did not again arise. It has been recorded in NATURE (August 12, 1922, p. 213) that Portuguese oysters have spatted in the waters of the river Blackwater, Essex, on experimental shells put out for the definite purpose of catching young oysters, and also (*loc. cit.*) that artificial fertilisations of the Portuguese oyster can be easily made.

The experiment would not have suggested itself but for the fact that on English oyster beds the Portuguese oyster spawns naturally only rarely, due no doubt to the relatively low temperatures occurring normally in English waters compared with those found in south European waters where the Portuguese oyster reproduces very abundantly. Nevertheless, there is no doubt that shelled larvæ can easily be produced artificially at temperatures which occur on English beds, but it is doubtful whether these temperatures are ordinarily high enough to ensure fixation of the shelled larvæ when the latter are ready to settle. The success of the experiment will depend partly on the occurrence of suitable conditions for fixation of the larvæ in the year of the experiment—and high temperatures and clean shell for attachment are probably the critical factors concerned in the sea,—partly upon the production of sufficient larvæ to leave a balance for settling after the enemies of the larvæ have had their fling, and partly upon the larvæ being reared in a body of water which will not carry them away from suitable places of attachment.

As a provisional experiment it is suggested that a thousand Portuguese oysters be cut into rather thick shreds and shaken in the sea over the oyster beds at half tide at the beginning of the neap tides. From 60 to 90 per cent. of the oysters would be female (see *J.M.B.A.*, vol. 14, p. 230, 1926), and from each would be released in this way an *estimated* average of at least three million eggs for medium-sized oysters. A plentiful supply of sperm would be available from the smaller number of males. If a thousand oysters were disintegrated in the sea on five successive days, there would be a greater chance of sufficient larvæ being produced to give a spatfall, other conditions being favourable. The time most likely to be favourable for the experiment may be fixed in the neighbourhood of the end of June in a normal year.

The experiment itself is so simple that it could be carried out by the normal summer staff at work on an oyster bed, but practical difficulties, such as the attraction of shoals of fishes and other marine animals to the locality of the experiment, might have to be obviated.

The creeks bordering on the Thames Estuary, north and south, and creeks and estuaries on the southern coast, such as occur at Salcombe and the Fal (River and Upper Estuary), and no doubt elsewhere on this coast where this oyster is unknown, would be suitable places to attempt the experiment.

A warning is, however, needed: the Portuguese oyster may procreate on some southern beds so well as to oust the native European, and it is not so valuable. At Arcachon (France) the Portuguese oyster was accidentally introduced on the fine beds of European oysters there and was regarded for decades as a pest, though at the present moment it is the salvation of many oyster-cultivators in that region.

I should be willing to give further suggestions on the method of carrying out the experiment to any oyster-producer who may desire to try the experiment.

J. H. ORTON.

The Laboratory,
The Hoe, Plymouth,
June 7.

Capture of Electrons by α-Particles in Hydrogen.

THE phenomenon discovered by Henderson (*Proc. Roy. Soc.*, 102, 496, 1922) of the capture of electrons by α-particles passing through matter has attracted much interest and has been subjected to theoretical investigation from various sides. By comparing the statistical equilibrium between capture and loss of electrons by α-particles with an equilibrium of thermal dissociation, Fowler (*Phil. Mag.* 47, 416, 1924) was able to account for many of the characteristic features of the phenomenon revealed by Rutherford's careful examination (*Phil. Mag.* 47, 277, 1924); in particular, for the fact that the ratio between the probabilities of capture and loss for α-particles of given velocity was nearly the same in all substances investigated and varied approximately as the fifth power of the velocity.

As pointed out by Bohr (*Zs. für Phys.*, 34, 142, 1925), this theoretical argument involves difficulties when applied to substances of small atomic number in which the interatomic velocities of the electrons are all small compared with that of the α-particles. Recently Mr. Thomas, working in this Institute, has examined this point more closely; his calculations suggest that the ratio between the probabilities of capture and loss in such light substances should vary as a much higher power of the velocity than that holding for the heavier substances examined by Rutherford, and that for high-speed α-particles this ratio should be much smaller for the light substances than that observed for the heavier substances.

At the suggestion of Prof. Bohr, the writer undertook an experimental investigation in order to test these results. The apparatus was of the same type as that used by Rutherford to examine the capture and loss of electrons by α-particles in gases. In this method the beam of α-rays passing into a vacuum through a mica window is deflected by a magnetic field. The distribution of the scintillations then shows two distinct peaks corresponding to singly- and doubly-charged α-particles. If now gas is let into the deflexion chamber, this distribution is changed on account of the loss and capture of electrons by the α-particles when passing through the gas.

On increasing the pressure of the gas the peak corresponding to the singly-charged particles gradually disappears and there is established between the two peaks a continuous distribution of scintillations due to particles which have either lost or captured an electron during the passage through the gas. When the pressure was so adjusted that the number of singly-charged particles had decreased in a given ratio, it was found that the continuous distribution in air was essentially different from that in hydrogen, the density of scintillations for any given deflexion in air being more than double that in hydrogen. This shows that the probability of capture is considerably larger in air than in hydrogen in circumstances in which the probability of loss is the same.

This conclusion was confirmed by a closer examination of the continuous distribution of scintillations in air and hydrogen at different pressures. While in air a considerable part of this distribution had to be ascribed to capture, it was found that the distribution in hydrogen could be accounted for within experimental error on the assumption that it resulted solely from the loss of electrons by the α-particles. In close agreement with Rutherford's measurements, the mean free paths for capture and loss in air (reduced to normal pressure and temperature) were found to be 2·1 mm. and $1{\cdot}0 \times 10^{-2}$ mm. respectively. The velocity of the α-particles was $1{\cdot}75 \times 10^{9}$ cm. per sec. At this velocity the mean free path for loss in hydrogen was found to be $7{\cdot}8 \times 10^{-2}$ mm., in satisfactory agreement with ionisation theory. As a lower limit for the mean free path for capture in hydrogen the experiments gave 200 mm. Although the probability of capture in hydrogen predicted by theory corresponds to a still longer mean free path, the experiments seem to afford suggestive support for the theoretical considerations.

J. C. JACOBSEN.
Universitetets Institut for teoretisk Fysik,
Copenhagen, May 17.

Birth of Peripatus in England.

A RECORD of the birth of living Peripatus in England is perhaps worthy of note, especially since the case is probably unique. At least it serves to show how a creature which is particularly susceptible to its environment may be carried very long distances overseas and kept in captivity. The present case is all the more striking because only a single animal was brought from Australia; it is not, therefore, one survivor out of many.

During 1925 one of us (Miss Fordham) visited Western Australia for the purpose of collecting certain zoological material for research. Amongst other items in the programme it was intended to collect a number of Peripatus late in the season (the animals disappear at the beginning of the dry season in Western Australia—say, October or November). Unfortunately the wet season was remarkably dry last year and extremely few Peripatus were to be found. Only one living Peripatus commenced the voyage from Australia to Europe, and this was captured on September 20. At this time of the year fertilised females may be found.

Contrary to our expectations, the specimen survived the ocean voyage and continued living at Liverpool, where it arrived in January. The animal turned out to be a female, and during the month of April, six months after its capture and at least five months after contact with other Peripatus and four months after leaving Australia, gave birth to young of which two are actually living now with the mother (May 18).

The specimen is kept on its native soil in a large glass museum jar with glass stopper. It has pieces of bark for shelter, and it is given bits of woodlice, which apparently it does not eat. A few termites were present in the soil and there are numbers of Protura.

It is thus quite clear that the Western Australian Peripatus receives spermatozoa during the wet season (winter), and that the period of gestation is upwards of six months, when normally the animals are hidden away within rotting wood or below the soil during the dry season.

WILLIAM J. DAKIN.
M. G. C. FORDHAM.
Zoology Department, University,
Liverpool, May 18.

The Sensitivity of Selenium Cells.

THE selenium cell, as a light-sensitive element, has always been held to have the inherent drawbacks of inertia and lag, and therefore to respond too sluggishly to changes in light intensity, and to return to its normal low conductivity much too slowly when the illumination to which it has been subjected is cut off. Several forms of photometer are now in use in which selenium or photo-electric cells are employed, and were selenium more certain and more prompt in action it would offer certain advantages over the photo-electric cell.

A. Korn did much to increase the utility of selenium by simultaneously subjecting two cells of different sensitivity to the source of light, using them on opposite arms of a Wheatstone bridge arrangement. He found that for an increase of illumination δI, the current y obtained for a given voltage passed through the cell was $\alpha\delta I e^{-\beta t^{-1}/m}$, where β is an inertia constant, and m the 'exponential inertia'; m should be as much below 1 in value as possible and depends on the mode of preparation of the cell.

By selecting two cells such that

$$\frac{d(y_1 - y_2)}{dt} = 0$$

where y_1 and y_2 are respectively the small increments in conductivity for an illumination of time dt—which means that the product $\alpha\beta$ of each cell is practically the same—wonderfully sharpened action can be obtained which should be of the greatest value if it were applied to photometric work.

I have recently tried passing a single-phase alternating current through a Kipp and Zonen selenium cell, and, as I anticipated, the lag is automatically eliminated at each alternation of current, with the result that the cell responds with great celerity to changes in illumination and returns to zero—*i.e.*, its 'dark conductivity'—with great swiftness. The cell returns to the same zero time after time after quickly repeated illumination, very unlike its ordinary behaviour when the conductivity in the dark creeps up each time the illumination is cut off through cumulative ionisation. The periodicity of the current must of course be greater than that of the changes in light intensity.

It is quite easy to rectify the current that is passed through the cell so that an ordinary galvanometer can be used. The experiments indicate that by using alternating current an entirely new field of possibility is opened up for the selenium cell. Some years ago, when reproducing records of the voice on kinematograph film with selenium, I found that so many as 8000 vibrations per second could be dealt with distinctly, which indicates that our conception of the rate with which selenium can respond to changes in light intensity has been greatly handicapped. By the employment of alternating current, and so accelerating its rate of change, we may find that the selenium cell is of an extremely high order of sensitivity.

T. THORNE BAKER.

Research Department,
Imperial Dry Plate Co., Ltd.,
Cricklewood.

Magnetic Properties of Single Crystals of Iron.

IN a letter to NATURE, May 29, p. 753, Messrs. Honda, Kaya and Masuyama give a short account of some magnetic properties of single crystals of iron. In this laboratory I have investigated various magnetic phenomena in single crystals. In the *Proc. Roy. Soc.*, **107**, 496, 1925, an account of the variation of the susceptibility with the direction in the crystal has been given, and it may be mentioned that later a theoretical explanation of the effect has been given by Mahajani (*Camb. Phil. Soc.*, **23**, 136, 1926). In the *Proc. Roy. Soc.*, **109**, 570, 1925, experiments on the effect of crystal structure on magnetostriction have been described. This work is similar to that now described by Honda, Kaya and Masuyama, and their results are in very good agreement with those of the present writer. The rods used by them were much larger than those of our experiments, and their accuracy may be higher, particularly in the measurement of the magnetic intensity, but our results are more definite in that the rods used by us were orientated, within two or three degrees, parallel to a (100), (110), or (111) crystal axis. For example, we showed definitely that for the (111) direction there was only a contraction, a fact surmised by Honda, Kaya and Masuyama.

We hope to publish shortly some work already completed, on the change of resistance of iron-crystal rods in a longitudinal magnetic field. The results of this work have an important bearing on the phenomenon of magneto-striction, as they indicate that the increase in length for the (100) axis is quite different in origin from the decrease in the (111) direction.

W. L. WEBSTER.

Trinity College,
Cambridge.

The Taxation of Research.

WE have received notification that the Inland Revenue authorities are about to challenge the right of the Chemical Society as a charitable institution to recover the income tax deducted at the source from the interest on its invested capital. For eighty years the Society has published freely new knowledge in chemistry, and has carried a financial burden which could not have been borne had not Governments in the past provided rent-free accommodation and relieved the Society from taxation.

The great increase which has taken place, and is still taking place, in the amount of research work in chemistry emanating from our universities and university institutions renders it difficult, even under present conditions, for the Society to carry out the duties assigned to it by its charter, in view of the fact that within the past seven years its expenditure has increased by some 7000*l.* a year.

The margin between solvency and bankruptcy is small and may disappear if the Society is subjected to the taxation suggested.

H. B. BAKER, President.
JOCELYN THORPE, Treasurer.

Royal College of Science,
South Kensington,
London, S.W.7,
June 8.

The Coal Fire.

IT is the opinion of every one with whom I have spoken on the matter, that a coal fire possesses some subtle qualities which a gas or electric fire lacks. In her letter to NATURE, March 6, p. 343, Dr. Stopes instances the great curative powers of a glowing coal fire, and the renewed vitality she experienced after exposure to it during convalescence. My own experience with chickens has a direct bearing on the subject.

A number of chickens hatched during April, and housed in dry quarters well heated by oil lamps, round which they could cluster, appeared to be in a half-dying condition and looked exceedingly unhappy. On being placed before a bright coal fire, recovery was rapid, and they became so lively in an hour or so that they were often difficult to recapture.

Contrary to the experience of Prof. Hill with animals (NATURE, April 3, p. 487), close up electric lamps apparently do not exert a similar beneficial influence on chickens. A visit to any establishment in this city where these birds depend on electric lamps for warmth and in part for light will bear this out.

J. D. FULTON.

The University,
Glasgow.

The Relationship of Physics to Aeronautical Research.[1]

By H. E. WIMPERIS, Director of Scientific Research, Air Ministry.

AVIATION is now entering upon a new and intensely interesting phase—one which will call for every scientific resource at our command. The materials of construction are changing: wood is giving place to metal. The engine proves to have most unexpected possibilities ahead of it through the increase of intake pressure; whilst the very lifting structure itself may possibly change, for some purposes at least, from linear motion to rotary. Now in aeronautical work there can be no doubt that scientific studies have been considerably stimulated by problems which have arisen directly from aeronautical engineering. The thought of those physicists who have in recent years done such brilliant work on the mathematical theory of fluid motion was stimulated in no small degree by the results obtained either in the wind channels of our aerodynamic laboratories or in free flight on the full scale.

Aeronautics by its youth escaped the medievalism of the old-time practical engineer; it was launched well in the modern scientific path by the formation some seventeen years ago of the Advisory Committee for Aeronautics, which after two phases of re-adjustment is still with us as the Aeronautical Research Committee. When I first knew it, it was presided over by that kindly and gracious being the late Lord Rayleigh; in those days the field of work was small enough for all matters to be dealt with by the single Committee. Now the scale is so much greater that many sub-committees and panels have to share its responsibilities. The latest phase is the organisation under the Air Ministry of a separate scientific research department to ensure that scientific investigations shall receive their due, and be vigilantly guarded against any competition for money, staff or facilities by the seemingly urgent claims coming from other quarters.

The scientific research staff of the Air Ministry closely resembles the corresponding staff at the National Physical Laboratory in its method of recruiting, its scales of pay, and its conditions of work. This staff is about eighty in number, and of this general 'pool' some four-fifths work in the laboratories at Farnborough and the rest at such stations as Martlesham, where the performance of new airplanes is studied, Felixstowe, where corresponding work is done for seaplanes, and the Air Ministry Laboratory in the Imperial College of Science, where special problems, mainly physical and chemical, are studied.

The examination of the flow around aerofoils and of the fluid forces brought into play has naturally formed one of the chief items of physical research in the wind channels of the aerodynamic laboratories throughout the world. The simpler measurements usually made on aerofoils are the lift and drag coefficients and the motion of the centre of pressure. These, the ordinary methods of classical hydrodynamics, are not capable of predicting from theoretical considerations alone, since the mathematics deal only with the motion of a fluid in which viscosity plays no part.

In the case of a simple mathematical shape, such as a cylinder placed at right angles to the flow, the positions of the streamlines, as determined for an inviscid fluid, differ appreciably from those which would arise in a viscous medium such as air. In the former fluid, moreover, no resultant force acts upon the cylinder, whereas measurements made in an air channel show that considerable forces are brought into play. Indeed, without such forces flying would not be possible.

If now to the streaming of the inviscid fluid past the cylinder there be arbitrarily added a 'circulation' of the fluid around the cylinder, there at once comes into existence a resultant force at right angles to the stream. This has an immediate analogy with the lift force experienced by an aerofoil, and with the propulsive force produced by the action of the wind on the rotating cylinder of the Flettner rotor ship.

It is seen, therefore, that by the addition of the idea of a 'circulation' around the body, a possible explanation is given for the existence of lift forces, and in recent years, by the employment of this convention, successful efforts have been made actually to predict the lift of certain forms of wing section. Naturally, a theory such as this has had to face much criticism, but some years of experience with it have enabled comparisons to be made with data obtained in the laboratory, and such comparisons have shown that it affords a close approximation to what actually happens. The theory itself was built upon the work of many investigators, and among that many I would like specially to refer to the work of Lanchester, Joukowsky and Prandtl. As a result of the work of these and other pioneers, therefore, we find it useful in aerofoil design to study the effect of imposing upon the motion of an inviscid fluid a 'circulation,' of unknown origin, around the aerofoil of sufficient amount to carry what is known as the 'stagnation point' to the trailing edge of the wing. 'Circulation' must have a physical existence, since the velocity is greater above the wing than it is below, though this real circulation is a circulation with no slip, whereas the mathematical circulation has slip. Hence the rather amusing situation arises of adding to the mathematical study of streamlines a conventional motion which could not really arise in an inviscid fluid! So long, however, as the limitations to the theory are borne in mind no harm can be done, whilst the results of such mathematical work are of the greatest utility as a first approximation as to what is happening.

One great merit of Prandtl's work is that his theory enables the lift of a wing of limited span to be deduced from the known performance of a wing of the same cross-section but of unlimited span; in other words, that the results of three-dimensional flow can be deduced from the known two-dimensional. The two-dimensional flow can be studied in two ways: experimentally, by means of a model wing-section stretching

[1] From a lecture delivered before the Institute of Physics, at the Royal College of Science, South Kensington, on June 7.

right across the wind channel; and mathematically, by the method initiated by Joukowsky, who found a way of predicting these forces by the mathematical step of converting a circle into the desired aerofoil shape by means of a suitable conformal transformation. For a limited number of aerofoil shapes it is therefore possible to deduce theoretically the performance for two-dimensional flow, whilst by the Prandtl theory it is possible to convert these results from two-dimensional to three-dimensional conditions. This work has been put to use by the Air Ministry scientific research staff, and some six aerofoil sections have been designed on this basis with the object of obtaining in the first instance a good thick wing, and in the second, a good racing wing. This theoretical work has been fully confirmed by subsequent experimental results on such aerofoils, whilst on certain of these wings full-scale work in free flight has been put in hand.

Many attempts have been made to build a type of aircraft known as a helicopter, which is fitted with rotating wings driven by one or more engines. Little success has, however, been met with in spite of considerable expenditure. But in the last year or two, real success has been achieved by Señor de la Cierva with his 'autogiro'; this machine is not strictly a helicopter, however, since the windmill is not power driven. But I think there is little doubt that it is through the autogiro, or, in English, the gyroplane, that we have the best means of studying the performance of all rotating wing machines. One of the difficulties with a rotating wing is that the part which is moving in the direction of flight has a higher airspeed than the retiring part, and this leads to greater lift on one side of the machine than the other. Mechanisms to balance these forces mechanically are most complicated to build and still more complicated to control. Cierva cut the knot of this difficulty by hinging his blades close up to the vertical shaft. This meant that the advancing blade merely lifted a little above its average position while the retiring blade fell a little below that level; thus the wings oscillated in a vertical plane during each rotation and presented some analogy to the flapping flight of birds. Centrifugal force prevents the wings from folding up about their hinges.

Owing to wall interference in the wind-channel tests that have previously been made on such windmills, or for some other reason, their capacity for slow descent under load was underestimated. This underestimate was first realised as a result of the tests carried out at Farnborough last summer with a Cierva gyroplane in which the vertical velocity was some 15 feet per second only, about half the speed of fall of a parachute carrying the same load and having a diameter equal to that of the windmill.

Full-scale tests on aircraft components usually require a greater space than can be given in a laboratory, and in consequence the physical investigations arising therefrom need to be carried out through the medium of models. It is no difficult matter to make an accurate scale model of any form of aircraft, and to provide a wind channel of such dimensions as will make the test reasonably representative. That is relatively simple, but a difficulty soon arises through what is known as 'scale effect.' The study of scale effect is intricate and much work has yet to be done. But it has been proved that model tests in the wind channel would represent what happens on the full scale if a certain physical ratio were preserved; this ratio is the product of length by velocity and divided by the kinematic coefficient of viscosity. This ratio is a non-dimensional one and it is coming to be known as the 'Reynolds' Number.' Model tests in wind channels as we at present know them give a value of the Reynolds' Number of but one-tenth of that appropriate to full scale. This is unfortunate, since it means that within the range of velocities available in the ordinary wind channel only a very small portion of the correction for the change of the characteristic under measurement with the Reynolds' Number can be studied: hence to deduce full-scale results from wind-channel experiments may mean extrapolation in the ratio of something like 10 : 1.

A limit to the air velocity in the channel is imposed by the considerable increase of horse-power for such operation; there is also an obvious limit to the dimensions of channels, and it follows that the only opportunity of obtaining a Reynolds' Number comparable with that applicable to full-scale conditions is by means of an increase in density of the air, or else of its replacement by some fluid having a higher specific gravity. Much interest has been taken in the pressure channel recently built at Washington, which is capable of being operated at an internal pressure of 20 atmospheres, so realising a Reynolds' Number equal to that of full-scale work, when allowance is made for the fact that a pressure tunnel is best run at about half the airspeed of an atmospheric tunnel, so that the amount of the forces acting upon the model may be kept within bounds. It is too early to say whether this channel has entirely fulfilled its constructors' hopes, but from such tests as have been reported it seems that the method of testing rendered possible by its use will prove to be of great utility.

Another form of model-testing is that carried out in the Yarrow tank at the National Physical Laboratory. This tank was originally built for the testing of ship models, but in recent years it has also been used for work on models of seaplanes. Investigations of this sort become specially necessary when the seaworthy characteristics of seaplanes need study. These craft have to be designed in relationship not only to their performance as flying machines, but also as to their habits when travelling on the surface of the water before they become entirely air-borne. For the aerodynamic characteristics the wind channel suffices, but for the study of the period prior to flight the tank is necessary. When considering the size and speed of a tank for this purpose one is faced with the consideration that the model must run at what naval architects term the 'corresponding speed' to that of the full-scale machine; speeds are said to be corresponding when the ratio of the velocity to the square root of the length of the model is equal to the velocity of the ship divided by the square root of its length. This ratio, it will be seen, is quite different from the Reynolds' Number above mentioned and it leads to totally different design requirements.

It might be thought from what has been said that the main purpose of the tank is to make accurate

quantitative measurements. This, however, is not the case, since probably the chief use of such tests is a qualitative examination of the wave motion created by the hull, particularly in relationship to the position in which the engines and propellers are proposed to be placed.

The physical problems presented by the aero engine are for the most part not peculiar to aeronautics, but are part of the general study of the internal combustion engine. The use of this type of prime mover for aircraft does, however, present special problems owing to the urgent demand for 'reliability' on one hand and lightness on the other. Moreover, there is always the tenuity of the air at altitude to be reckoned with.

As a matter of fact, the aero engine has improved enormously in recent years—not so much perhaps as the result of scientific study as by sheer hard efficient work on the part of the engineering staffs of the engine-builders. As witness to this remarkable success, I would specially mention the performance of the Napier water-cooled engine on the flight to South America, the excellent behaviour of the air-cooled Jaguar engine on Mr. Cobham's flight to South Africa and back, and by no means least, the remarkable achievement of an air-cooled Jupiter engine in flying 25,000 miles without any overhaul.

Need for lightness of construction brings in quite other considerations. For high output, high efficiency is necessary, and this calls for increased compression pressures and a consequent liability to the troubles induced by detonation. The study of detonation and the means of avoiding it are fitting studies for physicists. Equally fitting are the investigations necessary to ascertain whether the output of the engine in relation to its weight can be increased by what is known as supercharging, and if so, how far in that direction it is expedient to go. All the while it has to be borne in mind that the engine must not only be capable of operating in a normal atmosphere such as that in which most internal-combustion engines work, but also in conditions in which the pressure may be only one-third of that at sea level and in which the atmospheric temperature may be no less than 50° Centigrade below zero.

This sensitivity of the engine to atmospheric pressure has led naturally to attempts to create an artificial atmosphere of increased density in the engine intake. A scheme of this sort was indeed mooted by Sir Dugald Clerk more than twenty years ago, and was called by him 'super-compression.' It is now known as 'supercharging' when the effort is to maintain an intake pressure at all altitudes equal to that at ground level, or 'boosting' when the effort is to increase the intake pressure by a constant fraction at all heights. These developments present an infinitude of problems most of which are now beginning to be seriously tackled—their close relationship to detonation is a complicating phenomenon. There are such great possibilities in this direction that a material decrease in weight per horse-power at altitude may confidently be looked for in the not distant future.

We live in a wonderful age. Just as in the thirteenth century the splendour of life must have seemed most to surround the work of the architect, or in the fifteenth century that of the painter, so it appears to me in the present age does it crown the labour and achievement of the physicist.

Iron in Antiquity.[1]

By Dr. J. NEWTON FRIEND.

IT would be difficult to find a subject of greater interest than the study of iron in antiquity. Man's first acquaintance with the metal undoubtedly dates back, in certain districts, to the Stone Age. At that time meteoric iron would be much more common than now, and primitive man would soon observe that the metal was more malleable than ordinary stone, and could be cold worked, by repeated hammering, into simple shapes for ornament or for personal use. Probably this was the origin of the metal beads, the oxidised remains of which have been found in pre-dynastic tombs in Egypt, dating back to about 4000 B.C. But it was not until man had progressed slowly upwards through ages of unremitting toil that he learned of the connexion between metallic iron and certain of the stones around him, and succeeded in reducing the metal from its ores.

Iron appears to have been manufactured in the Near East at a fairly early date. The Hittites were beginning to use iron weapons for military purposes about 1300 B.C., and Rameses II., King of Egypt, is known to have applied to the Hittite king for a supply of the metal. Whether he obtained it or not is unknown, but a mutilated letter has been found, possibly addressed to Rameses II., in which the Hittite king states that he is sending an iron dagger, and promises to forward a supply of iron.

The Philistines are believed to have introduced the general use of iron into Palestine, although the metal was known many years prior to that. It is clear from references in the Old Testament (see 1 Sam. xiii. 19-22) that the Philistines retained the monopoly of working iron, with the result that at first there was no smith in Israel, and the only Hebrew persons possessing iron swords were Saul and Jonathan. In other words, the Philistines had already entered upon their iron age when the Israelites were still in their bronze age. By the time that David ascended the throne, however, the use of iron was becoming more general. Nevertheless, it is interesting to note that no iron tool was allowed to be used in the construction of Solomon's temple at Jerusalem. The employment of iron would have been offensive to God, who had in previous years spoken against the use of metal, and had ordered (Ex. xx. 25) any altars erected to Him to be made of unhewn stone. In view of this the following tradition is interesting. Whilst the present writer was in Jerusalem last year, his dragoman informed him of a curious belief prevalent amongst the Jews to the effect that if the crevices in the ancient wall at the famous Wailing Place are completely filled with

[1] Substance of a lecture delivered at the Royal Institution on June 3.

iron nails, Jerusalem will once again be restored to the Jews.

The Greeks and the Cretans would appear to have been the first European peoples to use iron. Homer, who lived about 880 B.C., was very familiar with the metal. The Homeric age, however, as depicted in the "Iliad" and "Odyssey," is several centuries earlier; the Phaeaceans referred to in the latter work are believed to have been the Minoans of Crete, famous for their sea power—the Britons of the Mediterranean. The Homeric period was transitional between the Bronze and the Iron Ages. Iron was listed amongst the treasures of the wealthy, but was in general use only in the peaceful pursuits of agriculture. Probably the metal lacked homogeneity and could not be relied upon in such thin strips as would be necessary for swords, owing to its tendency to bend or snap. The Vikings 2000 years later were familiar with this difficulty, as is evident from the Icelandic sagas. One frequently reads that the swords would not "bite," and occasionally we are told that the sword bent so seriously that the warrior often had to straighten it under his foot! This surely was giving his opponent too much of an advantage.

The Romans about 2000 years ago were skilled metallurgists. Virgil in his "Aeneid," written about 40 B.C., describes a smithy in full work, and refers to the steel hissing as it is quenched in water, showing that the art of tempering was practised. Pliny some years later showed a wide knowledge of the ores of iron and of the working of the metal. He appears also to record, in what is otherwise an obscure passage, the accidental production of cast iron. For this product, however, there was at the time no practical use, as the Roman furnaces were incapable of dealing with it. The tendency of iron to rust was regarded by Pliny as Nature's punishment on the metal which, owing to its use in warfare, "brings the greatest dangers upon perishable mortality." Occasionally, as now, the rusting of iron was turned to good account. A very clever metallurgical conception was attributed by Pliny to Aristonidas, who, wishing to express in a statue at Rhodes the "fury of Athamus subsiding into repentance after he had thrown his son Learchus from the rock, blended copper and iron, in order that the blush of shame might be more exactly expressed by the rust of the iron making its appearance through the shining substance of the copper."

Iron was regarded as symbolical of Mars, the god of war, and the alchemists represented it by the symbol ♂, which is usually supposed to be derived from the shield and spear of that god. The popular idea that iron is a useful remedy and invigorates the constitution owes its origin largely to this connexion with the virile god, who was supposed to transmit his strength to his dedicatee. Ancient legend has it that King Iphiclus of Phylacea about 1380 B.C. was very anxious to beget children, and was successfully treated by the shepherd Melampus, who dosed him with iron rust in wine—the earliest *vinum ferri* of the pharmacist on record!

Iron was known to the Britons long before the advent of Julius Cæsar. The Romans greatly extended its use in Britain, and numerous objects of iron are continually being unearthed on the sites of various ancient Roman stations. One of the most interesting of these is an iron ring, probably the remains of a ferrule, found last year at Uriconium. It appears to have been made by bending a strip of iron into a circle and soldering the ends together with some copper alloy. This is the first recorded example of such work.

Cast iron was known in Sussex by 1350 A.D. and soon became quite a familiar commodity. It was at first used exclusively for casting purposes. In 1516 a cast-iron gun weighing nearly 5 tons was made, and in 1588 the Spaniards armed their Armada with cast-iron guns as well as with the more familiar bronze weapons.

When, many years later, it was found that cast iron was the most suitable starting-point for the manufacture of iron and steel, the demand for it increased rapidly. In 1800 the United Kingdom produced about ¼ million tons of pig iron, a quantity that in 1913 had increased to a maximum of more than 10 million tons. In 1925 it had fallen to little more than 6 million tons—the aftermath of the War.

Structural Features of the Earth.[1]

ARGAND'S distinguished services in unravelling the structure and history of the Pennine Alps, and of the Alps in general, ensure a respectful hearing for his present wider venture. Wide it undoubtedly is, for its seemingly ample title, "La tectonique de l'Asie," in no way contains it. Asia furnishes the text, the subject is Suess's own, the face of the earth.

It is interesting to find de Margerie, who did so much to secure recognition for Suess's masterpiece, acting as godfather to the new arrival. Argand explains that the basis of his memoir is a manuscript map, of which he prepared a first draft in 1912. The following year, de Margerie introduced this map to the notice of the Canadian meeting of the International Geological Congress, and since then has done all in his power to secure its publication. The Belgian meeting, 1922, promised us the map. The memoir, at any rate, is in our hands. In acknowledging his debt to de Margerie, Argand admits that he could not have faced the task without the help of this 'prince de la bibliographie.' Where so much is given, it may seem churlish to grumble, but many a student will miss any attempt at a considered bibliography in connexion with Argand's memoir. Perhaps the author felt that, when one writes of the world, the catalogues of libraries are themselves the bibliography.

Argand considers that modern knowledge requires a modification and extension of Suess's achievement, not a reconstruction. He starts by adopting Bertrand's *time-definition* of mountain building, employing it in a somewhat elastic sense: the Caledonian Cycle of mountain-building belongs to Lower Palæozoic times; the Hercynian to Upper Palæozoic times; and the Alpine to Secondary, Tertiary, Quaternary, and Recent times.

The deformations produced by horizontal pressure acting during any particular cycle are of several

[1] "La tectonique de l'Asie," *Compt. rendus*, Congrès Géol. Internat., Session xiii, 1922; Belgique, 1924. By E. Argand. Pp. 171-372 (Contents, pp. 365-372), Figs. 1-27.

different kinds. Argand employs the following classification—the particular examples quoted belong to the Alpine Cycle :

(1) Deformation of thick comparatively unconsolidated marine sediments. This gives rise to *coastal chains*, such as girdle the Pacific Ocean, and to *geosynclinal chains* (generally double), represented by the great series that reaches from the Himalayas, by way of Persia, Anatolia, and Greece, through the Carpathians and Alps, and so into Spain. The Indo-African-Eurasian geosynclinal series unites with the Asiatic coastal series in the Malay Archipelago.

(2) Continental deformations that affect the foundations and cover of continental areas. The foundations of a continent consist of sediments compacted by some early cycle of mountain building (along with batholithic intrusions). The cover is the veneer of relatively unconsolidated sediments locally deposited on the foundations in epicontinental seas, fresh-water lakes, etc. *Foundation folds*, or *plis de fond*, may reach from any depth up to the surface. Where cover exists, it may be bent along with the foundation, and so give rise to one type of *cover fold*. Another type is exemplified in the Jura mountains, where cover has parted company with foundation.

Argand attributes very great importance to foundation folds. Their existence can be detected in a variety of ways. In Scandinavia it is the *present* height of the mountain chain that betrays its Alpine date. The Alpine fold responsible for the elevation (or re-elevation) is of so great a radius of curvature that it escapes purely geological search—all the readable folding and thrusting in this district are admittedly Caledonian. In the Pyrenees, Caucasus and Thian-shan, matters are easier for the geologist. These chains consist of groups of accentuated foundation folds that have broken into semi-rigid nappes, and have involved very considerable thicknesses of post-foundation cover. Many foundation folds, and these the more important, are a direct expression of the same push as makes the geosynclinal folds. Others, like the Mt. Blanc massif, have been produced indirectly through interaction with geosynclinal folds.

In his more definitely theoretical pages, Argand adopts Wegener's hypothesis of continental rafts of sial drifting upon sima. Geosynclines are intra-continental regions characterised by thick marine sedimentation. Their site is generally determined by a tendency for two parts of a continental complex to drift asunder. The connecting sial stretches, and as it stretches, its upper surface sags and thus provides a trough for the sea and its sediments, while its lower surface rises, followed by underlying sima. So long as the stretched connecting sial holds together, the subsidence is geosynclinal. Where the sial parts, the subsidence becomes oceanic. Eurasia and Indo-Africa have passed through long periods when they tended to drift apart. Such periods have seen the growth of the geosynclinal sea known to geologists as the Tethys, of which the Mediterranean is the latest recrudescence. During other periods, the two continental masses have tended to drift together, and have squeezed up geosynclinal mountains, that include the Himalayas of to-day as a supreme example.

One might continue this summary indefinitely, and discuss the making of the Mediterranean or the bow and stern phenomena of drifting continental rafts as exhibited along their oceanic margins. Space forbids. Let us merely recall the advice given to young Darwin preparing for his voyage on the *Beagle*. Lyell's "Principles" had just appeared. "Get the book," said orthodox old Henslow, "study it, but don't believe it." Argand has succeeded in correlating an enormous number of geological phenomena, and has thus given them a realisable unity. It may be wise, for the present, to consider his co-ordinating principles with a perfectly open mind ; but this should not render us any the less grateful for the accomplishment of a singularly arduous and helpful piece of research.

E. B. BAILEY.

Obituary.

SIR STEWART STOCKMAN.

IN the debate on foot-and-mouth disease in the House of Lords on Thursday, June 3, Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture, said that Sir Stewart Stockman, Chief Veterinary Officer to the Ministry of Agriculture, had died on Wednesday in Scotland, and Sir William Leishman, chairman of the Foot-and-Mouth Disease Investigation Committee, had died in London. In both cases the Ministry had lost very able research workers and administrators, and the loss, so far as his department was concerned, was a very serious one.

Stockman's name will be readily connected with the drastic action taken in Great Britain during recent years, at enormous expenditure, in dealing with the menace of foot-and-mouth disease by the 'stamping out' process—a method of disease control obviously impracticable to the epidemiologist, but in certain circumstances the proper means of combat in the face of epizootic diseases. Although in its application crude, *primâ facie*, consisting in the wholesale slaughter of known infected and all possibly contaminated animals, the policy of 'stamping-out' as understood by epizoologists is the rationally correct mode of attack when no other system can be readily applied or is likely to be efficacious, and the cost of the process is estimated to fall most decidedly below the losses to the community that will most certainly occur without resort to the method. It is by the adoption of the 'stamping-out' system that the cattle population of England was effectively cleared of formidable scourges in the shape of cattle-plague (rinderpest) and contagious pleuro-pneumonia during the latter half of the last century, and the same method was applied to foot-and-mouth disease, with, when one compares the incidence of this disease in neighbouring continental countries, most salutary influence upon the live-stock industry of the country.

During this period the disease has reappeared from time to time, usually for some mysterious reason, among our herds, but has been dealt with consistently in the same manner. Within the last few years, how-

ever, the disease has made its appearance with disturbing frequency and spread often to an alarming extent before it could be coped with by the "stamping-out" process. The heavy responsibility of deciding upon adherence to the standard policy fell during this time upon Sir Stewart Stockman, in his technical capacity as Chief Veterinary Officer to the Ministry of Agriculture, and the amount of direct observation and estimation of the technical situation that devolved upon him must have told very heavily upon his physical strength, for he was never a robust man. It is in connexion with his clear-sightedness and determination in the face of problems in disease control of almost unprecedented economic gravity that scientific workers in this pursuit will in future years appraise Stockman as a man of exceptional merit, claiming a status in epizoology comparable to that of the greatest workers, such as Gorgas, in the field of epidemiology.

Born in 1869, the fourth son of the late Mr. W. J. Stockman, merchant, of Edinburgh and Leith, Sir Stewart Stockman was educated at the Edinburgh High School and received his professional training at the Royal (Dick) Veterinary College, Edinburgh, whence he qualified as member of the Royal College of Veterinary Surgeons in 1890. He then studied at the École Nationale Vétérinaire, Alfort, Paris, and afterwards occupied the posts successively of demonstrator of pathology and professor of pathology at the Royal (Dick) Veterinary College, Edinburgh. He resigned his teaching appointment in 1900 to serve in the South African War (where he contracted dysentery, which undermined his health in later years), and after the termination of the war accepted a post in the Indian Civil Veterinary Department, which had then just been thrown open to recruitment by civilian veterinary surgeons. His stay in India was brief, for he was appointed Principal Veterinary Officer to the Transvaal in 1902; but while in India he already showed promise of his capacities for dealing with epizootic disease; his work on rinderpest in that country was of high value. In South Africa he was confronted with most acute problems in epizoology, for the cattle population of the country had become exposed to the ravages of rinderpest since 1896, and new epizootics, in the form of East-coast fever and "red-water," had appeared, threatening the virtual ruin of the live-stock industry of the country. The dispositions taken by Stockman then to bring under control and eradicate these diseases and restore the live-stock industry to one of paramount importance in the economy of the country remain models of veterinary police organisation, and his researches in collaboration with Sir Arnold Theiler, then veterinary research officer to the Transvaal, exhibit his genius as an experimenter. His early training, therefore, first as a research assistant and teacher, serving a prolonged apprenticeship under such masters as McFadyean, in England (with whom he remained in lifelong collaboration), and Nocard, in France, and secondly, as an executive administrative officer in countries where epizootic disease plays an extraordinarily conspicuous rôle in the economy of their populations, fitted him peculiarly for the assumption of the specially arduous duties of his later years.

In 1905 Stockman was appointed Chief Veterinary Officer to the Board (now the Ministry) of Agriculture and Fisheries, to administer the Diseases of Animals Acts. His activities lay in two directions in this capacity—first, in the organisation and development of a field service, comprised entirely of qualified veterinary surgeons trained to deal promptly and efficaciously with epizootics; and secondly, in the foundation of a properly staffed research section, to carry out investigation work into the nature and proper methods of control of disease directly affecting the interests of the British agriculturist. He was admirably supported in developing the research activities of his department by the Right Hon. Walter Runciman while Minister of Agriculture, and a first-class laboratory—the first institute of its kind in Great Britain—was erected near Weybridge for research into the animal diseases. The laboratory has since been amply justified, both by the character and output of the researches from it, and among works published dealing with animal pathology, those upon "red-water," epizootic abortion, and other diseases of cattle, scrapie and louping-ill of sheep, swine fever, and certain diseases of poultry, deserve special mention, while the investigations now carried out there upon the nature of the foot-and-mouth disease virus are of a highly delicate technical order and aim at the solution of one of the most distressing factors besetting the valuable live-stock industry of Britain. Stockman's research work into animal disease, and in particular his researches into bovine epizootic abortion, performed largely in collaboration with Sir John McFadyean, have earned him an international reputation as a shrewd and careful observer and as a resourceful experimenter. He was appointed Director of Veterinary Research to the Ministry when the Laboratory was opened.

As mentioned above, however, it is as an epizoologist that Stockman must be meted the largest measure of distinction. He worked laboriously to mitigate the dangers of epizootic disease afflicting British live-stock, and succeeded, taking advantage of the insular situation of the country, to an extent wholly unknown elsewhere. Mention may be made of his efforts to suppress rabies, to eliminate glanders, to mitigate the ravages of swine fever, to control epizootic abortion, and bring about the gradually diminishing incidence of sheep-scab. The responsibility shouldered by him, practically alone, in the face of the recent incursions of foot-and-mouth disease, is well known, and the strain entailed must have told very heavily upon him. He had only just returned from a three months' tour to the Argentine, to investigate the conditions of the meat trade there with Great Britain, but was unable to resume his duties on his return. He had journeyed to Glasgow to consult his brother, Dr. Ralph Stockman, professor of materia medica and therapeutics in the University of Glasgow, about his health, and succumbed suddenly at his residence on June 2.

Stockman was joint editor of the *Journal of Comparative Pathology and Therapeutics*, a member of the council and president for the year 1924–25 of the Royal College of Veterinary Surgeons, a former member of the council of the Royal Society of Tropical Medicine and Hygiene, member of the managing committees of the Tropical Diseases Bureau and Imperial Bureau of Entomology, and a member of the Board of Governors of the Royal Veterinary College, London. He edited

Walley's "Meat Inspection." He was knighted in the New Year's honours list of 1913 for his services. By his conscientious and unassuming manner he inspired the confidence to an extraordinary degree of the Ministry he served, the veterinary profession, and the farming community of Great Britain. He married in 1908 Ethel, elder daughter of Sir John McFadyean, Principal of the Royal Veterinary College, London, and he is survived by her and two daughters, to whom we tender our deepest condolences in their sad loss.

WE regret to announce the following deaths:

Dr. Albert B. Lyons, for many years a consulting chemist in Detroit, and formerly a member of the committee of revision of the "U.S. Pharmacopœia," on April 13, aged eighty-five years.

Sir Henry Morris, Bart., president in 1906–9 of the Royal College of Surgeons and in 1910–12 of the Royal College of Medicine, on June 14, aged eighty-two years.

Sir Frederick Walker Mott, K.B.E., F.R.S., formerly pathologist to the London County Asylums, on June 8, aged seventy-two years

News and Views.

THE letter from the president and treasurer of the Chemical Society, printed on p. 859 of this issue, raises a question that is of considerable direct importance to learned societies in Great Britain and of no small moment to the cause of science. Hitherto the Inland Revenue has allowed the Society's claims for repayment of income-tax deducted at source, and now such claims are to be disputed. The grounds upon which the Inland Revenue is changing its attitude are not stated, but presumably it will contend that the societies in question (for other societies are also involved) are not described as "charitable institutions" in their charters, and, perhaps, also that they lose any right to this appellation by making profits from advertisements inserted in their publications. On the other side, the societies will rightly contend that they should not be classed with purely commercial undertakings; their work is not undertaken for pecuniary profit, and it is of educational nature and of national importance. Remembering Napoleon's gibe and the saying that "a country has the government it deserves," our national neglect of science is not surprising, but it would not have been so persistent if scientific organisations had learned to speak with one voice. Here is an excellent opportunity for united action, and if a test-case comes into court, it is to be hoped that the scientific societies will stand together, possibly under the leadership of the Royal Society, which *is* a "charitable institution" by the terms of its charter.

IN view of the difficult times through which the professional classes and the learned societies have been passing since the War, it is very regrettable that the Inland Revenue should now go out of its way to increase their hardships, and unless a strong stand is made we fear that some of the scientific societies will be severely hit by the new exactment. The statement made by Profs. Baker and Thorpe with reference to the Chemical Society that the "margin between solvency and bankruptcy is small, and may disappear if the Society is subjected to the taxation suggested," seems to require, however, some slight modification. According to its published accounts in the year 1925 the Society had more than 39,000*l.* invested in high-class securities, and it recovered 188*l.* in respect of income-tax deducted at source. If the Inland Revenue were to claim tax on dividends from the 5 per cent. War Loan, 1929/47, which are paid free of tax, the maximum total claim for income-tax (at 4*s.* in the *l.*) from the Society would be about 340*l.* Now the excess of income over expenditure in 1925 was 466*l.*, so that the question is one of a margin between a surplus and a deficit on a year's working, and not of a margin between solvency and bankruptcy. We point this out because we think that any semblance of overstatement should be avoided in prosecuting what is from every point of view (except, possibly, the legal one, upon which we express no opinion) a very strong case.

IN the House of Commons on June 8, in Committee on the Finance Bill, a discussion took place on Clause 10 (Continuation and Amendment of Part I. of the Safeguarding of Industries Act 1921). This clause provides, among other things, for the continuance in force for a further period of ten years from August 19, 1926, of Part I. of the Act. The materials affected by the proposed duties are numerous—one speaker said that no fewer than six thousand separate articles were included in Part I. of the Act. The industries to be safeguarded in the way prescribed by the Act include the manufactures of optical glass, optical instruments and the component parts of optical instruments, as well as, for example, the manufactures of magnetos, fine chemicals and arc carbons. In the course of the debate some interesting statements were made by the President of the Board of Trade, Sir P. Cunliffe-Lister. Out of 37 motor manufacturing concerns in Great Britain only three were using British magnetos before the War; to-day all but three are using exclusively British magnetos. It was also stated that Great Britain is producing something like 75 per cent. of our home consumption of fine chemicals, compared with 10 per cent. before the War. In respect to insulin, Great Britain has a very large share, not only of the home market, but also of the world market as well. To-day there are three or four times the number of skilled chemists employed in the British fine chemical industry compared with the number employed formerly, while the optical glass industry is now being developed. (This is but a pale paraphrase of the tribute to the progress of that industry paid by Mr. F. Twyman in his presidential address to the British Optical Instrument Manufacturers' Association.) Those responsible for equipping the Army, Navy and Air Forces have all said that their most minute requirements are met by the optical industry, and the industry has developed a new testing apparatus which is better than any apparatus developed in other countries. (This, presumably, refers to the camera lens and photographic lens interferometers of Messrs. Adam Hilger, Ltd.)

THERE were the usual arguments advanced from the Protectionist and Free Trade sides respectively, arguments with the general character of which any student of politics for the past twenty years must be perfectly familiar. These political and fiscal considerations, as such, do not concern us here; but there are certain aspects of this question which touch nearly the interests of science and of scientific workers. In the first place, there seems to have been common agreement in the debate that there are certain industries which, from their character rather than from their size, are essentially key industries, that is to say, industries which, in the interests of the nation, both in peace and in war, cannot be allowed to languish and die, whatever fiscal system be regarded as best suited to the industries of the country as a whole. Whether the best method of safeguarding such essential industries be by a protectionist tariff, a direct subsidy, or a total prohibition of imports except under licence, is a matter of acute difference of opinion. The optical industry in 1920, for example, expressed its preference for the last course. Taking the optical industry by way of example, the scientific worker has two main interests. If there is not in Great Britain an efficient and progressive optical industry, in which there can be constant and close contact between the manufacturer and the scientific worker, the interests of the scientific worker and of science must suffer. If, on the other hand, the scientific worker is hindered, by tariffs or in other ways, in obtaining the materials and instruments he needs, or has to pay enhanced prices for them, again the interests of the scientific worker and of science must suffer, with inevitable injurious reactions upon the home industry itself. It should not be impossible to reconcile these apparently conflicting interests. But whatever be done, the primary and paramount duty of fostering scientific research, and more especially in any 'safeguarded' industry, remains. Safeguarding will be undoing if from a false sense of security it should lead to neglect of that most potent means of reviving a distressed industry, scientific research.

APPARATUS has now been installed for transmitting photographs between London, New York and San Francisco. The journey from London is over the 220-mile land line to the Marconi radio-telegraphic station in Carnarvon, thence by radio-transmission across the Atlantic Ocean to the Riverhead Station of the Radio Corporation of America on Long Island, and afterwards by land lines. A description of the transmitting and receiving apparatus for the radiograms is given in the *Electrical Review* for June 4. The principles of the method of picture transmission over telegraph wires were clearly specified by Alexander Bain in 1842. Practically every system is based on the division of the picture into small unit areas and the transmission of the dots in these areas successively. When, however, it is remembered that the number of dots per square inch in an ordinary newspaper half-tone block is about 4000, it will be seen that the operation would be very laborious. To make it commercially feasible it has to be quickened up very considerably. At Radio House, London, the photograph or document to be transmitted is first copied photographically on to a transparent celluloid film mounted on a horizontal glass cylinder. A powerful beam of light is projected into this cylinder and then refracted out radially. The light passes through small areas of the film progressively, the intensity of the issuing beam depending on the transparency of the portion of the film it passes through. It then falls on a photo cell, the current from which is proportional to the intensity of the beam. The effects produced by this current after amplification are transmitted by the land wires and by radio-transmission to the photogram receiver. The received impulses actuate a siphon recorder mounted on a travelling carriage and operated by a motor controlled by a tuning fork. One of the main difficulties has been to obtain sufficient signal strength to over-ride the effects of atmospheric disturbances. It seems highly probable that the sending of photo-radiograms will soon be a recognised method of communication.

IN his discourse on "The Spectrum of the Aurora," delivered at the Royal Institution on June 11, Prof. J. C. McLennan gave a short review of the knowledge of the constitution and state of the upper atmosphere. We are gaining interesting information regarding the constitution of the atmosphere at great heights from investigations on the spectra of the auroral light. From the work of Lord Rayleigh, Slipher of the Lowell Observatory, and Vegard, it is now known that the element responsible for a large proportion of the auroral spectrum is nitrogen. Vegard's view is that the well-known auroral green line originates in finely divided solid nitrogen in suspension, when bombarded by a corpuscular radiation from the sun. Prof. McLennan's work on the spectrum of solidified nitrogen, however, shows that none of the spectral lines found in the spectrum of nitrogen in this state agrees in wave-length with the "green line," while the phosphorescent spectrum of solid nitrogen consists of eight distinct wave-lengths, none of which is included in the spectrum of the auroræ. Prof. McLennan and his co-workers have observed a line at 5577·35 in the spectrum of oxygen when an electric discharge is passed through this gas, with helium present in excess. This spectral line possesses all the characteristics of the auroral green line, and it seems probable that both have their origin in oxygen. The line can be obtained with pure oxygen alone, but not with the same intensity as when helium is present. In seeking for the position of the wave-length 5577·35 in the spectral scheme of atomic oxygen, Prof. McLennan and his co-workers have been able recently to show that the spectral system of oxygen consists of three sets of terms, one of which involves triplet and quintet terms, and the others singlet and triplet terms. The line 5577·35 belongs to one or other of the singlet-triplet systems, but it has not yet been assigned to any definite position. From the observations on the spectrum of the auroral light it is clear that nitrogen and oxygen exist in the atmosphere at a height much greater than was supposed hitherto, while neither hydrogen nor helium appears to be

present. While it is difficult to understand how this comes about, it may be that the forces, probably electrical, that maintain oxygen and nitrogen at the great heights mentioned is sufficient to draw away the hydrogen and the helium completely from the earth's atmosphere.

THE *North Western Naturalist*, a new quarterly journal, the first number of which has just appeared, is successor to the *Lancashire and Cheshire Naturalist*. Under its new title it appeals to a somewhat wider geographical and faunistic area in the hope that sufficient support will be forthcoming to justify the enterprise and to meet the undoubted needs of this important region. Several universities and many societies and associations devoted to the study of natural history and archæology are included in the area, and it is indeed surprising that past attempts to maintain a journal which would link up these various activities should have met with so little success. To judge from the contents of the first number, the scope of the journal is varied and wide. Mr. H. F. Barnes contributes a valuable paper on the crane-flies of Carnarvonshire, in which both the geographical distribution and ecology of the species are considered. Prof. Boycott records the occurrence of algal cysts in the tissues of *Limnæa peregra*, a hitherto undescribed association, the elucidation of which will be awaited with interest. News from the universities, local societies and museums, résumés of current periodical literature, book notices and reviews, and interesting notes and records, go to the make-up of an interesting number. The journal is attractively produced, and will be issued for the present in quarterly numbers at a subscription rate of 7*s*. 6*d*. per annum. If the standard of this number can be maintained there should be no doubt of the success of the venture, and it is to be hoped that the editor, Mr. A. A. Dallman, will meet with that financial support which his enterprise deserves.

Popular Astronomy for May reproduces a short article distributed recently by Science Service—the scientific news agency of Washington, D.C., U.S.A.—in which it is stated that, according to information received from Leningrad, the 41-inch objective of the telescope being constructed at Newcastle-on-Tyne for the Simeis Observatory, in the Crimea, had failed to meet the optical tests specified and was absolutely useless. At the time when this report was received we sent a copy of it to Messrs. Sir Howard Grubb, Parsons and Co., and we are now informed that the statement is entirely erroneous. As a matter of fact, the degree of separation between the components of the object-glass and the radii of curvature were only officially agreed upon between the authorities at Polkovo and Sir Howard Grubb, Parsons and Co. at the end of April of this year, and until these were decided very little grinding could be done. One of the flint components of the objective was exhibited by the Parsons Optical Glass Co. at the Wembley Exhibition, and its quality and homogeneity were almost perfect. As, however, the company wishes in so large a lens to approach so closely as possible to perfection, several alternative flints have been cast, and others are in course of preparation; the best will be selected from them for the Russian telescope. The crown component is a perfect piece of glass, and is undergoing a final and more extensive process of annealing than has hitherto been employed in the manufacture of large telescope objectives. Prof. Kriloff was recently shown in England the report issued by Science Service, and we are authorised to say that "it is a complete misstatement of the matter." He adds: "The lenses for the 41-inch telescope have not yet been ground to curves, but only preliminary calculations of the curves have been made. There can therefore be no question of a test of the complete object-glass having been made and failed. The representatives of the Polkovo Observatory are now testing the discs intended for the object-glass in order to select the most perfect among several which are available."

IT is reported that Miss D. A. E. Garrod of the University of Oxford and member of the Institut de Paléontologie humaine, has discovered fragments of a human skull, including the frontal bone, associated with Mousterian implements at the Devil's Tower, Gibraltar, where she has been carrying on excavations for some time. The fragments were discovered at a depth of about 10 ft. and exhibit characters similar to those of the well-known Gibraltar skull which belongs to the Neanderthal group. If this is correct—and the preservation of the frontal bone, if it is complete, should place it beyond question—it affords a welcome corroboration of the attribution of this skull to the Mousterian period. Miss Garrod had already announced her intention of returning at an early date, and her arrival will be awaited with keen interest by anthropologists. The circumstances of the discovery will no doubt be fully described in the paper which Miss Garrod is to read at the forthcoming meeting of the British Association at Oxford.

MR. J. R. JACKSON, Deputy Chief Veterinary Officer of the Ministry of Agriculture and Fisheries, has been appointed Chief Veterinary Officer in succession to the late Sir Stewart Stockman.

PROF. A. BRACHET, professor of anatomy in the University of Brussels, has been elected a member, and Prof. Ch. Pérez, professor of zoology in the University of Paris, a foreign associate, of the Royal Academy of Sciences, Letters and Arts (Scientific Class) of Belgium.

THE annual phytopathological meeting of the British Mycological Society will be held at Harpenden, Herts, on July 3. Visits will be paid to the Pathological Laboratory of the Ministry of Agriculture and the Mycological Department of Rothamsted Experimental Station. The secretary, Mr. E. M. Wakefield, Herbarium, Royal Botanic Gardens, Kew, desires intending visitors to inform him not later than June 26.

WE are glad to learn from Mr. C. Cuthbertson, F.R.S., that his request for 20 c.c. of krypton and

xenon (NATURE, May 15, p. 699) met with a ready response. He received several sympathetic replies, while M. Lepape, of the Collège de France, offered a supply of the gases at a very reasonable cost, and they have now reached London by aeroplane.

THE following officers were elected at the anniversary meeting of the Linnean Society held on May 27: *President*, Dr. A. B. Rendle; *Treasurer*, Mr. Horace W. Monckton; *Secretaries*, Dr. W. T. Calman (Zoology) and Mr. John Ramsbottom (Botany). *New Members of Council*: Mr. Reginald Cory, Prof. J. Stanley Gardiner, Prof. E. S. Goodrich, Dr. E. Stuart Russell, and Dr. E. J. Salisbury.

THE Institution of Electrical Engineers is celebrating the jubilee of the telephone on June 24, when a luncheon will be held at the Hotel Cecil, Strand, London, W.C.2. In the afternoon Sir Oliver Lodge will deliver a lecture on "The History and Development of the Telephone" in the lecture theatre of the Institution. The lecture will be preceded by the presentation of the Faraday Medal to Col. R. E. B. Crompton. The annual conversazione will be held at the Science Museum, South Kensington, London, S.W.7, during the same evening.

WE have received a letter from Dr. L. A. Kulik of the meteorite department, Mineralogical Museum, Academy of Sciences, Leningrad, U.S.S.R., pointing out that the earth passed very close to the path of Pons Winnecke's comet on June 30, 1908, and will do so again on June 27 of this year. He states that on that date in 1908 many meteors were observed and also night luminous clouds, which may have been associated with the approach of the earth to the comet's path. He asks that particulars of observations of any such phenomena this year may be sent to him.

THE spring meeting of the Prehistoric Society of East Anglia will be held at the Royal Anthropological Institute, 52 Upper Bedford Place, on Tuesday, June 22, at 2.30 P.M. Mr. A. Leslie Armstrong will be in the chair, and will give a short account of his recent work of excavation in the caves at Creswell Crags, from which his researches in previous seasons have produced valuable material bearing upon the northward extension of upper palæolithic settlements in England. Among other communications, a discovery of worked flints at Beer, Devon, will be described by Mrs. Mae Alpine Woods, and Mr. H. Rainbow will present some notes on an iron socketed celt from the Thames.

THE ninety-fourth annual meeting of the British Medical Association will be held at Nottingham on July 16-24. The incoming president, Mr. R. G. Hogarth, will deliver his presidential address on July 20, and a popular lecture will be given by Prof. Leonard Hill on July 21. The annual exhibition of surgical appliances, foods, drugs, and books will be held on July 19-23. The honorary local general secretary of the annual meeting is Mr. A. M. Webber, 2 The Ropewalk, Nottingham. The provisional programme includes the following discussions, the opener's name being given in brackets: The treatment of cancer by lead injections (Dr. W. Blair Bell), relationship of streptococci to scarlet fever and its complications (Dr. R. A. O'Brien), food deficiency conditions in relation to preventable illness (Dr. S. J. Cowell, Dr. Helen M. M. Mackay, Sir Percy Bassett-Smith, and Dr. J. Wheatley), and the physical and mental effects of fatigue and monotony in modern industrial work.

IN connexion with his article on "Fossil Insects in Relation to Living Forms," published in NATURE of June 12, p. 828, Dr. R. J. Tillyard asks us to state that the very beautiful illustrations were prepared as reductions from the very fine photographic enlargements of the fossils made by Mr. W. C. Davies, Curator of the Cawthron Institute, Nelson, New Zealand.

THE Cambridge University Press announces the forthcoming publication, in two volumes, of "Aphasia and Kindred Disorders of Speech," by Dr. H. Head. Vol. 1 will contain a historical sketch of the progress of knowledge in this subject, an account of the new methods of examination employed by the author and the results of his clinical observations. Further sections are devoted to the question of cerebral localisation of function and to novel theoretical conclusions as to the nature and causes of aphasia. Vol. 2 will deal with a series of clinical reports of cases.

THE botanical library of the late Mr. J. S. Gamble, F.R.S., is to be sold by auction on Friday, June 25, at 115 Chancery Lane, W.C.2, by Messrs. Hodgson and Co. The works to be offered for sale include Van Reede's "Hortus Malabaricus," 12 vols.; Wallich's "Plantæ Asiaticæ Rariores," 3 vols.; Royle's "Botany of the Himalayas," 2 vols.; "Annals of the Royal Botanic Garden of Calcutta," 12 vols.; and Watt's "Economic Products of India," 6 vols. in 9.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant lecturer in geography at the University College of the South-West of England, Exeter—The Registrar (June 26). A senior demonstrator and a demonstrator of physiology at St. Bartholomew's Hospital Medical College—The Dean of the College, St. Bartholomew's Hospital, E.C.1 (June 28). Assistant lecturer in engineering, County Technical School, Wednesbury—Director of Education, County Education Offices, Stafford (July 6). A professor of mechanical engineering at the Manchester Municipal College of Technology—The Registrar (July 8). An assistant lecturer in physics in the University of Sheffield—The Registrar (July 8). A head of the mechanical engineering department and a head of the electrical engineering department of Robert Gordon's College, Aberdeen—The Secretary and Registrar (July 12). Lecturers in agriculture, chemistry, and economics at the Imperial College of Tropical Agriculture, Trinidad—The Secretary of the College, 14 Trinity Square, E.C.3 (July 13).

ERRATUM.—In NATURE for June 12, p. 839, last paragraph, for "short" read "Shortt."

Research Items.

ROCK PAINTINGS ON THE WEST COAST OF THE GULF OF CARPENTARIA.—Mr. Norman R. Tindale in vol. 3, part 3, of the *Records of the South Australian Museum*, in the course of the second part of his account of the natives of Groote Eylandt and the west coast of the Gulf of Carpentaria, discusses their pictorial art. They use four pigments—red, yellow, black and white. Three of these—white kaolin, yellow, a limonite and black, manganese oxide and clay—are found locally. The red pigment—a hæmatite—is obtained by trade from the interior of Arnhem Island in the country of the Rembarunga, who pass it on to various other tribes. It is much valued and used in colouring utensils, weapons, ceremonial objects, canoes, apparel, ornaments and persons. The pigments are produced by rubbing on a stone. The starchy liquid obtained by bruising the fleshy stems of various tree orchids is sometimes used instead of water for mixing, because it gives adhesive qualities to the colours. Brushes are either chewed sticks, pieces of bark, or pieces of leather one inch long fastened to a handle of the same length with gum or wax. Two or more colours are sometimes superimposed or mixed to give a special effect or tint, such as salmon colour. The designs are in most cases built up of dots and straight lines with occasional circles and other geometric combinations. No meaning is now known for the geometric designs, but sometimes the well-defined form of an animal is the central object. Tracing designs and pictures on the ground is a common amusement around the camp fire. Tracks of animals and birds are also cleverly imitated. During the enforced leisure of the wet season, designs are painted on the walls of rock-shelters and of the bark huts. The Ingura cave- and hut-paintings usually relate to sailing canoes, dugongs, turtles, fishes, parties of human figures, and hunting scenes. Hands are depicted by coating the rock with red clay on which the hand is imposed and used as a stencil, the outline being shown in white with kaolin.

SONGS OF THE COPPER ESKIMO.—In a further instalment of the Reports of the Canadian Arctic Expedition, 1913–18, forming vol. 14 of the series, Mr. D. Jenness, with the assistance of Miss Helen H. Roberts, deals with the songs collected by the Southern Party which worked on the Arctic mainland and adjacent islands, in this case at Barnard Harbour, in Dolphin and Union Strait, their headquarters. The songs were recorded by phonograph, and with some difficulty, as the Copper Eskimo had not previously been acquainted with the instrument, and thought a spirit was reproducing their words. It is, in fact, their custom not to sing their songs out of doors but only under cover, because they believe that in the former case a spirit might carry away their words and rob them of the breath of life. The songs recorded were, for the most part, dance songs and some incantations. The latter, though fewer than the dance songs, are sufficiently numerous to indicate that they form an important element in Eskimo life. All given here are incantations for fine weather, except one which is for healing the sick. The dance songs are essentially topical. They fall into two classes, the *pisiks*, in which the principal performer beats the drum, and the *atons*, in which one of the chorus of dancers beats the drum and the principal dancer's hands are free. A study of the distribution and comparison of the dances themselves suggests that the two dance forms were originally quite separate, and that the *pisik* is the characteristic form among the eastern branch of the race, predominating among the Copper Eskimo, and being known in the Mackenzie delta, while the *aton* belongs peculiarly to the western division, is the prevailing form in the Mackenzie delta, and exists in a minor form among the Copper Eskimo.

CRUSTACEA OF THE THAMES ESTUARY.—A report on the sea fisheries and fisheries industries of the Thames Estuary, prepared by the late Dr. James Murie, was published in 1903 by the Kent and Essex Sea Fisheries Committee. Mr. W. Pollitt, Librarian and Curator of the Public Libraries and Museum, County Borough of Southend-on-Sea, writes: "Of Part II of this work only the first section (36 pages) was set up in type, and it is not probable that the work will be completed." He has for disposal practically the whole of the copies of this section of Part II and will be glad to forward one or more to any person interested. There should be many people wishing to avail themselves of this offer as the section in question is a continuation of Dr. Murie's notes on the Crustacea of the Thames Estuary, containing valuable local information gathered from various sources as well as much original observation. These pages deal entirely with prawns and lobsters. The author adds to his excellent account of the common prawn *Leander serratus* in Part I descriptions and details of distribution with notes on breeding of three others—the white prawn *L. squilla*, Leach's prawn *L. adspersus*, and the ditch prawn *Palaemonetes varians*, directing attention to the fact that the prawn family is more widely distributed in the Kent and Essex area than has been generally supposed. In 1923 Gurney (*Proc. Zool. Soc.*, London) gave a good general survey of all these together with *L. longirostris*, in which he states that *L. adspersus* (= *Palaemon Leachii*) is "by no means an abundant species," although "it is taken in some numbers by the eel catchers." Both this species and *L. squilla*, the so-called "small prawns," are, according to Dr. Murie, frequently captured in the Thames Estuary together with the larger species, and although no separate fishery is established for these they are certainly of some commercial value. It would be a great pity if this unfinished paper were lost owing to lack of knowledge of its existence.

THE OYSTER-SHELL SCALE INSECT.—Although the oyster-shell scale, *Lepidosaphes ulmi*, has been known as a pest in the United States since 1794, only recently has any investigation been made of the differences between those found on apple and those on other host plants, *e.g.* lilac. Grace H. Griswold (Memoir 92, Cornell Univ. Agr. Exp. Stat., 1925) has made a comparative study of the two forms. The author points out the differences in morphological characters: second stage larvæ from the apple have fewer dorsal glands than larvæ from lilac; the pygidia of adult females from the apple have fewer circumgenital pores, insects from the apple are slightly smaller, and observations on the development during five years show that the apple insects are in advance of those on lilac at every stage. At Ithaca, where the work was done, both forms have only one generation. The lilac form is found also on shade trees. Transfer experiments have shown that insects from apple can complete their development on lilac and on other host plants, but in no case did insects of the lilac form live any length of time on apple or on pear. Whether the differences between the two forms are sufficient to warrant the erection of a new species or only of a new variety for the form on lilac is left in abeyance. Observations are added on the most common chalcid parasite, *Aphelinus mytilaspis*, which attacks the oyster-shell scale.

ORGANISATION IN PROTOZOA.—In an article on organisation and variation in Protozoa (*Sci. Monthly*, April 1926), Prof. G. N. Calkins points out that organisation in Protozoa is as definite and fixed as in any type of living things; that it is represented by visible structures which are not only temporary but are also subject to changes with metabolic activities. These visible structures are formed anew at conjugation or at fertilisation generally, or when parthenogenesis occurs, and they are formed anew at periods of cell division. With fertilisation, with endomixis, and with cell division there is evidence that the cell is completely reorganised and that the fundamental invisible organisation starts 'with a clean slate' after every one of these deep-seated phenomena. Gametes, when formed, are so modified that without fertilisation they cannot live, and ciliates without conjugation or endomixis in the majority of cases will live only with weakening vitality which ends in death.

INHERITANCE OF EGG-COLOUR IN BIRDS.—Certain writers have held that xenia exists in birds, *i.e.* that when species or strains differing in egg-colour are mated, the eggs laid will show changes in colour in the direction of that of the breed to which the male belongs. This has been recorded in crosses between canaries and finches, and also among domestic fowls. In an investigation which included a careful study of the variability of egg-colour in Leghorns (eggs nearly white) and Orpingtons (eggs brown), Kopec (*Journal of Genetics*, vol. 16, No. 3) concludes that no such effect exists. He finds a seasonal variation in egg-colour, the shell being darker during the winter months and lighter in summer. The colour also depends upon the age of the hen and whether she has previously been laying. Curves of egg-colour from the reciprocal matings, compared with control hens without mating, correspond closely in their seasonal variation. Repeated injections of Orpington testicular tissue into Leghorn hens and vice versa also produced no effect. It is concluded that seasonal variation in colour will probably account for the previous supposed observations of xenia.

LAVENDER OIL FROM THE IRISH FREE STATE.—Prof. J. Reilly, Mr. P. J. Drumm and Prof. C. Boyle of University College, Cork, have collaborated in a preliminary chemical examination of lavender oil distilled from plants of lavender grown at Cork and compared with oil obtained from English, French and Spanish sources. These workers have definitely in view the establishment of the cultivation of lavender and distillation of the oil as an Irish industry, and regard their preliminary laboratory experiments as hopeful in result and worthy of extension. Their paper is published in the *Economic Proceedings of the Royal Dublin Society*, vol. 2, No. 16, April 1926.

STARCH AND TRANSLOCATION.—We are beginning to realise how little is known about this problem. Starch is formed in the green assimilating tissue and in reserve organs of plants, but starch grains are also found in the parenchyma associated with the vascular strands. This latter starch is often spoken of as 'transitory starch' (the *wanderstärke* of the Germans), and the view has been taken that its formation by temporarily removing sugar from the cell sap, steepens the concentration gradient of the sugar along the vascular channel, which is assumed to be the driving force in the diffusion of the sugar. E. G. Pringsheim, basing himself in part upon the recent paper of his pupil, K. Bernhauer (*Beih. z. botan. Zentralbl.* 41, p. 84, 1924), reveals the inconsistencies of this point of view and its lack of experimental support in a brief discussion of the subject in *Die Naturwissenschaften* for April 9. Tollenaar has recently calculated that as starch appears in the chloroplasts of the tobacco leaf after five minutes' exposure to light, starch formation must follow when the concentration of sugar in the sap is increased by at most 0·01 per cent. On the other hand, as starch formation does not occur in a darkened strip of this leaf when the rest of the leaf is continuously illuminated for three days, apparently migration of sugar from the illuminated region is unable to raise the concentration in the darkened region by 0·01 per cent. in this time. Either, then, sugar is not actively translocated, or starch-formation is not simply determined by the sugar concentration; in any case the phenomena of starch formation and hydrolysis in the plant require much closer experimental analysis. Pringsheim seems to incline to the view that starch formation in starch leaves is of advantage as preventing an increase of turgor, which in sugar-storing leaves may reduce photosynthetic efficiency.

THE REVILLAGIGEDO ISLANDS.—Last summer the California Academy of Sciences, with the help of the U.S. Navy Department, sent an expedition under Dr. G. D. Hanna to the little known Revillagigedo and Tres Marias Islands off the Pacific coast of Mexico. Dr. Hanna gives a general report on the work of the expedition in the *Proceedings of the California Academy of Sciences*, 15, pp. 1-113. The Revillagigedo Islands have never been uninhabited, although their possibilities as a sheep farm have been considered more than once. There has thus been no interference with the natural fauna and flora. The Tres Marias Islands, which lie relatively near the mainland, are inhabited. The narrative of the expedition refers to many interesting collections but contains no summary of the result of the expedition as a whole. This is promised in a series of further reports.

SALINITY OF NILE WATER.—Some investigations by Mr. R. Aladjem on the seasonal variation of salinity of Nile water at Giza are published in Bulletin No. 69 (Technical and Scientific Service, Cairo). Mr. Aladjem shows that the alkaline portion of the dissolved matter in the Nile is small and is seldom greater than 18 parts per million. Moreover, he shows that the low Nile contains more sodium and potassium and the high Nile more calcium and magnesium. This appears to indicate that water laden with alkaline bicarbonates drains into the river from the subsoil during low water, or that some calcium and magnesium of the bicarbonates are thrown down at that stage of the river. The irrigation water used in Egypt thus contains more calcium and magnesium than sodium and potassium, which prevents the soil becoming alkaline, compact, impermeable and comparatively barren. Detailed tables give the analyses of the Nile water at Giza throughout 1924 and 1925.

CRETACEOUS AMMONOIDS OF EASTERN AUSTRALIA AND JAPAN.—The Ammonoids of the Rolling Downs formation of eastern Australia have been studied by Dr. F. W. Whitehouse (*Memoirs of the Queensland Museum*, 8, 3, 1926, p. 195, pls. 34-41). They are especially characterised by the profusion of heteromorphic forms, hitherto referred to Crioceras, for which several new genera are instituted. The author has been able to recognise zonal horizons in the Rolling Downs formation belonging to the Hauterivian, the Aptian and the Upper Albian. Ammonites from the Chalk of Japan are described by H. Yabe and S. Shimizu (*Science Rep. Tôhoku Imp. Univ.*, Sendai, ser. 2, Geol. 8, 4, 1925, p. 125, pls. 30-33); they belong to the family Prionotropidæ, which is rather rare in Japan.

PERMIAN INSECTS.—In part 7 of his work on the Permian insects of Kansas (*American Journ. Sci.*, 11, 1926, p. 133), Dr. R. J. Tillyard deals with the Mecoptera or scorpion-flies, an order with comparatively few representatives at the present day but not uncommon as a fossil, especially in the Upper Permian and the Mesozoic. From the Lower Permian of Kansas the author describes sixteen species belonging to six new genera. From what is known of the climatic conditions of Kansas in Permian times, Dr. Tillyard infers that the interpolation of the pupal stage in the life-history of the scorpion-flies was not for protection against severe cold, but that drought and heat were the determining factors. Since the Mecoptera are well represented in the Lower Permian, there can be little doubt that earlier forms existed, and the author believes that the Upper Carboniferous genus Metropator, hitherto placed in the Protorthoptera, is a true Mecopteron and a direct ancestor of some of the Lower Permian forms.

FIBROUS CRYSTALS OF SODIUM CHLORIDE.—In further reference to notes which have appeared in NATURE (October 24, 1925, p. 610, and March 13, 1926, p. 395) we have received a communication from Mr. W. A. Macfadyen, Longships, Capel-le-Ferne, near Folkestone, enclosing some very beautiful specimens of fibrous and banded crystals of naturally occurring rock salt. One set of these crystals, about 2 cm. in length, is stated to be common in Egypt as secondary infillings in small fissures close to the weathered surface of the ground, especially in the soft sandy limestones and green shales of Miocene age. These specimens were found at Shallufa, ten miles north of Suez. The other crystals, which form fibrous bundles 10 cm. in length closely resembling sal ammoniac, were found near Gebel Gharamul in the eastern desert of Egypt, and are said to form the domestic salt supply of the Ma'azah Bedouin. The crystals are extremely beautiful, and are evidently parallel growths, but the facets are not sufficiently sharp to give a clear indication of the direction of the axes.

DIELECTRIC CONSTANTS.—The issue of the *Physikalische Zeitschrift* for April 15 contains a summary of more than forty pages, by Dr. O. Bluh of Prague, of the practical and theoretical work done on dielectric constants during the past fourteen or fifteen years. So far as the theory is concerned, progress has been mainly in the application by Debye and others of the idea that each molecule is a dipole with a positive and a negative electric charge, first put forward by Sutherland in 1895 to explain the effect of temperature on the dielectric constant and the existence of anomalous dispersion. On the practical side, older methods of measurement of the constant have been improved, and new methods, generally depending on the use of the triode valve, have been devised. Gases and vapours have been investigated to a higher degree of accuracy, and the effects of temperature and pressure on the constants of liquids determined between 87° and 433° absolute and up to 200 atmospheres. Solutions of liquids in each other and of solids in liquids give results so divergent that no general laws have been evolved, but there seems little doubt that the dielectric constants of solutions play an important part in biological processes. In the case of solids the advances have been less extensive.

THE PREPARATION OF LEVULOSE.—No. 519 of the *Scientific Papers of the Bureau of Standards*, by R. F. Jackson, Clara G. Silsbee and M. J. Proffit, describes the preparation of levulose, the sweetest of the sugars, from the Jerusalem artichoke and the dahlia, which contain considerable amounts (8·5 to 23·8 per cent. and 9·3 to 14 per cent. respectively, in the samples examined). After extraction the plant juices, consisting largely of polysaccharides, are converted to sugar by acidifying, and methods of purification are given in the paper. Crystallisation, a process previously requiring the use of absolute alcohol or glacial acetic acid, may be carried out by carefully controlled cooling and seeding of the aqueous syrup.

ELECTROMETRIC TITRATION OF HALIDES.—The estimation of halides by electrometric titration is described by W. Clark in the *Journal of the Chemical Society* for April 1926. A calomel cell is joined by means of an ammonium nitrate bridge to a tube dipping into the solution under investigation and silver nitrate is added drop by drop, while the electromotive force is read by means of a potentiometer. The end point is indicated by the maximum rate of change of E.M.F. With mixed halides, the breaks in the E.M.F. curves indicating the respective end points are displaced by solid solution effects. The addition of ions strongly adsorbed by silver halides, such as barium and sodium nitrates in 5 per cent. solution, gives correct end points for a wide variation in proportions of the constituents of the mixtures. The results of the work are applied to the examination of the materials used in the manufacture of photographic emulsions.

RADIO WAVE PROPAGATION.—Radiotelegraphists have known for some years that when very short wave-lengths are used for transmission, the intensity of the received signals decreases as the distance from the transmitter is increased until it is too small to be observed, the distance then being of the order of one hundred miles. As the distance is further increased the signals are too faint to be detected over a well-defined interval. At a greater distance the signal strength rises to a maximum value and finally gets weaker gradually. The distance of the transmitter from the further edge of the interval of silence is generally called the 'skip' distance. This distance increases rapidly as the wave-length is diminished. For a specified wave-length it is longer at night than in the day, and it is longer in winter than in summer. Dr. Hulburt, in the *Journal of the Franklin Institute* for May, gives an interesting theory of radio wave-propagation round the earth which has the merit of giving simple explanations of most of the observed phenomena. He makes the assumption that there is a Kennelly-Heaviside layer in the upper atmosphere which is rich in electrons. From experiments carried out in the research department of the American Navy, it appears that for wave-lengths of 16, 21, 32 and 40 metres, the skip distances during daylight are 1300, 700, 400 and 175 miles respectively. The night skip distances are more than twice as great. The author considers that this phenomenon proves that the transmitted wave consists of two parts, one of which clings to the surface of the earth and decreases rapidly in intensity, while the other moves in an upward direction and returns after refraction at the conducting layer to the earth. Making certain assumptions as to the connexion between the electron density and the height above the earth, he concludes that during the daytime the electron density is a maximum at a height of between 70 and 150 miles. At night-time, when the sun's rays are absent, recombination of ions and electrons will occur. The electron density, therefore, becomes less and the radio rays must search higher altitudes before being turned back to the earth.

Activities of the South African Museum.

IN the first report that he presents as director of the South African Museum, Cape Town, Dr. Leonard Gill insists on the need for more space. In spite of this the staff goes on collecting. An expedition was made to the Kaokoveld in South-West Africa, carrying previous work as far as Zesfontein, where lives the decaying remnant of the Topnaar Hottentots; a further expedition was starting for the country north of Zesfontein, of which the natural history is almost unknown. Other expeditions were to Gordonia, between Upington and the border of South-West Africa, and to the Langebergen behind Swellendam, in continuation of the exploration of the mountain ranges in the south-west of the Cape Province. Various traces of early human occupation were also investigated. The whole report bears witness to activity in many directions in spite of crowding and the small number of the staff.

The output of the museum during the past year is represented by the issue of six parts of the *Annals of the South African Museum*. The old-established plan by which the papers are classified more or less strictly into homogeneous volumes (botanical, geological, entomological, etc.) is awkward in that it keeps so many volumes open for rather long periods, but it is decidedly convenient when once the volumes are finished and bound. The large amount of the year's work refers to South-West Africa (the former German territory), which is explained by the fact that a number of expeditions from the Museum have been at work in that territory in recent years. They have gone there by special invitation of the local Administration and with the aid of grants from it—an unusual example of enlightenment which deserves recognition. We are informed that several further papers on the flora and fauna of South-West Africa are already in type. Considering the fewness of their numbers, the amount of scientific work turned out by the members of the Museum staff themselves is noteworthy. It is in part due to the fact that the Museum itself is still awaiting its urgently needed extensions. Thus 'gallery work' is largely paralysed —a bad thing for the public, though it allows the staff more time than they would otherwise have for research.

Thanks mainly to the persistence and energy of Dr. J. D. F. Gilchrist, our knowledge of the marine fishes of South Africa, which was very inadequate some thirty years ago, is now approaching completion in regard to the characters of the species and their distribution. At the beginning of the century a survey of the shallower waters, up to 50 fathoms, of the Cape seas, succeeded in bringing to light many new forms, and also in discovering new fishing grounds. During the last five years a further survey has been carried out on a larger scale, its operations extending to Natal and including the deeper waters. Large collections from Natal made by Dr. Warren in 1906, and more recently by Messrs. Romer Robinson and H. W. Bell Marley, have been sent to the British Museum (Natural History) and have been described.

The present is an appropriate time for the results obtained to be brought together, and Mr. K. H. Barnard's memoir (*Annals of the South African Museum*, vol. 21, Pt. 1, "A Monograph on the Marine Fishes of South Africa, Part 1") should be of considerable service to ichthyologists and others interested in the fish fauna of South Africa. The scope of the work is much wider than the title would suggest, as it includes not only the fishes of the coasts of the Union of South Africa, but also those of East and West Africa northwards to 15° S., and oceanic fishes that have been recorded from within 200 to 300 miles of the east and west coasts and 400 miles southwards.

The fishes of Natal are mostly tropical, whereas those of the Cape are temperate and show Mediterranean affinities; we think that when Mr. Barnard comes to the perches, gobies, blennies, etc., which are so numerous in the Indo-Pacific region, he may regret that he has taken in the east coast northwards to Mozambique, and that only the fact that this area has not been too well explored will save his memoir from being overburdened with tropical species.

A number of papers enumerating and describing species belonging to various groups of S. African insects have been issued during the year. In a country so extensive as South Africa, animal life is abundant and of great interest, and we look forward to the time when the Government of that country will see its way to publish an authoritative "Fauna of South Africa." A model for such a work will be found in the "Fauna of India" series issued by the Secretary of State for India.

In vol. 19, Pt. 4, of the *Annals of the South African Museum*, 1925, Mr. L. B. Prout describes certain new species of Geometrid moths from material that has accumulated since his previous paper on the subject (*Annals S.A. Museum*, 1917), two well-executed coloured plates accompanying this article. In the same part Mr. F. W. Edwards deals with a number of species of Mycetophilidæ and Bibionidæ contained in the Museum collections. The most interesting feature brought to notice is the discovery of a living species of Heterotricha, a genus which has only been previously known in a fossil condition contained in Baltic amber.

Part 1 of vol. 23 of the *Annals* of the Museum is devoted to an extensive illustrated memoir on the Hemiptera of South-West Africa by Dr. A. J. Hesse. It lists all the known species of Heteroptera and Homoptera from that region, excepting those belonging to the families Jassidæ, Aphididæ, and Coccidæ. The Hemiptera of South-West Africa have been little studied in the past, and it is perhaps not surprising that as a result of the Museum expeditions up to 1924, together with the efforts of other collectors, 11 new genera and 58 new species are established. The most extensive additions pertain to the families Reduviidæ (3 new genera, 11 new species) and Fulgoridæ (5 new genera, 17 new species).

"Palæontological Papers published in conjunction with the Geological Survey" were added to the natural history publications of the South African Museum about a quarter of a century ago, thus extending their scope and usefulness. In the matter of the Mollusca, the non-marine early received attention, and if the papers have been few in number they have been important in matter. So early as 1900, Mr. W. E. Collinge had two papers on the slugs of South Africa; while one whole big part was devoted in 1912 to Major Connolly's valuable "Reference List of South African Non-marine Mollusca." This last was a piece of systematic work which has great value, on account of its carefully compiled synonymy and nomenclature, to others besides the immediate circle of those for whose benefit it was drawn up.

Lately another important molluscan paper, this time anatomical in character, has appeared (vol. 20, Pt. 4) from the pen of that past master in molluscan anatomy, Mr. Hugh Watson. He deals with "The South African species of the Molluscan genus Onchidella," and in addition to their anatomy discusses

their affinities with the species found in other parts of the world and the geographical distribution of the genus. Eight excellent plates from the author's pencil and camera, with their keys and a map, are appended in illustration.

A first contribution to "Reports on the Marine Mollusca in the Collections of the South African Museum," by J. R. le B. Tomlin, on the family Turritellidæ, accompanies the preceding. What it wants in length this paper makes up in importance. It is a purely systematic paper, but describes and illustrates two new species of Turritella, besides introducing a new term, "scalarescence," to denote a tendency to looser coiling sometimes exhibited in these shells. Conchologists will assuredly look forward to meeting with further such contributions in these *Annals*.

Vol. 22, Pt. 1, of the *Annals* contains five papers on South African fossils and fossil woods. Africa, especially in its more central parts, is still in large measure the undiscovered land so far as its extinct animals are concerned. The veil has been lifted a little on its Mediterranean borders chiefly through the work of the late Dr. C. W. Andrews. On the east coast, where the remains of the largest forms of extinct reptiles have been discovered, there is possibility of great further discovery. In the south our knowledge is fuller and of longer standing, though even here it must be recognised that the known and described forms can be only the merest fraction of the animals that lived and evolved there, and exploration is far from being finished. In South Africa is the well-known Karroo series of formations, which are perhaps the most important centre of reptilian and amphibian evolution that has as yet been explored. The earlier classical works of Owen, Huxley and Seeley are, many of them, based on specimens from here. So are the more recent classics of Watson and Broom.

In reviewing the labours of various researchers in this field, the assistance rendered by the Trustees of the South African Museum and by the Geological Survey of South Africa must not be underestimated; the *Annals of the South African Museum* contains many important papers on vertebrate palæontology by Broom and S. H. Haughton. A recent number contains the thirteenth paper by the latter author on extinct reptiles and amphibia of the district. The format of the publication, the typography, and the production of the plates are all excellent.

The grasses of Namaqualand, Damaraland, and Ovamboland are listed by Miss S. Garabedian (*Annals*, vol. 16, Pt. 2); representatives of most of them are now in the Herbarium of the South African Museum. It is hoped later to issue a list of the grasses of the mountainous country on the west called the Kaokoveld and the sand-dune belt between the mouths of the Orange and Cunene rivers, known as the Namib. Genera are arranged according to the key given by Dr. Stapf in the "Flora of Tropical Africa." Under the different species there are often notes as to the value of the grass as fodder, or its disadvantage as a weed in cultivation or as injurious to grazing stock.

Experimental Investigation of Dengue.

WHEN the Medical Research Board was organised for the Philippines in 1922 at the recommendation of the Surgeon-General of the United States Army, the investigation of the etiology of dengue was one of the most important problems to be studied. Lieut.-Col. J. F. Siler, Majors M. W. Hall and A. P. Hitchins were appointed, and commenced their labours in 1924 at Manilla, and in the *Philippine Journal of Science* of Jan.-Feb. (vol. 29, Nos. 1-2, pp. 304 + 8 plates) they describe their results.

The investigation was most carefully planned and most thoroughly carried out on the model of so many other etiological problems conducted by our American confrères. A very complete history of the disease is first given; the earliest accurate descriptions of dengue in epidemic form are from Cairo in 1779, from Batavia and Java in 1779, and from Philadelphia in 1780, showing that then it was widely distributed, and it still remains so, but there is reason to believe that its original home was in tropical America. Compared with yellow fever, to which the disease has many etiological similarities, this world-wide diffusion is remarkable. Throughout these areas some of the epidemics are often classed as "dengue-like" rather than true dengue, but the authors, after most careful consideration, state that "it would appear that among themselves they differ little, if any more, than do different outbreaks of dengue, and until specific etiological evidence is available the possibility of their essential identity must be borne in mind."

The experiments detailed in this monograph were carried out in the Philippines, and were made on sixty-four American soldier volunteers to determine the transmission of dengue by means of mosquitoes: the men were in screened wards and the mosquitoes used were bred from the egg. In one hundred and eleven biting experiments made by infected females of *Aëdes aegypti* (better known as *Stegomyia fasciata*), dengue was transmitted forty-seven times.[1] All experiments with *Culex fatigans* were negative, thus not confirming the early and useful work by Graham. The filterable virus of the disease is present in the blood of the case only during the first three days of the fever, and requires at least eleven days to develop in the mosquito before it can be transmitted. The infectivity of the insect continues throughout its life but is not passed on to its progeny. It was found that 58 per cent. of those who had suffered from the disease were immune, and in the others the course was modified. The rapidity of the spread of dengue is second only to influenza, but the diseases are not mutually protective.

The results brought out by the inquiry are in striking similarity with those observed in yellow fever, and strongly suggest some group relationship. Though so far in dengue the actual cause has not been definitely demonstrated, yet spirochætal forms have been reported for both. The authors were unable to transmit the infection to animals. From a practical point of view, the authors conclude that as dengue and yellow fever are transmitted by the same mosquito and the mechanism of transmission for each is almost identical, therefore epidemics of dengue and yellow fever are subject to the same control measures; the foremost of which is the reduction of the incriminating mosquito in the affected area; secondly, the protection of patients from mosquito bites during the first three days, by adequate mosquito nets, etc., during both day and night.

The previous work of other investigators is duly recognised and acknowledged, but the research here recorded is the most thorough and admirable on the subject.

[1] Of the sixty-four volunteers used, dengue was produced experimentally in fifty-two, or 81 per cent.

The Storage of Eggs.

MORE than four thousand million eggs are consumed in Great Britain during the course of a year; but this number would probably be increased if satisfactory methods of storing eggs produced at the glut period in the spring with the view of their consumption later in the year were generally introduced, especially as the producers would be encouraged to increase their stock, since the demand and the price fetched would show less marked fluctuations. But for a stored egg to be the equivalent of a new-laid egg in all respects requires considerable attention to detail: the factors on which good results depend are discussed by T. Moran and J. Piqué in a recent publication of the Department of Scientific and Industrial Research.[1]

In the first place, only carefully selected eggs should be submitted to storage: they must be clean and should never have been exposed to a temperature greater than 60° F., otherwise a certain amount of development of an egg, if fertile, may have occurred, resulting in its decomposition later in the store. The quality of an egg can be judged by its transparency to light, this process of examination being termed 'candling.' A new-laid egg appears clear and transparent, the yolk being vaguely seen as a rosy-tinted mass: the air chamber is small. As the egg ages it becomes less transparent, appearing slightly marbled; the yolk is movable along the long axis and the air chamber is larger. Bad eggs appear opaque on candling.

In the second place, attention must be paid to the method of packing when, as is most usual, the eggs are kept in the cold store; the material used should be clean, odourless and moisture-proof, and the eggs should be so packed that a free circulation of air can occur around them. The temperature of the store should be maintained at 32-33° F. and be kept as constant as possible: the humidity of the air should be about 80 per cent.: a higher humidity favours the growth of moulds, whilst a lower humidity increases the rate of evaporation of moisture from the eggs. Under the conditions specified the loss of weight of the stored eggs is about 2·68 per cent. over a period of seven months. A free air circulation is essential to keep them in good condition and prevent the growth of moulds. The authors consider in detail the various methods of packing eggs and of obtaining the requisite temperature and humidity in the storage chamber: they suggest that the loss of weight by evaporation may possibly be prevented by wrapping the eggs in waxed papers, although this would presumably increase their cost somewhat.

Certain changes occur in the eggs during cold storage: the white becomes more viscous, losing water both to the yolk and externally by evaporation; the yolk membrane becomes more delicate, and when the egg is broken the yolk also is very liable to break, a familiar sign of age in an egg. Moreover, after about six months the eggs acquire an unpleasant taste from the packing material unless, as mentioned above, this is odourless and moisture-proof. The food value of stored eggs, however, is probably little inferior to that of new-laid: no loss of vitamin A has been detected even after long storage.

The removal of eggs from cold store requires care, since unless their temperature has risen to that of the outside air, moisture will be deposited on their surfaces, or they will 'sweat,' as it is called: and a damp egg does not fetch so good a price as a dry one. The process of 'defrosting' requires about twenty-four hours.

After a short account of the storage of eggs in water-glass or lime-water, T. Moran describes some experiments on the effects of low temperatures upon eggs. After freezing and thawing again, it is found that the liquid part of the white has increased and the viscous part decreased in amount, the extent of the change depending on the temperature reached and the time of exposure to that temperature. On the other hand, the yolk shows no change unless the temperature has fallen below −6° C., and unless freezing has actually occurred. If the egg is kept at this temperature for a sufficient length of time, on thawing the yolk is found to be in a stiff pasty condition; if the processes of freezing and thawing are carried out sufficiently rapidly this change does not occur. It appears to be due to a precipitation of lecitho-vitellin, so that re-solution does not occur on thawing: it is to be noted that simple freezing alone, at a temperature above −6° C., does not produce the change, so that it occurs at a time when the egg is frozen solid.

The effect of temperature on the life of the embryo was also studied. At −6° C. the embryo dies immediately: fertility is maintained longest at 8-10° C., up to a maximum of about five weeks. The author points out in this connexion that the embryo is cold blooded up to about the twentieth day of development.

Apart from its scientific interest, the report merits the attention of all those engaged in the commercial production of eggs in Great Britain.

[1] Department of Scientific and Industrial Research: Food Investigation. Special Report No. 26: The Storage of Eggs. By T. Moran and J. Piqué. Pp. viii+80+9 plates. (London: H.M. Stationery Office, 1926.) 1s. 3d. net.

Commonwealth Fund Fellowships.

THE Committee of Award for the Commonwealth Fund Fellowships has made the following appointments to the twenty fellowships tenable by British graduates in American universities for the two years beginning in September 1926:

Mr. A. M. Adamson, University of St. Andrews, to the University of California, in zoology; Mr. F. N. Astbury, University of Liverpool, to Columbia University, in architecture; Mr. I. W. M. A. Black, University of St. Andrews, to Yale University, in physical chemistry; Mr. F. P. Chambers, Clare College, University of Cambridge, to Harvard University, in architecture; Miss M. E. Cranswick, King's College, University of London, to Columbia University, in education; Mr. R. Fisher, Hertford College, University of Oxford, to Yale University, in economics; Miss I. Gordon, University of Aberdeen and the Imperial College of Science and Technology, London, to Stanford University, in zoology; Miss H. A. C. Green, Westfield College, University of London, to the University of Pennsylvania, in literature; Mr. D. B. Harden, Trinity College, University of Cambridge, and the University of Aberdeen, to the University of Michigan, in archæology; Mr. R. L. Lechmere-Oertel, University of Birmingham, to Columbia University, in engineering; Mr. K. A. H. Murray, University of Edinburgh, to Cornell University, in economics; Mr. E. P. Mumford, University of Manchester and Christ's College, University of Cambridge, to the University of California,

in agriculture; Mr. M. A. Peacock, University of Glasgow, to Harvard University, in geology; Mr. G. S. Pryde, University of St. Andrews, to Yale University, in history; Mr. C. B. Purves, University of St. Andrews, to Johns Hopkins University and the Bureau of Standards, Washington, D.C., in organic chemistry; Mr. R. A. Robb, University of Glasgow, to the University of Chicago, in mathematics; Mr. W. Rule, Armstrong College, University of Durham, to Cornell University, in physics; Mr. F. J. Whelan, University College, Cork, to Harvard University, in literature; Mr. H. Williams, University of Liverpool and the Imperial College of Science and Technology, London, to the University of California, in geology; Mr. N. C. Wright, of Christ Church, University of Oxford, School of Agriculture, University of Cambridge, and the University of Reading, to Cornell University, in agriculture.

The purpose of the Commonwealth Fund is to promote mutual amity and understanding between Great Britain and the United States by offering opportunities for education and travel in the United States to young British graduates of character and ability. By terms of the Foundation it is necessary to effect a geographical distribution of Commonwealth Fund Fellowships among the universities of the United States from the Atlantic to the Pacific, without handicapping any individual in the advanced work on which he will be engaged. There were 178 applicants this year for fellowships, offering in all twenty-nine different subjects.

University and Educational Intelligence.

ABERDEEN.—The University Court has appointed Dr. Allan W. Downie to the Georgina M'Robert lectureship in pathology, with special reference to malignant diseases.

CAMBRIDGE.—The University has been officially informed that the Statutes recently made by the University of Cambridge Commissioners have been approved by the King in Council, no petition or address having been presented against them, while they were laid before both Houses of Parliament.

The members of the University Automobile Club, which has now been wound up, have offered to the University the sum of 450*l.* to endow an annual Ricardo Prize in thermodynamics.

The report of the Committee for Geodesy and Geodynamics contains some interesting references to Dr. Vening Meinesz's method of determining the value of g; based on g at Potsdam 981·274 cm./sec.^{2}, he obtained a value for Cambridge 981·265; independent observations made by Sir G. Lenox-Conyngham and Mr. Manley with the Science Museum pendulums gave the value 981·266. These pendulums are being taken by Mr. Manley this summer to Eastern Greenland in order that he may make a gravity determination near "Pendulum Islands," where General Sabine made observations in 1823 in latitude 74° 32′ 19″ N. During the absence of Sir Gerald Lenox-Conyngham in Japan at the Pan-Pacific Science Congress, Lieut.-Col. J. E. E. Craster will act as his deputy.

The report of the Director of the Solar Physics Observatory records the safe return of the instruments taken to the Crimea in 1914 to observe the total eclipse of the sun. A 6½-inch achromatic object-glass which used to belong to Sir George Stokes has been presented to the Observatory by Mrs. Laurence Humphrey.

Dr. A. C. Haddon is retiring from the readership in ethnology, and the General Board of Studies will proceed shortly to appoint a successor. The stipend is 660*l.* per annum, with an allowance of 200*l.* per annum if the reader is not a fellow of a College. The appointment will in the first instance be for three years from October 1. Applications should reach the Vice-Chancellor on or before Wednesday, July 14.

DR. W. EITEL has been nominated professor of mineralogy at the Technische Hochschule in Charlottenburg.

VACATION courses for mechanics and glassblowers, under the auspices of the "Vereeniging tot Bevordering van de Opleiding tot Instrumentmaker" (Society for the Advancement of the Training of Mechanics), Leyden, Holland, are to be held in August in the workshops of the Physical (Cryogenic) Laboratory of the University of Leyden. Particulars may be obtained from Dr. C. A. Crommelin, the Physical Laboratory, Leyden, Holland.

THE University of London Club, which was founded in 1914 for members of that University, and has its Club House in Gower Street (London, W.C.), has recently undergone a complete reconstruction. One feature of the reconstruction has been the widening of the basis of membership, so as to include graduates of other universities besides London, holders of certain diplomas granted by the University of London or its colleges, and persons who hold certain professional qualifications. A pamphlet giving an account of the Club, and of the facilities provided for the promotion of the social life of graduates can be obtained from the honorary secretary, 19 Gower Street, W.C. The chairman and members' committee of the Club will be At Home on June 22 at 8.30 P.M. to meet the Vice-Chancellor of the University of London (Prof. Gardner) and members of the Senate. The president of the Club is the Chancellor, the Earl of Rosebery.

THE sixth and last of the Watson Chair Lectures for 1926 will be delivered on Monday next at the University of Bristol at 5.30 P.M., the subject being "A Vision Postponed; Grover Cleveland's British-American General Arbitration Treaty killed by the Senate." The holder of the chair this year, Dr. Robert McElroy, professor of American history in the University of Oxford, is the authorised biographer of President Cleveland. The chair was founded in 1919, on the return of the Prince of Wales from his American tour, with the object of "knitting more closely together the bonds of comradeship between the two great English-speaking democracies, upon whose goodwill and friendship the peace of the world depends," and is of interest in connexion with the articles on "The Universities and International Peace," and on the recent awards of Commonwealth Fund fellowships, appearing elsewhere in this issue. The Watson chair has been held in succession by the late Viscount Bryce, Ex-President Hadley of Yale University, President Nicholas Murray Butler of Columbia University, Prof. A. F. Pollard of University College, London, and Sir Robert Falconer, President of the University of Toronto. Prof. McElroy's general subject is "Some British-American Crises: an Interpretation." He has delivered five lectures at London, Cambridge, Manchester, Leeds and Edinburgh respectively, and in addition an address, broadcasted by the B.B.C. on May 27, on "The International Mind in the Making."

Contemporary Birthdays.

June 19, 1858. Sir Henry J. Oram, K.C.B., F.R.S.
June 20, 1861. Sir Frederick G. Hopkins, F.R.S.
June 21, 1862. Sir Humphry Rolleston, Bart., K.C.B.
June 21, 1860. Dr. William D. Halliburton, F.R.S.
June 22, 1864. Sir Daniel Hall, K.C.B., F.R.S.
June 23, 1843. Prof. Paul Heinrich Ritter von Groth, For.Mem.R.S.
June 23, 1860. Sir W. Baldwin Spencer, K.C.M.G., F.R.S.
June 23, 1859. Lt.-Col. A. W. Alcock, C.I.E., F.R.S.
June 24, 1854. Dr. John A. Voelcker.

Sir HENRY ORAM, Engineer Vice-Admiral, received his technical training in Devonport Dockyard and at the Royal Naval College, Greenwich. He was Engineer-in-Chief of the Fleet from 1907 until 1917.

Sir FREDERICK GOWLAND HOPKINS, known widely for his long-continued researches in chemical physiology, especially in relation to the nutrition of the human subject, has been, since 1914, professor of biochemistry in the University of Cambridge. In 1918 the Royal Society awarded him a Royal medal. He was, indeed, among the very earliest to establish that minute quantities of certain bodies, the nutritive value of which had hitherto been unsuspected, exert an enormous influence upon growth and upon normal adult nutrition. He showed that without these accessory factors—vitamins—a diet otherwise full and seemingly complete is incapable of allowing growth, and even of maintaining body weight or life.

Sir HUMPHRY ROLLESTON, who was born at Oxford, was educated at Marlborough and St. John's College, Cambridge. Regius professor of physic in the University of Cambridge since 1925, he was lately president of the Royal College of Physicians.

Dr. HALLIBURTON, emeritus professor of physiology in King's College, London, a post which he adorned for thirty-three years, is a Londoner. He was educated at University College School, London, and University College. President of the Physiological Section at the British Association's Belfast meeting in 1902, he gave an address on the position (as it then stood) of chemical physiology.

Sir DANIEL HALL was educated at Manchester Grammar School and Balliol College. From 1902 until 1912 he was director of the Rothamsted Experimental Station. As chief scientific adviser to the Ministry of Agriculture and Fisheries, Sir Daniel has now an enlarged scope of work.

Prof. PAUL H. RITTER VON GROTH was born at Magdeburg and educated at the universities of Freiburg, Dresden, and Berlin. From 1872 until 1883 he occupied the chair of mineralogy in the University of Strasbourg, leaving to become professor of mineralogy in the University of Munich and curator of minerals in the State Museum, Munich. Prof. Paul von Groth is a recognised authority in chemical and physical crystallography. For many years he was editor of the *Zeitschrift für Krystallographie und Mineralogie*. In 1908 he was awarded the Geological Society's Wollaston medal.

Sir BALDWIN SPENCER, formerly (1887–1921) professor of biology in the University of Melbourne, was born at Stretford, Lancashire, and he was educated at Owens College and Exeter College, Oxford. A frequent correspondent of NATURE, we note a letter of his to this journal, so far back as 1885, on "The Eggs of Monotremes," and another, in 1886, on "The Parietal Eye of *Hatteria*."

Lieut.-Col. ALCOCK was educated at Mill Hill and the University of Aberdeen. For fourteen years he was superintendent of the Indian Museum.

Societies and Academies.

LONDON.

Royal Society, June 10.—A. C. **Downing**, R. W. **Gerard** and A. V. **Hill**: The heat production of stimulated nerve. The method adopted is thermo-electric. The thermopile contains about 390 couples of constantan-silver, made by electroplating (Hamilton Wilson), and current is recorded (to 2×10^{-12} amp.) by two moving-coil galvanometers coupled by a thermal relay (Moll and Burger). The heat appears in two stages: (*a*) during stimulation there is a rise of temperature of about 7×10^{-6}° C. per second of stimulation; (*b*) in the succeeding ten minutes there is gradual further production of heat about eight times as great as in stage (*a*), which for the present we attribute to a recovery process analogous to that occurring in muscle. Total heat corresponds closely to extra carbon dioxide found by Parker for stimulated nerve. There is difficulty, however, in explaining the *resting* values of oxygen and carbon dioxide found by him and others.—A. S. **Parkes**: (1) Observations on the œstrous cycle of the albino mouse. The average duration of the œstrous cycle (meta-œstrus to œstrus inclusive) of the unmated albino mouse was 5·7 days. The average duration of the cycle in normal females mated with vasectomised bucks was 11 days. This postponement of the next œstrous period is considered to be due to the formation of a decidua by the uterus, on mechanical stimulus by the vaginal plug, a process which has been demonstrated in the albino rat by Long and Evans. Pregnancy follows the detection of the vaginal plug in about 70 per cent. of cases, the gestation period being 19 days in almost all cases. The effect of lactation is entirely to inhibit œstrus (apart from the immediate post-partum period) for at least three weeks if an appreciable number of young are suckled. After the inhibition due to suckling, the cycle goes suddenly back to normal, even in cases where lactation is prolonged. Unilateral ovariotomy does not appear to influence the cycle. (2) On the occurrence of the œstrous cycle after X-ray sterilisation. Of 25 mice sterilised by exposure to X-rays at three weeks old, 22 experienced at least one period of œstrus when puberty was reached. In all, 53 periods of œstrus were observed in these animals, many of which exhibited a series of complete cycles of the normal length. Since none of these animals had oocytes, follicles, or follicular tissue in the ovaries, neither follicles nor *corpora lutea* appear to be essential to the occurrence of the normal cyclic activity of the uterus and vagina. The œstrous-producing hormone seems to be formed by the inter-follicular tissue, though also possibly by the follicles under normal conditions.—I. **Gordon**: The development of the calcareous test of *Echinocardium cordatum*. Bilateral symmetry is apparent almost from the beginning. The complex plating characteristic of the adult is only acquired at a comparatively late stage. There is no trace of teeth or of the lantern ossicles, but the perignathic girdle is represented by a single internal process. The membrane round the mouth is at first circular, but soon becomes pentagonal and then gradually alters to the 'reniform' outline of the adult peristome.—H. R. **Hewer**: Studies in colour changes of fish (ii.-iv.).—A. V. **Hill**: The viscous-elastic properties of smooth muscle. Gasser and Hill found that the sudden release during an isometric tetanus of the skeletal muscle of a frog is followed by an instantaneous drop of tension, and then by a gradual re-development along a curve identical with that of the original rise when stimulation began. This observation has been repeated on the smooth muscles of *Holothuria nigra*, in which the speed of contraction is less than 1/100 of that of frog's striated

muscle. The return to the tension characteristic of the new length is precisely similar in its time relations to the initial rise of tension. It is concluded that the development of a contraction during stimulation, and its re-development after release, are due to the same process, namely, the formation of an organised molecular pattern, arranged in space, whether of two or three dimensions, in the fibres of the muscles. Such a molecular rearrangement, either on stimulation or during actual shortening, is the basis of the 'viscous-elastic' phenomena found in all contractile tissues.—J. **Walton**: Contributions to the knowledge of Lower Carboniferous plants. The morphology of the genus Rhacopteris is discussed. The evidence is considered to support the view that Rhacopteris is more probably a fern than a pteridosperm. The presence of a rachis in the angle of the fork of the frond of *Sphenopteris Teiliana* is demonstrated in several specimens, and shown to have some characters of a fertile rachis of Telangium, and is interpreted as indicating the fundamentally pinnate structure of the frond. Thus probably the fructification rachis of *Telangium bifidum* was attached to the frond bearing the foliage pinnules in the angle of the main fork of the rachis, and possibly in many Lower Carboniferous fronds with apparently dichotomous rachis the frond is in reality pinnate in structure.—J. H. **Priestley** and E. **Rhodes**: On the macro-chemistry of the endodermis. —D. **Keilin**: A comparative study of turacin and hæmatin, and its bearing on cytochrome. The absorption spectra of turacin, hæmatin and hæmochromogen vary with the degree of dispersion of these compounds, and the bands shift from 100 to 200 Å.U. towards the red end of the spectrum as the degree of dispersion decreases. Artificial hæmochromogens composed of hæmatin and one of the nitrogen compounds can be prepared, showing either three or four absorption bands resembling those of cytochrome. The three components of cytochrome seem to be derived from one hæmochromogen compound, present in two distinct degrees of dispersion (b' and c'), and partly modified (a') by active process of oxidation and reduction in which these components are directly involved.—E. **Ponder**: The equations applicable to simple hæmolytic reactions. Time-dilution and percentage hæmolysis curves of experiment in especial are discussed. The action of the simple lysins on the cells is describable by expressions like those for chemical reactions of the first order, but in which is a term relating to extent of cell surface acted upon. Allowing for the fact that the reaction takes place at cell surfaces only, and not continuously throughout the system, the effect of lysins on suspensions of different strengths is explained in a simple way.—J. P. **Hoet** and P. **Kerridge**: Observations on the muscles of normal and moulting Crustacea. Glycogen was found in the muscles of normal hard-shelled Crustacea. Only small amounts were found in those of soft-shelled specimens of the same species. An early onset of *rigor mortis*, associated with alkaline reaction, was observed in crustacean muscles poor in glycogen. When glycogen was present in the muscles, there was a post-mortem development of acid comparable with that in mammalian muscle.—C. H. **Best** and H. P. **Marks**: Additional note on the effect of insulin on the lactacidogen content of the skeletal muscles.

Physical Society, May 28.—G. **Temple**: Static and isotropic gravitational fields. By limiting the investigation to the consideration of dynamical manifolds which are static and isotropic in character, it is practicable to abandon the notation and theory of the absolute differential calculus, and to substitute some classical theorems of Lord Kelvin and M. J. Liouville. This simplified theory serves to explain the construction and solution of Einstein's field equations, and their application to the problems of planetary motion and of the deviation of light in a gravitational field. It also makes explicit the various assumptions involved in Einstein's theory.—C. V. **Raman** and K. S. **Krishnan**: The diffraction of light by spherical obstacles. The diffraction of light inside the shadow, thrown by a small source of light, of a sphere and a circular disc of the same diameter, was studied, with special reference to the relative intensities of the central bright spots. With the source at about 2 metres from the obstacles, with a $\frac{1}{4}$-in. polished steel ball, the bright spot could be detected visually up to 3 cm. behind the obstacle, while with a steel disc of the same diameter, with the edges perfectly sharp, smooth and circular, the spot could be traced up to 2 cm. At small distances behind the obstacles, the spot inside the shadow of the sphere is much feebler than the disc-spot, approximating to the latter farther back from the obstacles, but even at 100 cm. remaining appreciably feebler.—A. L. **Narayan** and K. R. **Rao**: On the absorption and series spectra of nickel. The absorption spectrum of nickel was investigated by the under-water spark from λ6000 to λ2000. In the region λ3800 to λ2100, 180 wave-lengths were obtained in absorption. The majority of these lines were classified by Bechert and Sommer. Intensity values of the absorbed lines showed that the intensity rule and the selection rule for inner quantum numbers were accurately fulfilled. The results confirm the recent classifications of Bechert and Sommer in this spectrum. —H. C. **Hepburn**: The influence of electrolytes in electro-endosmosis. Determinations were made with certain aqueous solutions of electrolytes in glass diaphragms, and values are obtained for the interfacial potential of the Helmholtz electrical double layer. The dependence of the conductivity on the electro-endosmotic flow was investigated by measurements of the current flowing through the diaphragm during each determination, and the data used to trace the variations in the thickness and the charge of the electrical double layer by the application of a formula derived by Smoluchowski.

EDINBURGH.

Royal Society, May 24.—Malcolm **Wilson** and Miss E. J. **Cadman**: The life history and cytology of *Reticularia Lycoperdon*—one of the mycetozoa. After spore germination the blepharoplast arises from the nucleus and divides to form the centrosomes before division of the swarm-cell; four chromosomes are present. Fusion takes place between motile gametes which are identical with the swarm-cells. Before fusion of the gametic nuclei several swarm-cells coalesce with the zygote and their nuclei are ultimately digested. Ingestion of entire swarm-cells takes place later. The nucleus of the zygote divides repeatedly and the plasmodium is formed; eight chromosomes are present. Typical meiosis takes place after the emergence of the plasmodium from the wood, and cleavage and spore formation follow. The pseudocapillitium and sporangial wall are formed from masses of degenerating protoplasm.—Miss C. C. **Miller**: The slow oxidation of phosphorus trioxide (Part 2). The production of phosphorus tetroxide by direct oxidation of phosphorus trioxide. When phosphorus trioxide oxidises slowly at low temperature in oxygen containing a trace of water vapour, the only product of oxidation is phosphorus tetroxide.—A. C. **Aitken**: On Bernoulli's numerical solution of algebraic equa-

tions. The paper generalises Bernoulli's method of finding the greatest root of an equation. The extension gives a means of computing all the roots of the equation, whether real and different, complex or multiple.

PARIS.

Academy of Sciences, May 10.—Maurice **Hamy**: A particular case of diffraction of the solar images.—André **Blondel**: Remarks on the establishment of the régime in electrical circuits.—A. **Desgrez**, H. **Bierry**, and L. **Lescœur**: The fixing of sulphuretted hydrogen in the blood.—Charles **Nicolle** and Ugo **Lumbroso**: Granular conjunctivitis of the rabbit and the origin of trachoma.—**Mirimanoff**: The game of heads or tails and the formulæ of Laplace.—J. **Favard**: Linear differential equations with nearly periodic cœfficients.—E. **Gau**: The transformation of a system of two partial differential equations in involution into a unique equation of the first order.—.—. **Lainé**: The application of the method of Darboux to the equations $s=f(x, y, z, p, q)$.—S. **Zaremba**: A transformation of the problem of Neumann.—Georges **Bouligand**: The continuity of zero order in hydrodynamics.—A. **Alayrac**: The theoretical study of bird-like flight.—Jean **Chazy**: The calculation of the advance of the perihelion of Mercury under the action of the other planets. Comparison of the results of Le Verrier, Newcomb, Doolittle, and Hill.—Henri **Malet**: The invariant expressions met with in electrodynamics in systems in movement.—Félix **Ehrenhaft**: The observation and measurement of very small isolated magnets. The apparatus described is capable of determining the magnetic moment of isolated magnets down to a radius of 5×10^{-6}, and can fix the intensity of a magnetic field in an area as small as 0·01 sq. cm. It will prove useful in problems connected with the magnetic properties of small colloidal particles.—Jean **Thibaud**: A new technique in the use of gratings applied to the study of Millikan's ultra-violet. The use of a vacuum spectrograph with the method of tangential incidence permits the use of a grating with 200 lines to the millimetre instead of 500 to 1100 lines per millimetre used by Millikan, and the photographic plate is placed only 98 mm. from the grating. Details of the results obtained with copper are given.—A. **Portevin** and P. **Chevenard**: The complexity of the phenomena of tempering certain alloys.—Pierre **Jolibois**, Henri **Lefebvre**, and Pierre **Montagne**: The influence of the capacity of the discharge circuit on the decomposition of carbon dioxide under reduced pressure by the electric spark. The decomposition of carbon dioxide under reduced pressure by the spark is strongly influenced by the capacity of the discharge circuit. For a given tube a high degree of dissociation is only obtained if the capacity of the condenser giving rise to the spark is large.—Mlle. Suzanne **Veil**: The magnetochemical reactions of the hydroxides in the presence of hydrogen peroxide.—.—. **Marinesco**: Adsorption on large molecules in solution. Einstein's equation giving the relation between the viscosity of a suspension of fine solid particles and that of the intergranular liquid has been applied to the results of viscosity measurements on solutions of rhodamine (molecular weight 478) in water and various alcohols. The results show that the dissolved molecule is surrounded by a monomolecular layer in which the number of molecules of adsorbed solvent is fixed. Methyl alcohol furnished anomalous figures.—J. **Laissus**: The cementation of ferrous and copper alloys by tungsten, molybdenum, and tantalum.—Mlle. M. **Pernot**: The potassium iodomercurates which crystallise in acetone solution.—Clément **Duval**: A general method for the preparation of nitrites. Application to the simple nitrites of cobalt and nickel and to that of cobaltihexammine.—P. **Freundler** and Mlle. Y. **Ménager**: The estimation of rubidium by means of silicotungstic acid; the application of this reagent to the detection of rubidium in the ashes of *Laminaria flexicaulis*. The fractional crystallisation of the chlorplatinates has been proved to be an unsatisfactory method for determining rubidium in the presence of potassium and sodium, and the use of the silicotungstate ($Rb_8W_{12}SiO_{42}$ at 100° C.) is suggested as preferable. Details are given.—Jean **Meunier**: The detection and estimation of strontium by the spectrographic method in the hydrogen flame.—J. F. **Durand**: The direct preparation of mixed organo-beryllium compounds. Various attempts to prepare organoberyllium compounds under the conditions usual for the preparation of the magnesium compounds failed. In one experiment, in which some mercuric chloride was added to the reaction mixture, a compound behaving as CH_3 . BeI was obtained.—R. **Weil**: The temperature of paramorphic transformation of cristobalite.—Paul **Picard**: Violutoside, a new glucoside containing methyl salicylate, extracted from *Viola cornuta*. This glucoside was present in the proportion of 0·01 gram per kilogram of fresh plant. The new glucoside is formed from one molecule of methyl salicylate and one molecule of a hexopentose, and is not identical with monotropitoside.—R. **Combes**: The migration of nitrogenous substances in the beech in the course of the autumnal yellowing.—G. **Lafon**: The amplification and collective audition of the beats of the heart and the other sounds of auscultation. An account of the application of the methods of radio telephony to replace the stethoscope.—Jean **Saidman** and L. G. **Dufestel**: The visibility of the initial portion of the ultra-violet spectrum. It is shown that the line 365 Å.U. can be perceived by the human eye under favourable conditions. That it is not usually seen under ordinary conditions is due to the fact that the visibility of the eye in this region is only one-millionth of that of the radiations strongly impressing the retina.—Émile **Haas**: New researches on the successive differential light sensibility for white light.—L. **Velluz**: Contribution to the study of narcosis. The distribution coefficient of hypnotics between water and organic solvents, particularly solvents possessing ethylene linkages.—Jean C. **Faure**: The essential factors of a biological complex.—Alfred **Maubert**: The influence of thorium X on the ammoniacal fermentation.—J. **Cantacuzene** and O. **Bonciu**: The modifications undergone by streptococci of non-scarlatina origin in contact with filtered scarlatina products.

VIENNA.

Academy of Sciences, April 29.—R. **Kremann** and A. **Tröstek**: Electrolytic conduction in molten metallic alloys (xvii.). Experiments on the electrolysis of zinc with lead, cadmium, of antimony with lead and bismuth, and of cadmium with lead and bismuth.—R. **Kremann**: Communication xviii. Comprehensive consideration of the results so far obtained in this series of communications.—K. **Spitzer**: On the content of ortho-dioxy-benzole derivatives in the cocoons of the Emperor moth (Saturnia).—J. **Krames**: On the degeneration of striction lines in ruled surfaces. O. **Koller**: Some new fishes from the island of Hainan. Includes a new genus of Siluridæ and a new species of Cyprinidæ.—O. **Koller**: A critical review of the hitherto described central and south European species of the Cyprinid genus Barbus.—O. **Richter**: On the

large iron requirements of the rice plant, *Oryza sativa*. —J. **Hepperger**: The influence of the attraction of the earth on the frequency of meteors.—O. **Dischendorfer** and H. **Grillmayer**: Investigations in the domain of photo-chemistry (iii.). On betuline.—F. **Seidl**: Investigations on 'self-sounding' crystals. A possibility of the transformation of electric into acoustic vibrations finding application in a telephone without diaphragm.—K. **Przibram**: The interpretation of the coloration of salts.

Official Publications Received.

Department of Commerce: Bureau of Standards. Scientific Papers of the Bureau of Standards, No. 521: Measurements of the Index of Refraction of Glass at High Temperatures. By C. G. Peters. Pp. 635-659. (Washington, D.C.: Government Printing Office.) 10 cents.

A Bibliography of Indian Geology, Part 4. Palæontological Index. Compiled by T. H. D. La Touche. Pp. iv+vii+414. (Calcutta: Government of India Central Publication Branch.) 7·14 rupees; 11*s.* 6*d.*

Records of the Botanical Survey of India. Vol. 9, No. 4: Freshwater Algæ from India. By Dr. Nellie Carter. Pp. 262-302+2 plates. (Calcutta: Government of India Central Publication Office.) 14 annas; 1*s.* 6*d.*

Report of the Felsted School Scientific Society for the Years 1924 and 1925. (No. 29.) Pp. 33. (Chelmsford.)

Southern Rhodesia. Report of the Director, Geological Survey, for the Year 1925. Pp. 5. (Salisbury, Southern Rhodesia).

Union of South Africa: Department of Agriculture. Bulletin No. 2 of 1925: Some further Remarks on Tobacco Cultivation for Nicotine. By J. Vernell Cutler and J. J. Theron and J. du P. Oosthuizen. (Division of Chemistry Series No 45.) Pp. 23. 3*d.* Science Bulletin No. 36: Some Experiments on the Solubility of Saldanha and Grahamstown Phosphates in the soil. By A. Stead. (Division of Chemistry Series No. 53.) Pp. 15. 3*d.* Science Bulletin No. 43: Some Factors influencing the Keeping Quality of Butter. By D. J. Retief. Pp. 2?. Science Bulletin No. 44: A Biometrical Analysis of Merino Wools. By Prof. J. E. Duerden and V. Bosman. Pp. 16. Science Bulletin No. 46: Co-operative Fertiliser Experiments with Potatoes. By Thos. D. Hall. (Division of Chemistry Series No. 65.) Pp. 14. (Pretoria: Government Printing and Stationery Office.)

Ingeniörsvetenskapsakademien. Handlingar Nr. 48: Radio Wave Propagation. By E. F. W. Alexanderson. Pp. 10. (Stockholm: Svenska Bokhandelscentralen A.-B.) 0·70 kr.

British Museum (Natural History). Picture Postcards. Set F12: British Flowering Plants, Series No. 9. 5 cards in colour. 1*s.* Set F13: British Flowering Plants, Series No. 10. 5 cards in colour. 1*s.* Set F14: British Flowering Plants, Series No. 11. 5 cards in colour. 1*s.* Set F15: British Flowering Plants, Series No. 12. 5 cards in colour. 1*s.* Set F16: British Orchids, Series No. 1. 5 cards in colour. 1*s.* Set F17: British Orchids, Series No. 2. 5 cards in colour. 1*s.* (London: British Museum (Natural History).)[1]

New Zealand State Forest Service. Bulletin No. 4: Monograph on the New Zealand Beech Forests. Part 1: The Ecology of the Forests and Taxonomy of the Beeches. By Dr. L. Cockayne. Pp. 71. (Wellington, N.Z.: W. A. G. Skinner.) 4*s.*

Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 62: Report on a Mission to California (U.S.A.) to study New Methods of Fumigation of Citrus Trees. By Neguib Eff. Iscander. Pp. ii+41. (Cairo: Government Publications Office.) 5 P.T.

Proceedings of the United States National Museum. Vol. 68, Art. 14: Termites collected on the Mulford Biological Exploration to the Amazon Basin, 1921-1922. By Thomas E. Snyder. (No. 2615.) Pp. 76+3 plates. (Washington, D.C.: Government Printing Office.)

Navy (Health). Statistical Report of the Health of the Navy for the Year 1923. Pp. v+149. (London: H.M. Stationery Office.) 5*s.* net.

Proceedings of the Royal Society of Edinburgh, Session 1925-1926. Vol. 46, Part 2, No. 17: Some Hyperspace Harmonic Analysis Problems introducing Extensions of Mathieu's Equation. By Prof. Pierre Humbert. Pp. 206-209. 6*d.* Vol. 46, Part 2, No. 18: The Invariant Theory of Forms in Six Variables relating to the Line Complex. By Prof. H. W. Turnbull. Pp. 210-222. 1*s.* (Edinburgh: Robert Grant and Son; London: Williams and Norgate, Ltd.)

Dominion of Canada. Report of the Department of Mines for the Fiscal Year ending March 31, 1925. (No. 2076.) Pp. iii+75. (Ottawa: F. A. Acland.) 15 cents.

Canada. Department of Mines: Victoria Memorial Museum. Museum Bulletin No. 40 (Biological Series No. 9): Birds collected and observed during the cruise of the *Thiepval* in the North Pacific, 1924. By Hamilton M. Laing. (No. 2072.) Pp. ii+46. 15 cents. Department of Mines: Geological Survey. Memoir 143, No. 124 Geological Series: North Shore of Lake Huron. By W. H. Collins. (No. 2052.) Pp. iii+160. 30 cents. Summary Report, 1924, Part B. (No. 2077.) Pp. 127B. (Ottawa: F. A. Acland.)

Proceedings of the London Mathematical Society. Second Series, Vol. 24. Pp. lxi+498. (London: Francis Hodgson.)

Diary of Societies.

SATURDAY, JUNE 19.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern District) (at Town Hall, Stockton-on-Tees), at 10.45.—W. A. Smith: The North Tees Joint Town Planning Scheme and Notes on Stockton-on-Tees Housing Schemes.—J. P. Wakeford: Notes on Stockton and some of its Municipal Works.

MONDAY, JUNE 21.

ROYAL SOCIETY OF EDINBURGH, at 4.30.—Prof. W. H. Lang: Contributions to the Study of the Old Red Sandstone Flora of Scotland. III. On *Hostimella* (*Psilophyton*) *Thomsoni*; IV. On a Specimen of Protolepidodendron from the Middle Old Red Sandstone of Caithness; V. On the Identification of the 'Large Stems' in the Carmyllie Beds of the Lower Old Red Sandstone as Nematophyton.—S. Williams: A Critical Examination of the Vittarieæ.—Dr. F. R. Cowper Reed: Some New Ordovician and Silurian Fossils from Girvan.—Prof. Graham Kerr: Note on the Fossil Fang of an Extinct Snake.—*To be read by title*:—J. M. Whittaker: On a Polarised Light Quantum.—Dr. W. W. Taylor: (*a*) Note on a Theory of von Weimarn; (*b*) Ferric Hydroxide and the Lyotrope Series.

ARISTOTELIAN SOCIETY (at University of London Club), at 8.—F. H. Cecil Brock: Implications of the Philosophy of Bergson.

ROYAL INSTITUTE OF BRITISH ARCHITECTS, at 8.30.—Presentation of the Royal Gold Medal.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS (Summer Meeting, Scarborough) (continued on June 22 and 23).

INSTITUTION OF NAVAL ARCHITECTS (in Belgium) (continued until June 27).

TUESDAY, JUNE 22.

PREHISTORIC SOCIETY OF EAST ANGLIA (at Royal Anthropological Institute), at 2.30.

ROYAL SOCIETY OF MEDICINE, at 5.30.—General Meeting.

ROYAL ANTHROPOLOGICAL INSTITUTE, at 8.30.—V. Gordon Childe: The First Colonisation of Central Europe.

WEDNESDAY, JUNE 23.

ROYAL COLLEGE OF PHYSICIANS, EDINBURGH, at 5.—Dr. J. Cowan: The Failing Heart (George Alexander Gibson Lecture) (1).

GEOLOGICAL SOCIETY OF LONDON, at 5.30.—Prof. H. F. Osborn: Methods and Results of American Museum Explorations in the Gobi Desert of Mongolia (Lecture).

RADIO SOCIETY OF GREAT BRITAIN (at Institution of Electrical Engineers), at 6.

NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY (Summer Meeting at Norwich) (continued on June 24 and 25).

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (at Bristol) (continued until June 26).

THURSDAY, JUNE 24.

INSTITUTION OF ELECTRICAL ENGINEERS, at 3.30.—Sir Oliver Lodge: The History and Development of the Telephone (Lecture).

ROYAL SOCIETY, at 4.30.—J. C. McLennan and A. B. McLay: On the Structure of the Arc Spectrum of Gold.—J. C. McLennan and H. G. Smith: On the Series Spectra of Palladium.—A. M. Tyndall and L. R. Phillips: The Mobility of Ions in Air. Part III.—L. C. Jackson: Investigations on Paramagnetism at Low Temperatures. Part II.—Sybil Cooper and D. Denny-Brown: Responses to Rhythmical Stimulation of the Cerebral Cortex.—*Papers to be read in title only*:—Karl Pearson: Researches on the Mode of Distribution of the Constants of Samples taken at Random from a Bivariate Normal Population.—Lord Rayleigh: Further Spectroscopic Studies on the Luminous Vapour distilled from Metallic Arcs.—Sir William Hardy: A Microscopic Study of the Freezing of Gel. Part I. and Part II.—Sir William Hardy and Millicent Nottage.—Studies in Adhesion. I.—T. Moran: The Freezing of Gelatin Gels.—W. Jevons: The More Refrangible Band System of Cyanogen as developed in Active Nitrogen.—J. A. V. Butler: The Equilibrium of Heterogeneous Systems including Electroytes. Part I.—(The late) Mrs. Hertha Ayrton: Primary and Secondary Vortices in Oscillating Fluids. Their Connexion with Skin Friction.—T. T. H. Verschoyle: Isotherms of Hydrogen, of Nitrogen, and of Hydrogen-Nitrogen Mixtures at 0° and 20° C. up to a Pressure of 200 Atmospheres.—E. W. Marchant and J. L. Miller: The Loss of Energy in Metal Plates of Finite Thickness, due to Eddy Currents produced by Alternating Magnetic Fields.—W. Sucksmith and H. H. Potter: On the Specific Heat of Ferromagnetic Substances.—L. B. Pfeil: The Effect of Occluded Hydrogen on the Tensile Strength of Iron.—T. E. Allibone: The Infra-red Secondary Spectrum of Hydrogen.—D. C. Rose: The Scattering of Alpha Particles through Small Angles.—V. H. Stott, D. Turner, and H. A. Sloman: Effects of Thermal Treatment on Glass as shown by Precise Viscometry.—J. E. Lennard-Jones and Miss B. M. Dent: The Forces between Atoms and Ions. II.—J. Topping and A. E. Ludlam: Tables of log $K_0(x)$ over the Range $x=2$ to $x=12$ at Intervals of 0·001.—B. Lambert and K. T. Hartley: An Investigation of the Effects of Variations in the Radiation Factor on the Efficiency of Dewar Vessels.—J. E. Lennard-Jones and W. R. Cook: The Molecular Fields of Hydrogen, Nitrogen, and Neon.—H. Florey: Observations on the Resolution of Stasis in the Finer Blood Vessels.—T. S. P. Strangeways and Honor B. Fell: Experimental Studies on the Differentiation of Embryonic Tissues growing *in vivo* and *in vitro*. II. The Development of the Isolated early Embryonic Eye of the Fowl when cultivated *in vitro*.—Nesta Ferguson: The Aloinæ—a Cytological Study, with especial reference to the Form and Size of the Chromosomes.

ROYAL COLLEGE OF PHYSICIANS, EDINBURGH, at 5.—Dr. J. Cowan: The Failing Heart (George Alexander Gibson Lecture) (2).

OPTICAL SOCIETY (at the Imperial College of Science), at 7.30.—M. von Rohr: Joseph Fraunhofer and the Development of Optical Instruments.

FRIDAY, JUNE 25.

PHYSICAL SOCIETY OF LONDON (at Imperial College of Science), at 5.

DIESEL ENGINE USERS' ASSOCIATION (at Caxton Hall, Westminster).—J. E. Stackford: Some Deleterious Properties of Lubricating Oils.

SATURDAY, JUNE 26.

BRITISH PSYCHOLOGICAL SOCIETY (at University College, Gower Street, London, W.C.1), at 3.—Prof. C. Spearman: The Passing of the Psychology of 'Shapes' (*Gestalten*) into that of 'Wholes' (*Ganzheiten*).—Rex Knight: Modern Theories of the Self.